UNIVERSITY OF CALIFORNIA, SAN DIEGO

Sorcerer's Apprentice:
Creating the Electronic Health Record,
Re-inventing Medical Records and Patient Care

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy in

Communication

by

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Signature page

To Dorothy and Chon Gregory for their love
and for the independence and curiosity
they instilled in me.

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ABSTRACT OF THE DISSERTATION

Sorcerer's Apprentice:

Creating the Electronic Health Record,

Re-inventing Medical Records and Patient Care

by

Judith Gregory

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Philip E. Agre, Chair

What makes it so difficult to design tools for patient care interactions and clinical work practices? The case study concerns an ambitious effort by a U.S. health maintenance organization and a clinical informatics company to

create an electronic health record (EHR) to replace paper-based patient charts. The author participated in this EHR Prototype Project for five years (1993-1998) from a baseline period through iterative design and clinical use of the first three versions of the prototype. This is a story of two logics—the "beautiful logic" of the EHR system-in-the-making and the logics of clinical work practices and patient care interactions.

The field research and analysis are framed by activity theory with influences from critical studies of science and technology. Ethnographic observations and video documentation lay the basis for discussion of practice and design dilemmas and difficulties that confront this particular vision of the future in practice. Findings are discussed in three areas: theory, health informatics, and changes in patient care.

Theory. To think about innovation-in-the-making, a concept is offered--the *incomplete utopian project*--that is sociohistorical, heterogeneous and argumentative in structure. Three substantive dimensions are schematized--clinical, technical, and managerial—that are engaged in this particular EHR effort and its articulation of informational and functional requirements associated with an emerging *managed care package* of concepts and techniques.

Health informatics. The findings offer insights into dilemmas encountered by designers and practitioners, difficulties related to

commitments to different logics, and the power and problems of utopianism. *The incomplete utopian project of EHR invention* draws from longstanding utopias: the search for a perfect language; managerial desires for far-reaching control over practices; the quest to rationalize and scientize medicine, notably the evidence-based medicine movement; and the idea of intelligent software.

Changes in patient care. It is argued that, by analyzing the experiences during prototyping and imagined future scenarios of EHR use through the lens of the incomplete utopian project of EHR invention, we discern deepening contradictions between commodity and social use values of patient care, not as temporary problems of EHR prototyping but as contradictions deepening in patient care as it is changing.

CHAPTER I: INTRODUCTION

The Pupil in Magic [Der Zauberlehrling]

I am now, -- what joy to hear it?--
Of the old magician rid;

And henceforth shall ev'ry spirit
Do whate'er by me is bid;
I have watch'd with rigour
All he used to do,
And will now with vigour
Work my wonders too.

. . .

Goethe, 1797, pub. 1798

Many health care providers are convinced that to practice medicine today and in the near future, they need clinical information tools that they do not yet have and a comprehensive clinical information infrastructure that does not yet exist. Langdon Winner writes that, as for all scientific projects, innovation projects involve utopian visions; new technologies represent new "forms of life" (Winner: 1986). What comprises a viable theoretical framework for understanding innovations that are not yet realized? How are we to understand the consequences--potential social benefits and risks--involved in innovations in-the-making, in their nascent stages? When do utopian projects open up new boundaries and when do they represent consolidations of power?

Health care systems development is distinguished by two attributes that are self-evident in their simplicity. Systems design of patient care information systems carries with it a responsibility to patients as well as to health care workers as systems users. And "patienthood is ubiquitous" (Yalom: 1980); each of us has the experience of being a patient. What will be the consequences of a new clinical information technology for patient care teams and for patients at the point of care? What roles do new computer systems play in the efforts of health care organizations to improve the delivery and quality of patient care? Why and how does the rebuilding of clinical information infrastructure matter to us as patients, as health care workers and as citizens? Where is the patient in patient-centered clinical information systems design?

The case study presented is that of a complex innovation effort to create a new clinical information technology, an electronic health record (EHR) or computer-based patient record (CPR) system to replace paper-based patient charts with a distributed on-line system (see, e.g., Dick and Steen: 1991). The Committee on Improving the Patient Record of the Institute of Medicine defined the computer-based patient record as "an electronic patient record that resides in a system specifically designed to support users through availability of complete and accurate data, practitioner reminders and alerts, clinical decision support systems, links to bodies of medical knowledge, and

other aids." The committee stressed that "merely automating the form, content, and procedures of current patient records will perpetuate their deficiencies and will be insufficient to meet emerging user needs" (Dick and Steen: 2-3). I will refer to the many diverse at-large efforts as *EHR/CPR* efforts as the term "computer-based patient records" has a more general and encompassing meaning than 'electronic health records." I will use the term *EHR* to refer to the HMO effort that I analyze.

The spirit of the discussion is to identify issues of general importance, not to critique particular companies or particular user interface designs. The difficulties discussed herein should not be interpreted as unique to any software development company or health care organization. Rather. the focus of the discussion is to articulate problematics of the interface between EHR/CPR design and development and clinical work practices and interactions as they confront both designers and users of electronic health records.

In this case study, the overall effort entails rebuilding the national clinical information systems infrastructure of a very large health maintenance organization (HMO). The national effort of the company will integrate computer-based clinical documentation to patient charts, referrals and other physician orders, results reporting, clinical messaging, registries for disease management and population-based care management, provider network

capabilities and a unified clinical data repository. The Electronic Health Record[1] (EHR) about which I am writing is one software application within this comprehensive clinical information infrastructure effort. I will refer to the particular innovation effort as the EHR Prototype Project to connote the *prototyping phase* in which I participated and to specify the focus on *clinical documentation to patient charts.*

The EHR Prototype Project was launched by a core group of physicians, nurses and information technology staff of the southern California region of the HMO and a small state-of-the-art Software Company based in Silicon Valley. The Software Company is a leading EHR/CPR developer pursuing what is called a *structured content* strategy for clinical documentation, through which clinicians simultaneously *codify* clinical terminology when they enter progress notes into an on-line patient chart in the distributed computer system (see, e.g., Campbell: 1997; Campbell and Musen: 1992a, 1992b; Campbell, Wieckert et al.: 1994; Henry, Douglas et al.: 1998; Musen, Wieckert et al.: 1995; Zingo: 1997).

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1 Originally called the Electronic *Medical* Record (EMR), the EMR was renamed the Electronic *Health* Record (EHR) at the urging of the nurses in the HMO and the Software Company who objected to "medical record" as connoting the *medical model* (physician model) whereas "health record" encompasses nursing models and other patient-centered models.

Progress notes--also known as *clinical progress records*--are documented by a clinician[2] to the patient chart, the legal and medical patient record. In the world of handwritten and dictated patient records, *progress notes* usually refer to notes that are narrative or otherwise relatively free in form at the discretion of each clinician--thus the descriptive term *free text*. In his or her progress notes, a clinician records salient information from an encounter with a patient (an interaction whether in person or by telephone and whether in a hospital or an ambulatory setting). Handwritten progress notes often incorporate symbols and both standard and idiosyncratic abbreviations. Progress notes vary in composition and medium (handwritten, dictated) depending on clinical domain and type of encounter (primary care, specialty care consultation, history and physical, triage / assessment, emergency care, surgery, to name a few examples). For a primary care office visit, outpatient progress notes typically cover four core areas: subjective findings (S), objective findings (O), assessment, problem(s) and / or diagnosis (A), and plan of care (P), thus the acronym SOAP note for progress notes explicitly organized to address each of these four areas. The SOAP note, the problem-

2 The term *clinician* refers to any clinical practitioner who engages in clinical decision-making (diagnosis and treatment) including but not limited to physicians, registered nurses, nurse practitioners, midwives, physician assistants and licensed clinical social workers. Following the language conventions of the EHR Prototype Project, I will generally use the inclusive term *clinicians* unless I am specifically referring to *physicians*.

oriented note (see, e.g., Weed et al.: 1976) and the problem list are important innovations in the history of progress notes and medical records.

In addition to progress notes and alpha-numeric data such as laboratory test results and biomedical readings, there are many specialized patient records that are paper-based templated forms, for example for an outpatient History and Physical, a cardiologist's Echocardiogram Report, a Treadmill test performed by a registered nurse and a cardiodiagnostics technician or documentation of Telephone Triage. Conventions guide dictation for a hospital admission History and Physical, a hospital Discharge Record, a consulting specialist's Report, and so on. Such paper-based templated forms and structured conventions for dictation are meant to guide documentation for salient clinical information to ensure ease of review by colleagues who look for the information they require in expected places. Standardized formats are also meant to ensure that medical legally required information and information required for regulatory reporting is documented. Modifications to patient records and any new forms require the approval of one or more Medical Records Committees. Conversely, when regulatory and medical legal requirements change, patient record forms may require changes to update data fields. The information that a health care organization deems essential to document a specific problem--for diagnosis and treatment, for regulatory reporting, for performance measures (quality assurance,

enforcement and improvement of standards of care), for outcomes analysis (clinical research, practice guidelines and protocols), for utilization review, and for medical legal purposes (medical chart review)--may be referred to as a *minimum data set* in the rubric of medical informatics.

New clinical information systems have the potential to reorganize health care delivery through their combination with short term and long term agendas of health care institutions and long-standing social medicine ideals of clinicians and care givers who see themselves as patient advocates. These agendas include enterprise modeling, total quality management, practice guidelines and protocols, clinical and epidemiological outcomes research, disease management, patient-centered care, critical care paths and linkages between outpatient and inpatient records and networks of patient care providers and teams. Many people I worked with in this EHR development effort believed that "the electronic health record will be the real health care reform."

The questions I have been asked most often are: Why is it hard to put patient records on a computer system? Why hasn't electronic health record design and implementation already been accomplished? In the world of medical informatics the transformation from paper-based patient charts to a distributed computer-based system represents such a paramount challenge that it is described as "a quest for a Holy Grail" (Hogan and Mattison: 1994).

What makes EHR/CPR invention both deeply compelling and elusive? What difficulties does this utopian project encounter with everyday clinical work practices?

For software design and development and from a work practices perspective, the central question is: How can clinical teamwork and communication be better supported to improve patient care? For this particular EHR design, how might structured clinical content capabilities improve patient care? Practice issues--the organization of work, the interactive, collaborative and distributed nature of clinical expertise and cognitive processes--need to be understood and articulated if they are to be improved and if a complex structured content documentation strategy is to be integrated into daily practices. The problematics engaged in transitions from *free text* to *structured entry* are embedded in long-standing daily clinical practices, interactions and patterns of communication--the work required to carry out patient care. Patient care interactions (encounters) are the referent activities for the representations (documentation in clinical records) inscribed in patient charts. One needs to understand how patient data gets into a patient's chart, how clinical information is dynamically created and how it is used, when, where, why and by whom. As an information technology manager for the HMO said to Software Company managers: "Our logical models match. Now we need to match up our logical models with the

physical models [in clinical settings]." In other words, the logical and conceptual models for design need to be reciprocally informed by "physical models" of how people actually work in their clinical practices. At the same time, design activity involves reflection and changes in the representations and practices by which documentation of patient data are generated and used. Everyday practices change to conform to the requirements of new systems (Agre: 1994). For the inner logic of this system to be realized, how are clinical work practices imagined to change? I explore baseline (pre-EHR) clinical work practices in outpatient care and imagined scenarios of future work practices with use of the EHR in Chapter IV: Changing Patient Care.

EHR/CPR developments need to be considered in their specific contexts. For this case study, the national context is the U.S. health care system with its historically determined constraints, contradictions and crises in delivery of care. The institutional context is that of an integrated *non-profit* HMO undergoing change in relation to competitive market forces, particularly the dramatic rise of *for-profit* managed care companies since the mid-1980s. The HMO has a tri-partite management structure with physicians represented by a Physician Partnership co-managing the company with its administrative entity known as the Health Plan and its Hospital

Administration.[3] In addition to its constitution as a non-profit company, the HMO I discuss differs from for-profit managed care competitors in that it is internally insured by the Health Plan whereas most managed care companies rely on external insurance companies which establish and approve patients' eligibility for benefits and health care providers' reimbursements. The role of insurance companies in setting terms for health care coverage, exploiting the ease of access to on-line confidential patient records for non-clinical business purposes, and increasingly shaping the content of patient records to generate criteria for financially-based approval or denial of the costs of patient care services are critically important issues in public interest debates in the United States regarding the health care system and the privacy of computer-based patient records. However, given the different structure of the HMO leading the EHR effort I describe, it is a limitation of my dissertation that I was not directly exposed to the controversies related to the role of health insurance companies. In many ways, during most of its history of more than fifty years, the HMO was "a world unto itself"[4] (an expression I heard often during 1993 and 1994) until the recent period of rapid market changes.

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3 At the time of writing, the HMO is fully integrated in California--including directly owned hospitals--but nowhere else in the country. Medical Centers outside California and some within California have "partnering" relationships with external hospitals for inpatient, surgical and emergency services.

4 While this sense of difference, indeed a sense of uniqueness, was widely reflected in day-to-day discourse and interactions in the clinics and the EHR Prototype Project, there are clearly

In the United States generally and in the organizations engaged in this particular EHR effort, redesign of current clinical work practices and routines is considered to be pivotal. Thus EHR systems and re-engineering initiatives become inextricably bound. The strong re-engineering assumptions that characterize U.S. computer-based patient record (CPR) efforts are not universal, however. One manifest difference is that of electronic patient record developers who advocate natural language processing (NLP) strategies rather than the structured content approach. The NLP strategy focuses on developing means to automatically parse and analyze narrative notes as they are freely dictated, word processed or handwritten by clinicians. The differences are based in philosophy and politics as well as conflicting interpretations of linguistic phenomena and limits to their reduction to standardized codification. Among European proponents of *free text* strategies, there is a strong belief that physicians should be left to practice as they decide; in other words, physicians should not be forced to change how they

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limits to the generalization. For one thing, there is considerable turnover among patient members of the HMO; many patients change HMOs or other managed care providers either by choice, as the result of changes in employment, or as the result of a change in employers' choice of health care coverage. The assumption that the HMO's patient members are insulated from rules about pre-existing conditions and decision-making by non-clinical insurance company managers seems to be based on an imagined stability of the patient population; within the company, this is the prevailing image of the HMO's membership. Indeed, a significant percentage of the HMO's patients are multi-generational members. Secondly, the HMO began differentiating market segments in the 1990s to gain market share among new patient populations. For example, members can join the HMO as individuals rather than only through employers. Members joining as individuals are screened for pre-existing conditions. Clinical services covered are stratified by benefits packages and premiums.

practice in order to accommodate EHR systems that are based on structured coding of clinical documentation.

That physicians are leading EHR/CPR efforts such as this one deserves attention given that physicians are powerful practitioners. The complexities of any domain cannot be understood without somehow engaging the participation of expert practitioners. Medical and clinical expertise cannot be understood without significant involvement of physicians, nurses and care providers in specific practice domains (on expertise and intuition, see, e.g., Dreyfus and Dreyfus: 1986). In the EHR Prototype Project, the user community comprises constituencies with considerable power: physicians and registered nurses serving as project leaders and sponsors. clinicians using the prototype in daily clinical practice, and physician specialists selected as representative domain experts participating in software design and clinical informatics discussions. From 1993 through 1997, the regional Physician Partnership group led the EHR Prototype Project, in contrast to the command of the national effort to rebuild the HMO's clinical information infrastructure by the Health Plan's Information Technology (IT) department. The Software Company's slogan--"Founded by Clinicians for Clinicians"--underscores a central commitment.

Whereas one might anticipate tensions between software developers in the *context of design* and expert practitioners in *context of use*, as Wieckert and others have found (Wieckert: 1995), here tensions ran more often along the boundaries between *clinical* and *non-clinical* understandings and sensibilities. The Software Company's slogan, "Founded by Clinicians for Clinicians," identifies clinicians as the primary actors in both design and use of the EHR. That many of the Software Company's staff are physicians, nurses and other clinicians was an important criterion for the HMO's selection of the company in 1993 from among more than two hundred competitors. An EHR Prototype Project report asserts that "the EHR is, first and foremost, a clinical tool," to support patient care and clinicians' decision-making. The insistent statement signals physicians' concerns over who will ultimately control the EHR system's development. Because the EHR is intertwined with agendas to change physicians' practices, tensions that are both implicit and explicit in kind are introduced. Tensions between clinical and non-clinical perspectives are writ large as struggles between the Physician Partnership and the Health Plan over business decisions perceived by the Physician Partnership doctors as potential threats to the autonomy of physicians' clinical decision-making.

If realized, the inner logic of the system, in the name of helping clinicians by building proactive alerts for protocols and guidelines and clinical research findings into daily practice, will bring the organizational

agenda--evidence-based medicine, outcomes analysis, continuous performance measurement--to the interface between each clinician and his or her computer. To do so demands considerable changes in work practices--especially for physicians and registered nurses–that will lay the basis for further cycles of change. The utopian project of the EHR Prototype Project, framed this way, holds together core tenets of the visions of the clinicians leading EHR development and the HMO's management that are or might otherwise be in contention.

For the visionary clinician leaders, the EHR development effort is a carrier of utopian visions for the realization of social medicine ideals. They express a powerful desire that EHRs will "make medicine whole," overcoming its crises of fragmentation. The clinicians in the HMO and the Software Company involved in EHR Prototype Project express hopes that an integrated and comprehensive electronic health records system will be a vehicle to promote patient-centered care and enhance collaborative teamwork. Nursing participants look to the EHR as a means to promote more independent nursing practices, greater recognition of nurses' clinical skills and roles, and more equal relations of colleagueship with physicians by virtue of improved access to clinical information among care providers. It is hoped that the EHR will (indirectly) promote more active engagement by patients in following care plans and understanding medical knowledge by

sharing on-line resources on the Internet and the World Wide Web. For example, a patient may enter his or her history, current problems, or functional status (quality of life indicators) directly into a computer. For patients living with chronic illnesses, results of home monitoring (self-monitoring or assisted monitoring of blood pressure, blood sugar and blood levels for medications, for example) may be transmitted by confidentially linking patients with their care providers. The idea, imagined to be on the near horizon, is that when constituted as "intelligent" (and confidential) clinical objects, such results can be immediately entered into one's electronic patient chart in the correct section(s) of the chart and in the correct schema of interactive relations with all other relevant data.

One of the physician inventors of the EHR explained to me that the idea was for the system "to read between the notes" (between the progress notes in a patient's charts and other records such as results). In this image, while clinicians are engaged elsewhere, the computer system continues its interpretive work in the patient's chart, finding connections between data documented to the chart from diverse sources by many authors. The system, we assume, will then present newly meaningful elements of the clinical case, surfacing clues to the dangers lurking "between the notes" by synthesizing dormant, previously disparate annotations, for the individual patient and then, by extension of interpretation through databases, for affected

populations of individuals. Thus it is imagined that the EHR system extends clinicians' abilities to avert dangers, points more quickly to diagnoses and their cures, and opens onto the epidemiological project, shedding light on areas of the unknown in medical knowledge. Multiple intelligent automata become assistants engaged in perpetual analysis. With the new technology continuously perusing patient data, one is able to see patterns and connections that were previously unseen or hard to discern--or that simply "fell through the cracks" by virtue of gaps and limits in people's and organizations' everyday physical and temporal working abilities.

When the HMO was founded in 1938, its founding physicians espoused social medicine ideals. They shared orientations to public health and commitments to "cradle to grave" care, family medicine, the integration of occupational health and environmental health, epidemiological and population-based approaches. But whereas the HMO can be thought of as "socialized medicine in one company," socialized medicine (universal health care provided by the state rather than the private sector) was anathema to its corporate founder as it was and remains so to the United States health care industry and most policy makers. Indeed, in the 1950s, several of the HMO physician leaders were persecuted by the American Medical Association, alleged to be Communists for their beliefs in "socialized medicine" during the period historian Rickey Hendricks calls "medical McCarthyism" (Hendricks:

1993; Regional Oral History Project). I provide an abbreviated history of the HMO's early years in relation to the vision for the EHR in Chapter III: Incomplete Utopian Projects.

Material as well as ideal desires obviously drive this EHR effort as they do any business venture given the private and proprietary contexts of the software and health care industries in the United States. However, everyday talk in the EHR Prototype Project did not explicitly refer to profit motives. A sketch of a joint meeting gives a sense of the framing of discussions. In the fall of 1995, I attended a bilateral "off-site" (akin to a retreat) with representatives of the HMO and the Software Company. The meeting was held in a landmark inn built to resemble a Spanish mission in a special room with paintings of saints and martyrs in various states of mortification, redemption, crucifixion, or resurrection mounted high above the conference table in such a way that the iconic figures depicted seemed to be watching over the meeting's participants. I was included in the off-site "to independently observe how the two companies communicate with each other." Leaders of the organizations exchanged introductory remarks. The CEO of the Software Company referred to "the dream of the EHR" and evoked the language of religion: "We are on a mission, a quest. If we cannot get across this bridge, why live?" The HMO's physician leader spoke in the language of war and military tactics: "We are at war in the marketplace." "We

have the strategic plan, now we need to hammer out the tactical plan." Very rarely did anyone talk in open meetings about the money at stake: success for the Software Company means that its founders and many of its staff could become millionaires overnight; the HMO seeks rapid market expansion and the competitive advantage that comes with integrative networked infrastructure.

A. The Sorcerer's Apprentice

The Pupil in Magic [Der Zauberlehrling]

I am now, -- what joy to hear it?--
Of the old magician rid;

And henceforth shall ev'ry spirit
Do whate'er by me is bid;
I have watch'd with rigour
All he used to do,
And will now with vigour
Work my wonders too.
. . .

Goethe, 1797, published 1798

The Sorcerer's Apprentice came to me in a dream as the underlying narrative for clinician inventors' visions of medical expert systems in 1992 while I was exploring a pulmonologist's invention of an expert system for occupational pulmonary medicine (Harber: 1991a; Harber and McCoy: 1989;

Harber et al.: 1990).[5] I heard themes that evoked the story's beginning: the excitement of bringing new tools to life and delight in imagining their use. The expert system was being transformed from an apprentice and research assistant to expert clinicians, into a fellow clinician possessed of diagnostic expertise, into a mediator or arbitrator capable of adjudicating disputes between clinicians holding differing diagnoses based on the same evidence. The pulmonologist inventor quickly expanded his horizons, proposing the use of neural nets to conduct a complete rewrite of established federal coding schema in the Dictionary of Occupational Titles (DOT codes) and Standard Industry Classification (SIC codes) in relation to arrays of descriptors offered by multi-disciplinary practitioners for toxic agents, states of industrial hygiene, work practices and risks for work-related pulmonary illnesses (Harber: 1991b) that provide a means to improve upon static classification of dynamic processes through neural net modeling and interactive objects (in the context of object-oriented programming). To this physician and expert system builder, the world of pulmonology, particularly the words with which the dynamic world of occupational pulmonology processes and practices is expressed, is in need of transformation.

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5 At the time, I was participating in a seminar given by Bruno Latour in the Science Studies program at the University of California at San Diego.

The story of the sorcerer's apprentice was indelibly popularized in the United States by Walt Disney's animated depiction in Fantasia (1940) in which Mickey Mouse (starring as the apprentice) is nearly drowned when pails and brooms, beginning as helpful tools brought to life by the apprentice to assist him in cleaning the sorcerer's laboratory, proliferate madly until relentless buckets of water become a torrential flood and brooms multiply and advance menacingly. Paul Dukas, the French composer who wrote the scherzo, *L'Apprenti Sorcier* (Dukas: n.d., 1983), was inspired by distinctly political points of reference. Dukas' composition takes its title from a ballad by Goethe, The Pupil of Science (*Der Zauberlehrling*) written in 1797 (Goethe in Bowring: 1974). Goethe's Pupil of Science--also translated as The Sorcerer's Apprentice--has been interpreted as a cautionary tale and critique of science, particularly German science, its rise and the havoc it wrought in the world (Paul: 1972). In Goethe's poem, the laws of nature that guide the relationships between people, tools and objects are disrupted, indeed thrown into fearsome chaos, by the well-intentioned if capricious and inexpert use of magic by the apprentice. The apprentice begins with bravado: "I am now, -- what joy to hear it?-- / Of the old magician rid; / And henceforth shall ev'ry spirit / Do whate'er by me is bid. . ." There is a note of defiance in using the master's magic to overturn the established work order. In his moment of hubris and excitement, the apprentice has set in motion forces he lacks the power to

control. He calls on the old magician for help: "Great is my dismay! / Spirits raised by me / Vainly would I lay!" The sorcerer restores the world to order, proclaiming: "To the side, Of the room, Hasten, broom, As of old! / Spirits I have ne'er untied / Save to act as they are told." Yet we sense that the previous order of the world is only uneasily and temporarily restored by the master sorcerer; the laws of nature, the constraints and possibilities for human and inanimate objects, once having been changed, are disrupted forever.

The narrative of the sorcerer's apprentice struck deeper chords for me early in my explorations of evolving electronic health record systems, my experiences in HMO clinical settings and my exposure to EHR design discussions. On behalf of patients, clinicians are engaged in creating new tools that will help them to identify patients' needs proactively within a system that makes it possible to see patients' progress along complex networked continua of care.[6] But the same new tools clinicians are creating

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6 A continuum of care and continua of care refer to the longitudinal chain of encounters, episodes and other interactions between a patient and diverse care providers in the health care system at diverse points of care. The continuum of care for a patient links outpatient preventive care (immunizations, screening for breast cancer or prostate cancer, among others), walk-in urgent care (fever of unknown origin, adverse reactions to medications), emergency care (an accident, presentation of abdominal pain or chest pain), major procedures (mammogram, MRI, angiogram), hospital treatment (episode of angina, other), telephone triage (beginning of another episode), telephone consultation (side effects of medication, modifications to plan of care medications) and so on. Visualizing a patient's lifelong continuum of care is an ideal of EHR/CPR development. In the meantime, *continuum of care* may refer to as much of the patient's life as can now be linked together. *Continua of care* also refer to the patterned linkages of care encounters and episodes for populations of patients who live with the same illnesses or otherwise experience similar enough circumstances to be conceptualized as a group.

are also embedded within an overall package that includes managerial and administrative tools that introduce new potentials to shape clinical decision-making and exert control over physicians' work practices. As in the story of The Sorcerer's Apprentice, with all the best intentions to do good and fervent beliefs in their abilities to change the world, the clinicians and designers inventing the electronic health record release forces that are then beyond their control.

When I mentioned The Sorcerer's Apprentice as my working title to a few physicians, each saw himself [sic], as a powerful expert practitioner, as the sorcerer with the EHR as apprentice or the EHR as capable of releasing a multitude of apprentices, inanimate objects transformed into "intelligent agents" (also known as "intelligent objects"). Trilling his fingers on the table to mimic the signature music of advancing tools gone magical and autonomous, one physician exclaimed, "Of course! If only we could clone ourselves, we could get the job done faster!" But to me, an immediate alternative interpretation is that the HMO is the sorcerer, as part of an enduring collective entity (the United States health care industry) committed to the continuity of its power and order. Yet things will never be completely the same for the institution and its clinical practitioners once new tools are introduced.

One new feature that computer-based patient record systems introduce is a *continuous electronic audit* by which, it is said, "everything becomes traceable." By establishing a continuous electronic audit trail that connects diverse dimensions of care provided by multiple care providers at multiple sites of care to episodes and critical events in a patient's life, this central aspect of EHR systems establishes the semblance of a *panopticon* for providers' practices (Bentham in Mack: 1969: Foucault: 1977; Foucault in Gordon, C.: 1980; Zuboff: 1988). For patients, a continuous electronic audit entails a similar pair of dualities. It establishes an unprecedented longitudinal record of one's care as a potential new tool for a patient, whether on paper or on-line via an interactive electronic medium. The metaphor of the sorcerer's apprentice can thus be extended to refer to the ways in which the Internet and the World Wide Web offer new tools for patients in combination with on-line EHR/CPR systems of health care institutions. For example, these new communication media make it possible for people who have such access to participate in on-line patient support groups and discussions of evolving medical knowledge. It also becomes possible to communicate with care providers via e-mail within a confidentially circumscribed Intranet.[7] At the same time, the electronic ubiquity of computer-based patient records is the

7 A confidential and proprietary Internet site owned by a private entity whether a company or other proprietary organization or a special interest group.

basis for heightened concerns regarding their confidentiality and security (see, e.g., National Research Council: 1997).

For health care organizations, the duality takes parallel form for medical-legal concerns. That "everything is discoverable" refers to the ever-present spectre of malpractice allegations that seems to permeates discussions at all levels of U.S. health care institutions. Yet the new abilities to see and connect "everything" make it possible, first to visualize and thereafter to analyze an unprecedented longitudinal view of a patient's health history, what some already call a *lifetime patient record*. Clinicians want EHRs to provide protections from risks for their patients and for themselves.

Two illusory premises--that on-line clinical information is or can come to represent "everything" one needs to know about caregiving and interactions between patients and care providers, and the utopian desire that clinical information systems can "eliminate risk" and that medical mistakes can be eliminated--are points of contention enjoined in the unfolding story of electronic health records. The more one tries to align reality with design based on these two premises, the more one learns how deeply artful, emotional and interpersonal, and complex clinical realities are; as new tools to "capture" reality are set in motion, we encounter the multiplying pails and brooms that confronted the sorcerer's apprentice.

New instruments make it possible to "discover" (define) new diagnoses and illnesses at finer and finer granularity. In other words, new illnesses are socially constructed with the aid of new visual technologies (Haraway: 1991). As the identification of new diagnoses proceeds, for every step towards finer definition, many more shades of gray also become discernible. In the electronic health record development effort described herein, the pursuit of evidence-based medicine provides a key example (discussed in Chapter III: Incomplete Utopian Projects).

B. The case study

This dissertation provides an account, from mid-story, of a leading innovation project to design an EHR system meant for routine clinical use in a distributed computer-based system. The EHR Prototype Project was a multi-year, multi-million dollar co-development effort between the southern California region of a national HMO and a small state-of-the-art Software Company founded by clinicians and based in Silicon Valley. The national HMO intends to implement an EHR system-wide, whether the software application discussed here, another system among its competitors in the clinical software market, or a combination of systems. During the time I spent in the EHR Prototype Project, estimates ran from five to ten years for the time required for organization-wide clinical information systems implementation

and from ten to fifteen years for the transition from paper patient charts to electronic health records.

The software design strategy pursued by the Software Company and the HMO for this particular EHR effort is especially ambitious; few EHR/CPR systems entail such a thorough-going commitment to *structured* clinical content documentation. The fundamentally new dynamic is the creation of an electronic substrate of structured (coded) patient data linked to an underlying knowledge base of clinical and medical terminologies. "[O]ur text has this certain life in it ... it knows where it came from, it knows where it is going."[8] The structured electronic text simultaneously represents "both a legal text note that is the chart record and an underlying coded form of the note to support analysis and research" (Crist-Grundman et al.: 1995). In addition to maintaining the patient chart, the medical legal document of record, audit trails and databases for clinical research are generated “automatically” through the structured documentation of each interaction with the patient. By doing so, the design of the electronic health record is intended to provide the basis for unprecedented capabilities at the computer desktop of a clinician or an administrator: (1) flexible display for varying clinical views of the patient or patient population(s) for case management and population-based management of groups of patients with like problems; (2) real-time analysis

8 Interview with Software Company physician, 1997.

as the basis for decision support and other forms of algorithm-based reminders, prompts and alerts related to clinical protocols and practice guidelines; (3) cumulative outcomes analysis for populations of patients living with illnesses, following and receiving particular treatments; and (4) new audit and reporting capabilities for clinical, regulatory, medical legal, quality assurance, utilization review purposes, and cost benefit analyses.

The EHR Prototype Project involved a diverse team of physicians, nurses, administrators, business analysts, management engineers, systems designers, computer scientists, and social scientists. Project planning and interim progress reporting were channeled through advisory bodies of physicians, nurses, information specialists, and administrators. Leaders of the project are active in collaborating with other health care organizations, software design companies, medical informatics academicians, national entities for CPR policy and laboratory simulation, and national and industry standards-setting bodies for development of controlled medical terminologies (CMTs). Within the national HMO, EHR prototyping and planning efforts are linked to overall enterprise modeling of patient care business practices and informational requirements of patient care encounters across outpatient and inpatient environments. An important characteristic of the EHR Prototype Project is that it is explicitly regarded as an enabler and catalyst for

organizational re-engineering including changing work flow and facilities design, and implementing clinical practice guidelines.

The software application introduces client server and object-oriented technologies into an organization whose scale is that of a small European country. At the time of writing, the HMO estimates its patient membership at approximately nine million across the country. In 1993, the HMO was the largest in the United States, with twelve regions across the United States, with more than 9,000 physicians, and total assets approximating five billion dollars. Its home base is in California, with an estimated seven million patients.

The HMO's administrators are devoted to continuous quality improvement (CQI) and alignment of performance measures with enterprise-wide strategic goals. Furthermore, the HMO has deep roots in industrial forms of efficiency and economies of scale, with an emphasis on management engineering of work organization in the Taylorist and related scientific management traditions. To implement the EHR system thus envisioned will require explicit system-wide changes in work practices of clinicians at the point of interactions with patients and documentation of patient-provider interactions. How are clinical work practices and patient-provider interactions likely to be reorganized? The iterative prototyping period

offered glimpses of reciprocal modification between the contexts of design and use of a new technological system as it undergoes development.

Clinical information systems are implicated--generally, not only in this HMO--in planning for simultaneous down-sizing and market expansion. The EHR projects represent capital investments in technological innovation meant to further and accomplish thorough-going corporate reorganization (enterprise modeling, practice guidelines, outcomes research, total quality management and so on) for which redesign of work is pivotal. Put more simply, the HMO's corporate managers want its new integrated information infrastructure (for all clinical and financial business processes) to facilitate cost-cutting (local down-sizing through budget-tightening) and expansion (within its regions and nationally) in the face of greater market competition, continued economic uncertainty, and anticipation of eventual national health care reform in the United States. While such a statement of purpose is a "given" or a commonplace to HMO administrators, planners, systems implementers, and advocates for CPR/EHR projects among physicians, local clinical and hospital staff may ask how capital expenditures for technology as well as facilities expansion fit in with budget tightening affecting their daily work lives.

Although a non-profit corporation, the company earned approximately $800 million in net revenues in 1992, the year before I began

field research in the HMO's clinics. If it were a publicly traded company (rather than a non-profit), the HMO would have ranked among the top one hundred companies in the Fortune 500 in 1993. In the early 1980s, it was estimated that the HMO "will end the twentieth century with about a $10 billion capital spending plan in California" (Hendricks: 1993, p. 2). Approximately ten percent of the capital fund will be spent on clinical information systems.

During the four year period of the field research reported here, the national HMO entered a period of considerable change and restructuring. The first year I worked in the EHR Prototype Project, 1993, was also the first year that staff had been involuntarily laid off in the company's fifty year history. In 1993 and 1994, the three regions of the HMO which owned hospitals began making decisions to divest or close many of their hospitals. In 1997 the HMO posted the first net loss in its history--a quarter million dollar deficit (equal to less than two percent of its operating budget)--when rapid growth in the number of new patients outpaced clinical services capabilities in combination with a multitude of restructuring and market strategies advised by major consulting firms. When my involvement with the EHR Prototype Project began, there were eleven regions of the HMO across the United States and at least as many competing CPR/EHR projects and approaches. In 1995, the number of regions was summarily condensed by

corporate administrators who mandated at the same time that the regions were to "converge" their CPR/EHR strategies and systems rapidly. In 1996, the HMO hired a Chief Information Officer (CIO),[9] a new position located in the Health Plan, the home entity for the Information Technology department. The physicians of the Physician Partnership groups across the country began organizing new entities to represent their interests, including a national federation, with the intent to hire their own officer at the CEO/CIO level to negotiate on behalf of the physicians. In the first quarter of 1997, corporate administrators launched a major restructuring of the Health Plan, unfurling a strategy developed in consultation with a prominent international consulting firm. In the second quarter of 1997, the CIO accelerated convergence of the HMO's diverse clinical information systems by forming a task force assigned to determine the single "national solution," with the goal to begin implementing the CPR/EHR solution in mid-1998 (a goal since passed). Building the clinical information infrastructure is regarded as a powerful force for national integration.

In 1997, the HMO and fourteen unions in the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), representing the majority of its workforce, agreed to a labor-management accord to establish

9 The HMO hired an experienced information technology manager from the financial services industries with no prior experience in clinical information systems development.

relative peace in labor relations for the period of union contracts (most of the contracts are five year agreements). The notable exception to the labor-management accord is a non-AFL-CIO union of registered nurses in northern California (registered nurses are also represented by other unions that are signatories to the multi-union-HMO agreement).

Through analysis of case examples from patient care encounters and EHR design discussions, I explore a set of themes that guided my field research:

- different logics between the contexts of EHR design and clinical use, particularly regarding patient presentation of problems, patient-provider interactions, and clinical teamwork (communication, coordination and collaboration);
- the problematics of transitions from free text and handwritten notes to structured content and "templating" linked to controlled clinical terminologies (CMTs);
- variations in relation to the impending wave of standardization: variations in practice styles; variations in localized work practices; variations in clinical cases, particularly those of complex patients; variations related to specialized care and to varying models of patient care.

This is a story of two logics[10]: the inner logic of the new system and what it requires in terms of changes in work practices, clinical practices and intellectual thought processes of clinical and medical decision making and

10 In my use of *logics* to describe both the logic of the EHR system design and the logic of patient care interactions and clinical work practices (clinical logics), my intentions are to posea balance or symmetry between the two. Whereas Berg (1997a) proposes “logics” as a useful and generalizable concept, my use of logics is more specific.

rapid integration of new medical knowledge (cognitive changes) and the logic of present clinical work practices, patient care interactions, and modes of patient care. It may seem odd to use the term "logic" to describe current, largely informal clinical work practices. I use logic here in the spirit in which Lucy Suchman and Brigitte Jordan point out the importance of appreciating the social practices of a community of practice on its own terms rather than implicitly conceiving "an empty vessel" into which advanced technological practices should be poured (Suchman and Jordan: 1989). Suchman and Jordan wrote about women's knowledge in mid-wifery and office work in contrast to assumptions in medical and information technology projects that what is new, what is modern, what is "high tech" is filling into "an empty vessel." For patient interactions and clinical teamwork, interpersonal communication and emotional aspects of in-person communication are at the heart of patient care and its logic, intertwined with diagnostic and therapeutic reasoning and up-to-date medical knowledge.

Clinical expertise itself develops in collaborative, iterative activity. Expertise in patient care involves more than expert medical reasoning. Clinical team members' knowledge of patients and their families over time, prospects for a patient's active participation in treatment plans, the holistic nature of memory and recall of clinical narratives--all of these alert

practitioners "intuitively" to anomalies as well as common patterns. And all of these are informed by and communicated through the dynamic creation and sharing of patient records and clinical information, handwritten, electronic, and spoken communication with patients and among colleagues.

In the analysis of the field research themes, I refer to historical periodization of modes and models of patient care and attempts to improve medical records documentation practices and tools. The medical record system of paper-based patient charts and disparate multi-media images and data is problematic as a communication tool. Historically, medical records and patient charts have undergone periods of innovation; the problem list, introduced in the 1960's, was one such innovation. Yet problem lists, medical record systems and patient charts have eluded degrees of orderly structure, accessibility, analyzability, and rationalization. In the data analysis presented in Chapter IV: Changing Patient Care, I explore why such design breakthroughs are so difficult for those engaged in the transition from paper to electronic patient records.

Along with many people I worked with in this effort to create on-line patient records, I believe that the current medical record system is in need of repair and improvement. "Let's face it. The medical record system is broken," Paul Tang told participants in the Symposium on Computer Applications in

Medical Care (SCAMC), in 1993.[11] Over the next few days of the symposium, Tang's matter-of-fact statement was referred to as a marker that "the problems are out in the open." In this respect, I believe the story of electronic health records will prove to be a story similar to the story of medication errors, medical mistakes and risk. Until recently, medication errors were largely an internal matter, well known among health care professionals but rarely discussed in public venues. Once systemic means for recording medication errors were put in place, the extent of previous under-reporting of errors became apparent. For patient records, we will not know how bad things have been until there are new means by which to see and redress fragmentation, gaps, discrepancies, and breakdowns in communication important for continuity of patient care carried out by members of multi-professional and multi-disciplinary teams and networks. Gaps in medical records, discontinuities in care such as delays between primary care and specialty care, and problems in coordination of care for a patient being seen by multiple care providers are likely to become more visible and more widely known; in other words, the picture will look worse as errors become more visible before remedies are devised and then put in place. Systemic problems become visible and are then defined as "manageable problems" for which

11 Tang is a prominent computer scientist in medical informatics development. At the time he made the remark, he was working in Hewlett Packard's team to create a computer-based patient record system in collaboration with the Mayo Clinic.

system improvements may be devised and implemented; this is an historical process by which "solutions" produce and define "the problems to be solved." Organizations leading in CPR/EHR development such as the HMO may become lightning rods in the short run for such heightened visibility and public awareness. More important for my argument, system capabilities thus developed will address certain genres of mistakes and problems but not the error-ridden nature of clinical practice, the inevitability of medical mistakes and human limitations in the face of illness and mortality.

From the narrative discussions of these grounded themes, I summarize systemic dilemmas (Billig: 1987; Billig et al.: 1988; Middleton: 1992; Timpka and Arborelius: 1990a, 1990b, 1991; Timpka and Nyce: 1992) that confront EHR designers, the care providers who will use these new systems, and the health care organizations that will implement them. The redesign of clinical work practices and routines are considered to be pivotal by EHR designers and the health care organizations that plan to implement them. Contest over the organization of work intensifies as contradictions deepen between the social medicine ideals of care providers, extensions of the commodification of patient care, and industrial efficiency models of work organization in large HMOs and other managed care entities. These contradictions are considerably sharpened by the influence of changed market

forces, particularly the rise of for-profit managed care organizations since the mid-1980s. As late as 1987, only 4% of the U.S. population received patient care from HMO's (Hendricks: 1987). In 1992, the HMO's closest competitor had approximately 800,000 members. This has changed as consolidation of the health care market and particularly the managed care market has progressed.

C. Research approach, research sites, methods, data and sources

Why patient care? I focus on patient care for several reasons. Patient care is an intimate activity governed by covenants of healing, care for life, interpersonal and community interactions (e.g., Dreier: 1997; Gordon, S.: 1997; Paget: 1988). As such, it deeply challenges conventional ways of understanding commodified work and industrial models for productivity as indicators for the outcomes of labor as it is reorganized with new tools offered by information technologies. Health care brings the contradictions between use value and exchange (commodity) value into high relief. This intimate and interpersonal service and ethical responsibility is irreducible, beyond a certain degree, to commodification. Debate over the boundary between patient care based on social medicine ideals and product definitions based on cost-benefit calculations is actively engaged in the general public and within particular health care institutions. This contradiction permeates patient-care

provider interactions and patient care delivery systems. And it permeates public mistrust towards managed care.

Work organization shapes development and use of skills and expertise and modes of collaboration among members of patient care teams. I was also drawn to patient care because the teamwork required for patient care is exceptionally interdependent, collaborative, and multi-layered while simultaneously stratified by roles that are constituted as hierarchical on legal and organizational bases. Work organization also shapes models of patient care and interactions with patients, thus constraining individual care providers' abilities to act upon their ideals and imagined models of patient care and preferences about how to interact with patients.

Considering the emotional aspects of interactions with patients and their significant others, health care practitioners are compelled to take into account the psychological sensitivities and emotional stakes involved for patients. Whether this is done well or poorly, the “subjective” realities of patients' lives must be handled somehow; they may be variously acknowledged, suppressed or “ruled out." In parallel ways to patients' living with illness, pain, limits, fear or sadness, caregivers must somehow manage such feelings themselves. Boundary-setting in patient-care provider interactions and reliance on institutionalized boundaries are obvious

externalized means of recourse; however, they can ameliorate but not remove "the complex sorrow of clinical work" (Paget: 1988).

When Marianne Paget wrote of "the complex sorrow of clinical work," she wrote also of "the anguish of clinical action and ... the moral ambiguity of being a clinician" given the inherently "error-ridden" nature of patient care and the ways in which medical mistakes unfold over time to become mistakes (Paget: 1988). The desire to transcend the error-ridden nature of patient care is one of the deepest utopian desires of caregivers engaged in the invention of electronic health records. Could "intelligent" computer systems designed to bring on-line real-time decision support to clinical work enable clinicians and health care organizations *"to eliminate mistakes"* and *"to eliminate risk"?* Modern medicine and physicians, who rose from suspicious transgressors to admired miracle workers, have fallen from the grace of a lay priesthood to the realm of questionable human agents and entities given the pariah status of corporate managed care in the United States. Can technology make heroes or superheroes of medicine and physicians? These two desires–to overcome error and sorrow, to transcend human limits--are marked as utopian, the former by (noble) impossibility, the latter by immodesty.

C.1. Research sites

My primary access for my field research was within the HMO. The field research discussed in this dissertation was conducted in clinical settings

and related organizational settings of the HMO. My points of access to the Software Company were secondary: regularly reading and interpreting system requirements and specifications and participation in meetings between Software Company and HMO representatives, usually on the premises of the HMO.[12]

To this day, it is rare for any organization to commit significant time and resources to field research *before-the-fact* of the introduction of a new technological system. The project discussed is unusual in affording an opportunity for baseline research, during the year prior to the introduction of the first version of the EHR prototype into clinical use, and through the iterative development of the first three versions of the EHR prototype in clinical use.

The EHR Prototype Project was formally launched in July 1993. Before the official "kick off," the Software Company was selected from among more than 200 competitors that responded to the HMO's request for proposals. One of the HMO region's medical centers was selected as the EHR Prototype Site Medical Center from among three of the regional medical

12 A noteworthy exception is a mid-project series of interviews about EHR template design strategies conducted in early 1997 that elucidate how the critically important feature of templates is conceptualized. The interviews were conducted with eleven of the software company's principals including product developers, medical informatics experts and the software architect. Three of the HMO's project leaders (a nurse specialist in clinical informatics and two physicians) were also interviewed at that time.

centers that competed to be the first site for EHR prototyping.[13] Each medical center in California consists of a central campus with a hospital tower (for inpatient, emergency and urgent care) and medical offices tower (for outpatient primary and secondary care) and numerous off-campus clinics (for single or combined outpatient clinical services, for example family medicine, obstetrics and gynecology, psychological services). At the time, the EHR Prototype Site Medical Center served more than 250,000 patients, making it one of the smallest of the region's twelve medical centers.[14] In 1993, the EHR Prototype Site Medical Center was only five years old, making it one of the newest facilities. More recently recruited, physicians at the EHR Prototype Site Medical Center are younger than average for the HMO's physicians. Computer literacy was a prerequisite for newly hired physicians (as opposed to those who transferred from one of the HMO's other medical centers). Within the EHR Prototype Site Medical Center, patient care teams competed for the honor of being pioneers in developing the EHR. Regular in-progress meetings, particularly the bi-weekly EHR Prototype Site Medical Center

13 One factor in the selection of the Prototype Medical Center was the track record of good labor management relations. The registered nurses at the Prototype Medical Center are represented by a different union than the union that authorized a strike in Southern California in 1996 and the union representing registered nurses in Northern California that went on strike in 1997.

14 At more than a quarter million patients, on the other hand, the Prototype Medical Center's patient population is roughly equivalent to the patient membership of many of the HMO's regions outside California.

steering committee meetings, served as an important forum for expression and articulation of the vision for the EHR system and the problems encountered along the way. The first clinical setting for EHR prototyping was a patient care team in an off-site outpatient Family Medicine Clinic located approximately twenty miles from the main medical center campus. The second clinical setting was a Cardiology and Internal Medicine patient care team located on the main medical campus in the medical offices tower, the outpatient specialty and sub-specialty services provided by the cardiologists and medical internists.[15]

The Family Medicine Clinic is the farthest eastern outpost for the HMO in southern California. It is further removed by a notoriously demanding commute to and from the Los Angeles headquarters--forty percent of the eastern county's employed population commutes into greater Los Angeles on a daily basis. The selection of the clinic was a testament both to the strong reputation of the patient care team chosen and to the foresight of the Clinic's Physician-in-Chief (PIC) who required a few years earlier that the new clinic building was to be "wired for computers." The choice of the clinic as far as possible from the regional headquarters offices in Los Angeles also signaled a desire for a "laboratory-like environment" removed from casual

15 The senior cardiologist in the EHR prototype module was also the Chief of Service for the Internal Medicine Department overall and a member of the Physician Partnership's Regional Board, in other words, an influential leader and peer representative among physicians.

curiosity. As an organizational veteran commented about who would be willing to make the long drive to the Clinic: "That'll separate the men from the boys!"

At the time of writing, the third version of the EHR prototype was being used by physicians, nurses, clinic assistants and technicians in the two outpatient modules.[16] The first Family Medicine patient care team began using Version 1 of the EHR prototype in August 1994, Version 2 in 1995, and Version 3 in 1996. The second patient care team, in Cardiology and Internal Medicine, began using Version 3 of the EHR prototype in November 1996. In 1998, the HMO and the Software Company were poised to implement the fourth version of the EHR prototype in another medical center and another region.

During the period discussed, the Family Medicine patient care team comprised eight care providers: three physicians, one physician assistant (PA), one registered nurse (RN), two licensed vocational nurses (LVNs),[17] and

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16 The HMO uses the term *module* to refer to the smallest organizational unit in ambulatory care. A module is typically comprised of one or two patient care teams, between 10 and 30 care providers (physicians, nursing staff, ancillary care providers, technicians, receptionists). An outpatient module is an approximate counterpart to an inpatient unit (hospital ward). Early in my field research, health care professionals in other organizations pointed out to me that this use of the term module is unique to the HMO and reflects its penchant for structure. As a physician friend explained, "Most of us just are not that organized."

17 Licensed vocational nurses (LVNs) are also known as Licensed Practical Nurses (LPNs) in other parts of the country.

one trained clinical assistant (TCA).[18] The Cardiology and Internal Medicine module comprised three cardiologists, a medical internist[19] with cardiology responsibilities, a rheumatologist, five RNs, three LVNs, two TCAs, and six cardiodiagnostics technicians.

In Chapter IV: Changing Patient Care, my discussion of case examples begins by focusing on three pre-EHR (baseline) primary care patient visits and the teamwork of the care providers, their interactions with patients and each other, and their uses and creation of patient records. The patient visits were video recorded in late February and early March of 1994 in the Family Medicine Clinic. The care providers are the first to use the EHR prototype in clinical practice, beginning in August 1994. I discuss problematics of transitions from free text and handwritten progress notes to structured content (structured text) documentation of patient records. The discussion points to dilemmas care providers may face in trying to accomplish structured documentation within the realities of clinical work practices and work organization.

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18 Trained clinical assistants (TCAs) are also known as Medical Assistants (MAs). The terms are used interchangeably within the HMO.

19 By "medical internist" or "internist," I refer to a physician who is a specialist in Internal Medicine, not to be confused with an "intern," a role of a new medical doctor (M.D.) in the final phases of completing his or her clinical practice training as a physician.

I lived in the community of the EHR Prototype Site Medical Center from the fall of 1993 until February 1996, the period of the field research that I describe in the dissertation. My apartment was in a neighborhood approximately equidistant between the Family Medicine Clinic and the main EHR Prototype Site Medical Center campus. I was trained as a patient advocate volunteer in the fall of 1993 and served as a volunteer in the emergency room in the winter of 1994 (more on this below). The Family Medicine Clinic provided a research office that was my main work location for the first year and a half. In addition to formal, scheduled periods of observation in the clinic--shadowing the physicians, physician assistant, nursing staff and others for the clinical half day, shadowing nursing staff in their rotations in the walk-in Triage area, accompanying the physicians on hospital rounds--I also celebrated birthdays and the occasional baby shower and wedding, participated in holiday potlucks, and attended the Clinic Christmas parties. I was declared "family." I often just walked through the module on an errand, to schedule something or just to say hello. When I did, there was always something of interest going on and, more often than not, something one or more people wanted to talk about concerning the prototype software. In early 1995, the research office was moved to the EHR Prototype Site Medical Center campus in order to be situated nearby the Cardiology and Internal Medicine module. In addition to proximity of time and geography,

working in the clinic and living in the community were important in another way. In the clinics, people talk about the relation between the region and the clinics in much the same ways that people in big cities talk about "Downtown" and "the Neighborhoods." People talk of regional "'tudes" and "suits" in contrast to "real people." There are suspicions about "what the region is going to do to us now" or "what the national headquarters is going to make us do."

In the late spring of 1995, I was included in a new business unit created within the regional Physician Partnership to carry out clinical systems development including the EHR Prototype Project and my main work location changed to the regional headquarters in Los Angeles. It proved impossible to sustain an ethnographic approach and relationships once I was moved into the Headquarters offices with concomitant shifts in my roles and responsibilities.

C.2. Research methods

Activity theory and developmental work research provide the primary methodological framework for my field research. My focus in interpreting the field research is to understand expertise as collaborative activity among members of patient care teams and networks and transformations of activity systems--how work practices, technological and other tools, forms of teamwork and modes of patient care change (see, e.g., Engeström, Y.: 1990b, 1991c, 1992; 1999b; Engeström, Y., Engeström, R. and

Saarelma: 1988; Engeström, Y., Virkunen et al.: 1996). For the field research, I employed qualitative research methods including ethnographic observations in the clinical settings, video documentation of clinical teamwork for patient care encounters, analysis of patient records for varying documentation styles and content, interaction analysis of video taped patient care encounters, and discourse analysis of project team meetings and design discussions. To analyze these phenomena, I combine principles from activity theory with influences from science studies and related work in detailed ethnographic analysis. I establish the building blocks of my theoretical framework for the dissertation in Chapter II: Theoretical Framework. In Chapter III: Incomplete Utopian Projects, I present the concept of incomplete utopian projects as an intermediate construct for thinking about historicizing and envisioning in innovation efforts.

Following the sociohistorical principles of developmental work research, I conducted representative historical research on the founding motivations of this particular HMO and the model of HMOs in general. Because the HMO leading this clinical information systems effort is also one of the first health maintenance organizations established in the United States, a set of oral history interviews conducted in the 1980s with its founding physicians and administrators are available and these proved vitally useful (Regional Oral History Project). Among other contributions, the HMO's

founding physicians offered prescient formulations of medical informatics through their commitments to population-based and "evidence-based" medicine (Regional Oral History Project; see also, e.g., Collen: 1995). To understand the long-standing problems that EHR/CPR developers are trying to solve, I explored the history of medical records and selected attempts to improve them. I familiarized myself with medical informatics, the field that emerged approximately twenty years ago as the application of artificial intelligence and other computer science techniques to the domains of medical and clinical expertise.

What is the distinction that I am drawing between "frameworks" and "methods"? By "framework," I refer to the theoretical grounding that shapes the methodology within which particular methods are employed. By "methods," I refer to general and specialized techniques such as interviewing, shadowing, participant observation, discourse analysis, and interaction analysis that can be used within quite different theoretical frameworks. By "methodology," I refer to the particularization of methods in relation to their permeation by theoretical principles; methodology is the intermediate (practical, applied) instantiation of the theoretical framework. Methods informed by different theoretical frameworks are carried out differently and to different analytic purposes. In regard to the relationships between methodology, methods, and one's theoretical framework, I follow Yrjö

Engeström who writes: "By methodology, I mean a coherent set of general principles and guidelines of research associated with a certain philosophical orientation or theoretical framework. A method, in contrast, is a specific technique or procedure of research."[20]

Perhaps the best way to explain is to contextualize these relationships in relation to my field research. In developmental work research, Y. Engeström proposes a distinctive methodology that organizes the use of methods in particular ways that are informed by activity theory principles and that will in turn contribute to articulation and expansion of the theory (Engeström, Y.: 1987, 1990a, 1991a, 1991b; Engeström, Y., Brown et al.: 1991). Identification of a unit of analysis is an example that illustrates the interdependencies between theoretical framework, methodology, and methods. One of the activity theory principles important to the identification of a unit of analysis is the emphasis on *joint activity* which we can also think of as an emphasis on *team* coordination, communication and collaboration rather than *individual* cognition and psychology. Another principle is the concept of a *cell* or *germ* of activity (I prefer the term *nucleus*) connoting the conditions of *development* and generalizability. A third principle is that an activity system is always *changing* (developing, expanding). Change in any dimension of an

20 Engeström, Y. XMCA@weber.ucsd.edu, December 7, 1997.

activity system (tools, division of labor, rules, community, for example) has the potential to transform the activity system as a whole. To determine a viable unit of analysis requires ethnographic immersion in the field setting to gain phenomenological understanding. Which joint activity carried out by which people engaging in which interactions do we need to understand to appreciate the dynamics of the activity system and its potential transformation? In this case study, what helps us to understand potential transformation and change related to the invention of new tools for documentation and communication of patient records?

In the HMO outpatient clinical settings, I identified the instantiation of patient care in the office visit as a core patient care encounter type engaging teamwork interactions and patient-care provider interactions and the use and creation of patient records to support and document these interactions. The identification of the office visit as the unit of analysis then shaped foci for ethnographic observations. It particularly shaped the video documentation of office visits that I conducted. Rather than focusing on patient-physician interactions in the exam room, for which there exists an impressive body of research and analysis (see, e.g., Arborelius and Timpka: 1990a, 1990b; Arborelius, Bremberg and Timpka: 1991; Arborelius, Timpka and Nyce: 1992; Engeström, R.: 1995; Frankel: 1990; Heath: 1986), I set up the video documentation to follow the use and creation of patient records in relation to

the "patient path" through the office visit from intake and vital signs at the nursing station to the exam room consultation with the physician or physician assistant to closing interactions related to the plan of care and instructions at the nursing station. At the same time, pre-exam room chart review and post-exam room documentation in the physician or physician assistant office were video recorded as were any activities by the nursing staff occurring simultaneously with the exam room consultation or the completion of documentation in the physician or physician assistant offices. Choosing the office visit and the clinical teamwork entailed as the unit of analysis expands upon the previous research that closely analyzes interactions during patient-physician consultations. The work of Christian Heath and Paul Luff (Luff and Heath: 1998; Heath and Luff: forthcoming), for example, highlights the multi-faceted flexibility and mobility of paper-based patient records as artifacts dynamically used by an individual physician in consultation with an individual patient (see, e.g., Luff and Heath: 1998). In my analysis of office visits and clinical teamwork, the singularity of the paper-based medical-legal patient record becomes immediately problematic for members of the patient care team who need concurrent access to the record. I discuss three of the video taped patient visits in Chapter IV: Changing Patient Care.

It is my sense that such an ethnographic approach is more crafted and driven by activity theory framing and developmental work research

methodology than one would expect to find in anthropology, especially following ethnomethodology, with its emphasis on phenomena defined by the people whose lifeworld it is. Certainly there are principles in common between activity theory and grounded research methodologies (Glaser and Strauss: 1980 (1967); Strauss (1993); Strauss and Corbin: 1990, 1997; Strauss et al.: 1997 (1985)) and ethnomethodology (see, e.g., Garfinkel: 1984a (1967), 1984b (1967)), particularly in the reciprocal and iterative shaping of observations and analysis. For example, Katherine Brown combines ethnomethodology and developmental work research in her analysis of the shift to digitized photography, suggesting potential for theoretical integration and convergence between methodologies (Brown: 1996).

Partly due to institutional constraints, partly shaped by developmental work research, and partly by my own choice, I employed ethnography as a strategic or crafted method, what I think of as "distanced ethnography." I think of my ethnographic research as "distanced" in several ways. First, activity theory, particularly developmental work research, tends towards a system perspective (Scribner: 1985; Scribner in Tobach et al.: 1997). In other words activity theory framing and research methodologies are oriented towards understanding *activity systems qua systems*. By definition, theories that emphasize system perspectives are concerned with generalizable concepts abstracted--distanced--from the phenomenological experience of

individuals qua individuals. The emphasis on generalizability entails further degrees of abstraction and selectively organized attention. The particularities of ethnographic understandings are filtered through an activity theoretical lens. The systems perspective (partially) explains the seeming riddle of how ethnographic methods combine with an intervention methodology such as developmental work research and how activity theoretical approaches seem so well suited for computer systems design and development. The riddle and associated dilemmas are not unique to followers of activity theory but confront ethnographers working in organizational and corporate contexts, notably anthropologists' involvement in computer systems design and work redesign (see, e.g., Blomberg, Suchman and Trigg: 1994, 1996: Grudin and Grinter: 1995; Kindermann: 1992; Suchman: 1994a, 1994b, 1999; Winograd: 1994; Wynn: 1979).

Angelika Kindermann offers a critical discussion of the tensions between anthropologists' and computer systems designers' perspectives, ethics, research practices, and concepts of participatory design when working together in work redesign in a large corporation (Kindermann: 1992). Kindermann contrasts "the anthropological model of work as embedded in and depending on social structure and a computer model of work as a conglomeration of tasks, positions, and materials" (Kindermann: 1992, p. 1). The computer modeling system's requirement that data must be "measurable

and quantifiable" meant that "only officially prescribed tasks, positions, and communication channels were included, resulting in an 'optimal' depiction of the process" (Kindermann: 1992, p. 6). Whereas the multi-disciplinary design team first rejected a Tayloristic approach, instead adopting participatory design principles, Kindermann concludes that the computer model "shows a striking similarity to 'scientific management' ideas and Tayloristic approaches to work analysis resulting in restrictive representations of work processes" (Kindermann: 1992, p. 8). She writes of the two "diverging and conflicting models":

> The anthropological view tells us that work entails more than just fulfilling an assigned task and that employees are constantly creating and recreating their work. In addition to the prescribed methods and procedures, employees use a variety of means to 'get work done.' These include work arounds, using informal channels of communication, and creating social alliances that aid in completing assignments. This view however is not obvious to workers, managers, or computer scientists. ...
>
> Contrary to the anthropological evaluation of work as embedded in and dependent upon social structure, the computer model was oriented towards a quantitative depiction of work ... [using] a tool to depict work flows and to model any changes introduced into the existing flow. For this purpose tasks are broken down into quantifiable steps with assigned time sequences and costs (Kinderman: 1992, pp. 3-4).

Let me now return to the crafting of ethnographic observations and video documentation that I described above in relation to identification of units of analysis in activity theory. The strategic crafting of research activities

was also required by the HMO's project managers: for approval, any and all plans and activities had to be persuasive in terms of cost, staff time, resource (clinical staff) time, values (deliverables), and turnaround time. In the EHR Prototype Project, field research should maintain a strategic focus for knowledge acquisition from which systems design recommendations can be generated that contribute to system requirements. Early video ethnography--video recording of baseline primary care patient visits--was supported to the extent that analysis of the patient visits contributed to the translation of interactions into information (data) elements and standardized components (decomposition of activities) to address design problems. Being thus required to meet both the pragmatic and theoretical tests of the EHR Prototype Project and my dissertation respectively may be regarded by many as a healthy condition for conducting accountable research. Developmental work research framing proved sufficiently matched to meet project litmus tests in the early period. But the tensions built quickly between what we may think of as "instrumental" or "administrative" research--what I describe as "knowledge acquisition" in the context of systems design and informatics--and more "critical" theoretical commitments and reflection on practice other than those that match pre-defined business objectives for organizational change. The demands and constraints that the institution imposed combined with my own human limits and my isolation from colleagues from like-minded

intellectual communities of practice to make it impossible to fully pursue developmental work research methodology. A commitment to an ethnographic approach was important to me (even a distanced approach that many ethnographers might not undertake) but, to my regret, I could not sustain ethnographic relationships with the nurses and physicians in the clinics once my project responsibilities changed in my third year (as discussed above).

Lastly, let me explain what I mean by describing a distanced ethnographic approach as a deliberate choice. My stance is shaped by practical concerns and ethical principles about research in work settings (Gilbert et al.: 1991). In terms of practical realities, recall the small size of the two patient care teams and their composition. Realistically, although proper names were not used in notes or reporting, there was never any way to conceal or protect individual identities: there was only one registered nurse, only one physician assistant, only one physician with D.O. training (as a doctor in osteopathy) and so on. Given the high visibility of the EHR Prototype Project, it was extraordinary that the participating care providers and clinic administrators subjected themselves to the scrutinies of the prototype research. The research I discuss was only one of many forms of research for the EHR Prototype Project: business analysis including data analysis and quality assurance (QA) chart reviews as well as information

needs assessment; management engineering and other forms of operational analysis for work flow analysis and time motion measurement. Unlike the former research methods, the qualitative research that I conducted was governed by the HMO's Institutional Review Board for human subjects research; thus participation in the research I describe was based on voluntary informed consent of the clinical staff as well as patients. The Staff Consent Form stipulates that research documentation is strictly for research purposes for EHR prototype design and development and that: "Information gathered about my work may not be used for purposes of evaluating my work performance." The informed consent process formally ensured voluntary participation, protection from consequential evaluation, and the basic rights assured to research subjects in the State of California including the right to withdraw one's participation at any time. The reader may wonder why I am preaching to the converted about these requirements of law and research practice. Do they have special significance in these research sites? It is a privilege to be "a fly on the wall," involving trust relationships and judgments about what is on and off the record. It is often surprising where the boundaries of privacy lie for individuals in a given community; learning what people consider to be public or private is part of learning about a community of practice. In any clinical setting, including this one, a researcher will quickly see gaps between formal policies and informal practices, how people really

get things done. As for health care organizations generally, the HMO has a strong policy-driven orientation. An example of an everyday workaround was the common practice by many physician assistants to always keep a number of pre-signed prescriptions--"bullets"--in one's coat pocket to avoid being slowed down by the need to catch a moment of a physician's time in-between exam room consultations to obtain his or her signature on each prescription (at the time, physician assistants were restricted by licensure from writing prescriptions on their own). In other words, this was a routine workaround between colleagues who trusted each other (the physician assistant and physician) to help one another work efficiently–at the time, it was "illegal" in addition to being outside of policy.[21] In contrast to ideal logical models, the contingencies of real clinical life become immediately apparent, complicating the realization of policy mandates and idealized work flows based on structured analysis.[22]

In the effort to focus on analysis of generic patterns of interactions, work practices and processes and systemic dilemmas, breakdowns, gaps,

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21 Physician assistants were subsequently granted the right to sign prescriptions by the California State legislature. Many physician assistants, including the person who showed me this workaround, had the right to sign prescriptions when they worked in United States military service.

22 Practice dilemmas between policies and clinical work practices are evident in a seemingly simple pediatric immunization visit, the first of the video recorded patient visits that I discuss in Chapter IV: Changing Patient Care.

problems, and workarounds rather than individual "errors" or "mistakes" or simply variance from policies and procedures, I proposed the development of graphic representations as media to communicate research findings abstracted from video exemplars which inevitably evoked individual personae. Inspired by the work of members of the participatory design community (e.g., Blomberg, Kensing and Dykstra-Erickson: 1996; Chatfield et al.: 1998; Greenbaum and Kyng: 1991; Trigg et al.: 1994), I proposed and led the development of a core set of graphic representations for the EHR Prototype Project as visual means for communicating the field research to the multi-disciplinary project teams, particularly to create a bridge between the HMO and Software Company software engineering staffs. The graphic representations developed for the prototyping modules were local to the EHR prototype research, created from off-the-shelf applications (Quark, PhotoShop, CADLite, Word), simple to create and change. These representations emphasize relationships and interactions involved in communication, coordination and collaboration between patients and care providers, among care providers at diverse points of care (outpatient, inpatient, home care) and between care providers and behind-the-scenes staff. The early graphics share certain conceptual affinities with object-oriented design approaches particularly in their emphasis on interrelated roles, processes, and interactions between and among actors and objects. By early

1997, the graphics were being pulled away from the interactive conceptual approach and towards instrumental, step-by-step procedural work flow analysis. I interpret this tension as representative of an important dilemma for health care organizations and software designers, that they need to bridge new object-oriented methodologies that emphasize interactive complexity highly suited for substantive clinical activities with traditional structured analysis methodologies for operational work flow actions and business process modeling that are deeply embedded pragmatically and deeply entrenched conceptually in the HMO's information infrastructure.

Project methods used by the HMO to graphically represent patient care and business processes include several of the large scale mapping and representational tools that generate relational databases meant to support software architecture and programming: Texas Instrument's IEF (used for Business Area Architecture data modeling), Oracle Designer 2000 (for analysis of the outpatient call centers--appointments and messaging processes–and outpatient encounters--office visits, consultations, diagnostic procedures), IBM's Knowledge Representation tool, K-REP (knowledge representation for clinical object modeling, systematization and standardization of clinical and medical terminologies), and yet another representational tool used for analysis of each of the HMO's hospitals (also to serve as a representational base for establishing networked partnerships with external hospitals). To

represent work flows, project teams also use simpler tools such as Visio that are not linked to relational databases and therefore do not entail complex claims about automatically generated coding (for example, Oracle asserts that its Designer 2000 can automatically translate a client's relational database into software programming). Several of these graphic tools were being used concurrently by different project teams even though project managers expressed the need for compatible--if not common--mapping tools to concatenate information gathered from workflow, data, and object-oriented analyses.

For the HMO's Information Technology departments, one of the difficulties in the software market at large is the lack of analytic tools that can translate between structured analysis and object-oriented analysis. In other words, the logic of object-oriented programming (well established in the software domain) was persuasive for the HMO (for clinical domains and for the health care organizational domain) but the tools were not yet developed to fully support object-oriented analysis as a methodology that can integrate clinical objects encoded in controlled structured terminologies with data and operational work flow. Meanwhile, the HMO has historically based investments in structured analysis that are inscribed in the existing information infrastructure to date, embodied in the long-standing methods used by its cadres of business analysts (in information technology) and

management engineers performing operational analysis. Structured analysis methods and industrial engineering methods have thus shaped the design of legacy systems and the reporting generated from them for senior management. These are methods that evolved historically hand in hand with the techniques and principles of Taylorism and scientific management principles and methods.

C.3. Access limits and constraints on research methods

I have already described several constraints related to the research site and my role(s) within the EHR Prototype Project above. I enumerate access limits and constraints below. My own gaps in knowledge necessarily pose limits and constraints to my understandings, in that I have neither a clinical nor a technical background. It is my hope that I am able to convey respect for each of these communities. I did my best under the circumstances to familiarize myself with their respective perspectives, languages, and concerns.

As I mentioned above, my primary access was to the HMO clinical settings and a subset of EHR Prototype Project meetings. I did not have access to the inner circles of project decision-making nor to senior management decision-making for the HMO regionally or nationally. I did not have direct access to the Software Company or its design meetings. I had intermittent contact with software developers when they were on the HMO's

premises, in training sessions teaching clinical staff how to use the EHR, in the prototype clinical settings observing use of the system, and in joint meetings for planning and input to design. I developed relationships with several of the Software Company's key staff for EHR design and development.

The trade-off for access to the HMO's EHR Prototype Project for my dissertation research was that I contribute actively to the development efforts. In other words, the only way that I could be around was to join the effort; being able to observe and interview for the purpose of the dissertation independent from contributing to project efforts was never an option. I describe my roles and responsibilities in the EHR Prototype Project below.

I encountered many practical constraints for my thesis research. To understand these is to appreciate two important kinds of circumstances that presented access limits and constraints for my thesis research as first proposed. First, the EHR Prototype Project research was framed within the instrumental knowledge acquisition efforts for electronic health record prototyping development. Opportunities to pursue ethnographic research were severely limited by the complex structure of project decision-making and formal and informal rules regarding research design, time spent on the clinic floor and time spent with the physicians and nurses away from patient care. Secondly, the "production environment" of the HMO (their term, not mine) was itself a formidable constraint. The high-volume fast-paced

continuous flow of patient care in the clinic limits opportunities to build the kinds of close relationships associated with becoming a member of a community as a tenet of classic ethnographic approaches. Combined, these two circumstances significantly constrained ethnographic methods during the period discussed in the dissertation.

I adapted research methods as necessary given constraints structured by the HMO's organization of the EHR Prototype Project, my role(s) within it, and the clinical settings. The nature of clinical work presents constraints. The fast pace, confined space, and the atmosphere of intense concentration are among the characteristics of the outpatient modules that struck me first. In the first clinic I entered for the pre-study, I was advised: "You can talk to the doctors, they have some time, but you can't talk to the nurses--they're too busy."

Formal interviewing independent of instrumental knowledge acquisition needs for the project was rarely possible. It was considered too costly ever to conduct reflective interviews reviewing video documentation with participating care providers (see, e.g., Arborelius and Timpka: 1990b, 1992; Engeström, Y.: 1990b). Interviews could be conducted to elicit step-by-step workflow and for information needs assessment but not to explore individuals' life or career trajectories, motivations, models of patient care. The cost of the clinical staff's time was weighed at all times in relation to

anticipated project values (preferably in the quantifiable form of "deliverables"). The cost of physicians taking time away from patient care was factored into project costs. To give a tangible example: during the first year of the EHR prototype research, another field researcher and I were required to report any times during shadowing observations or other research activities in the clinic that took more than fifteen minutes of a physician's or nursing staff member's time.

In the pre-study I conducted in the winter of 1993 in a different primary care module, I conducted interviews exploring individual nursing staff members' and physicians' career histories, motivations, and models of patient care with the majority of the patient care team on a strictly voluntary time basis, in other words not during paid work time. These interviews helped me early in my work to gain general understandings of clinical work practices in the HMO and the complexities they present for the development of clinical information systems. The pre-study interviews also gave me a sense of how various care givers critique current practices and imagine change. In the EHR Prototype Project, my sense of imagination and discourse about the EHR is informed by *in situ* comments, analysis of video documentation of clinical teamwork and work practices, discussions in meetings, and my participation in daily project work.

The proprietary nature of the EHR project represented a profound constraint for me albeit a constraint of a different kind. For the HMO region, the EHR initiative was deemed the highest risk, highest visibility strategic undertaking of the HMO at the time. Bound together with strategies to gain advantage in the national marketplace, it was governed by non-disclosure agreements of all participants protecting proprietary and intellectual property rights. For the Software Company, intellectual property rights (particularly regarding patents pending) are paramount as they are throughout the highly competitive software development world. In 1997, a critically important patent was approved for the browsers for the clinical content knowledge base (the underlying libraries of clinical and medical terminologies) invented by the company. Given the co-development period of EHR prototyping that I discuss, the intellectual property rights issues between the HMO and the Software Company were always problematic and, at times, contentious. (Intellectual property rights agreements also govern business relationships with the many "third party" companies involved as needed.) Although there is much of interest to followers of the legal developments of intellectual property rights, these issues are beyond the scope for this dissertation.

For me, the main consequence of working inside a proprietary innovation project was the "closed world" effect I experienced: the constraints on my ability to freely discuss my early understandings, analysis and

problematizations as I formulated them with academic colleagues other than those who signed the non-disclosure agreements. I found myself intellectually isolated from intellectual communities with which I could otherwise engage the critical analytic work required for the thesis (in contrast to the instrumental research for EHR prototyping). I described the closed world of a proprietary innovation project in a private journal entry in early 1996:

> [T]he experience of working within this extraordinary innovation project has been one of nearly total immersion. I feel like Jonah swallowed by the whale, living in its huge belly. The restrictions hung heavily over my experience. I wondered often how participants in such innovation projects manage the labyrinth of secret successes and problems, open secrets, public knowledge and publicity, and, simply, the need to talk with one's fellow human beings. The need to make sense of one's life and work, to weave an intelligible narrative about one's triumphs, troubles and bewilderment.
>
> For all of the fervor of the project and my love of many of the people engaged in it, my private experience has been tinged through with isolation, sequestration, silencing of my voice and suppression of my lifelong passion for intellectual argument. . . It is as if I am crawling out from under an avalanche, wandering a vast and peopleless landscape, not having spoken to a soul for some uncounted period of time and when I finally encounter people, we do not have a language in common. Or is it that my words and thoughts no longer make any sense in the world I once shared?

C.4. My involvement in the EHR Prototype Project

I was employed on a full-time basis as a research associate in the EHR Prototype Project within the southern California region of the HMO from July 1, 1993 to March 1997 and from October 1997 through March 1998. I was a co-investigator for the EHR Prototype Research from February 1995 until the prototype research was formally ended March 31, 1998. My primary responsibility was to conduct research in the clinical settings for EHR prototyping. From February 1995 to March 1997, I was responsible for planning, directing and reporting on eight baseline and evaluation studies. I was responsible for in-progress reporting to as many as five project teams and committees on a monthly basis. In April 1998, I was reassigned to a new area for usability evaluation with an emphasis on user interface design, a joint team of the HMO's national clinical information systems department and the Software Company's design team.

My unexpected degree of involvement afforded me the extraordinary opportunity to experience the prototyping phase of a major technological innovation *from the inside* and *before-the-fact*. In a profound sense, the ethnographic relationship in which I found myself was in my position day-to-day as a member of the EHR Prototype Project staff in what became the clinical systems development business group of the HMO's Physician Partnership, rather than the ethnographic research approach I originally intended in relationship to the care providers in the patient care teams chosen

for EHR prototyping (and that I was able to sustain from the fall of 1993 until April 1995).

The shift to the region in mid-1995 meant concomitant changes in my role and additions to my responsibilities. I was assigned as the "Lead" (a defined organizational role) for the EHR Prototype Research Team. The members of the team included one or more research assistants, management engineers from the Operational Analysis Department and liaisons from other teams for requirements, implementation, education and training, and clinical tnformatics. I participated in "master planning" undertaken by HMO project managers with the guidance of an international consulting firm to align project activities (including the research) with software development cycles and business reporting and decision-making cycles. The Master Plan was a time consuming meta-task that was admirable in many respects but perpetually troubled by the reality of interdependent deadlines that slipped and slipped again. In late 1995, I was assigned to develop an overall conceptual framework for evaluating the EHR prototype in relation to enterprise-wide goals including clinical strategic goals (discussed in Chapter III: Incomplete Utopian Projects). In late 1995 and early 1996, I organized and led a series of seminars for representatives of the Software Company's product development, software engineering, clinical informatics, and client services teams. The seminars were designed to help the software designers to

understand the complexities of the clinical and operational settings in which the EHR prototype was in clinical use and into which the EHR system would be implemented.

The shift to the region had several consequences for me. As I explained above, it took me away from daily contact with the clinical settings. Second, it exposed me to regional points of view and the world of enterprise-wide goal-setting and measurement of clinical strategic goals, quality improvement and resource utilization. I was most powerfully affected in two ways. First. I experienced Taylorization firsthand in that I faced demands that I decompose my own work into detailed step-by-step plans. This involved the insistent breakdown into ever smaller *tasks* characteristic of Taylorism. Generally, I saw how such a process of specification can lead attention away from holistic motivated activities while generating (and reifying) idealized standardized business process models against which variations may be identified that are in turn modeled as standardized representations.[23] I also perceived tensions between Taylorist approaches underlying structured analysis methods used in information technology and more interactive relational modeling introduced by object-oriented programming.

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23 Furthermore, generalizability, reusability, and standardization need to be differentiated conceptually and in practical form.

Second, I was exposed to the regional culture of attitudes to which people in the clinics refer. Several of the non-clinical regional staff expressed hostility towards physicians as powerful practitioners; these were generally off-the-record informal remarks for obvious reasons. I came to recognize these as expressions of organizational desires to gain control over physicians. At least one internal consulting department recommended to one of the international consulting firms advising the senior management on restructuring the HMO that "it's time to dissolve the Physician Partnership" since the physicians' power was considerably eroded by the rise of managed care entities in the health care market ("now that our physicians have nowhere else to go"). In day to day talk, such sentiments were not universal but rather shared among a subset of non-clinical members of the project staff. For example, a management engineer told me: "I love learning this clinical stuff--what I'd really like is catch these physicians not doing all the things they're supposed to do!" An information technology manager expressed frustration at the famous difficulty of prescribing physicians' work practices: "I don't see why we can't just figure out the best way to do something and then make all the doctors do it that way and have done with it! We do that with everybody else." The staff included members of a team that had successfully implemented a region-wide on-line appointments system who exhibited frustration over the additional difficulties of coordination and scheduling

with physicians in contrast to appointments clerks. An important difference (and persistent problem for predictability of planning) being that a physician cannot guarantee arriving at a scheduled time given the unpredictability of patient responsibilities. But frustrations with physicians' independence and insistence on professional individualism should not be ascribed only to non-clinical staff. A highly placed administrative physician and clinical researcher responded to my ease in working with physicians: "You should specify that on your resumé! Physicians are impossible [to work with]!" I was also exposed occasionally to attitudes towards registered nurses as powerful practitioners when nursing strikes were authorized by unions representing registered nurses in southern California (prior to the 1997 labor-management accord between the HMO and AFL-CIO unions) and during the series of strikes by registered nurses in northern California in 1997.

In summary, my primary intention was to learn about the context of use for the EHR by developing ethnographic understandings of clinical work practices from the perspectives of patient care teams. To appreciate the context of design of the iterative prototyping of the EHR system, I learned a great deal from the perspective of clinical use and joint discussions between the HMO and the Software Company about how to improve the EHR from one prototype version to the next. I did not set out to learn about the organizational culture of planning, change management, performance

measurement, and evaluation research from a large health care institution's perspective but I learned these per force by working in the regional headquarters in this strategic effort during the period from mid-1995 through March 1997. By being re-deployed as a resource and myself made subject to these organizational practices, I learned by living them.

In the winter and spring of 1993, I conducted a preliminary study in a primary care clinic where I spent five months with a primary care team undergoing a local conversion from one computer-based patient records system to another.[24] From here forward, I will refer to this as my *pre-study*. This study preceded and was independent from the HMO region's EHR Prototype Project (launched in July 1993). The outpatient Primary Care clinic is one of the clinics of a medical center of the HMO in a different city. At the time, the Primary Care module comprised approximately twenty clinical staff who had been using a rudimentary computer-based local area network (LAN) for electronic progress notes for more than four years. The two computer-based patient record (CPR) software programs--the one that had been in use for about four years and the new program selected for the conversion–were both from an early generation of CPR software available on the market in the early 1990s, markedly different in design from the EHR prototype being co-developed by the HMO region and the Software Company. Both software

24 My preliminary study is discussed in Gregory et al.: 1995.

programs were characterized as "glorified word processing" augmented by basic coding for medical terminologies, specifically for the International Classification of Diseases (ICD)[25] for coding diagnoses and Current Procedural Terminology (CPT) for coding procedures.

The pre-study was important for the formulation of the grounded research themes for the subsequent field research I pursued in the EHR Prototype Project. The preliminary study introduced me to the organizational culture and the organization of work in the HMO. The data from this first study provided the basis, in limited ways, for a degree of comparison between contrasting primary care teams by broadening my appreciation of variations in localized teamwork, patient care interactions, and patient records documentation practices.

Analysis of the small scale conversion attempt--which proved to be unsuccessful--generated an initial *cartography of dilemmas* that a large organization is likely to face in implementing electronic health records system-wide. I use "cartography" because I visualized these inter-related dilemmas in my mind as if seen as an aerial map, a view of a vast terrain from above. The image was evoked by the expression "islands of automation" used by the medical center's information technology support staff to describe

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25 The ICD-9 in this case.

the idiosyncratic archaeology of legacy systems and localized instances of EHR/CPR use such as the LAN-based system in the Primary Care module. To the initial cartography of dilemmas, I added, modified, deepened, and extended my understandings as I learned about the EHR Prototype Project and the particularities of the software design and organizational change efforts it entails.

At the organizational level, one dilemma involves the risk of choking off localized innovation efforts led by physician inventors and creative users of new technologies, in the name of developing a single integrated system. Exactly the physician leaders who are to promote the regional (later national) EHR system being developed were asked to defer many innovation efforts of their own and/or efforts among their colleagues in their respective medical centers. Local developers were further advised that it might prove impossible to integrate localized databases into the national system; in other words, the accumulated data might require reconstruction or it might simply be superseded (not accessible through the new system).

I witnessed a second dilemma involving physician leaders of computer-based patient records development and use. Nursing staff members and the appointments clerks distinguished "physicians who love computers" from "physicians who care about their patients." In the pre-study primary care team, these two categories were rarely if ever combined.

Nursing staff distinguished different patterns among "physicians who love computers," for example those perceived as computerphiles from the start in contrast to those perceived as having become more interested in computers than in their patients. In the EHR Prototype Project, I witnessed an additional phenomenon that clinicians selected as liaisons to CPR/EHR development may lose their representativeness as they are drawn more and more deeply into systems design. As occurred in the Scandinavian Technology Projects in the late 1970s and early 1980s, leaders selected to represent a peer community became separated from their peers when and if they “crossed over” to the technical design perspective. In a sense they crossed from the context of use to the context of design. To give up one's clinical practice and go completely into computer development carries a certain liability for clinician leaders and developers. Among the first questions physicians will ask about a physician leader introducing them to the EHR system, whether the physician is from the HMO or from the software company, is, "Is he/she practicing?" "Is he/she seeing patients?" "Is he/she using [the EHR] to see patients?" "Physicians who love computers" may not be generalizable representatives of their peer communities of physicians while physicians with a patient-centered practice orientation may not be as available or induced to contribute as intently to EHR/CPR development.

Any large organization also faces dilemmas between investments in new and legacy information systems. Legacy systems contain enormous stores of data whose conversion to a new system may be very costly but whose loss from availability to clinicians and the organization may also come at a high price. The dilemma I saw is that the changeover from paper-based patient charts and legacy systems to an integrated on-line system will involve significant interim periods of greater fragmentation of information along the intended path to integration. In the meantime, clinical staff "live the gaps in the system" through workarounds (both formal and informal), redundant efforts, and precautionary backup systems.[26]

I perceived a dilemma concerning the shift in EHR/CPR software design from individual physician-centered approaches (physician workstation) to team-based approaches (multi-professional, multi-disciplinary teams either co-located or virtual and extensible to networks). The pre-study generated questions: Why was the shift from individual physician to patient care *team* a difficult focus to sustain at the center of design? How much are the design difficulties implicated with tensions between prior and emerging models of patient care, particularly between medical, nursing, patient-centered, and active patient models? If

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26 A "quantum leap" or "big bang" implementation was not considered to be available to the HMO given its scale whereas such total-change-overnight approaches have reportedly succeeded in stand alone hospitals.

developmental movement is in the direction of holistic patient-centered care as a model that shares significant affinities with the nursing model of care, why is it so difficult to integrate nursing participation at the heart of EHR/CPR development? If nursing voices are hard to hear, how will patients be heard? The usual explanation for the marginalization of patients' and nurses' voices is cut and dried, that it is the consequence of the power of physicians, but the power of physicians per se does not seem a sufficient explanation to me. My sense is that different commitments are involved, following Cussins, the values and commitments that organize attention, interactions, and daily practices.

In the pre-study, I saw the dilemma of time and work organization that confronted clinicians required to change documentation practices to incorporate structured coding of diagnoses and procedures. This dilemma becomes more acute in EHR prototyping. Closely related are dilemmas between the standardization that EHR/CPR systems introduce and variations between clinicians regarding deep preferences in their interactions with patients and documentation styles and in variations between clinical domains and clinical cases.

I saw that the introduction of EHRs/CPRs will heighten dilemmas between informal and formal work practices (practice dilemmas and gaps

between policies and practices). EHR systems inscribe the formalization of differential access to patient records and differential affordances for action according to licensure and organizational policies governing the scope of practice of clinical staff and the confidentiality of patient records.

In the first training sessions I observed, I perceived a dilemma between learning the system and learning how to practice with it. What I first understood as a dilemma presented a window onto the differences between the logic of the computer system and the logic of patient care and the impending changes in work practices that may be required by use of the new system depending on the degree to which the system is designed and implemented to accommodate work practices or work practices are required to change to accommodate the system as a carrier of the agenda of changes of the health care institution.

To the cartography of dilemmas I saw in the pre-study, I add the dilemma between the consumer model and the clinical or medical model of care. This dilemma is evident, for example, in telephone triage conducted by registered nurses. The "patient as customer" or consumer model is dilemmatic as a "solution" to resolve the question of how to realize patient-centered care. The consumer model, explicitly a commodified form of activity, only intensifies dilemmas between the medical model and patient-centered care. Effective problematization of patient-centered care will remain

elusive until patients are substantively included as subjective actors considered full team members collaborating in joint care planning.

From 1993 to 1996, I attended and audio recorded most of the bi-monthly or monthly Prototype Medical Center steering committee meetings. I identified these meetings as an intermediate site for understanding mediation and negotiation between the regional leadership team, the Prototype Medical Center administration and the local leaders for the EHR Prototype Project and the patient care teams chosen as the pioneer users of the computer prototype. The meeting discussions were wide-ranging, including direct and indirect reference to regional and national (enterprise-wide) imperatives for EHR prototype development and how these presage organization-wide implementation. Early prototype design and implementation issues were formally and informally raised and problematized. Strategies were negotiated and decided upon or otherwise assigned for further action. For example, an issue might be identified as one to be reviewed by regional policy makers responsible for medical-legal matters or as one to be worked out in contractual or joint design discussions with the Software Company. These discussions provided me with a longitudinal view for a set of recurring software design and organizational problems, as expressed by representatives of the health care organization. They point to dilemmas explicitly identified by project participants and to implicit dilemmas entailed in the design of

EHR systems and their introduction into organization-wide clinical use. They also helped me to discern silences of certain issues that went unspoken or were taken for granted or assumed either as common sense or as natural (automatic) expectations of the EHR system.

Joint design discussions between HMO and Software Company representatives provided additional windows for understanding the EHR Prototype Project goals, vision, and teleological object. On rare occasions, I participated in and audio recorded joint working group meetings involving representatives from the health care organization and the Software Company. Fortunately, I was able to participate in representative sessions of a pivotal series of joint design meetings in late 1995 and early 1996. These opportunities to document the discussions were highly generative and valuable in providing instances of the far-reaching and exacting imaginative work of translating the practice needs of clinicians and health care organizations from the physical world of patient care to conceptual and logical models required to articulate usable and robust working design from clean underlying architecture through "intuitive" hands-on user interface features. Joint design discussions--translating between the contexts of clinical use and contexts of design--highlight the complexities involved in designing new clinical information tools and systems based on analyzing and re-imagining clinical work practices in order to improve patient care.

In "Working Disparate Knowledge Traditions Together: Partially Connecting Ontic/Epistemic Imaginaries" (Watson-Verran: n.d.), Helen Verran writes about iterative imagining as re-making the world as iteratively imagined in ways that evoke the spirit of EHR prototype joint design discussions. Verran describes a culture of argument over metaphors and visions within and between "many local knowledges" in the context of an Australian aboriginal community's preparation for negotiations over land rights: "... [A] whole range of metaphors ... provide the possibilities for imagining new categories, and for reworking old categories in new ways." The process of deciding which vision will prevail involves argumentation, "the on-going struggle for cognitive authority, waged through pitting metaphor against metaphor. ... Given time one metaphor will carry the day, and it will be been greatly enriched for the controversy surrounding its being settled upon" (Verran: 1998, pp. 241-242). To work together different imaginaries with their respective commitments, Verran argues that the imaginaries of different communities need to be recognized, respected, engaged, and iteratively developed: metaphors and argument over metaphors, the "cognitive maps" shared by a community and performed to display and elaborate shared knowledge to include new actors and extend commitments. As for the practical orientation of systems design prototyping, she emphasizes the lived practices of imaginaries in societies rather than

individual minds: "Images and the stories which people tell with their metaphors and causal connections, mobilize these immanent imaginaries and only in this indirect way contribute to constituting them" (Verran: 1998, p. 252).

C.5. Additional exposure to the domains

Before initiating the field research for my thesis project, I was fortunate to have opportunities that provided me with exposure to many of the issues I would encounter in the EHR prototyping and clinical settings. Below, I briefly describe my prior exposure to expert systems, computer-based patient records research and development efforts, and to clinical settings. First, I explored the development of an expert system by its physician inventor, the specialist in occupational pulmonary medicine to whom I alluded to earlier.

In the summer of 1992, I received a Travel Grant from the University of California-San Diego that enabled me to visit the Intelligent Systems Laboratory at the University of Pittsburgh where I spent a week immersed in the research milieu and the creative and contentious issues of a multi-disciplinary design team, led by Bruce Buchanan, one of the founders of the field of medical informatics, developing an interactive artificial intelligence based computer system for sufferers of severe migraine headaches. The five-year Migraine Project was a model project for designing systems to help

patients living with chronic illnesses (see, e.g., Buchanan et al.: 1992; Buchanan et al.: 1995; Forsythe: 1992,1995, 1996; Forsythe and Buchanan: 1992). The artificial intelligence aspect of the Migraine Project is its basis in natural language processing (NLP) for queries by a patient making use of the system (system responses sensitive to the context and questions the individual patient presents). I sat in on the team's design meeting and I interviewed each of the primary system developers: the project leader, the senior anthropologist, the neurologist, computer scientists specializing in computational linguistics and computer simulation, and a visiting scholar who had developed an interactive system for people living with diabetes. I also met with associated colleagues in the Medical Informatics Department and their graduate students. I was provided with an orientation to the history of the early decision support system for clinical diagnosis, Quick Medical Reference (known as QMR) by its original and current developers. I was introduced to Boolean logic and probabilistic models of physicians' decision-making as they are employed in EHR/CPR systems design (e.g., Cooper: 1990).

From July to September of 1992, I was a Summer Intern at the Institute for Research on Learning (IRL) based in Palo Alto, California. During the summer at IRL, I participated in ethnographic research regarding the development of a decision support system for eligibility and care protocol

management for people living with AIDS and participating in clinical trials. For this, I attended weekly design meetings and assisted in video documentation of the clinician reviews of the prototype interface and structured content terminology in development (see, e.g., Campbell, Wieckert et al.: 1994; Musen, Carlson et al.: 1992; Musen, Wieckert et al.: 1995; Ohno-Machado et al.: 1993). I interviewed the lead registered nurse in the county clinic and the specialist in nursing informatics who was part of the decision support system design team. From this systems design effort, I learned about two general problems: I was introduced first-hand to the complexities of controlled medical terminologies (CMTs) and the structured content strategy for clinical documentation. And I was introduced to what seemed inexplicable difficulties of integrating viable nursing participation in the system's early design and implementation planning.

In addition to the research precursors described above, I volunteered in two clinical settings. Volunteering helped me to see through patients' eyes. While they lasted, my volunteering experiences kept me honest to the experiences of patients, their families, and significant others in contrast to the perspectives of the clinical staff (doctors, nurses, others) and the organizational and policy-driven orientations of the EHR Prototype Project. Although volunteering was important for my appreciation of caregiving, the hospital ward and the emergency room in which I volunteered were not

research sites for me.[27] For one thing, the work of volunteering demands one's complete attention to the patients, their significant others and the clinical staff whom you are supporting. I decided not to keep research notes; occasionally, I committed especially moving experiences to my personal journal.

During the winter of 1993, I was a volunteer in the oncology ward of a major metropolitan hospital; the cancer ward was also the ward for people living with AIDS requiring inpatient care. The census for this 36-bed ward was never fewer than 31 patients on the Fridays when I volunteered over a period of four months.[28] Given that at the time it was not unusual for hospitals to have a census of only 30%, this was an intensely utilized unit[29]

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27 My decision was reinforced when I was a patient advocate volunteer in the emergency room at the EHR Prototype Medical Center because I was asked by the project's clinical liaisons not to treat the emergency room as a research site. They stipulated the emergency room as a site for my volunteering for which EHR implementation would be scheduled farther in the future rather than sooner.

28 The "census" refers to the total number of patients present at any given time. The census of each ward is continuously monitored for capacity, staffing needs (physician-nursing-patient ratios) and assignments of staff to specific patients. Tracking the census is an important local practice for coordination of the unit team's work in a constantly changing environment. In many hospital units and emergency rooms (including the emergency room in which I volunteered), a large "white board" in the central nursing station displays each room with patient occupant(s), clinical staff (MD, RN) assigned responsibility for each patient, and any special risk conditions such as "risk of falling," that should be known about a patient. The white board is the key point of reference for the staff to quickly determine where a new patient can be roomed, what type of room becomes available when a patient goes home, is transferred to another clinical service or is admitted to the hospital. The nursing staff and ward clerk or unit secretary ensure that the white board is continually kept up to date.

29 "Unit" is another term for ward. My experience was that "unit" was the preferred term among the health care staff with whom I worked while "ward" is the term more often used by lay people (the non-clinical public).

meeting specialized patient care needs; it was only one specialty care area among many clinical services in a large hospital whose services include tertiary care.[30]

Subsequently, when I moved to the community of the medical center selected as the EHR prototype site, I applied and I was trained as a patient advocate volunteer for the hospital's small emergency room. During a period of four months in early 1994, I volunteered on Friday nights from 8 p.m. to midnight (sometimes later), a busy time in any emergency room. The emergency room has eleven beds and it is not the emergency room designated in the city for trauma[31] (trauma cases requires tertiary care capabilities). The hospital had 100 beds available but often had only 30 to 35 patients (approximately a 30% census) during the first year that I was around. To summarize the contrast in size between these two settings, the smaller

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30 Tertiary care is the next degree of specialized care beyond secondary care (specialty care, sub-specialty care) and primary care (family medicine, preventive care, outpatient or ambulatory care). An example illustrates the relationships: a patient's risks for heart disease should be identified by his or her primary care physician who will refer to the patient to a specialist for secondary care, in this case a cardiologist (as an internist, a specialist; as a cardiologist, a sub-specialist meaning further specialized) who may then determine that the patient requires the even more highly specialized tertiary care of a cardiac surgeon. Tertiary care and quaternary care are concentrated in particular medical centers as the needs for these clinical services are relatively rare requiring highly specialized physicians with the skills and training and specialized biomedical equipment and technologies to perform them.

31 Trauma in this context refers to life-threatening injuries such as those suffered in accidents, fire, explosions. For these reasons, trauma care begins in transit when possible in specially equipped paramedic vans and helicopters, for example.

hospital's total census was often equal to the census of the single oncology ward of the large hospital in which I first volunteered.

To familiarize myself with trends in EHR/CPR development and medical informatics, I attended two of the annual industry based conferences focused on computer based patient records when I was able to do so: Towards the Electronic Patient Record (TEPR) organized by the Computer Patient Record Institute (CPRI) and the Medical Records Institute (MRI), and the Annual Symposium on Computer Applications in Medical Care (known as SCAMC) renamed the AMIA fall symposium after its sponsoring organization, the American Medical Informatics Association (AMIA). The AMIA (formerly SCAMC) fall symposium is the major academic conference whose organizers are the founders of the field of medical informatics, born by conjoining clinical information systems development with the elite computer sciences, artificial intelligence, and expert systems. I attended MEDINFO '95, the bi- or tri-annual symposium of the International Medical Information Association (IMIA), of which AMIA is the U.S. member.

I participated in the bi-annual Participatory Design Conference (PDC) in 1994, 1996, and 1998. Many PDC participants are currently (or have previously been) involved in health care related computer systems design in various countries (for example, in Scandinavia, Europe, Nigeria).

To familiarize myself with developments in clinical knowledge, I attended selected annual clinical symposia offered by the HMO to its clinicians as part of the organization's continuing education program. In 1995, 1996, and 1997, I attended symposia on topics in Internal Medicine (diabetes, women's health, new treatments for people living with AIDs), Primary Care Research, Cardiology (with an emphasis on preventive cardiology), Physician-Patient Interaction, and Primary Care National Health Priorities. I was fortunate in being invited to the Health Outlook symposium of the Institute for the Future in May 1997.

D. Locating the dissertation project intellectually

My dissertation contributes to communication theory regarding social consequences of advances in information and communication technologies by examining the early developmental phases of a new clinical information infrastructure of national importance. My discussion draws from and will contribute to the multi-disciplinary intellectual communities engaged in ethnographic studies of work practices and technological innovation. The theoretical framework with which I approach these questions draws from activity theory and developmental work research, labor process theory, and approaches from a subset of the evolving fields of science studies and related critical studies of science and technology.

I am striving to make contributions along three inter-related dimensions. First, by contributing to theorizing relationships between work and technology. Secondly, by constructing a concept, the *incomplete utopian project* that is sociohistorical, heterogeneous and argumentative in structure as a conceptual construct to expand theorizing about innovation, work and technology and to describe the concrete phenomenon of *envisioning* as constructed within innovation and organizational efforts. Third, by contributing analysis of detailed case examples from a complex case study of a leading innovation project to replace paper-based patient charts with a distributed computer-based electronic system intended to transform medical records and patient care practices.

My dissertation has primary relationships to two areas of communication theory: studies of the social consequences of information and communication technologies, and socio-historical or socio-cultural studies of human activity and cognition from critical and developmental perspectives. These two areas share emphases on the centrality of labor in human activity, communicative activity understood as labor and invention among societal individuals, the collaborative and interactive nature of expertise, and the organization of work as important aspects for communication theory, albeit aspects that until recently received scant attention (Agre: 1994, 1995, 1997; Bakhurst: 1988, 1991; Cole et al.: 1997; Engeström and Middleton: 1996;

Engeström, Y.: 1990a, 1991a, 1991b, 1991c, 1992; Schiller, D.: 1996, 1999; Shaiken: 1984, 1990; Suchman: 1987, 1994a; Wertsch: 1979). My dissertation has links with intellectual communities that increasingly share theoretical, methodological, and / or substantive interests with communication scholars. One such community includes scholars exploring communities of practice and related studies of know-how and expertise as socially shared and interactive processes rather than individually held possessions (Bakhurst and Sypnowich: 1995; Bowker and Star: 1991, 1994; Chaiklin and Lave: 1993; Engelsted et al: 1993; Hutchins: 1995; Jordan: 1978; Lave: 1988; Lave and Wenger: 1993 (1991); Law: 1991; Star: 1991; Star and Strauss: 1999; Wenger: 1998). To combine insights afforded by activity theory and labor process theory, I draw on major works on the labor process, post-industrial theory, and scientific management (Adler: 1993; Banta: 1993; Bell: 1976 (1974), 1989; Braverman: 1974; Burawoy: 1979, 1985; Edwards: 1979; Hales: 1980; Hirschhorn: 1984; Kanigel: 1997; Noble: 1979 (1977), 1984; Sacks: 1988; Taylor, F. W.: 1967 (1911); Wood: 1989; Zimbalist: 1979; Zuboff: 1988). By exploring incomplete utopian projects as constituents sustaining innovation, my dissertation extends analyses of envisioning as a dimension of organizational change (see, e.g., Engeström, Y.: 1990b, 1999b; Engeström, Y., Virkunen et al.: 1996).

The discussion particularizes general patterns and social concerns associated with the advent of new information and communication technologies (Adler: 1986; Agre: 1994, 1995, 1997; Agre and Rotenberg: 1998; Horwitz: 1989; Schiller, D.: 1982; Schiller, H.: 1984, 1996; Shaiken: 1984, 1990, 1996) in relation to the domain of health care. This case study in the ubiquitous domain of health care extends previous understandings by exploring the potential power of innovations in clinical information technology and infrastructure and suggesting how these may reorganize patient-care provider interactions, patient care team interactions, the organization of clinical work and the delivery of patient care services in relation to the changing shape of market forces in the industry.

My interest in narrative interpretation and the organizing concept of an incomplete utopian project are also influenced by critical studies of the practices of scientific and technological invention and imagination (Bowker and Star: 1994; Bowker, Timmermans and Star: 1995; Bowker, Star et al.: 1997; Collins: 1990; Haraway: 1989, 1991a, 1991b; Keller: 1985; Latour: 1991, 1993a, 1993b, 1996; Law: 1991; Lynch: 1985; Mörtberg: 1999; Shapin: 1994; Star: 1989, 1995, 1996 (1995); Star and Ruhleder: 1996; Suchman: 1987, 1989, 1990, 1994b, 1998). These intellectual communities engaged in cultural studies and science studies share affinities with intellectual communities engaged in critical cognitive sciences studies as well as studies of mind, culture and activity that

explore resources of imagination and creativity in narrative, artistic or scientific modes of representation (Bakhtin: 1981; Bibler: 1984; Bruner: 1986, 1990; Dreyfus and Dreyfus: 1986; Ilyenkov: 1977a; Verran: 1998; Wartofsky: 1979). The concept of an incomplete utopian project builds upon recent work in a subset of science studies, studies in the anthropology and philosophy of science and technology, and feminist critiques of science (Bordo: 1987; Bratteteig and Verne: 1997; Latour: 1996; Haraway: 1989, 1991b; Harding: 1986; Harding and O'Barr: 1987; Keller: 1985; Longino: 1988; Noble: 1992, 1998; Star: 1989, 1997; Suchman: 1985, 1987, 1992; Suchman and Jordan: 1989; Wagner: 1994, 1997). Together, these interdisciplinary studies emphasize narrative, the ontology of non-human actors, the work practices of invention and practices of argumentation, partial and situated perspectives, heterogeneity and indeterminacy. This EHR case study will build upon and extend understandings of the practices of a technological invention that its inventors believe has world-changing potential to transform the daily work practices of clinicians at the point of interactions between patients and care providers. In the eyes of its inventors, the electronic health record is what Bruno Latour calls "a funnel through which the world is changed."[32]

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32 Latour employed this expression throughout a graduate seminar in Science Studies at U.C.S.D. in the spring of 1992 in which I was a participant. The better known expression is Latour's reference to the creation of "an obligatory point of passage" (Latour: 1987).

My dissertation is also informed by the work of a second cluster of intellectual communities comprising ever-widening circles of people from an array of disciplines actively and reflexively engaged in the theory and practice of computer systems design and use, particularly inter-disciplinary pursuits of participatory design approaches (Agre and Schuler: 1997; Bjerknes et al.: 1987; Bjerknes and Bratteteig: 1995; Dahlbom and Mathiassen: 1993; Ehn: 1988; Greenbaum and Kyng: 1991; Holtzblatt and Beyer: 1993; Katzenberg: 1997; Katzenberg et al.: 1996; Kindermann: 1992; Markussen: 1994; Nyce and Timpka: 1993; Sandberg: 1976; Schuler and Namioka: 1993; Sjöberg: 1996; Suchman: 1992, 1994a, 1994b, 1998; Tellinglu et al.: 1998; Timpka et al.: 1989; Timpka and Sjöberg: 1994; Wieckert: 1995; Winograd and Flores: 1986).

I have drawn on the work of historians only selectively for this dissertation, and I recognize that its historical moorings need to be strengthened. I consulted histories of medicine and of health care in the United States (Foucault: 1975 (1963); Henderson et al.: 1997; Roemer: 1976; Smillie, W. G.: 1946, 1955; Starr: 1982), accounts of the histories of HMOs and managed care (Hendricks: 1987, 1993; Institute for the Future: 1997; Regional Oral History Project; Smillie, J. G.: 1991), histories of medical informatics (Berg: 1997a; Collen: 1995; Lindberg: 1979), and histories of technology and science (Keller: 1985; Kuhn: (1970 (1962); Latour: 1988; Noble: 1979 (1977), 1984, 1992; 1998; Shapin: 1994).

Analyzing health care and clinical information systems innovation expands understandings of work and technology based on studies in industrial settings, the emerging body of ethnographic research in service sector workplaces, and recent work analyzing the work practices of invention in technological innovation and scientific discovery. This case study of patient care teams and EHR development will extend previous understandings gained from studies in industrial settings that have provided the basis for much of the debate over labor processes, technological change, and new forms of work organization such as "team concepts," continuous quality improvement (total quality management) regimes, and comprehensive performance measurement regimes (e.g., Adler: 1993; Agre: 1995).

Finally, it is my hope to contribute to the substantive fields related to the domain of my thesis field research in health care and the development of clinical information systems and infrastructure. Within the diverse medical informatics community, my work shares questions and concerns with researchers and developers approaching organizational impacts, clinical work practices, information infrastructures, and participatory design from critical and multi-disciplinary perspectives (Anderson, Aydin and Jay: 1994; Anderson and Jay: 1997a, 1987b; Aydin and Rice: 1991; Ball et al.: 1988; Berg: 1997a, 1997b; Campbell: 1997; Campbell and Musen: 1992a, 1992b; Campbell,

Wieckert et al.: 1994; Chute et al.: 1996; Forsythe: 1992, 1999; Forsythe and Buchanan: 1992; Henry, Campbell et al.: 1994; Henry, Holzemer et al.: 1994; Heath and Luff: forthcoming; Lorenzi and Wiley: 1995; Luff and Heath: 1998; Musen: 1992; Musen, Carlson et al.: 1992; Musen, Weickert et al.: 1995; Timmermans et al.: 1998; Timpka: 1989; Timpka and Marmolin: 1995; Wagner: 1993, 1997). Through discussion of selected qualitative case examples (exemplars), I offer modest contributions to the body of ethnographic and discourse analysis of patient-care provider interactions, patient care activities and the collaborative nature of caregiving and healing (Dreier: 1997; Engeström, R.: 1995; Engeström, Y., Engeström, R. and Saarelma: 1988; Forsythe: 1996; Frankel: 1990; Gordon, S.: 1997; Heath: 1986; Jordan: 1978; Paget: 1988; Saarelma: 1992; Strauss et al.: 1997 (1985)).

There are many more connections between this case study and important precedents and developments in communication theory and related fields than I can pursue here. For now, I will acknowledge only two of these. I have long been inspired by the work of theorists of metropolitan, regional and global organization in their relation to restructuring of markets, sectors, product design, and innovation in labor processes and work organization (Castells: 1996; Berger and Piore: 1980; Herzenberg et al: 1997; Piore and Sabel: 1984; Storper and Walker, 1989). However, pursuit of these theoretical contributions from urban geography, urban planning, and political

theory are beyond the scope of my present discussion. I recognize another area, quite different from the latter, to which my work can be linked. Employing developmental work research and discourse analysis suggests ways that my discussion can be related to organizational communication and organizational learning (e.g., Argyris and Schön: 1978; Engeström, Y.: 1999a; Taylor, J. R.: 1995, 1999). This, too, remains beyond my present scope other than those ways in which my discussion may indirectly contribute to this emerging field.

E. Chapter outline and synopses of chapters

Chapter I. Introduction

An overview of the dissertation project, the case study and field research sites, research approach, and lines of argument are provided. The Sorcerer's Apprentice narrative is introduced as a metaphor for the invention of electronic health record (EHR) systems, also known as computer-based patient records (CPRs).

The Sorcerer's Apprentice

The Pupil in Magic [Der Zauberlehrling]

Goethe, 1797, pub. 1798

I am now, -- what joy to hear it?--
Of the old magician rid;

And henceforth shall ev'ry spirit

Do whate'er by me is bid;
I have watch'd with rigour
All he used to do,
And will now with vigour
Work my wonders too.

. . .

Chapter II. Theoretical Framework

Wander, wander
Onward lightly,
So that rightly
Flow the torrent,
And with teaming waters yonder
In the bath discharge its current!

And now come, then well-worn broom,
And thy wretched form bestir;
Thou hast ever served as groom,
So fulfill my pleasure, sir!

On two legs now stand,
With a head on top'
Waterpail in hand,
Haste, and do not stop!!

In this chapter, I present the theoretical framework for my dissertation field research approach and interpretation applying an activity theoretical framework. My dissertation project is informed by activity theory with additional influences from critical studies of science and technology practices. I combine these in the desire to integrate detailed explorations in the field of living practices with socio-historical structuring of practices and socioeconomic concerns. I begin by presenting conceptual building blocks of

activity theory that guided the field research and contribute to the analysis and interpretations of the case examples from the research.

I briefly review the contributions of a subset of theorists whose ideas have influenced my thinking: Ilyenkov, Bakhurst, Wertsch, Leont'ev, Scribner, Engeström, and Wartofsky. I introduce two important innovations in relation to workplace studies: Sylvia Scribner's "practice framework for cognition" and Yrjö Engeström's developmental work research. Keywords and concepts suggest how activity theory is distinguished from conventional frameworks of individual psychology and individualist frameworks for cognition. My choices for emphasis within activity theory are linked to my interests and case study: work and how we analyze changing work practices, technological change, and utopian projects in relation to innovation-in-the-making. Activity systems are understood to be historically developing, expanding and undergoing transformation. My discussion adds to analyses of envisioning as a dimension of organizational change by exploring utopian projects as co-constituents sustaining innovation.

The problem that I take up is derived from a preliminary cross-critique of the theoretical frameworks that influenced my thesis project. I argue for more explicitly thinking about resources of imagination in the heterogeneous, argumentative and, at times, oppositional structuring of work life experiences and participation in innovation. In particular, I will argue

that to understand innovation projects, we need to understand the resources of imagination brought to bear in the worldly, technical, and practical efforts at hand. I call the intermediate concept to coalesce the dimensions of this aspect of my argument an *incomplete utopian project* as it is constructed and sustained among project leaders, participants, and recruits.

Chapter III. Incomplete Utopian Projects

Wander, wander
Onward lightly,
Do that rightly
Flow the torrent,
And with teeming waters yonder
In the bath discharge its current!

See! he's running to the shore,
And has now attain'd the pool,
And with lightning speed once more
Come here, with his bucket full!
Back he then repairs;
See how swells the tide!
How each pail he bears
Straightway is supplied!

To think about innovation-in-the-making in electronic health record (EHR) prototyping, I offer a concept, the *incomplete utopian project*, that is socio-historical, heterogeneous, and argumentative in structure. An incomplete utopian project is a conceptual construct to open up theorizing about innovation, work, and technology and to describe and explicate the concrete phenomenon of *envisioning* as constructed, evoked, and employed within innovation and organizational efforts.

The concept of an incomplete utopian project draws on principles from three sources: (1) philosophical discussion of the concept of the ideal within activity theory (Ilyenkov: 1977a), the relative autonomy of new representations in the arts and science (Wartofsky: 1979) and tensions between reproduction (systemic durability, hegemony) and developmental change (transformation, emergence of new activities and artifacts) (Bonavoglia: 1993; Engeström, Y.: 1987, 1990a, 1991c; Latour: 1991, 1993b; Lave: 1988); (2) the emphasis on narrative, discursivity, heterogeneity, and argument as necessary dimensions animating the invention of something new in the world and the social construction of knowledge (Billig: 1987; Bruner: 1986, 1990; Haraway: 1991b; Keller: 1985; Latour: 1987, 1988, 1996; Latour and Woolgar: 1979; Sjöberg: 1994; Sjöberg and Timpka: 1995; Verran: 1998); and (3) labor process and post-industrial theories and critiques of management and organizational strategies (Braverman: 1974; Agre: 1995; Noble: 1979 (1977), 1984; Shaiken: 1984, 1990, 1996; Zuboff: 1988).

I treat the expression "utopian" as problematic. To describe a project or quest as utopian is to convey long-standing deeply shared desires characterized by their unrealizability and simultaneous tendencies towards over-reaching reality. My stance is that the state of incompleteness of a utopian project is not only analytically accurate (and usefully so) but also desirable. Incompleteness and heterogeneity are desirable because by their

openness they provide opportunities for new and/or different actors, new elements which may be discontinuous from historical precedents, and alternatives that may be oppositional or engage resistance.

The significance of the concept of an incomplete utopian project is to enable us to see envisioning and historicizing together. My discussion adds to analyses of envisioning and historicizing as dimensions of organizational change by exploring utopian projects as co-constituents sustaining innovation (see, e.g., Engeström, Y.: 1990b). I argue for more explicitly thinking about resources of imagination in the heterogeneous, argumentative and, at times, oppositional structuring of worklife experiences and participation in innovation. In particular, to understand innovation projects, we need to understand the resources of imagination brought to bear in the worldly, technical and practical efforts at hand.

Where does the "imaginative power" required to launch and sustain such utopian projects come from? How are the powers-that-be persuaded to release the necessary resources, to commit, at times seemingly to gamble, organizations and cadres of creative talent to the high stakes–high cost, high risk, high gains–to create something new, by definition not yet proven? For the development of electronic health records, what contradictory or competing goals are entailed and how are these worked out or left unresolved? What are the long-standing problems that inventors, designers

and practitioners are trying to solve? Where do these problems come from? How are these problems produced?

I outline dimensions that are engaged in the particular EHR effort: the unique history of the HMO and its twin motives of industrial efficiency and social medicine; the Taylorist scientific management project that permeates the organizational culture and organization of work in the HMO; the technical project that combine software and infrastructure design (object-oriented programming, client server, networking, open architecture) and medical informatics (the structured content strategy for clinical documentation, standardization and inter-translatability of medical and clinical terminologies) as they contribute to the definitions of problems to be solved and breakthroughs to be achieved; changing and co-existing models and modes of patient care (medical, nursing, patient-centered and active patient models).

Heterogeneous motives are engaged in EHR systems development: the pursuit of social medicine ideals and industrial efficiency goals; desires to achieve evidence-based medicine and to rationalize medical work; plans for simultaneous expansion and downsizing. Certain of these conflict openly while others contribute to deepening contradictions in the activity and work of patient care. Industrial efficiency and social medicine represent the contradictions between the commodity forms and social use values of patient care and how these manifest as dilemmas in the activity of patient care. Work

organization is deeply implicated in the change efforts intertwined with electronic health records development and with the contradiction between commodity and social use values of patient care.

Chapter IV. Changing Patient Care

Stop, for, lo!
All the measure
Of thy treasure
Now is right!–
Ah, I see it! woe, oh woe!
I forget the word of might.

Ah, the word whose sound can straight
make him what he was before!
Ah, he runs with nimble gait!
Would thou wert a broom once more!
Streams renew'd for ever
Quickly bringeth he;
River after river
Rusheth on poor me!

Now no longer
Can I bear him;
Knavish sprite!
Ah, my terror waxes stronger!
What a look! what fearful sight!

Oh, thou villain child of hell!
Shall the house through thee be drown'd?
Floods I see that wildly swell,
O'er the threshold gaining ground.
Wilt thou not obey,
Oh, thou broom accurs'd?
Be thou still, I pray,
As thou wert at first!

I have three goals in this chapter: to introduce the activity of patient care; to introduce the first clinical setting and patient care team in the

outpatient Family Medicine Clinic; and to introduce the teleological object of the EHR Prototype Project to improve patient care through the imagination of future scenarios in which clinical work practices are re-imagined in relation to use of the electronic health record.

This chapter introduces patient care in outpatient settings, clinical teamwork, and work practices in three baseline (pre-EHR) examples of office visits. I walk through these as representative of the daily worklife of one patient care team in a Family Medicine clinic (how patient care is imagined now), then walk through them again as in an imagined future scenario in which the Electronic Health Record is used (how patient care is changed in the imagined future EHR scenario). Having explained the inner logic of the new system in relation to the examples, I discuss what the inner logic of the new system requires (to realize its logic) in terms of changes in current work practices.

In this case study, the explicit goals of the EHR Prototype Project are to improve patient care. That is to say the shared objects of the activity systems, the patient care team and the HMO's EHR Prototype Project, involve not only *accomplishing* patient care but *improving* patient care. Both are animated by complex objects and motives. To understand the motive of “improving patient care” requires an appreciation of present clinical work practices. By "clinical work practices," I refer to the communication,

coordination and collaboration required among members of the patient care team in their interactions with the patient, with whoever may accompany the patient, and their interactions with each other and with other (clinical and non-clinical) staff within the HMO as required to accomplish the work at hand for the outpatient encounter. I will use "practice" and "practices" to refer to clinical work practices, following the "practice perspectives" expressed in the anthropology of work and situated cognition.[33] The patient care team's collaborative work practices provide an ethnographic basis for considering work organization, divisions of labor and collective skills.

How is it possible to provide sketches of imagined future scenarios? I develop these sketches by two related means. To represent the object of improving patient care with a degree of concreteness, we re-visit the video taped exemplars of patient care activity from the baseline case study. Through this, we can enter an imagined future scenario of patient care with the electronic health record as a tool and as a constitutive element of the changed environment that will structure (restructure) the activity system of patient care in the clinic as a *nucleus* for thinking about outpatient care activity in the HMO.

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33 Please note that I am not using "practice" as it is used within communities of clinicians to refer to one's clinical specialty and the patient population for which one provides care.

The orientation to clinical work practices and patient care activity lays the basis for an initial understanding of the differences between two logics: the logic of the daily practices of patient care teamwork and patient-caregiver interactions and the logic of the computer system being prototyped. In re-visiting the encounter, the imagined future scenario (partially) illustrates the changes in work practices required for this particular electronic health record system to perform according to its inner logic and design. We also gain insight into dilemmas to be addressed and differences in the two logics that confront users and designers. As we proceed from one case example to the next, I comment on the ways that the research in the pre-EHR baseline period contributed to formulations of design problems taken up by the co-developers in the Software Company and the HMO (sometimes resulting in contention between the two).

Chapter V. Conclusions

Will enough
Never please thee?
I will seize thee,
Hold thee fast,
And they nimble wood so tough,
With my sharp axe split at last.

See, once more he hastens back!
Now, oh Cobold, thou shalt catch it!
Crashing on him falls my hatchet.
Bravely done, indeed!
See, he's cleft in twain!
Now from care I'm freed,
And can breathe again.

Woe, oh woe!
Both the parts,
Quick as darts,
Stand on end,
Servants of my dreaded foe!
Oh, ye gods, protection send!

And they run! and wetter still
Grow the steps and grows the hall.
Lord and master, hear me call!
Ever seems the flood to fill,
Ah, he's coming I see,
Great is my dismay!
Spirits raised by me
Vainly would I lay!

"To the side
Of the room
Hasten, broom,
As of old!
Spirits I have ne'er untied
Save to act as they are told."

Goethe, 1797, published in 1798

In this chapter, I summarize discussion of the dissertation's core questions. I critique the research methods and methodologies I used. Can the research methods address the questions posed? What are the limits of the research approach? The social construction of a new clinical information system needs to be more fully contextualized in relation to long-standing problems of health care in the United States than I am able to accomplish here. As a starting point, I have illustrated, through the specific instances presented,

how larger socio-economic concerns show up in daily patient care interactions and in electronic health record design discussions.

When do utopian projects open up boundaries and when do they represent extensions and consolidations of power? In recent years, social scientists and philosophers engaged in science studies have undertaken efforts to overcome dualisms, whether philosophically Cartesian, Hegelian, and Marxist as well as persistent popular and intellectually canonized dualisms that counterpose the cultures of literature (narrative) and science (fact), human and non-human, social construction (the practices of scientific discovery) and the real world (the world out there awaiting discovery). Critical science studies represent important alternative theoretical resources that invite fuller consideration of the resources of imagination that actors bring to both daily life and to incomplete utopian projects. Feminist and critical theorists emphasize the situated and partial nature of knowledge(s), hence their commitments to a multiplicity of theories, the irreducibility of heterogeneity, and a stress on anomalies (and monstrosity) as generative clues to new knowledge.

I conclude my discussion by returning to the utopian project shared by the inventors of this particular EHR: their desires that the use of the EHR will improve patients' health, well-being, and quality of life. To consider the social consequences of a new technology such as the EHR, one needs to

consider carefully how and in what contexts EHR systems may improve patient care.

CHAPTER II. THEORETICAL FRAMEWORK

Wander, wander
Onward lightly,
So that rightly
Flow the torrent,
And with teaming waters yonder
In the bath discharge its current!

And now come, then well-worn broom,
And thy wretched form bestir;
Thou hast ever served as groom,
So fulfill my pleasure, sir!

On two legs now stand,
With a head on top'
Waterpail in hand,
Haste, and do not stop!!

My dissertation project is informed by activity theory with additional influences from critical studies of science and technology practices. I share with many others the desire to systematically link detailed explorations in the field of lived practices with sociohistorical development of practices including political economic structures. In this chapter, I present the theoretical framework for my field research and interpretation, primarily activity theory, and how I applied an activity theoretical framework to research approach, methods and concepts. I introduce the building blocks of activity theory that informed the field research and the selection and analysis of case examples.

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My choices for emphasis within activity theory are linked to my interests and case study, particularly how we analyze technological change and changing work practices. This chapter also lays the basis for the concept of incomplete utopian projects as constituents of innovation, presented in Chapter III: Incomplete Utopian Projects, and analyses of case examples from my field research in clinical environments, presented in Chapter IV: Changing Patient Care.

The discussion proceeds as follows. I briefly respond to the question, why activity theory? I introduce core concepts in activity theory and related theories that share significant affinities with the sociohistorical perspective. I describe selected gaps, problems and directions, among which I am especially interested in the problem of context (sociohistorical context). I discuss resources of imagination and I extend the discussion of resources of imagination to highlight the argumentative, dilemmatic and heterogeneous nature of thinking and the power of different imaginaries. I explain how I applied an activity theoretical perspective to the field research of patient care and EHR prototyping.

Why activity theory? There are several reasons for my choice of activity theory as the framework for this dissertation project: (1) the contributions of activity theory to communication theory; (2) its pragmatic

match with the EHR Prototype Project field research; (3) the methodology and methods (tool kit) of developmental work research (the application of activity theory to work practices) and (4) affinities between activity theory and labor process theories.

Communication studies often focus on a medium, media or mediation as the focus of attention *per se* rather than establishing as the primary focus the substantive phenomena or content being mediated. My interests are in social practices and especially work practices: What is being mediated, how and why? How are diverse kinds of media, mediation, and mediating artifacts shaping social practices and toward what purposes? Communication technologies and information technologies are common foci for communication studies; a technology or medium is positioned in a leading role as an agent or catalyst for change. If one considers studies of technological change that argue against technological determinism from a meta-analytic perspective, technology keeps its primacy as leading actor even in discussions whose authors argue for the importance of other forces shaping change. Activity theory is distinguished from and extends mainstream communication studies, first, by its emphasis on *human labor* and secondly, by its emphasis on *teleological objects of activity* that motivate activity systems. Mediation and technological change are situated within a practice-based

sociohistorical framework that sustains analysis of interacting dimensions of continuously changing activity. Mediation is not separated from activity but thought of integrally as *mediated action* (Wertsch: 1991). Activity theory offers the field of communication potentially robust methodologies to explore questions such as: What motivates the emergence and creation of new tools (new technologies, new communication media) and towards what purposes? How are work practices and interactions changed and/or reproduced when new tools and new technologies are introduced?

Communicative activity understood as labor and invention, the collaborative and interactive nature of expertise, and the significance of the organization of work in relation to skills, learning and power--these themes have emerged recently as important areas of study for communication theory although they received scant attention until recently (Agre: 1994, 1995, 1997; Bakhurst: 1988, 1991; Cole, Y. Engeström, Y. and Vasquez: 1997; Engeström, R.: 1995; Y. Engeström, Y. and Middleton: 1996; Engeström, Y.: 1990, 1991a, 1991b, 1992; Schiller, D.: 1996; Shaiken: 1984, 1990; Wertsch: 1979, 1985, 1991). Activity theory research articulates specific constructs in sociocultural theories of cognition, context and mind such as *practical thinking* (Scribner: 1997, 1990), *interactive expertise* (Engeström, Y.: 1992), *voice* and *speech genre* as mediated action (Engeström, R.: 1995), and *voice* and *arena* (Sjöberg: 1996).

Interest in developmental work research and discourse analysis is growing among researchers in the fields of organizational communication and organizational learning (see, e.g., Engeström, Y.: 1990b, Taylor, J. R.: 1995). Generally, there is movement towards integrating inter-disciplinary and multi-disciplinary approaches.[34] Sjöberg notes the latter trend: "With the emerging third generation, activity theory is moving from the starting point with development, history and 'zone of proximal development' to also focus on cultural diversity, multi-voicedness, dialogue, macro-level networks, networks of activity and boundary crossing" (Sjöberg: 1996. p. 51).

There was a pragmatic match between activity theoretical framing and field research for the EHR Prototype Project. Iterative prototyping involved analysis of baseline clinical work practices and clinical use of three successive prototype versions by two patient care teams during the first four years of software design and development efforts. Ethnographic research methods and video and audio documentation proved fruitful for the early phase of EHR prototyping. Jordan and Henderson argue that reciprocal relationships between researchers and research participants and methods such as Interaction Analysis that elicit multiple perspectives are especially suited for knowledge organizations (Jordan and Henderson: 1994). As action research,

the principles and constructs of developmental work research are conceptualized for organizational change and organizational learning. Developmental work research framing met initial pragmatic tests for the kinds of detailed field research that can generate innovative resources for EHR designers and developers, practitioners and planners. Many activity theory tenets and concepts were consonant with the "philosophies of design" envisioned by EHR Prototype Project leaders and participants: analysis of communication, cooperation and collaboration within and between multi-disciplinary multi-professional teams and networks (Engeström, Y. et al.: 1991); interactive expertise and distributed teamwork; identification of emerging activities and structural dilemmas; envisioning use of new tools and experimentation with new ways of working.

Despite the shared points of interest between the research needs of EHR prototyping and activity theoretical perspectives, there were severe limits and constraints to pursuing an activity theory research approach in a project that was not formally constituted as developmental work research. This illustrates the difficulty of dis-integrating a methodology meant to be holistic. It also points to the persistence and institutional power of conventional methods and agendas. I experienced both of these difficulties in

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[34] See, e.g., program and abstracts for the activity theory congress, ISCRAT 1998, Aarhus,

seeking to pursue qualitative (and labor-intensive) analytic research methods within a corporate project.

Regarding methodology and methods generally, I found in developmental work research (Engeström, Y. : 1991a, 1991b) a framework to guide detailed field research and an evolving tool kit of means to make sense of practices *in situ* within a framework for which history and change are central. Socio-economic analyses need to be better informed by closer-to-the-ground studies of work activities, the skills and interactions they entail, and how they are changing. Furthermore, I found the principles of developmental work research useful for the context of technological change in health care, a vital service in which the nature of the work--patient care--challenges industrial paradigms for productivity.

Activity theory and labor process theory share points of emphasis: the centrality of labor and social practices, particularly collective labor, teamwork, and collaborative activity; emphasis on history and dialectical materialist approaches to historical grounding; appreciation of the complexity of skill, the skillful contributions of people throughout organizations that are essential to accomplishing work but too often unrecognized, the valuation of skills that are usually rendered invisible, and how skill is socially achieved in

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Denmark.

situated activity (Scribner: 1997, 1990). The invisibility of work and the silence of many voices is reflected in "peopleless" models such as game theory and rational choice. Ethnographic and other detailed field studies can be powerful in making work visible (Suchman: 1994, 1987). Activity theory and labor process theory both stress history, but they do so differently. A point of differentiation between the historicizing strategies is where one sees continuity and discontinuity. And, in contrast to activity theory's systemic view, the partisan question, "Whose progress?" is a starting point for labor process inquiry. Given the developmental (rather than relativist) and systemic perspectives of activity theory, we need to ask: when changes are seen in terms of progress--for the better--who is involved in defining what is "better"? In this case study of EHR/CPR invention, how may patient care and patient care work practices be improved through expanding capabilities of patient care teams and networks to better care for and collaborate with patients?

The importance of the activity theoretical stress on *expertise as collaborative activity*, the fundamentally collaborative nature of work and expertise, teams and networks (in which individuals collaborate), and "cognition in the wild" (Hutchins: 1995) should not be underestimated in contrast to mainstream stress on the psychological states of individuals (the

dominant frame in organizational psychology), cognition as a matter of mind to be studied in controlled experiments (the dominant frame in medical informatics), and abstract "logical" modeling (simulation modeling, enterprise and data modeling of business practices, object-oriented software programming).

Designing for computer supported collaborative work is not new, but realization of practical team-based design is difficult. For developers and implementers of EHR/CPR systems, designing for patient care teams and networks rather than (or in addition to) designing for individual physicians represents a significant shift and challenge to realize in design. For computer-based patient records, this is complicated by the unresolved status of electronic signature in combination with policies and procedures for confidentiality and verification of doctors' orders. The complexities are underscored by the basis of patient care teamwork in the real-time, real world contingencies of practice that illuminates the coordination, communication and collaboration of diverse members of teams and networks, the interactive expertise required to instantiate the motivating object of an activity system.

For an organization the size of the HMO, organization-wide integration of non-clinical and clinical information systems is infrastructure building on the scale of a small country. For scalability testing, the HMO uses

a rule of thumb of 250 people possibly needing access to one patient's records at the same time. The scenario combines clinical and non-clinical staff who may need to review a patient's chart. To give this some context from my experience as a volunteer, in a hospital ward for oncology / AIDS care, the ward kept a list of more than 300 clinical resources (physicians, specialists, psychologists, discharge planners, technicians, social workers, pharmacists and so on). The team caring for a patient was composed from the personnel listed, combined with the core staff dedicated to the ward, with myriad additional staff throughout the organization including pharmacy, laboratory, radiology, admitting, transfer / transport), clerks, additional primary care and specialty care physicians, other clinicians and ancillary staff caring for the patient, and so on.

How, when, where and by whom are patient care (and business) data generated? Qualitative research that seeks to understand *how* work is accomplished collaboratively has the potential to correlate the physical model and logical model in projects such as the EHR Prototype Project. Affinities between activity theoretical approaches and object-oriented design approaches also suggest contributions that these kinds of action research offer to software development and systems design.[35]

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[35] Obviously, there are significant limits to these points of affinity.

A. Activity theory core concepts, building blocks

How is activity theory distinguished as a theoretical framework? What does activity theory uniquely add to practice perspectives on cognition? I begin by presenting conceptual building blocks of activity theory that are important to my discussion. I briefly review the contributions of a subset of theorists whose ideas have influenced my thinking: Ilyenkov, Bakhurst, Bakhtin, Bibler, , Y. Engeström, Lektorsky, Leont'ev, Scribner, Vygotsky, Wartofsky, and Wertsch. The meanings of keywords and concepts suggest how activity is distinguished from conventional frameworks of individual psychology and individualist frameworks for cognition. By introducing core concepts of activity theory, I also present my glosses of key terms in relation to varied uses among activity theorists and differences between the meaning of keywords in activity theory and other frameworks.

Activity theory offers a social constructivist framework strongly identified with realist theory. David Bakhurst characterizes Evald Ilyenkov, the principal philosopher of activity theory, as a "radical realist."[36]

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[36] Ilyenkov's philosophical project in the post-Stalin "thaw" period is the reinstatement of dialectics in dialectical materialism (see Bakhurst: 1991). Bakhurst describes his exposition of Ilyenkov's writings as a "philosophical ethnography" in which he immersed himself in the historical contexts of the arguments in which Ilyenkov engaged in order to see the world from

"Materialism," Ilyenkov wrote, "recognizes the following fact: the world with which the mind is 'in touch' and the (real, object) world we perceive are *one and the same,* and not two different worlds, between which we need to find a 'bridge,' an interchange, or an interaction" (Ilyenkov cited by Bakhurst: 1991, original emphasis). Seen from this realist and materialist philosophical stance, Bakhurst stresses that "the point of the activity approach is not to posit activity as a bridge between subject and object, but to show how activity is the source of their unity, or 'dialectical identity,' as moments of a single monistic system" (Bakhurst: 1991).

Social practices are thus at the heart of activity theory. Theorists of the sociohistorical or sociocultural school are especially concerned with sign-mediated activity encompassing language, labor, and learning. Following Marx, the essence of human labor lies not only in relation to use and development of tools and artifacts, but also in uniquely human resources of imagination and symbolic, conceptual mediation. Activity theoretical perspectives emphasize communicative activity (thought and language, thinking and speaking) among societal individuals engaged in labor and continuous invention. Activity systems are understood to be historically developing, expanding and undergoing continuous transformation.

Ilyenkov's position in relationships to philosophical opponents and allies in the debates of the day.

Transformations include qualitative changes over time and changes in context.

> *...(A)n activity is a process characterized by constant transformations.* An activity can lose the motive that inspired it, whereupon it is converted into an action that may have a quite different relation to the world, i.e., implement a different activity. Conversely, an action can acquire an independent, energizing force and become an activity in its own right (Leont'ev: *(*1979), p. 65).

Through the concept of *activity*, activity theory organizes attention differently than in either structuralist or individualist theories. Activity constitutes and is constituted by social individuals acting within the lifeworlds of communities of practice (Lave and Wenger: 1991; Wenger: 1998). Within the fields of psychology and philosophy, activity theory is, from its inception, in an argument with behaviorism (historically, Skinner) on one side and individualist and idealist conceptions of mind on the other (Piaget, Freud, Cartesian and Kantian philosophies). Scribner points to activity (labor) as a distinctly new starting point for psychology, following Vygotsky and Leont'ev.

> We must start, (Leont'ev) said, not from the features of the subject's organization taken by itself, and not from the reality surrounding her, taken by itself, but from an analysis of life processes that really link these two together. The concept of

> activity applies to and encompasses all those processes that, by linking humans to the world, meet specific human needs.
>
> The integrated nature of human activity finds its first expression in the labor process, the archetypal form of human activity. The two fundamental features of labor, which later become characteristic of human activity in general, are its mediated structure and its collective social organization (Scribner: 1997, p. 284).

To understand an activity system dynamically, analysis focuses on joint externalized activity among individuals understood as *social subjects* (Bakhurst and Sypnowich: 1995), *societal subjects* (Engelsted, Hedegaard *et al.*: 1993), or *collective subjects* participating in and continuously expanding an activity system (Engeström, Y. : 1987). A patient care team is an example of a collective subject. All individuals are understood to be social or societal subjects, whether alone in thought, acting individually or acting jointly with others. An activity theoretical perspective is then an historical and systemic view that insists on looking beyond the usual frames of individual psychology.

> As individuals participate in these socially patterned activities, they acquire the cultural forms of acting and thinking incorporated in them; reciprocally, they contribute to changing these activities and in inventing new modes of action and thought. ... For cognitive inquiry, the theoretical implication is that empirical sciences such as developmental psychology need to shift away from preoccupation with the 'individual human mind' as the sole or principal unit of analysis for understanding modes of thought (as in Piagetian theory) to a consideration of

> the systems of socially constituted activity in which human consciousness and behavior develop (Scribner: 1997a, p. 270).

James Wertsch summarizes the distinctive features of the concept of activity as: (1) the levels of analysis in the theory of activity; (2) goal-directedness at the level of analysis concerned with actions; (3) mediation (mediated action, mediation-in-action), (4) genetic explanation, (5) social aspects of activity, and (6) internalization (Wertsch: 1981, p. 37). Wertsch emphasizes mediated action and mediation by signs, symbols and artifacts. Mediated action is characterized by "... an irreducible tension or dialectic between mediational means, with their reiterative properties on the one hand and the uniqueness, or nonrepeatability of instantiation on the other" (Wertsch: 1994, p. 206).

A. N. Leont'ev distinguishes three levels of activity which he describes as "units" for the analysis of activity. Activities, actions and operations are differentiated: "separate (particular) activities, using their energizing motives as the criterion: actions--the processes subordinated to conscious goals; operation which depends directly on the conditions under which a concrete goal is attained" (Wertsch: 1979, p. 65). Leont'ev stresses the dynamic and systemic interrelationships between these levels.

> These "units" of human activity form its macrostructure. An important feature of the analysis that leads to distinguishing these units is that *it does not rely on separating living activity into*

> *elements. Rather, it reveals the inner relations that characterize activity.* The transformations that emerge in the course of the development of activity are concealed behind these relations. Objects can become energizers, goals, and tools only within the system of human activity. When taken out of this context they no longer serve in these capabilities (Leont'ev: 1981 (1979), p. 65, emphasis added).

One needs to gain a thorough understanding of the object of the activity. For this, ethnography and phenomenology are important in combination with systemic analysis and sociohistorical contextualization. An activity system may be considered as the unit of analysis for sociohistorical research and for developmental work research as the application of activity theory to workplace practices. In developmental work research, analysis is focused on the communication, coordination and collaboration required of members of teams and participants in networks to accomplish actions that are guided by *goals* of the activity at hand and to instantiate the *object of the activity* that motivates the activity system. Two points of stress in the preceding statement are noteworthy in distinguishing the activity theoretical perspective of my discussion of EHR prototyping from conventional approaches in the United States. The emphasis is consistently on interactions, teamwork, and collaborative expertise rather than the actions and expertise of individuals as individuals. My interest is in the *objects of activity* that motivate the activity system rather than the participating individuals' conscious goals in and of

themselves. In other words, I am interested in the interplay between objects of activity and goals as expressed and as such expressions open windows onto changing work practices, dilemmas, conflicts and contradictions.

Yrjö Engeström (1987) articulates a methodology for organizational "learning by expanding" in which envisioning and proposals for new ways of working are important as lenses for critiquing the present and for bringing about systemic change. Y. Engeström (1987, 1991a, 1991b) provides a methodology for exploring expansive transitions, for analysis of emerging activities, and for action research interventions. In developmental work research, disturbances, breakdowns and "trouble scenarios" are important junctures for innovation. Structural dilemmas and contradictions are openings for expansive transitions that go beyond situated problem-solving to potential transformation of an activity system through the emergence of new ways of acting, talking, thinking and imagining (Engeström, Y.: 1990).

Activity theory shares with science studies an appreciation of anomalies as instances of difference, disturbance, and novelty. Alertness to novelty, "listening to the material," and "engaging in a conversation" in which we let the data speak are important principles for the conduct of research (Keller: 1985). The very kinds of information and knowledge that do not fit in a theory or disrupt a paradigm eventually make it possible to expand theories

and to change paradigms (Kuhn: 1970 (1962)). Evelyn Fox Keller comments from within scientific practice on the importance of sustaining diverse viewpoints for the sake of individual scientists and new knowledge, that many different theories flourish. She writes:

> A healthy science is one that allows for the productive survival of diverse conceptions of mind and nature, and of correspondingly diverse strategies. In my vision of science, it is not the taming of nature that is sought but the taming of hegemony (Keller: 1985, p. 178).

A.1. Teleological objects of activity

The *object of activity* confronts the participants in an activity system and is transformed through the activity. "This means that the object itself is a 'transitional being' that is taken up in the analysis by means of inner tensions and contradictions within activity systems" (Engeström, R.: 1995, p. 202). The object of activity is a teleological object, motivating the activity system in which participating individuals interact. My use of object differs from Sjöberg's use of object as "intention, perspective and orientation" {Sjöberg: 1996) and Bødker's frequent use of object interchangeably with goal (Bødker: 1991). For the purposes of my discussion, I will reserve *object* to refer to an *object of activity* and I will refrain from using "object" and "objects" to refer to "tools," "artifacts" and "material objects."

Susanne Bødker contributes a useful typology of objects in relation to computer-based artifacts:

> In many cases, computer-based artifacts, as compared to traditional artifacts, allow no direct access to the subject or object of the actions conducted through the artifact. We cannot see, hear, or feel the subjects or object directly, only indirectly through the representation given by the computer. Often, the object does not even exist as something separate from the artifact (Bødker: 1991, p. 35).

I think of objects as teleological. The characterization of the object of activity as teleological refers to two inter-related dimensions: (1) the purposive activity of individuals, including but not limited to the conscious intentions of people acting together in purposeful activity; and (2) the historical development of activities and transformations of an activity system--how history works "behind the back" in ways that move beyond the conscious goals and purposes motivating activity. The socially defined subject is "essentially dependent on his or her ancestors and peers" (Bakhurst: 1991, p. 215). Nor does participation in the coordinated object-oriented activity require self-conscious motivation such as that understood as affective commitment. The motive of the object (Leont'ev: 1981 (1979)) is only partially available consciously to the participants of an activity system because it is produced historically and co-constitutes the on-going development of the activity system "behind the back." It is not possible for actors within an

activity system to have full comprehension of--much less willful control over--the historical trajectory of an activity system. From this perspective, History becomes a leading actor.

A.2. Object-hypotheses and mediator objects

Lektorsky writes that: "Scientific activity is only possible where… there is a realization of the modes and norms of cognitive activity inherent in the collective subject" (Lektorsky: 1980, p. 20). He highlights the role of "mediator objects"—man-made instruments which express cognitive norms and act as "object-hypotheses" existing outside individuals. These are assimilated by the individual as he or she is confronted by the idealized object world. Expansion of knowledge and experience occurs through the evolution of mediator objects which are "independent" (within limits) from the world as it is. The emergence of new systems of mediator objects also marks the appearance of new cognitive possibilities, of other worlds in a sense but other worlds which involve continuity. In science, they open up "qualitatively new content expressing previously unknown aspects of objective reality" (Lektorsky: 1980, p. 213).

Whereas Lektorsky is writing of scientific practices, we can relate his analysis of mediator objects to technology, in this case iterative EHR prototyping. In the invention of the electronic health record, there is a

dialogue between realized prototyping and as-yet unrealized thinking. The design strategy of "rapid iterative prototyping" involves cycles of design and clinical use of successive versions of a computer system prototype. In the EHR Prototype Project, Version 1 was put into use by the first patient care team in the primary care clinic for a year. Meanwhile, Versions 2 and 3 were in development. Clinical use of Version 1 was evaluated and scrutinized for "enhancements" to improve future versions of the prototype (Versions 2, 3 ...) and for changes in practice and disruptions to practice to address in planning implementation strategies. Iterative prototyping involves reciprocal modifications of design and use of the new system. New cognitive possibilities (emerging activities) open up in the world of practice while at the same time experiences in clinical use open up design to further changes. Each developmental version of the prototype can be seen as a hypothesis (or set of hypotheses) about how to realize design strategies so that they can be readily used in practice. Design strategies, as they relate to imagined use by clinicians, are hypotheses--theories--about practice. The prototype versions, design hypotheses and theories about practice envisioned are mediator objects and object-hypotheses.

A.3. The "problem of the ideal" in dialectical materialism

Ilyenkov is especially concerned with particular kinds of non-material objects: moral values and objects of activity that are suffused with moral values. In "The Concept of the Ideal," Ilyenkov traces the history of the concept of the ideal and poses the question for materialist philosophy: How do non-material objects (ideal objects) come into the world? "Ideality," "idealized culture" and "spiritual culture" are created by human activity and all of nature and the world around us is idealized (Bakhurst: 1991; Ilyenkov: 1977a). By saying that human activity "idealizes nature," human activity "means not the projecting activity of individual minds, but 'real, sensuous, social, object-oriented' activity" (Bakhurst: 1991, p. 190, following Marx). Put another way, *labor* is at the heart of human activity.

Writing of Ilyenkov's argument for "the objectivity of the ideal" (Bakhurst: 1991, p. 181), Bakhurst explains another sense in which idealized culture is "behind the back" while confronting us.

> The fact that ideal forms take shape 'behind the back' of consciousness and confront individuals with an absolutely objective claim on their actions explains how it is possible for human beings to see this idealized environment not as an expression of their own creative powers but as an alien authority. Under conditions where these forms rigidly dictate to individuals, the individual will come to see them as autonomous and absolute, either by representing them as manifestations of a divine authority or by attributing to them a quasi-naturalistic status. To attach an autonomous existence to that which is a product of human activity is, for Ilyenkov, what Marx means by fetishism; and in fetishizing the ideal, human

> agents are alienated and estranged both from a product of their activity and from their own creative powers themselves (Marx: 1867; Ilyenkov: 1963, cited in Bakhurst: 1991, p. 193).

Following Ilyenkov, Bakhurst describes "the ban on anthropocentricity" rooted in idealism and the dominant Western philosophical tradition of the Enlightenment that inscribes mind / body dualism ("two worlds dualism") and individualism. The Western contemplative model dictates that "nothing can be a constituent of mind-independent reality if understanding its nature and origin requires essential reference to the distinctive perspective of human subjects" (Bakhurst: 1991, p. 9). Mind / body dualism is enforced by this ban on anthropocentricity. If we are to understand how non-material (ideal) objects such as moral values, social norms, beliefs and ideas come into the world, the ban must be lifted (Ilyenkov in Bakhurst: 1991; Bakhurst: 1988, p. 9).

Ilyenkov's relocation of "the ideal" in activity is helpful in interpreting the simultaneous "materiality" and "ideality" of artifacts and objects (motives). Ilyenkov relocates "the ideal" in activity, in interactions between people in activity, altogether constituting "spiritual culture." He argues that "only in the reciprocating movement of the two opposing 'metamorphoses'—forms of activity and forms of things in their dialectically contradictory mutual transformations—DOES THE IDEAL EXIST" (Ilyenkov:

1977a, p. 99, original emphasis). When Ilyenkov writes that “the ideal exists as the ‘subjective’” in the things people create, he is arguing that “the ‘ideal’ exists only in man” understood as the “collective individual” who has assimilated a particular “spiritual culture.” It is in this sense that motives (both material and ideal) are “found in the object,” and both material and ideal objects (motives) contain contradictory dualities which are irreducible.

How do moral values come to infuse scientific practices and technological invention? In A Social History of Truth, Steven Shapin, a scientist and scholar of scientific practices, argues that "truth" has its genesis in the norms and conventions of gentlemanly behaviors that arose concurrently with modern science (Shapin: 1994). What we come to know as objective truthfulness claimed by scientific methods and results is born of social relations and actively, effortfully constructed socially; it does not spring into being only (or fundamentally) from a special relationship to nature and phenomena of study. In The Religion of Technology, historian David Noble argues that "...the present enchantment with things technological--the very measure of modern enlightenment--is rooted in religious myths and ancient imaginings" (Noble: 1998, p. 3). In A World Without Women, he documents how misogynous desires permeate Western science (Noble: 1992). And in his social histories of automation, Forces of Production and America by Design,

Noble establishes the dominant role that management agendas and Taylorist scientific management principles have in the social construction of new technologies for the industrial workplace (Noble: 1984, 1979). In the EHR Prototype Project, I heard not only the business objectives one would expect of proprietary corporate innovation but also desires among clinicians that the EHR might "make medicine whole," "eliminate risk" and mistakes, equalize power relations between nurses and physicians, and bring into being new forms of interactions and collaboration between patients and care providers. I think of these desires as constitutive of the incomplete utopian project of the EHR prototyping. I found the vision shared among EHR Prototype Project participants was powerful enough to override the present at certain times when early versions of the prototype proved difficult for patient care team members to use as designed.

A.4. History, transformation, and change

"We are born into a world that history has made cognizable" (Bakhurst).

Activity theory is guided by the principles of dialectical materialism (Bakhurst: 1991; Ilyenkov: 1977b, 1982 (1960)). Historicizing--an activity system, its practices, tools, division of labor--is essential. Naturally occurring activity is not understandable through observation in the moment, in other words an understanding of its history is necessary for interpretation. "We are

born into a world that history has made cognizable" (Bakhurst: 1991, p. 198). Exploring the history of an activity system and its object(s) of activity in material and ideal forms lays the basis for analysis of systemic dilemmas and contradictions. In this case study, the activity system is the HMO's EHR Prototype Project; the activities are clinical work practices, the work organization of patient care including changes in divisions of labor; the object(s) of activity are patient care and improving patient care through the invention of the EHR system. An appreciation for the activity system's history makes possible to discern emerging activities and to envision potential transformations.

Scribner revisited Vygotsky's work in developmental psychology and identified three levels of history in his research program: general history, child history, and the history of mental functions.

> Vygotsky was advancing a complicated proposition for psychologists to consider: Look to cultural history for hypotheses about the origin and transformation of higher functional systems. His work may be read as an attempt to weave three strands of history--general history, child history, and the history of mental functions--into one explanatory account of the formation of specifically human aspects of human nature (Scribner: 1997b, p. 258).

To pursue practical thinking and cognition at work, Scribner schematized Vygotsky's three levels of history in relation to contemporary terms of cognition, mind and work. Scribner develops "a practice framework

of cognition" to guide a research program on intermediate constructs such as practical thinking and to integrate cumulative knowledge. In Learning by Expanding, Y. Engeström incorporates the levels of history conceptualized by Scribner into developmental work research and adds transformative cycles and expansive transitions as a fourth dimension.

By introducing developmental work research, Y. Engeström makes a profound contribution to methodology from the activity theoretical framework. Scribner credited Y. Engeström also with "internationalizing" activity theory (Scribner: 1987). In extensive investigations of work teams across diverse settings by Y. Engeström and his colleagues, one's attention is organized to see movement towards *interactive expertise* (Engeström, Y.: 1992). Disturbances, discoordination, breakdowns, gaps, and dilemmas present opportunities for innovation through expansion as people figure out how to overcome troubles that confront them. Expertise may be extended--expanded--by use of tools supporting integrative collaboration among individuals (subjects, participants) whether co-located and contemporaneous or temporally and spatially dispersed. Activity theory is advanced in several ways. As for the practice framework guiding Scribner's program, Y. Engeström's program of developmental work research concretizes a methodology and tool kit for a research agenda of comparative analysis

across diverse domains. Philosophical principles that inform activity theory are elaborated and applied in action research and thereby given life rather than existing only as abstractions. The research group led by Y. Engeström contributes to recent efforts to integrate activity theory with other disciplines and methods with which activity theoretical perspectives share significant affinities.

Y. Engeström 's activity system triangle embeds the theoretical framework in a graphic depiction of an activity system (Engeström, Y.: 1987). The triangle is a tool for maintaining a dynamic picture of an activity system while exploring specific activities, mediating artifacts, rules, the division of labor and other dimensions that constitute the system as a whole (a life world). Leont'ev's point is important here: "the analysis that leads to distinguishing these units is that *it does not rely on separating living activity into elements*. Rather, it reveals the inner relations that characterize activity" (Leont'ev: 1979, p. 65, emphasis added).

For the purposes of periodizing change, we can break out the dimensions. A change anywhere in the system will effect changes throughout the system, introducing new problems and possibilities, and deepening contradictions. Change anywhere in the system can transform the activity system as a whole.

Historicizing an activity system, here the HMO's EHR Prototype Project, activity, here work practices and work organization, and the object of activity in its material and ideal forms, here patient care and improving patient care, lays the basis for analysis of dilemmas and contradictions. From such analysis, it becomes possible to analyze emerging activities and to envision potential transformations. In the activity system of the EHR Prototype Project, I am interested in the EHR as a new tool being introduced to improve patient care and the potential of this new tool to transform the activity system of patient care within the HMO.

Concurrently with the development of the EHR system, there are numerous changes in motion along nearly every dimension of the HMO activity system. It is beyond the scope of my discussion to do justice to the complexity of these larger changes. I will refer to them through description from secondary sources that suggest the larger context.

A.5. Gaps, problems, directions

How, then, does one conceive and carry out field research within such an ambitious multi-level and multi-dimensional framework? Whereas activity theory calls for integrated analysis of the dynamism of an activity system, in research practice it is difficult to devise and carry out such a holistic approach. The development of intermediate constructs supports

analysis of object-oriented activity. Examples include *practical thinking* (Scribner: 1987, 1990) and *interactive expertise* (Engeström, Y.: 1992). The intermediate concept I construct is an *incomplete utopian project* (discussed in Chapter III).

Three problems and directions are of special interest to me: sociohistorical context and its integration with detailed field research; non-material objects such as morals and values, and objects of activity that are suffused with moral values such as the incomplete utopian project of EHR prototyping; and resources of imagination and how they may be more fully included in activity theory.

To what extent can activity theory act as a bridge between detailed ethnographic research approaches and those leading with socioeconomic concerns in order to integrate the interpretations respectively constructed? Concern over how to bridge detailed ethnographic and other field research with social policy and socioeconomic analyses is neither new nor uniquely associated with activity theory. This also suggests consideration of continuities and discontinuities, consolidations and extensions in analysis of transformations and change. The problem or set of problems is variously referred to as *the problem of context* or the *context of context* (Chaiklin and Lave: 1993; Cole, Y. Engeström and Vasquez: 1997), or simply "the big picture" of

socio-economic and social policy concerns. Sociohistorical context includes managerial regimes, management science agendas, and market forces that also shape new technologies. Context or sociohistorical context has been identified as a crucial level for theory development that is difficult to get at methodologically (see, e.g., Cole, Y. Engeström and Vasquez: 1997 and Chaiklin and Lave: 1993).

How are sociohistorical contexts and actors implicated in shaping "working relations" and the reproduction of the systemic order in people's work and lives? These concerns are identified as analytically and methodologically difficult by theorists engaged in studies of situated cognition in which detailed ethnographic methods and fine-grained interaction, discourse and semiotic analysis are employed. Suchman and Blomberg *et al.* strive to make the effortful production and reproduction of working relations visible and thereby accountable (Blomberg *et al.*: 1994; Suchman: 1994). Lave outlines "the dialectical problematic of practice" (Lave: 1988, p. 179). Bonavoglia, striving for a comprehensive theory of human activity and cognition, credits Lave's modes of analysis for articulating *the dialectical problematic of practice* with the potential to bridge methodological approaches. "Lave aims to situate the analysis of local activity in a larger context pointing out that the context of context is important to the analysis of

practice" (Bonavoglia: 1993, pp. 101-102). Yet the very conceptual framework proposed by Lave remains "an unexplored thread," difficult to concretize in research. "This framework tells us theoretically where to direct our attention but does not tell us how it corresponds to the real world" (Bonavoglia: 1993, p. 103).

Analysis of social practices is integral to activity theory yet, as a metatheory (grand theory), "there is no formula for a search for specific mediating mechanisms. Working from the level of a general theory to the generation of particular hypotheses requires the usual mix of knowledge, example, and intuition" (Scribner: 1997, p. 271). Scribner points to the "incompletenesses" in Vygotsky's historical approach: "He did not encompass the full range of 'phenomena in movement' on the level of either general history or individual history" (Scribner : 1997, p.259). By asking, "Where do we begin the inquiry? We cannot begin with the general abstract philosophical notion of activity--it does not connect with actual life" (Scribner: 1997, p. 286), the methodological problem of activity theory is posed in the most open form of "ascending from the abstract to the concrete."

Within philosophy, Bakhurst describes the gap between Ilyenkov's clear philosophical claims and how one might investigate them as "(Ilyenkov's) failure to develop this appeal to activity into a systematic theory

of the conditions of thought and experience" (Bakhurst: 1991, p. 211, footnote 12). Whereas "the question of what the world is like prior to idealization is the question of what difference our activity makes to reality" (Bakhurst: 1991, p. 210), it is unclear how one might pursue analysis of activity so as to make "the world 'in itself'" accessible other than "by imagination and by building theories" (Bakhurst: 1991, p. 202, p. 210).

In two recent case studies that apply activity theory, conversation analysis and discourse analysis are employed to integrate the sociohistorical context of activities. In the first, Ritva Engeström applies an activity theoretical approach to analysis of *voice* and *speech genres* as mediated action in doctor-patient interactions (R. Engeström: 1995). In the second, Cecilia Sjöberg combines activity theory and grounded theory (Glaser and Strauss: 1980 (1967); Strauss and Corbin: 1990) with the concept of arenas (Gärtner and Wagner: 1994) to analyze *voice* and *arena* in participatory design meetings in the early phase of a medical informatics effort. Conversation analysis is a primary method for gaining understandings of externalized joint activity and for providing windows onto cognitive processes to the extent that these are manifest in discourse and non-verbal forms of communication and artifact-based representation.

In "Voice as Communicative Action," R. Engeström devises a strategy to evoke the larger sociohistorical context in "constituents of social action related to talk and meaning construction" by emphasizing the *referentiality* of talk that is locally produced and reproduced interactively by patients and physicians as they cre ate shared objects in medical interviews. "Conversations are examined as dialogic from two socially constructed perspectives: from the perspective of local speakers and from the perspective of a cultural-historical situation. As communicative 'actions' by the speakers, voices are 'doing' the construction of referentiality in talk" (Engeström, R.: 1995, p. 211).

R. Engeström's methodological concern is to create an "expanded unit of actions"--"context-in-action"-- that expands conversation analysis to more fully express institutional context and the practical and political activities in which people engage when talking in institutional settings. "... I try to indicate in regard to meaning construction how collective 'activity' produced (globally) by people reveals itself (in the flow of conversation) as different referential possibilities which are at work through 'actions' (locally) by the parties in conversation ..." (Engeström, R.: 1995, p. 198). Bakhtinian concepts of utterance, voice, social genre and social language are interpreted within an activity theory perspective. R. Engeström constructs six voices that carry the

"culturally given" in doctor-patient interaction, based on a review of the literature on the social construction of medicine: everyday dialogue about somatic-biomedical issues; medical dialogue about somatic-biomedical issues; bureaucratic dialogue about somatic-biomedical issues; medical dialogue about psychological-social issues; bureaucratic dialogue about psychological-social issues; and everyday dialogue about psychological-social issues. "Voice is further defined as communicative 'action' and as 'a speaking subject's perspective, conceptual horizon, intention and world view' (Wertsch 1981, p. 51). ... Communicative actions bear practical activities of which they are a part" (Engeström, R.: 1995, p. 199).

Trouble (including silences) between conversational partners is regarded as potentially generative for "the appearance of new, emergent voices in sequences of locally produced interactional disturbances and innovation" (Engeström, R.: 1995, p. 192). Each conversation involves unique local production and articulation. "Instead of being an 'adequate complete utterance' in terms of rules, the outcome of interaction is seen in terms of the referentiality of talk." The action--each utterance in a medical interview--"is directed to some *referential object*. ... Instead of standardized knowledge, the object is connected to language 'in its historical life,' 'in its heteroglot development' (Bakhtin: 1981, p. 356). The unit of analysis expands by the

historically constituted social / collective action of meaning construction, with contexts of practical activities in which the language has lived its intense social life" (Engeström, R.: 1995, pp. 197-198). R. Engeström writes:

> (T)he 'activity level' exists inside an individual subject and reveals itself as external collective activity rather than as individual consciousness ... as 'communicative 'actions,' voices, by invoking and bringing up referential potentialities (social languages), carry out the activity of which they are a part. ... The historically former content is described in the formal properties of the genre and may even remain unknown to the individual (Engeström, R.: 1995, pp. 201-202).

R. Engeström is especially interested in discoordination and emerging activities, troublesome moves, and innovative improvisations. "Such deviations or 'unidentifiable voices' are particularly considered because they may represent locally produced potentialities of change, 'buds' and 'shoots' of emerging novelty in referentiality. Such anticipatory 'innovative' forms often take shape through disturbances and ruptures in discourse" (Engeström, R.: 1995, p. 203). As the psychological and social realm continues to extend health care, R. Engeström perceives the emergence of a new way of talking that may overcome genre boundaries of disease-orientedness (biomedical discourse that divides "imaginary" and "real" illness) and disease-nondisease (patient discourse that bypasses the division between "imaginary" and "real" illness). The dimension of disease-nondisease seems to emerge in modern medicine's action and discourse and to reorganize the

'object' of clinical action" (Engeström, R.: 1995, p. 210). In one medical interview, R. Engeström points to "the doctor's extension of the dialogue by invoking a 'third party' from the computerized records is analyzed as an innovation in interaction." But she acknowledges limits to interpreting any fixed correlation between a local instance of innovation and the emergence of new mediational means or activities: "... the conversation in the consultation does not seem to advance in spite of the innovation. Innovations do not necessarily differ much from disturbances or breakdowns (Engeström, Y. , 1993)" (Engeström, R.: 1995, p. 207).

In this case example, the time pressures of work organization are implicated in a post-interview comment by the doctor when asked why she didn't discuss fear of cancer with the patient: "Well, did I actively plan to postpone it to the next time, or was it because it was almost half an hour late in schedule, (abridged) I really had a bell ring in my head when he mentioned the fear of cancer. (Abridged) Perhaps it was because this was a pretty long consultation in itself, and I was late" (Engeström, R.: 1995, p. 209).

Work organization permeates discussion of the case examples of patient care teamwork, early EHR prototype use and imagined future scenarios with EHR use (see Chapter IV). The first three case examples I discuss differ from the case examples of medical interviews that R. Engeström

discusses in that my documentation and analysis focuses on teamwork among clinical team members (physicians, physician assistant, nurses, ancillary nursing staff) in which doctor-patient interaction (the medical interview, exam room consultation) occurs.

As in R. Engeström's analysis of medical interviews, Cecilia Sjöberg's methodological strategy employs Bakhtinian concepts of utterance and voice, arguing that voice affords a more robust theoretical basis for sociocultural analysis than previous analyses of professional roles. To explore "power structures influencing design," Sjöberg combines the concept of voice with the concept of *arena* (Gärtner and Wagner 1994), defining an arena as "a location, a geographical or cultural terrain that the actors in the dialogue occupy, use and shape. An arena thus reflects more than the inner-organizational dynamic" (Sjöberg: 1996, p. 66). Drawing on the work of Gärtner and Wagner (1994) and Strauss and Corbin (1990), Sjöberg constructs three arenas: workplace arena, organizational arena, and societal arena. She invokes the metaphor of a "battlefield" (between competing voices) to gloss Bakhtin's concept of *heteroglossia.*

> When contrasting a harmony versus a conflict perspective, Bakhtin's terminology can be used. In this study, *heteroglossia* was characterized in the interaction property of 'power and conflict,' while polyphony was described in 'story-telling.' Narratives can be categorized as *polyphony*, which in this

> study is used to express democracy and harmony. ... The term *heteroglossia* implies dissonance (Sjöberg: 1996. p. 130).

That participants have different agendas and each voice has a different object lays the basis for potential conflicts. "Hence, it has to be accepted that when a multi-professional participatory design group attempts to cooperate, conflicts and disagreements were inevitable" (Sjöberg: 1996. p. 123). "... [C]onflict and disagreement seem to be unavoidable elements in participatory design in practice, and have to be acknowledged and managed. ... In disagreements, the members of the group were seen to argue from separate perspectives, which was interpreted as a symptom of lack of a shared understanding" (Sjöberg: 1996. pp. 125-126).

The context for Sjöberg's case study is a managed care system in the Swedish health care sector. As for the EHR Prototype Project in which I worked, the project Sjöberg studied carries a larger change agenda for organizational learning and quality improvement to be supported by information technology: "The organizational model from this project was also to have an impact on similar developments in health care, and specifically in primary health care" (Sjöberg: 1996. p. 132). The HMO's EHR Prototype Project is a hybrid in relation to the approaches to the early design phase that Sjöberg describes. Sjöberg's study differs from mine in that I focus on an EHR

development process (iterative prototyping and requirements) from the point of view of the context of clinical use and early problematization of patient care and clinical use of the prototype, with a subset of planning discussions (the EHR Prototype Site steering committee meetings) as background.

Sjöberg focuses on "the development process and only secondarily on the systems product" (Sjöberg: 1996. p. 121). By the participatory design process, she is particularly interested in "the encounter between practitioners and designers" (Sjöberg: 1996. p. 124). She problematizes participation and includes proposals of criteria for establishing and evaluating "a truly participatory approach." "In staging a 'democratic dialogue'... democracy is defined in terms of a forced equity among social actors in the possibility to access, distribute and display information. Power and dominance are thus meant to be visualized, not neutralized" (Sjöberg: 1996. p. 4). However, as Sjöberg acknowledges: "... Such debates have to be balanced against managerial and technical interests with a solution focus, which are central in a time-critical organizational context (Cross et al. 1981). ... " (Sjöberg: 1996. pp. 3-4).

Whereas the participatory design group whose collaborative process she analyses is situated in a public sector setting, she acknowledges constraints in commercial projects in private sector settings. Commercial

projects have different characteristics, especially different time constraints and demands for prioritization: "It has been noted that in commercial p rojects it is important to be able to prioritize and make trade-offs between the requirements in order to meet the most significant requirements in early releases" (Sjöberg: 1996. p. 13). Design processes may also differ between in-house and commercial development efforts: "In-house development projects can be characterized as requirement-driven, i.e. oriented towards meeting the needs and requirements of different users, while commercial development projects can be described as market-driven, i.e., oriented towards foreseeing future market opportunities (Larsson and Vaino-Larsson 1994)" (Sjöberg: 1996. p. 10). I submit that, in the United States, these constraints also mitigate against a culture of argument and the more fully participatory processes of the Scandinavian tradition.

The design theme emerges as possible common ground, suggesting the achievement of an important goal of the participatory design approach: "A possible common ground was the design theme, where the voices contributed on equal terms. An underlying expectation could here be discerned in the design group, that the end product in the ideal case would be a combination of the different perspectives involved and thereby be suited to the workplace and work activities" (Sjöberg: 1996. p. 122). But is the common ground of

design temporary, an artifact of the exploratory, problematizing, and prototyping period of design? Or do the common ground and flexibility become lasting constituents of institutional change?

Although I have the research materials to support longitudinal analysis of the EHR Prototype Site steering committee meetings, I am not pursuing discourse analysis in this dissertation. I frame the sociohistorical context of EHR prototyping differently as an *incomplete utopian project* which suffuses the collective imagination of the EHR Prototype Project in its early phase. I devised the intermediate concept of incomplete utopian project as a means for thinking about sociohistorical context and possible futures. My construct of an incomplete utopian project contributes to articulation of the relationship between historicizing and envisioning and to exploration of resources of imagination that animate innovation projects and daily worklife alike in contradictory, dilemmatic, and argumentative ways. Through the substantive constitution of the incomplete utopian project, competing agendas and desires are introduced into the discussion.

B. Resources of imagination

The problem that I take up regarding resources of imagination originally derived from a preliminary cross-critique of the theoretical

frameworks that influenced my dissertation project. In activity theory and developmental work research, one's attention is organized to see *externalized* group activity within a developmental (distinctly non-relativist) systemic viewpoint. The social constructivism of activity theory is thorough-going, hence the affinity with many of the theorists of critical science and technology practices in diverse communities of practice. Sociocultural and sociohistorical approaches stress multi-voicedness, dialogicality, hybrid constructions, and heterogeneity. Activity theorists have addressed phenomena of group creativity and individual personality (e.g., Engeström, Y.: 1990, 1991c). Although the heterogeneity of individuals' conceptual models and motivations is acknowledged, the strong stress on externalized joint activity and the privileging of systemic transformation tend to subordinate the role of self-consciousness to the systemic view.

I began with particular kinds of imaginative resources in mind: utopian projects (visions, ideas, images) motivating technological change, and inventiveness and innovation grounded in experientially based knowledge often referred to as “tacit” knowledge or “invisible skills.” What insights do realist materialist theories offer regarding *resources of imagination* as part of an effort to theorize the relationships between work and new information and communication technologies? How can conceptualization of imagination in

invention and everyday work be enhanced by narrative and semiotic analyses such as those elaborated in science studies by Latour, Haraway, and others, and by understandings of disparate imaginaries as discussed by Verran and others?

Returning to work settings and the question of resources of imagination at work, we might ask simply, does it matter what people *think* they are doing? How do we analyze the relationships between objectified activity--what people do, what they are consciously *trying* to do, and how they interpret what they do? In a clinic of the HMO, what we may describe as distributed teamwork (dispersed among people and over time and space) correlates well with what administrators understand as organizational teamwork. Physicians who described their experience as working in a strong and well-run team also wished for more development of social relationships amongst colleagues. A systemic view–in activity theory as for the HMO's administrators –grants scant consideration to descriptions such as these by people working in relatively well-coordinated activity systems in which they experience worklife as "teamwork without community." I argue for more explicitly thinking about the argumentative and, at times, oppositional structuring of worklife experiences and participation in innovation. My interest is in how daily worklife and the work of innovation are animated by

the contradictory, dillematic, and argumentative nature of common sense along the lines of analysis developed by Michael Billig et al. (Billig: 1987; Billig et al.: 1988) and shared visions, metaphors, and images along the lines of communal imaginaries (Verran: 1998).

How do ideal (non-material) objects come into the world? How are creativity and imagination regarded from materialist sociohistorical perspectives? Resources of imagination are conceived as mediated and mediating artifacts. For example, varying models of patient care and medical concepts for diagnosis and treatment are conceived as secondary (how?) and tertiary (why?) artifacts (tools) (Engeström, Y.: 1990b). I summarize certain arguments of Wartofsky, Lektorsky, Ilyenkov, and Bibler as these inspired my conceptualization of utopian thinking and incomplete utopian projects in innovation. Wartofsky, Lektorsky, and Ilyenkov argue for degrees of autonomy of ideas, art, and science, and their relationships to change. This view of creative thinking relies on conceptual positions underlying activity theory. The individual is understood as a social, collective individual. The dualities of the ideal and material aspects of objects of activity (motives) are irreducible. Dialogicality, polyphony, and heteroglossia characterize all language and communication (Bakhtin: 1981). And “sense” prevails over

meaning in inner speech understood as internal dialogue (Vygotsky: 1986; Wertsch: 1985).[37]

In The Dialogic Imagination, Mikhail Bakhtin underscores the multiplicity of contexts through which meanings are refracted, and the ironic, contradictory, discursive layering of utterances, different social languages, sense, and meanings not only between but within historic moments--the heteroglossia which enrich the dialogicality and polyphony of modern narrative forms (Bakhtin: 1981). "Hybrid constructions"--utterances that juxtapose more than one social language--receive special attention from Bakhtin.

Resources of *imagination* and *reflexivity* are central to Wartofsky's model of perception. By taking up perception, he also takes the "unconscious" and "subconscious" (dreams) into account. Wartofsky argues that human perception is distinguished as historical rather than natural, as a mode of action mediated by representation, and as activity which fundamentally involves change and variations in modes of representation. His model of human activity provides room for visions of "alternative worlds" as well as material historical transformation. In particular, Wartofsky suggests that resources of individual and collective imagination

have some autonomy in that they are derived from *but not bounded by* the world "as it is" (as it confronts individuals, as individuals experience the world) but also as it is thought of and imagined. Perceptual activity is continuous with outer action or praxis "*in the* world, and *of a* world as it is transformed by such activity" (Wartofsky: 1979 (1973), p. 194, original emphasis and emphasis added).[2] Lektorsky reiterates two principles of activity theory that are important to discussion of thinking about technological innovation. First, that all forms of thinking involve the "objectification of ideas." Secondly, that "the direct links between practical activity, cognition and communication are disrupted" in higher levels of consciousness (conceptual, scientific, artistic thinking). Here we have again "the off-line loop" Wartofsky suggests for conceptual artifacts.

In Wartofsky's schema, the development of historical human praxis involves three interrelated levels of artifacts: (1) the creation or production of *primary artifacts*, tools, skills, including modes of symbolic communication or "languages"; (2) *secondary artifacts* which embody representations and images,

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[37] "Language reveals its true being only in dialogue... The word dies in internal speech, giving rise to thought" (Vygotsky: 1986).

[2] "Activity" here includes perceptual activity as a form of outward activity: "I take perception itself to be a mode of outward action; to be derived, in its genesis, from other direct forms of outward or motor-action or *praxis* and to be, in perceptual practice itself, continuous with, or a part of such outward action or praxis. In this sense, it is perceptual activity *in* the world, and *of* a world as it is transformed by such activity" (Wartofsky: 1979, p. 194, original emphasis).

involving reflexivity, “mimicry” and “imitation” as dimensions of reproduction in human activity (canons of representations embody “conventions” which, as intermediate forms, blur towards the category of tertiary artifacts); and (3) *tertiary artifacts*—art, technology, and science—which, “abstracted from their direct representational function,” become especially important for feedback and for change because they have “off-line” qualities.

> (W)e may speak of a class of artifacts which can come to constitute a relatively autonomous ‘world,’ in which the rules, conventions and outcomes no longer appear directly practical, or which, indeed, seem to constitute an arena of non-practical, or ‘free’ play or game activity. This is particularly true when the conventions of representation—e.g.. in art, or in language—become transparent ... (Wartofsky: 1979 (1973), p. 209).

Y. Engeström restates Wartofsky's schema of artifacts as: primary artifacts (what?); secondary artifacts (how?); tertiary artifacts (why?), and adds a quaternary artifact type (where to?). "Why?" and "where to?" artifacts are created through innovation and are constitutive of innovation but not predictably or deterministically.

Dreams offer both a metaphor and structure for understanding the “derivative and abstractive” relationship between tertiary artifacts and “the acquisition of skills (in which) intentionality or conscious teleology makes its *first* appearance” (Wartofsky: 1979 (1973), p. 204).

> ... just as in dreams our imagery is derived from our ordinary perception, but transcends or violates the usual constraints, so too in imaginative praxis, the perceptual modes are derived from and related to a given historical mode of perception, but are no longer bound by it (Wartofsky: 1979 (1973), p. 209).

"**Possible worlds become actual, differentially**" (Wartofsky).[38]

Such imaginary worlds I do not take as 'dreams' or 'in the head,' but as embodied representations, or better, embodied alternative *canons* of representation; embodied *in* actual artifacts, which express or picture this alternative perceptual mode. Once the visual picture can be 'lived in,' perceptually, it can also come to color and change our perception of the 'actual' world, as envisioning possibilities in it not presently recognized. The activity of imagination is a mode of alternative perceptual praxis (Wartofsky: 1979 (1973), p. 209).

I think of conceptual artifacts--Wartofsky's tertiary artifacts, Y. Engeström 's "why?" and "where to?" artifacts--as resources of imagination. Resources of imagination can be conceptualized as mediating artifacts from a dialectical materialist perspective. I extend this understanding of resources of imagination to include and highlight imaginaries (Verran: 1998; Watson-Verran: n.d.), narrative resources such as interactive storytelling (Sjöberg:

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[38] Wartofsky: 1979 (1973), p. 207.

1996, see also Orr: 1996), and argument (Billig: 1987; Billig et al.: 1988; Sjöberg: 1994; Sjöberg and Timpka: 1995).

B.1. Internalization oriented towards externalization

Bibler writes of creative thinking and the societal individual. Inner speech, he writes, is "not so much a 'phenomenon of internalization' as the intention of the 'externalization' of thought, as an embryo of a new, not yet objectively posited culture ... an embryo concentrated in the concept." Social relations are transformed in an individual's inner dialogue and thought where "they acquire a new (as yet unrealized) sense." It is the movement from internalization to externalization that Bibler refers to as the "logical level" of individual creative thinking when an individual engages in "a future-oriented form of creativity."

> ... (T)he process of immersion of social relations in consciousness ... is, at the logical level, a process of transforming expanded and relatively independent 'cultural models,' prepared cultural phenomena, into the culture of thinking, a dynamic culture, which is fused and condensed in the individual person. An objectively developed culture acquires a subjective determination in inner speech, i.e., a determination in which it is manifest as a future-oriented form of creativity, of new, as yet non-existing, merely possible models of culture. ... [I]nner speech (and its elementary form of mono-dialogue) may be represented as the dialogue of those cultural-historical models of thinking (activity) that are internalized in the different voices of my own 'I,' the argument among these functioning as a kind of positing, the creation of new cultural phenomena (knowledge, ideas, works of art) ... (Bibler: 1984, pp. 52-53).

"Sense" prevails over meaning in imagination, literary and creative thinking, and in the persistence of concepts and visions (Vygotsky: 1986; see also Bakhtin). The prevalence of sense contributes to the persistence of imagination over time in the invention of new artifacts.

Both Wartofsky and Lektorsky emphasize the externalization of creative cognitive processes as a prerequisite for historical realization and thus as the basis for analysis. Sensuous human activity is required for off-line perceptual activity to become historical.

> My argument is that it is precisely the evolution of representation, or of symbolic embodiments or objectifications of modes of action or praxis, *in* an objective artifact, that provides the very genesis of such cognitive consciousness and of such teleology ... The objectification of human intention is embodied both in the tools used in production, in the skills acquired and adapted to this use, and in the forms of symbolic communication which develop in language, in art, in dance and poetry, in their origins. Now, it is my argument that our perceptual activity is an activity mediated or conditioned by these very forms themselves (Wartofsky: 1979 (1973), pp. 204-205).

When Wartofsky and activity theorists stress the material, objectified form of artifacts, they presuppose that all human artifacts are *idealized.* Creative thinking involves continuities and discontinuities. Continuities and discontinuities are important in relation to production, reproduction, and change. "The artifacts of the imaginative construction of 'off-line' worlds I take to be derivative, and abstractive" (Wartofsky: 1979 (1973)). Wartofsky writes:

> I will do no more than suggest here that this in no way affects the general thesis that such disinterested or 'off-line' activity depends in its formal structures on the practical rules, rituals and modes of praxis which are represented in the on-line models of this activity. Which is initiatory is an open question; my own view, at present, is that it is in the direct forms of necessary productive praxis that generate the representational forms themselves; and that only by this means is the perceptual activity mediated and does it become historical. The artifacts of the imaginative construction of 'off-line' worlds I take to be derivative, and abstractive (Wartofsky: 1979 (1973), p. 208).

Schematizing the ideal and material aspects of consciousness and objectified activity may parallel how these dimensions may be experienced consciously as separate, despite their living existence as inseparable. The contradictions of an object, and of an activity system, are not self-evident but need to be discovered; historical analysis is a means for such discovery (Ilyenkov: 1997a, 1977b, 1982 (1960)); Y. Engeström: 1987). In everyday experience, an activity system's contradictions may be masked variously by common sense or ideology (powerfully shared images and norms, socially embedded understandings about the use value and exchange value of commodities including services) or alienation[39] (separation from the object of the activity as a whole and/or separation from participation as an

[39] This use of alienation needs to be distinguished from the connotation of alienation as objectification in Ilyenkov (see Bakhurst: 1991). Employed in the context of everyday experience of the commodity form of labor and commodity fetishism, my use of alienation is closer to Herbert Marcuse's discussion in One Dimensional Man (1964). See also Raymond Williams review of multi-faceted meanings of alienation in Keywords: A Vocabulary of Culture and Society (1976).

autonomous subject). Our imagination of our work, our skills, how they are valued and recognized, are affected powerfully by shared social and cultural ideas, even when these images may contradict practical experience. Understandings of the reciprocal relationships between practical activity as mediated "on-line" by primary and secondary artifacts (the corresponding technological systems, tools, skills) and as mediated by conceptual artifacts "off-line" (utopian projects, reflection on what one is doing) may be variously disjointed, contradictory, or argumentative, in ways which can engender either dialogue, creativity, or confusion. The variety of "alternative worlds" also suggests conflicting voices of multiple subjects, particularly in activity systems involving arguments about the future such as work settings undergoing technological change. Bakhtin's concept of the dialogicality of texts and the *heteroglossia* which infuse different interpretations is also useful here, in his emphasis on the multiplicity of contexts through which meanings are refracted and indeterminate not only between but within historic moments (Bakhtin: 1981). Perhaps these explanations provide insight into the origins of "argumentative structure" in common sense and how it is that we hold contrary views at once, as Billig and his colleagues discuss.

B.2. Argument, dilemmas, and heterogeneity

In their analysis of *ideological dilemmas*, Billig and his colleagues highlight not only the argumentative structure of thinking and common sense but also the inventiveness of everyday life. They explore "the dilemmatic aspects of everyday life," focusing on ideological dilemmas found in everyday conversations, routines, arguments, and popular imagery. Their methodological commitments are to qualitative and interpretative approaches for analysis of "complex phenomena ... containing within them themes and structures which are contradictory in principle" (Billig et al.: 1988, p. 162). They are interested in "recurring and novel difficulties of everyday judgment."

> ... these conflicts are of interest ... not to find how they might be institutionally resolved or functional for the social system, but to show how they give rise to both problems and opportunities for reflection, doubt, thought, invention, argument, counter-argument. Hence our conception suggests that in everyday thought the individual is a lay philosopher, not a marionette dancing to the desires of a great design (Billig et al.: 1988, p. 163).

The Oxford English Dictionary (OED) defines a dilemma as follows: "a dilemma involves 'a choice between two (or, loosely, several) alternatives which are or appear equally unfavourable" (cited by Billig et al.: 1988, p. 8). Drawing on the OED definition, Billig et al. describe another sense of dilemmas that characterizes dillematic practical activities other than (or concurrent with) dilemmatic thinking and rhetorical activities. "To experience

a dilemma is to live out an opposition, so that one is divided upon it in the failure to achieve a resolution" (Billig et al.: 1988, p. 91).

Their analysis is distinguished from conventional Western psychological theories by a concern with the historical creation of thinking, how dilemmatic preconditions are produced and lived in ideology as society's way of life including "what passes for common sense within a society" (Billig et al.: 1988, p. 27). For example, one manifestation of the difficulties of liberalism in everyday discourse is that the descriptions "ideological" and “political” are used in argument to suggest "bias" and "duplicity." "Thus a conception of logic itself is involved: truth is free from logical contradiction" (Billig et al.: 1988, p. 151). This particular conception of logic is then favored over argument. "Psychologists interested in thought processes have shown a tendency to venerate logical thinking to the neglect of the sort of rhetorical, or argumentative, thought..." (Billig: 1987, p. 5). Yet, Billig urges, "Rhetoric need not cravenly submit to the invasion of logic" (Billig: 1987, p. 164).

Billig et al. argue particularly that liberal philosophy "is reproduced neither as a series of philosophical solutions, nor as singular positions that people consistently occupy, but as dilemmas. ... In this way, the ideology is not reproduced as a closed system for talking about the world. Instead it is

reproduced as an incomplete set of contrary themes, which continually give rise to discussion, argumentation and dilemmas" (Billig et al.: 1988, p. 6).

> ... [H]istory is daily continued in everyday life. ... Those social psychologists who might study the routines of everyday life seldom try to link the content of routines, or of cognitive schemata, to the processes of history. By contrast, we have sought to draw attention to the continuing ideological history of liberalism, and of the Enlightenment, in the comments of our respondents (Billig et al.: 1988, p. 145).

Billig et al. present a critique of individualist cognitive perspectives, the information processing cognitivist model, experimental psychology, and the growing number of "(m)odern psychologists (who)... take the goal of individual adjustment as their psychological ideal..." (Billig et al.: 1988, p. 35). Contra cognitive and ideological theorists, they write: "In contrast to the cognitive psychologists, we stress the *ideological* nature of thought; in contrast to theorists of ideology, we stress the *thoughtful* nature of ideology. ... (I)deology, and indeed common sense, are seen to comprise contrary themes (Billig et al.: 1988, p. 2, original emphasis). Their analysis of the social individual and the social nature of thinking differs from schematic or information processing models and “harmony as balance” models. "Our view sees the individual as existing within a social context, in which all dilemmas and oppositions cannot possibly have been worked out. Moreover, the individual, by possessing the common sense of the community, also

possesses the contrary aspects of beliefs which permit debates to continue both internally and externally. This is a different image from that conveyed by psychological theories, which see thinking in terms of a desire for inner attitudinal harmony or in terms of the processing of incoming information" (Billig et al.: 1988, p. 19). Billig et al. differ also from a "multiple perspectives" point of view regarding ideology and social conflict. Rather, "social opposition" is seen as a foundational resource for the self-reflection required for self-determination. "Thus citizens are encouraged to think for themselves within and beyond the limits imposed by the networks of constraints" (Billig et al.: 1988, p. 155).

In Arguing and Thinking: A Rhetorical Approach to Social Psychology (1987), Billig critiques the one-sidednesses of interpretations of rhetoric that follow the game and theatre metaphors in ways that caricature the activities of sport and theatre production. Indeed, Billig points out, the much talked about moments of these two activities involve *cessation of argument*: "the deliberate suppression of argument" for the dramatic performance on stage; "obedience to the rules of the game" in the sports game on the field or court. These represent only "a partial perspective, which ... fails to appreciate the argumentative element within its own chosen world (Billig: 1987, p. 19). The theatre and game metaphors have often been

employed to stress role-following and rule-following behaviors. Yet, our repertoires include rule-bending, rule-disputing, and rule-creating, not only rule-following.

> The [theatre metaphor] assumes that social actors resemble the script-following actor rather than the script-creating playwright. Similarly the game-playing metaphor sees us all as rule-following players, rather than high level administrators, who make and change the rules, and who frequently are too old in body to engage in the sporting activity themselves. In short, it could be said that for rules to exist, there must be more than rule-following. There must also be rule-creation. Moreover ... rules are created in the context of argument (Billig: 1987, pp. 22-23).

Dilemmas are social, grounded in the shared values of communities. Dilemmatic thinking involves moral evaluation; dilemmas "impose an assessment of conflicting values" (Billig et al.: 1988, p. 163). "These dilemmas can only arise because people share values, norms, social expectations, duties, guilt feelings, wishful hopes and so on. In this respect the individual decision-maker is not alone, although the act of choosing can itself be a lonely act" (Billig et al.: 1988, p. 15). The concept of the societal individual is consonant with that of activity theory. "There is a tension in the discourse, which can make even monologue take the form of argumentation and argument occur, even when all participants share similar contrary themes" (Billig et al.: 1988, p. 144). The ideological factor is perpetuated if analysis

concentrates on negotiations between *individuals*. "The dilemmas involved in these interpersonal negotiations represent more than the problem of the individual personalities involved. Similarly, they represent more than the tensions of the organization involved. They are representations of a basic ideological dilemma. The values which the participants wish to respect, and to be seen to respect, are central ideological values" (Billig et al.: 1988, p. 70-71).

Billig, as Ilyenkov, is especially interested in moral values. Dilemmas, by pulling to opposing "common-places" and "moral markers," counteract the one-sidedness of "a single, unqualified principle [that] can so easily overstep reality" (Billig: 1987, p. 243). Dilemmas are essential for the creation of moral discourse. "It is because of this proximity between the undefined borders of opposites, that common-sense can provide us with dilemmas to think and argue about; and, only if there are such dilemmas and deliberation, rather that the smooth and unthinking categorization of all worldly particulars, can our discourse bear a moral quality" (Billig: 1987, p. 208). Inconsistency is not seen as a problem in itself and gaps between thought and action are also seen as potentially productive. "In this context, inconsistency is neither avoided, nor is it feared. Instead, it provides a medium through which cultural knowledge is advanced and new insights are

gained" (Billig: 1987, p. 169). Billig argues (following Pareto) that by the complexity of contrary principles that are brought to or called upon in most social actions, "...dilemmas, and potential arguments, are inherent in social life. There will always be problems and controversies arising from the claims of rival principles. ... Such social dilemmas are not unfortunate accidents, but are an inevitable consequence of there being principles or values" (Billig: 1987, p. 212).

In summary, Billig *et al.* see dilemmas as resources of imagination for critical thinking and as signs of a healthy social and political openness, a culture of argument, critique, reflexivity, and self-determination. "In a real sense social argumentation can be seen as providing the model for social thinking (Billig, 1987)" (Billig et al.: 1988, p. 17). Dilemmatic thinking manifests conflicts between values within a community or between communities.

> In this way the characteristics of dilemmas are revealed as fundamentally born out of a culture which produces more than one possible ideal world, more than one hierarchical arrangement of power, value and interest. In this sense social beings are confronted by and deal with dilemmatic situations as a condition of their humanity (Billig et al.: 1988, p. 163).

My interest in dilemmas is twofold. The discussion by Billig and his colleagues of argumentation and ideological dilemmas is important to my construction of the concept of incomplete utopian projects (see Chapter III). In

the analysis of case examples (Chapter IV), I discuss another kind of dilemma described by Billig et al., what I will call *structural dilemmas* or *practical dilemmas* that present themselves in practice. For example, the work of registered nurses conducting telephone triage is highly dilemmatic in that they experience moment-to-moment time conflicts, torn between urgent responsibilities that demand attention simultaneously and for which time delays may entail risk to one or more patients. The example of telephone triage illustrates how types of dilemmas are intertwined rather than distinct and particularly how practical dilemmas involve moral and ethical values. The terms in which caring for patients are expressed have changed over time as systemic contradictions are expressed in language; clinical work practices become increasingly dillematic as both ideological and practical dilemmas confront care providers.

B.3. Conflict in design

In Susanne Bødker's analysis of interface design, conflict in design is an important resource for creativity. "Design is fundamentally a collective activity, in which the various practices of the participants meet in a process of mutual learning. This meeting creates conflicts that create new possibilities in design" (Bødker: 1991, p. 48). Conflicts arise in relation to multiple needs,

multiple objects, and the alienation individuals experience within institutions and the order imposed by work and societal institutions.

> The individual will meet this order through power relations, institutions, and grouping of interest in society, under which the human being lives, at the same time as she can contribute to their change. In most societies, the division of labor has caused a separation of the needs of the individual and the goal of the activity in which she takes part. Furthermore, the needs of the individual as part of different collective activities might differ and even conflict. We can say that the human being has not one need in the concrete activity but a whole cluster, some of which are conflicting (Bødker: 1991, p. 23-24).

Sjöberg frames doubt and doubts, openness, incompleteness and lack of closure, iterative processes, critique of both the product and processes of design, and argumentation as important resources to be valued in the design process. The design process is understood as a culture of argument suggesting similarities to Verran's description of Australian aboriginal communities' arguments over competing metaphors from which the going metaphor and a shared cognitive map are enriched (Verran: 1998). In some ways, Sjöberg's framing of the creativity of argumentation among diverse participants as a design resource suggests, as Billig and his colleagues contend, that there is always an argumentative structure to thinking and to being in the world. However, Sjöberg also describes argumentation as problematic, to be managed. I see possible reasons for conflicts and disagreements somewhat differently, not as problems to be solved but as

always present, in the sense of different commitments and values that might not be ultimately commensurable, and as healthy for collaboration if they can be voiced and negotiated freely. I find the principle of "democratic dialogue" in participatory design and argumentative design strategies admirable: "Power and dominance are ... meant to be visualized, not neutralized" (Sjöberg: 1996, p. 4).

B.4. Imaginaries, metaphors, and stories

Thinking of different communal imaginaries as proposed by Helen Verran (1998) extends how resources of imagination are conceived within activity theory. Verran's proposal regarding "working disparate knowledge traditions together" provides an example of recent work that emphasizes metaphor, narrative, and argumentation. Verran's interest is in "the imaginary" and "its necessary involvement in knowing and knowledge making," "something constitutive of, and constituted by, ontic and epistemic commitments." The imaginary is "an element inherent in knowing and knowledge making" yet one "almost entirely ignored by practitioners of social studies of science." Until recently, she notes, discussions had as starting points the questions of "whether or not 'traditional' knowledge systems had theory, and if they did, whether or not it was rational," followed by a shift in the early 1980s to "the maze of debates over relativism and realism." As in

Philip Agre's call for critical practice in computer design (Agre: 1997) and Adrian Cussins' proposal of "intentional travel,"[40] self-awareness of one's design metaphors and philosophical explanations and their consequences in re-imagining and re-shaping the world, Verran calls on us to "include our use of Imaginaries in our accounts of our knowledge. We could understand this taking of our imaginaries in full, and taking them seriously, as changing ontic / epistemic mode" (Verran: 1998, p. 249).

Verran stresses the practice-based basis of imaginaries: "... imaginaries are not located in minds. ... Images and the stories which people tell with their metaphors and causal connections, mobilize these immanent imaginaries and only in this indirect way contribute to constituting them. ... The imaginaries immanent in practices interpellate those objects / subjects that / who are implicated in and by the practices, helping to constitute them as objects / subjects" (Verran: 1998, p. 252). Maps and land title are two compelling examples of the power of shared imaginaries. Maps represent imagination of Western land title "as mythical empty space" (Verran: 1998, p. 242). "Titles have agency, but their agency is potent only in a community which has a commitment in a shared, or a partially shared, imaginary" (Verran: 1998, p. 252). A community continuously creates a shared

imaginative map, a kind of "cognitive map." "Knowing the map" and being able to produce "metaphoric insights to express this 'map'" demonstrate the practical and social nature of resources of imagination.

Sjöberg found interactive storytelling to be an important resource in multi-party collaborations such as the design process, as performative narratives and metaphors are for iterative construction of communally shared imaginaries in Verran's analysis. Design group participants jointly tell stories that construct shared meaning for design and use of the software application.

> Stories concerned work practice, possibilities and limitations of technology and technology in relation to practice. Therefore, the stories could be viewed as multi-party conversation and also as collaborative products with no single intention and meaning (Atkinson et al.: 1978). Agar (1985) claims that culture is a symptom of storytelling. The stories told, in any of the three voices, may thus also reflect the community these institutions represent. Hence, interactive storytelling appeared in this study as a means, influenced by several institutions, to create consensus, bring clarity and stage user participation in design (Sjöberg: 1996. p. 129).

Verran describes two imaginaries--two different logics--in her analysis of land rights negotiations in Australia: one "rational" (legalistic property rights claimed by pastoralists and corporations, maps representing the imagination of Western land title "as mythical empty space"), the other culturally historical (aboriginal imagination about land expressed in

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[40] Adrian Cussins' expression, discussed in a philosophy seminar at the University of

metaphors, stories and communal ceremonies, reciprocal ownership of and by the land). By proposing *working together* disparate knowledge traditions, Verran takes up the challenge of "how to go beyond heterogeneity" without arriving at one homogenizing "translation" (by the dominant party) and its prerequisite "purifications" (following Latour: 1993). In the Western traditions of modern science and rationality, "... true knowledge has no imaginary. Modernity circumscribes its imaginary as of aesthetic, but not ontic or epistemic interest" (Verran: 1998, p. 243). "Reason contains no creative power, only a regulative power which gives rules and standards" (Le Doeff: 1989 cited by Verran: 1998, p. 245). An important starting point for joint work between communities adhering to different logics is to explicate and embrace the expressive works of imagination by which their respective logics are shaped and shape ontic/epistemic commitments.[41] In the Australian land dispute, the Western pastoralists "would need to understand that both an imaginary and a logic, intimately meshed, are involved here" (Verran: 1998, p. 243), that is, for both Western pastoralists and aboriginal communities.

California at San Diego in which I participated in 1993.

[41] Ontic and epistemic commitments are defined as "forms of meaningfulness (ontic commitments), and the explanations of its origins (epistemic commitments)..." (Verran: 1998, p. 246).

In telling the story of an EHR prototyping effort, I tell a story of two logics, the inner logic of the new system and what it requires in terms of changes in work practices, clinical practices, and intellectual thought processes of clinical and medical decision making and rapid integration of new medical knowledge (cognitive changes), and the logic of present clinical work practices, patient care interactions, and modes of patient care. In the world of patient care, for example, institutional health care providers and physicians trained in medical models of knowledge need to imagine patients' lifeworlds and the logic of caregiving practices of multi-disciplinary members of patient care teams, as well as the science of medicine and the formal logics of medical informatics and controlled medical terminologies.

C. Activity theory approach to field research

I apply an activity theoretical perspective to my research approach on two levels: (1) the EHR Prototype Project field research employing ethnographic methods and audio and video documentation; and (2) sociohistorical contextualization of case examples through the intermediate construct of the incomplete utopian project of EHR invention.

Before I describe the field research, some background on the early prototyping phase of EHR development is important to the context of my case

study. Pre-EHR baseline research and evaluations of clinical use of successive versions of the prototype generated resources for design: identification of new problems for design; new problematization of problems in practice; confirmation of design strategies; problems with clinical use of the prototype and disruptions to clinical work practices. "The prototype acts as a stimulus to explore new aspects of the domain (Sutcliffe 1995)" (Sjöberg: 1996. p. 11). Experience in multi-professional, multi-disciplinary prototyping efforts can also change working relations of participants. In her longitudinal study of a multi-disciplinary participatory design project design team committed to "democratic dialogue," Sjöberg found that the participants became "more innovative" and developed abilities to move in and out of different voices given time, experience and knowledge, and explicit support in group processes.

Appreciating the future orientation of design activity and the unusual characteristics of the early design process (degrees of openness, emphasis on problematization) are important for appreciating the prototyping phase of EHR design and development in contrast to the implementation phase or implementation of existing software (implementation entails different complexities). Bødker points out that design involves orienting to a future time horizon. "The future use situation is the origin for design..." (Bødker:

1991, p. 43). Bødker points to the importance of breakdowns in triggering conceptualization during computer systems design activities (Bødker: 1991). In interface design, conceptualization is evoked in breakdowns; breakdowns are important scenarios for design. "(T)o be a good designer means to be able to facilitate reflection and transformation in breakdown situations" (Bødker: 1991, p. 44).

> Conceptualization can take place in breakdown situations, situations in which some unarticulated conflict occurs between the assumed conditions for the operations on the one hand, and the actual conditions on the other; between the human reflection of the material conditions, and the actual conditions. ... In design we are going to change operations and their conditions for a specific activity, and for that reason we need to focus on both actual operations and conditions, and future changed ones (Bødker: 1991, p. 27).

Writing of interface design for systems that support work practices, Bødker writes that design means dealing with and conceptualizing "articulated, nonarticulated, and nonarticulable aspects of practice. Therefore "...*the conditions that trigger a certain operation from the repertoire of operations are what we need to investigate in user interface design*. ... [O]nly breakdowns can draw attention to the triggering and the actual conditions (to get around what is already involved in personal competence) ... the subject / object-directed aspects of the user interface are examined only through actual use situations" (Bødker: 1991, pp. 46-47, original emphasis).

Design is a social process that involves creating a shared picture of future use, whether iterative prototyping or other techniques are used to bridge and communicate between the context of design and the context of use. Because design is social, it inevitably involves debate and conflict among participants with diverse perspectives committed to differing agendas. "What has to be taken into account involves interpersonal, cultural and organizational issues ..." (Holtzblatt and Beyer: 1995 cited by Sjöberg: 1996). Activity theory is well suited for analyzing a moving target such as iterative prototyping for computer systems design combined with organizational change.

The *context of clinical use* for EHR prototyping comprises the work of clinicians and patient care teams in two ambulatory (outpatient) care settings: a Family Medicine Clinic and the outpatient offices of a Cardiology / Internal Medicine Department. I conducted ethnographic field research in the first clinical environments for EHR prototyping and through participation in project team meetings and project work contributing to EHR design requirements, evaluation, and organizational planning. To understand the *context of the EHR Prototype Project*, I participated in and audio recorded bi-weekly steering committee meetings between Regional leaders and EHR Prototype Site Medical Center administrators during the early prototyping

period. I also participated occasionally in *ad hoc* joint meetings between HMO and Software Company representatives.[42]

From a practice-based perspective on EHR/CPR development, I focus on the work practices of patient care teams; patient care is the motivating object of activity of patient care teams. In my analysis, the object of the activity system of the EHR Prototype Project is improving patient care. As simple as this statement seems, it was neither obvious to all participants nor unanimously agreed among researchers. Two alternative analyses of the object of activity are common in medical informatics and efforts to create electronic health record systems. In the first, the object is improving the *medical record*, the written documentation of the clinical work of diagnosis and treatment. In the second, *medical reasoning* (especially diagnostic reasoning) is the object as the phenomenon to which much of medical informatics is devoted in artificial intelligence, expert system, and decision support system

[42] The steering committee represented a longitudinal intermediate forum between the clinical liaisons from the use settings for EHR prototyping and representatives from the Information Technology Department, the Regional Physician Partnership, and the Medical Center administrators for the tripartite entities (Physician Partnership, the Health Plan, the Hospitals). For these reasons, I audio recorded the meetings from the fall of 1993 through 1996. In this dissertation, I do not conduct discourse analysis but rather consider the discussions as background that informs my analysis of patient care activities and how they are imagined to change with future use of the EHR system in the case examples discussed in Chapter IV: Changing Patient Care.

efforts.[43] These are certainly important objects of activity within their respective framings of knowledge representation and physicians' cognition as research foci. However, both are seen as mediating tools (artifacts) when the object of activity is seen as improving patient care.

Neighboring activity systems (Engeström, Y.: 1987) share the joint object to improve patient care while pursuing objects of activity that are prerequisites for achieving the successful creation of a comprehensive EHR system that can contribute to improving patient care. Two neighboring activity systems are referred to throughout my discussion: the Software Company co-developing the EHR system with the HMO and the Information Technology (IT) department of the HMO. Clinician founders and staff of the Software Company share commitments to the joint object of improving patient care. Concurrently, the object of activity for the Software Company is to develop the software engineering of the system's interface (front end), knowledge base and intelligence (structured clinical content knowledge base, logic and rules), architecture (conceptual and working logic) and back end (inner workings on mechanical and substantive levels including, for example capabilities for creating and interacting with clinical data repositories). Within the HMO, the Information Technology (IT) department can be

described as a neighboring activity system as its mission and responsibilities encompass all information systems, clinical and non-clinical, with responsibility to create and manage the interfaces among and between systems and the EHR application(s) designed by the Software Company and other software (for example, third party specialized applications such as medical logic modules). These neighboring activity systems in closest proximity to the EHR Prototype Project give a glimpse of the complexities entailed and the embeddedness of the EHR prototyping within concurrent organizational change and technology efforts. They also contextualize the choices I made and my access to EHR prototyping among many related activities. My focus on patient care work practices is not meant in any way to diminish the importance of the related activities that must be accomplished to create the EHR system. The relationships point to the complexity of the shared object and the coordination required (see, e.g., Campbell: 1997 on controlled medical terminology (CMT) coordination). Nor is there a common language amongst members of the multi-disciplinary and multi-professional teams within and across activity systems that must coordinate their efforts.

I identified the office visit (outpatient encounter) as a unit of analysis for the activity of patient care. As part of the baseline (pre-EHR) field

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[43] See, e.g., the annual proceedings of the American Medical Informatics Association (AMIA)

research, in early 1994 we videotaped twenty-four primary care office visits in order to analyze the work of the patient care team at the point of interactions with the patient and with clinical team members. Video documentation followed the patient's path through these outpatient encounters at three locations: at the nursing station (intake, vital signs, follow-up on orders and the plan of care, explanation, education and / or instructions for the patient), in the exam room (patient-care provider consultation, physical examination, explanation, education and / or instructions for the patient, nursing interventions), and in the physician / physician assistant office (chart review, completion of documentation). At each of these points--nursing station, examining room, office--two cameras were used, one with a wide angle lens for an overall view of interactions and the other set for a close-up view for handwritten documentation and chart review (exam room, office) and / or use of computer-based information systems (pre-EHR on-line information systems accessed at nursing stations and in physician / physician assistant office for appointments, patient chart requests, immunization tracking, lab results). In Chapter IV: Changing Patient Care, I discuss three patient care encounters selected as exemplars for analysis of the complexities of clinical teamwork in the Family Medicine clinic. These are: a seemingly routine

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and the International Medical Informatics Association (IMIA).

pediatric immunization visit; a complex visit involving a new problem presented by a complex patient living with multiple chronic illnesses; and a bi-annual check-up for an older multiple problem patient with a "laundry list."

The videotaped patient visits proved useful as initial windows onto the activity of outpatient patient care. Obviously, it is essential to analyze patient care beyond single encounters in order to design for continuity of care within and between episodes and events, for disease management, and for complex patient trajectories. Graphic representations, data flow diagramming, and patient care business process modeling are used within the HMO to understand comprehensive organizational teamwork and patient care processes.

To summarize: among work practices, I began with a focus on the patient care teamwork required to accomplish patient care in outpatient primary care environments. The initial unit of analysis of patient care activity was the office visit which I regard a *nucleus* for understanding the activity of patient care and the clinical documentation used and created. Within an office visit, the patient's path, patient-care provider interaction, and the activities of nursing staff and the physician or physician assistant were video recorded. As field research for the purposes of the EHR Prototype Project,

analysis of primary care office visits contributed to the team-based philosophy of design for EHR prototyping referred to as *a module point of view for design*. The *module point of view* w, as a metaphor for the *team-based* nature of patient care rather than a physician-centric perspective, was communicated by the HMO to the Software Company as "a cornerstone in the philosophy of design." For my analytic purposes here, discussion of the video exemplars contributes to understanding patient care interactions and collaborative interactive expertise involved in the activity of patient care, the dilemmas that confront care providers, and how clinicians imagine possible futures with EHR use.[44]

From the analysis of these qualitative case examples (exemplars), my aim is to present a concrete contrast between the logic of daily clinical practices and interactions and the inner logic of the EHR system being prototyped. How can the apparent messiness of everyday work practices ever compete with such a beautiful logic as that of the EHR system as it is imagined? What changes in present clinical practices are required to realize the demanding inner logic of this EHR system? Envisioning how the EHR system may change patient care, clinical work practices, and work

[44] The field research for the EHR Prototype Project did not pursue questions of patients' collaboration, nor do I here. This represents a significant limit to my analysis and a focus for future research.

organization is then grounded in a critique of the present contingencies and particularities of clinical practices in relation to the imagination of future scenarios of EHR use and, *vice versa*, a critique of the contingencies and particularities of imagined future scenarios in relation to present patient care interactions and practices.

In Chapter III: Incomplete Utopian Projects, the EHR Prototype Project and its vision are historicized in the organizational context of the HMO and the context of patient care in the United States. The concept of an incomplete utopian project combines envisioning and historicizing as a way to explore sociohistorical context in a dialectical relationship with innovation. It is an open-ended (non-determinist) concept for thinking about dilemmas, argumentation, heterogeneity, and contradictions in the work of technological innovation.

In Chapter IV: Changing Patient Care, I discuss case examples from video documentation of work practices in the clinical use settings for EHR prototyping. In discussing the case examples, I explore the dilemmatic nature of clinical work practices, the interplay of two logics (the logic of patient care and the logic of the EHR system), and the power of the incomplete utopian project of EHR invention as a shared imaginary.

CHAPTER III: INCOMPLETE UTOPIAN PROJECTS

Wander, wander
Onward lightly,
Do that rightly
Flow the torrent,
And with teeming waters yonder
In the bath discharge its current!

See! he's running to the shore,
And has now attain'd the pool,
And with lightning speed once more
Come here, with his bucket full!
Back he then repairs;
See how swells the tide!
How each pail he bears
Straightway is supplied!

To think about innovation-in-the-making in electronic health record (EHR) prototyping, I offer a concept, the *incomplete utopian project*, that is sociohistorical, heterogeneous, and argumentative in structure. The phenomenon I seek to understand and explain involves the prototyping period in the near-present (from 1993 up to the time of writing) of a technological invention (a new clinical information system and infrastructure) for which implementation will occur in a future time horizon (during the next five to fifteen years from the time of writing). An incomplete utopian project is an intermediate conceptual construct to concretely describe the phenomenon of *envisioning* as constructed, evoked, and employed within an innovative intra- and inter-organizational effort, and to open up theorizing about innovation, work practices, and technology.

I have two aims in offering a way to analyze the content of utopian ideas as they are actively constituted in an innovation project such as the EHR Prototype Project. First, to contribute to our appreciation of the complexity of sustaining innovation, defined here as an effort to realize (make real) something that has not existed before. The EHR Prototype Project, as it is constructed by project leaders in the HMO and the Software Company, is such an innovation project. My second purpose is to contribute to theorizing relationships between technological change and work. The narrative accounts we actively construct to make sense of what we are doing and what we are trying to do in the world are important dimensions of shared sense within communities. I am interested in the argumentative structure of making sense of what is happening around us and to us, and what we are doing: what we consider to be new or old, who we imagine ourselves and others to be in unfolding events, the hopes and fears we have, the contradictions we perceive and those we do not or cannot see. There is much to be gained by exploring contested motivations, representations of power relations, organizing principles for new ways of creating and working with new technologies, and contests over how they come into being. This is potentially a vast landscape; my aim for now is to begin by painting a sketch, to take a modest step forward.

The discussion is presented in the following sections:

A. The concept of incomplete utopian projects

B. Abbreviated history of the HMO

C. Dimensions and actors: clinical, technical, managerial

D. The incomplete utopian project of EHR invention

A. The concept of incomplete utopian projects

What do I mean by an *incomplete utopian project*? What are my inspirations for the concept? Why look at technological innovation this way and how does it help to tell the story of this EHR prototyping effort? What does is it mean as an organizing concept for thinking about this case study? What work does it do analytically? How does the intermediate concept of an incomplete utopian project help me to interpret ethnographic data and to link detailed case examples with sociohistorical analyses?

The concept of an incomplete utopian project draws on principles from three areas: (1) philosophical discussion of the concept of the ideal within activity theory (Bakhurst: 1991; Ilyenkov: 1977), the relative autonomy of new representations in the arts and science (Wartofsky: 1979), and tensions between reproduction (systemic durability, hegemony, continuities) and change (development, transformations, emergence of new activities and

artifacts, discontinuities) (Bonavoglia: 1993; Engeström: 1987, 1990, 1991a, 1991c, 1995, 1999; Kuhn: 1970 (1962); Latour: 1991, 1993; Lave: 1988; see also Berger and Piore: 1980; Storper and Walker: 1989); (2) the emphasis on narrative, discursivity, argument, and heterogeneity as they animate the social construction of knowledge and the invention of something new in the world (Billig: 1987; Bruner: 1986, 1990; Haraway: 1989, 1991a; Keller: 1985; Latour: 1987, 1988, 1996; Latour and Woolgar: 1979; Sjöberg: 1994, 1996; Sjöberg and Timpka: 1995; Verran: 1998); and (3) labor process and post-industrial theories, and critiques of management and organizational strategies towards new technologies and work (Adler: 1986, 1993; Agre: 1995; Banta: 1993; Bell: 1976 (1974), 1989; Braverman: 1974; Burawoy: 1979, 1985; Dohse et al.: 1985; Kanigel: 1997; Noble: 1979 (1977), 1984; Shaiken: 1984; 1990, 1996; Taylor: 1967 (1911); Zimbalist: 1979; Zuboff: 1988). Occasionally, I draw on popular utopian and dystopian images and metaphors as images employed by project participants when they talk about the EHR, and / or as narratives and metaphors I perceive as expressing how the EHR is imagined.

Where does the *imaginative power* required to launch and sustain an innovation effort such as the EHR Prototype Project derive from? How are the powers-that-be persuaded to release the necessary resources? To commit, at times seemingly to gamble, organizations and cadres of creative talent to the

high stakes--high cost, high risk, high gains--to create something new, by definition not yet proven? For the development of electronic health records, what contradictory or competing goals are entailed and how are contradictory and heterogeneous desires manifest, worked out, or left unresolved?

I begin by establishing the *incomplete utopian project* concept and the precursors that inspire, inform and motivate it. I then present an abbreviated history of the first HMO and its twin motives of industrial efficiency and social medicine. I schematize three substantive dimensions--clinical, technical, and managerial--that are engaged in this particular EHR effort, as they contribute to the definitions of problems to be solved and breakthroughs to be achieved. The *clinical dimension* includes, for example: changing and co-existing models and modes of patient care (medical, nursing, patient-centered, active patient, and consumer models), and the HMO's pursuit of evidence based medicine (EBM), also known as evidence based practice (EBP). The *technological utopian projects* that comprise the technical dimension combine software and infrastructure design and development (object-oriented programming, client server, networking, open architecture, virtuality) with medical informatics (a strong structured content strategy, standardization and inter-translatability of medical and clinical terminologies, problem lists and problem-oriented notes). The *managerial dimension* includes the scientific

management project that permeates the organizational culture and the organization of work throughout the HMO, the administrative, regulatory, and market benchmarking regimes for quality assurance, performance measurement, and continuous quality improvement, particularly extensions of technologies of accountability (Suchman: 1991) including extensions of quantitative measurement into qualitative areas of clinical work and experience. My summary discussion of the *incomplete utopian project of EHR invention* briefly describes how clinical, technical, and managerial utopian projects inter-animate each other and how heterogeneity, argumentation, and incompleteness characterize this innovation effort.

A few explanatory comments on the terms of the descriptor "incomplete utopian project" are warranted. I treat the expression "utopian" as problematic. To describe a project or quest as utopian is to convey long-standing deeply shared desires simultaneously characterized by their unrealizability and their devotees' tendencies to over-reach reality in their pursuit. My stance towards utopianism is that utopias are not equated with goodness. Utopian and dystopian fictional narratives dramatize the contingent "goodness" of utopias depending on the relationships and perspectives of inhabitants of purportedly utopian states towards dominant desires, values, or ideological commitments. Keeping in mind the multi-

faceted dimensions of an incomplete utopian project is also a way to evaluate my own desires, values, and commitments, or at least to remind myself to do so.

"Project" in the expression "incomplete utopian project" refers to intellectual projects, the construction and persistence of concepts and ideas that are manifest materially (partially) over time. Examples of such generative projects include artificial intelligence (computer science), constructivism (art), the Bauhaus (design), Taylorism and scientific management (managerial regimes), and post-industrialism (e.g., Bell: 1976 (1974), 1989). As for da Vinci's vision of human flight or Babbage's "difference engine," an idea may exist in individual and collective imaginations from generation to generation before it is first materialized pragmatically. Iterative changes and transformative cycles may occur gradually or in qualitative bursts, periods of invention that draw on changing sociohistorical context including development of new artifactual means.

The meanings of "project" as an on-going, evocative, conceptual, and creative project and "project" as pragmatically committed activity by specific teams and networks of actors are necessarily blurred. For a degree of clarity of reference in my discussion, I will refer to the particular innovation effort as the EHR Prototype Project and to the *official vision* of the EHR Prototype

Project as its "vision" or "utopian vision." The substantive clinical, technical, and managerial dimensions of EHR invention are constituents of the *incomplete utopian project of the EHR Prototype Projec*, my problematization of the official vision in order to break up its glossiness and claims to unity by highlighting its heterogeneity and argumentative structure.

In the context of a utopian project, "incompleteness" does not refer only to an assessment of the state of things at a moment in time, nor does it point to something as being "incomplete" rather than "complete." Rather, *incompleteness* is an analytically accurate description of a utopian project whose completeness is not fully realizable as a practical achievement but whose partial realizations--whether as instantiations of an idea or materialized as iteratively developed tools and forms of activity--engage actors in collaborative activities that produce and reproduce its instantiations over time. Interpretation and explanation of phenomena generated by the pursuit of utopian projects--by participants, inventors, analysts--also change over time. My stance is that the state of incompleteness of a utopian project is not only analytically accurate (and usefully so) but also a desirable state. The ideal is realized only in activity, becoming a living reality only in the social interaction of individuals engaged in worldly practices (Ilyenkov: 1977). Rather than conceiving of totalization, the incompleteness of a utopian project

points to its partial realization at any given time. Rather than a smooth ideological unity, incompleteness points to its heterogeneous, argumentative, and contradictory motives and constituents. In other words, following Keller, Haraway, and others, not only are scientific and technological utopian projects incomplete as grounded phenomena and from analytical points of view, but let us hope they remain so.

What do I mean by asserting that incompleteness is a desirable state? Desirable for whom? What work does an incomplete utopian project do for the participating actors? The shared utopian project links heterogeneous actors engaged in diverse efforts by giving their purposes together coherence and momentum. But it does more than that. It carries participants beyond the tasks at hand and beyond the boundaries of present reality; in the case of the EHR Prototype Project, carrying forward the desire to transform and improve patient care. Incompleteness keeps possibilities open and offers hopefulness in the face of difficulties encountered in unprecedented situations so long as possibilities for breakthroughs, change, success are not shut down or precluded. Incompleteness keeps genuine spaces open for the actors and by doing so, allows and encourages actors and allies to keep moving, whether by keeping faith in a plan, by improvising and enlisting new allies and actors, or by inching or lurching ahead together towards an interim semblance of

completion. Incompleteness and heterogeneity are desirable because by their openness they provide opportunities for new and/or different actors, new elements which may be discontinuous from historical precedents, and alternatives that may be oppositional or engage resistance.

Persistence is an important marker: utopian projects outlive any particular attempt at realization, nor is any particular failure sufficient to spell the end of a utopian quest. Persistence of belief--in a concept, a design idea, a theory, or an hypothesis for discovery–is crucially important for sustaining scientific practice and technological invention. "Scientific management" illustrates the persistence and fixedness of powerful commitments in the realm of corporate and organizational management in the United States.

During the summer of 1992, I sat in on the weekly meetings of a medical informatics team developing a decision support system for clinical protocol management for people living with AIDS. I was struck by the way in which members of the design team lived in the future time horizon of the system they were struggling to create. For example, possible future visions of the system's design were presented to a clinician sponsor with the enthusiasm and passion of describing something tangible, accomplished, or so close at hand that its practical accomplishment is within one's grasp. From other ethnographers of computer systems design, I learned that the phenomenon of

computer scientists' imaginatively jumping from the present into the future time horizon during design meetings, talking as though the future is already the present, is common.[45] Indeed, it is a convention of the medical informatics literature that conceptual descriptions are presented in the present tense, suggesting states of development of innovations-in-the-making as more fully realized than is often the case, and blurring the time horizons between the present and the future and the relationships between design concepts and logical models and whether and how the systems are in use. When I joined the EHR Prototype Project in 1993, I was again struck by the phenomenon of project participants talking and imaginatively living in scenarios of multiple future times, as time went on sometimes dramatically leaving the mundane and troublesome present behind or at least mute. As Bødker points out, imagining a future time horizon is characteristic of the prototyping phases of computer systems design and development; it exemplifies the ability to imagine alternative possible futures that characterizes human activity (Bødker: 1991).

The prototyping period is especially open, by definition, to experimentation and discovery. Prototyping requires intense imaginative and exacting analytic work in order to translate between the context of use

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[45] I thank Susan Newman and Kären Wieckert for these early discussions.

and the context of design of the system-in-the-making while both contexts of design and use are moving targets, themselves undergoing changes that may be related to or independent from the iterative prototyping of a new system. From my own experience in the EHR Prototype Project, I can testify to the complexity of holding in mind different time horizons and, respectively, different iterative versions of the software application as they can be imagined from design descriptions. My work and that of my colleagues involved translating critiques of one version into recommendations not only for the next version but for at least one version beyond, while analyzing diverse and changing clinical work practices during baseline (pre-EHR) periods and subsequently during periods of clinical use of successive versions of the EHR prototype. Scores of people were so engaged: the Software Company's product design, engineering, and clinical informatics staffs; the HMO's cadres of business analysts, clinician participants, and project managers in the Physician Partnership and Information Technology Department, care providers using the prototype, EHR Prototype Site Medical Center and Clinic administrators, members of numerous governance and advisory boards, and numerous external consultants. For participants in the EHR Prototype Project, engagement in iterative prototyping required learning new forms of participation and collaboration, in both subtle and explicit ways, and striving

for degrees of reflection on current practices required to build new tools for clinical practice as part of a new clinical information infrastructure. Participants in this distinctive early period of EHR prototyping displayed some degrees of freedom from the usual institutional rules in order to allow for discovery and experimentation.

A.1. Influences and inspirations for the concept

I describe influences and inspirations for the concept below. The concept of incomplete utopian projects expresses my general interests and concerns regarding utopian projects in relation to innovation-in-the-making, technological change, and how we analyze changing work practices. The incomplete utopian project of the EHR Prototype Project is a substantive and analytic construct--an intermediate construct--that selectively represents the sociohistorical context of the case study (to which I turn in Section C below).

Prior to my engagement in this case study of EHR invention, I began an exploration of utopian and dystopian fiction as they bear on the imaginative power that the scientific project of artificial intelligence (AI) has in the public imagination. For this, I reread the classic works of utopian and dystopian fiction and selected recent works, and I focused on the film Blade Runner (along with the novel and film scenario that inform it) as a retelling of the Frankenstein story in the era of artificial intelligence. I employed the

feminist critiques of science as the analytic framework (Bordo: 1987; Haraway: 1989, 1991b; Harding: 1986; Harding and O'Barr: 1987; Keller: 1985; Longino: 1988). Literary, narrative, and theoretical hopes and apprehensions of utopian and dystopian scenarios are important sources for the concept of incomplete utopian projects. I am moved by these critiques of the totalitarian and authoritarian risks of utopian visions if they become practices that are asserted in totalizing theories, regimes, and institutions in their social, political, cultural, organizational, and scientific guises. These readings inspire the spirit of critique of any singularity of knowledge or universal claim to rationality. They underscore the understanding that a utopian project not only looks different from the perspectives of different actors but also that the content of what is considered utopian changes over time.

Wartofsky's realist philosophical analysis helps us to appreciate the longevity of artifactual representations and the socially shared nature of persistence in imagination and invention. Wartofsky suggests that resources of individual and collective imagination have some autonomy, that they are derived from *but are not bounded by* the world "as it is" but also as it is thought of and imagined. Wartofsky argues that human perception, as a mode of action mediated by representation, is distinguished as historical rather than natural, and as activity which fundamentally involves change and variations

in modes of representation. "The activity of imagination is a mode of alternative perceptual praxis." Innovative idealizations combine the old and the new, combining established canons of representations and unprecedented new forms and modes of representation. Because new representational forms in the arts, technology, and science have "off-line" qualities, they become especially important for feedback and for change (Wartofsky: 1979). My proposal regarding incomplete utopian projects and envisioning meets the qualities Wartofsky ascribes to human action or *praxis*: "effectiveness in the world, as a constituent of practical activity (causal efficacy); intentionality (as it is involved in the conscious teleology of human action); and, necessarily, a mode of physical or organic activity… and exhibiting as well the specific features of reflexiveness or internal activity…" (Wartofsky: 1979, p. 196).

To understand innovation projects, we need to understand the resources of imagination brought to bear in the worldly, technical, and practical efforts at hand. I call the intermediate concept to coalesce these dimensions an incomplete utopian project as it is constructed and sustained among project leaders, participants, and recruits. In an incomplete utopian project, histories and visions of the future are lived and imagined in their combinations. My discussion extends analyses of organizational change and envisioning by exploring utopian projects as co-constituents sustaining

innovation. I argue for more explicitly thinking about resources of imagination in the heterogeneous, argumentative, and, at times, oppositional structuring of work life experiences and participation in innovation. In electronic health record invention, clinical, technical, and managerial utopian projects are engaged in shaping meaning and valuation in the course of the project, and in structuring dilemmas and contradictions.

The significance of the concept of an incomplete utopian project is to enable us to see envisioning and historicizing together. Following activity theory, sociohistorical analysis takes the discussion beyond the "vision statement" consciously crafted by a corporation or enterprise. As Peter Miller and his colleagues point out, strategic vision statements are changing, as in the case of Caterpillar, for example, to stretch the future timeframe for change (for commitments of capital investment and calculations of return on investment) and to encourage multiple production models rather than a singularly standardized model.[46] Additional dimensions and aspects of an organization's historical trajectory are important to the constitution of the utopian project whether or not they gain explicit expression in the official vision. The larger historical terrain (sociohistorical context) co-constitutes the

[46] Remarks by Peter Miller in Symposium on the Service Sector, Xerox Palo Alto Research Center, Palo Alto, California, 1997.

specific utopian project; to paraphrase Karl Marx, "History acts behind men's backs."

The concept of an incomplete utopian project combines envisioning and historicizing as a way to explore sociohistorical context in a dialectical relationship with innovation. It is an open-ended (non-determinist) construct for thinking about dilemmas, argument, heterogeneity, and contradictions. It should help us to respond to the question: When and how do utopian visions and dystopian critiques represent extensions or consolidations of the world as it is (continuities), and when do they offer departures (discontinuities) which may transform an activity system and transform the world as we have known it?

Relating the question to work settings and resources of imagination at work, we might ask simply, does it matter what people *imagine* that they are doing? How may we think about the relationships between what people *do* and what they are consciously *trying* to do? Are distinctions between the two meaningful and analytically useful? I have in mind two particular kinds of imaginative resources in relation to work practices and work contexts: (1) utopian projects (ideas, images) motivating technological change, and (2) inventiveness and innovation grounded in experientially based knowledge, sometimes referred to as “tacit” knowledge or “invisible skills.” The latter

represent a crucial, and contested, terrain for managers who seek to reverse the dysfunctional divisions of labor, fragmentation of work, and alienation which are the legacy of Taylorism. Workers / experts themselves are not necessarily conscious of the forms of knowledge they use; skills are not wholly understood or articulated explicitly by expert practitioners (see, e.g., Dreyfus and Dreyfus: 1986). As one example, Scribner and her colleagues identify workers' everyday use of algorithms without the abstract, scientific concept of algorithms. As a scientific concept, MRPII provides a utopian motive which is incompletely realized as a concept and as a practical system yet significantly organizes and structures the orientation of activity (Scribner: 1990).

Schematizing the ideal and material aspects of activity suggests how these dimensions may be experienced consciously (imagined) as separate, despite their dynamic existence as inseparable dualities. The contradictions of a teleological object, and of an activity system, are not self-evident but must be discovered; historical analysis is a means for such discovery (Ilyenkov: 1977, 1982 (1960); Engeström: 1987). In everyday experience, an activity system's contradictions may be masked variously by common sense or ideology (powerfully shared images and norms, socially embedded understandings about the use value and exchange value of activities and

commodities including services) or alienation (separation from the motive and object of an activity as a whole and / or separation from participation as a "subject," a subjective actor). Our imagination of our work, our skills, and how they are valued and recognized are affected powerfully by shared social and cultural ideas, even when these images contradict practical experience. One often hears a worker say, "I'm just a cog in the wheel," when he or she performs work that any analyst will regard as skilled and vitally important. A manager may believe fervently that he or she is acting in the best interests of everyone in the company yet many people will be hurt by those same actions.

Understandings of the reciprocal relationships between practical activity as mediated "on-line" by secondary artifacts (technological systems, tools, skills) and as mediated by "off-line" resources of imagination (reflection on what one is doing, utopian projects) may be variously disjointed, contradictory, or argumentative, in ways which can engender confusion or dialogue. Perhaps this provides another insight into the origins of the "argumentative structure" of common sense and how it is that we hold contrary views at once, as discussed by Billig and colleagues (Billig: 1987; Billig et al.: 1988). I suggest that Billig's concepts can be extended to the dialogue (argument) between practical and ideal activity as it informs the argumentative structure of everyday work experience.

In relation to incomplete utopian projects in general and the EHR Prototype Project in particular, this extension of Billig suggests that various relationships coexist between present practical realities and the imaginative power of shared utopian projects. At best, technological and organizational change projects have a dialogic relationship with present realities that sustains the openness of argument and heterogeneity. But these can also break down into ideological relationships in which important aspects of reality that challenge the envisioned future are overstepped. In the development of computer systems, one way this can occur is when the present is glossed over by jumping into imagined future time horizons; if this occurs, pragmatic realities will assert themselves soon enough in the near present. Or, the phenomenon of reaching for a utopian future may become manifest in ways that foreshadow coercion and / or explicit engagement of struggles between actors and their perspectives.

B. Abbreviated history of the HMO

The substantive content for my analysis of what is considered utopian in the particular EHR development project is drawn from several sources. Historical roots of the EHR Prototype Project vision are found (partially) in ideals expressed by the founders of the HMO. Abbreviated references to

clinicians', managers' and public ideals regarding improving health care and patient care in the United States suggest the broader sociohistorical context for the content of clinical and managerial dimensions and actors of the incomplete utopian project of EHR invention. The design problems the Software Company and the HMO are trying to solve--technical utopian projects--are informed by technical quests in medical informatics, controlled medical and clinical terminologies, object-oriented programming, and information infrastructure building. I turn first to a brief history of the HMO as the organizational context for the EHR Prototype Project, locating the HMO's unique social history within the historical context of health maintenance organizations in the United States health care industry as recounted by Paul Starr in The Social Transformation of American Medicine (Starr: 1982).

The United States has long been alone among Western industrialized nations in lacking a universal health care system; proposals for health care reform have yet to succeed. At the time of writing, the crisis in United States health care has only deepened; as one manifestation, estimates are that 20% to 25% of the population lacks health care coverage. The crisis of health care in the United States and the dramatic rise of the for-profit managed care sector are but two historical developments that create a dramatic juncture in the

history of the HMO in relation to the health care market at large. The transformed situation and roles of HMOs and managed care entities compelled the HMO to shift from relative insularity--being "in a world of its own"--to being open per force to market forces--being "at war in the marketplace."

In 1993, the HMO was the largest health maintenance organization in the United States, with regions in twelve states across the country (two regions in California, one for the north, the other for the south), 28 medical centers with more than 7,400 hospital beds, and 255 additional locations for outpatient care (clinics and medical offices). By 1990, the HMO's total assets were estimated at $4.9 billion. In 1994, the company reported $11.9 billion in total revenues. According to its official Facts Book for 1994-1995, the HMO had more than 6.6 million patients (members) enrolled in its Health Plan, more than 9,000 physicians (57% in primary care), and nearly 75,000 non-physician employees (clinical and non-clinical staff).[47] The Southern California region employed more than 2,725 physicians in its Physician Partnership with a non-physician workforce of more than 21,000 clinical and non-clinical staff. At the time of writing, the HMO estimates its national

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[47] All employment figures in the official facts book are calculated as FTEs, full time equivalents. In other words, these workforce numbers do not represent significant numbers of *per diem* physicians, on-call, and / or part-time employees.

enrolled membership to be approximately nine million patients. Its home base is in California, where approximately seven million patient members reside. In some California communities, the HMO is the health care provider for one in three "covered lives"; receiving health care from the HMO is "a way of life" for multiple generations of many families. Since the 1940s and 1950s, working for the HMO is a multi-generational way of life for many of its employees and their extended families. The HMO's employees are also patient members.

It is my sense that the HMO's social contract with its workforce was "old-fashioned" in the context of the aggressively "lean and mean" organizational strategies of United States corporations in the 1990s and unusual in the context of the competitive and largely non-union service sector; it is closer to that of unionized industry sectors or unionized public service employment. The company's employee benefits package is extraordinarily complete and there is a high degree of job security among the general workforce. In some important ways, the social contract between the HMO and its employees has more in common with industrial relations models outside the United States health care sector than with its competitors in the private health care market.

Job tenure (seniority) is long among many categories of staff throughout the organization. Many of the clinical and non-clinical staff with whom I worked had worked for the HMO for more than ten years, several for more than twenty years. It was not uncommon that a middle manager has worked for the company all of his or her professional life. Registered nurses have long tenure and they also must have had a significant number of years of nursing experience before they are qualified to be hired by the HMO. A figure frequently circulated was that reportedly fifteen percent of the HMO's registered nurses earn more than $100,000 a year, given frequent overtime hours combined with the union differential which can be as high as twenty-five percent higher than salaries paid by non-unionized competitors.

Working relationships between members of patient care teams are often long-standing, involving a great deal of implicit (unwritten) shared knowledge and close knowledge of individuals' working styles, particularly variations in individual physicians' styles of interaction with patients and staff, and their work practice preferences and work habits. The HMO is strongly committed to the development of its internal labor market through policies of internal promotion and on-going in-service education and training. From its early years, the HMO's administrative physicians preferred training their own clinical staff (Regional Oral History Project). When it began, the

HMO was unique as a comprehensive, prepaid, group practice program. Because it had such a different organizational model, the tendency from the beginning its early years was to train and promote personnel from within. "We learned very early from [the founding industrialist] to train and develop from within. As soon as you moved up and became a department chief, you brought up an assistant chief. If you became physician-in-chief, then you'd bring up a department chief. [The founding physician] would tell us that this is the way the [industrial] organization worked, you've got to train you own people all along the way. We had a whole hierarchy, so as soon as you moved up the ladder, somebody had been trained to take your place" (Regional Oral History Project).

The period during which I worked in the EHR Prototype Project, 1993-1998, coincided with an increasingly competitive market period during which certain of these long-standing relationships began to change. Until 1993, the HMO's employees in the Southern California region had never experienced involuntary lay-offs; approximately 1,200 positions were terminated during 1993. In an orientation session for the EHR Prototype Project research team, we were advised that organizational sensitivities were high: "Everyone knows someone or knows of someone who has been laid off."

In 1995, as part of a series of interrelated corporate restructuring efforts, the organizational structure was condensed from twelve to five regions. In 1997, the HMO posted a significant net loss for the first time in its fifty years of existence, from which it had not recovered at the time of writing. Deficits incurred in its operating budget do not signal the end of this health care giant's existence, given the company's substantial capital assets, but they may, ultimately, herald the eventual end of the HMO's non-profit status given the highly competitive market environment for managed care, and the greater influence financial institutions may exert.

In the early 1990s, it was estimated that the HMO "will end the twentieth century with about a $10 billion capital spending plan in California" (Hendricks: 1993, p. 2). A widely circulated rule of thumb by the accounting firm Deloitte and Touche advised health care organizations that they should increase their commitments to clinical information infrastructure development from three percent to ten percent of capital expenditures. By 1998, the anticipated investment in building a comprehensive national clinical information infrastructure, including the development of an electronic health record system for clinical documentation, was estimated by the HMO's CEO at $1.2 billion. It is certainly likely to approach $2 billion or more.

One consequence of the national clinical information infrastructure building efforts is that numerous new staff and consultants were hired in order to expand the Information Technology Department's skill set, in other words to have the human capabilities necessary for new technical elements and integration associated with developing, implementing, and maintaining client server based, internally and externally networked, object-oriented applications, systems, and interfaces, and establishing advanced communication media and technical protocols in a mixed open architecture environment. To give a sense of the scale involved, as of the fall of 1998, approximately 650 staff were devoted to national clinical information systems efforts; the figure does not include Information Technology staff responsible for related non-clinical systems. The national clinical information systems efforts were restructured twice between 1996 and 1998. In late 1998, a reduction in force—from 650 to 400--was announced, and a third organizational restructuring plan was set in motion.

The HMO regards the development of its national clinical information infrastructure as a business necessity for its survival in the changing health care market, as a means and rationale for internal integration of what has been until recently a looser federation of relatively autonomous regions, and as a strategic advantage--the ability to offer integration into the health care sector's

lanes on the national information highway–either for acquisition of or partnership with non-profit health care institutions that find themselves isolated in a sea of for-profit competitors, or for building alliances with external institutional partners and networks of physicians and other specialized care providers. While such a statement of purpose for investing in clinical information infrastructure building is a “given” or a commonplace to the HMO's senior managers and administrators, strategic planners, and clinician advocates for the EHR Prototype Project and the national clinical information systems efforts overall, staff in the clinics and hospitals may ask how capital expenditures for technology fit in with budget tightening affecting their daily work lives. The questions have an echo of recurrence. In the HMO's history, decisions to expand facilities in order to reach into new markets were hotly contested. Physician leaders in the Physician Partnership challenged the founding industrialist’s administrators over priorities regarding the timing and degree to which investments should be committed to existing clinical facilities or to new facilities to extend the health plan's market reach. The role of the Physician Partnership in co-managing clinical practices in new areas was central to the controversies, in other words whether the tri-partite organizational model in which the Physician Partnership groups participated in co-management of the health plan would be extended into

new markets. The pivotal period of argument is known as the Tahoe period, named after a summit meeting held at Lake Tahoe (Hendricks: 1993; Regional Oral History Project). The Tahoe period resurfaced as a point of reference among senior physicians and those familiar with the contentious history between the Physician Partnership and the founding industrialist's Health Plan administrators when, in 1996, Health Plan administrators (on the advice of a multinational consulting group) unilaterally launched a statewide restructuring plan in California, without the agreement of the Physician Partnership. At the time, the organization had ambitious plans for national expansion that left open a number of questions regarding the role of physicians in decision-making about new alliances with physician networks and health care entities external to the HMO, about the exclusivity agreements between the Physician Partnership physicians and the Health Plan within current areas of service, and whether and how the model that the HMO represents would be extended and assured in practice in new market areas. New clinical information technologies and networked communication technologies are centrally implicated in these questions. In the changed context of the 1990s, the exclusivity agreement with the Physician Partnership physicians is an asset that the physicians do not want undone whereas Health Plan managers are interested in contracting with additional external networks

of physicians and external institutional partners. "It's like Tahoe all over again," a senior physician chided the regional Medical Director regarding the heightened tensions between the Health Plan and the Physician Partnership. "You see, we're acting more like a union of physicians now."

B.1. Historicizing the HMO

In this section, I present an abbreviated history of the HMO in the case study in which I have interpreted certain aspects of the HMO's social history as constitutive for the incomplete utopian project of the EHR Prototype Project. I draw primarily from two histories: The Social Transformation of American Medicine by Paul Starr (Starr: 1982), and A Model for National Health Care: The History of Kaiser Permanente by Rickey L. Hendricks (Hendricks: 1993, see also Hendricks: 1987). Starr's history of American medicine provides the broader sociohistorical context for the HMO model within the unique structure of health care in the United States. Hendricks analyzed the HMO founders' papers, and oral history interviews with the founding physicians and administrators (Regional Oral History Project).

The United States has eschewed socialized medicine and reform efforts to ensure universal health care coverage to all residents. Although the early model of a non-profit health maintenance organization represented by the HMO may be conceived as "socialized medicine in one company," the

analogy is ironic given that socialized medicine was antithetical to the HMO's founding industrialist (Hendricks: 1993). In the history of social medicine in the United States, the trade union movement was never united in support of socialized medicine; instead, the trade unions held conflicting stances towards socialized medicine and the role of the state in health care (Starr: 1982). Among the original HMOs, Starr characterizes the HMO Health Plan as representing a "corporate capitalist" model in contrast to the "cooperative" model represented by Group Health Cooperative.

Hendricks regards the HMO as a potential national model for health care in the United States in the future. HMOs represent a compromise regarding health care delivery unique to United States health care. Hendricks writes:

> As a free enterprise alternative to national health insurance and socialized medicine perpetually rejected by the nation's policy makers, [the HMO] was a prototype for health care reform within the limits of United States politics and liberal economics, a masterpiece of ideological ambiguity and political consensus (Hendricks: 1993, p. 2).

Hendricks provides a biographical history of the HMO, told as the merger of the genius for industrial efficiency of its founding industrial magnate and the vision of social medicine of its founding physician. The HMO's founding industrialist is described as "a brilliant industrialist able to reduce societal as well as technological problems to their most basic

mechanical elements." Hendricks identifies the industrial founder's "entrepreneurial dedication and genius" as "the seed from which all that followed germinated." The founding physician's "professional idealism and practical ability," together with the leadership of carefully selected physician leaders, "contributed [the HMO's] essential human elements of quality care, and collegial coordination and professional commitment" (Hendricks: 1987, pp. 638-639). Hendricks emphasizes the social medicine ideals of the founding visionary physician and the core group of founding physicians.

> Without its humanistic and idealistic components, the legacy of the first decades of [the HMO's] development would be only the economically efficient assembly-line system of which Program detractors have warned for half a century. ... It is questionable whether the elusive melding of skills held by [the founding industrialist] and [the founding physician] can be duplicated by the founders of other plans. American society continues to prefer individualism and a highly personalized doctor-patient relationship in medical care. Facilities and industrially efficient organization are not enough to attract consumers (Hendricks: 1987, p. 641).

Physicians I met in the HMO described themselves as more likely to be "socially conscious" than doctors in general. The first few Physician Partnership physicians I met in early 1993 were quick to identify themselves as favoring "socialized medicine." I was told, by way of introduction, that "What you need to understand is that [the HMO] is socialistic," and "You see, we're socialistic here."

The two motives that Hendricks describes--industrial efficiency and social medicine–combine and conflict from the HMO's inception onward. These twin motives infuse the activity system of patient care in the HMO with considerable tension. They represent the contradictions between the commodity forms and social use values of patient care and how these manifest as dilemmas in the activity of patient care. How then will electronic health records weigh into historically rooted tensions between the two motives of social medicine and industrial efficiency?

The HMO's Medical Care Program was founded in 1938 by an industrial magnate (hereafter referred to as the HMO's founding industrialist), founder of a group of industrial companies that carried out construction of the dams in the West, shipbuilding during World War II, and production of aluminum and steel, and a visionary physician (hereafter referred to as the HMO's founding physician). The HMO was shaped by three functional principles during its formative years from the 1930s through the 1950s: pre-payment through its own Health Plans, group practice in the Physician Partnership groups, and complete facilities supported by its Hospital Administration (Hendricks: 1987, 1993; Smillie, J. G.: 1991). At the time, both group practice and prepayment were controversial. The HMO continues to have a tripartite organizational structure along these lines. The most

important feature is co-management of the company by the physicians who are represented by the Physician Partnership groups in each of the HMO's region.

Writing about Kaiser Permanente, Hendricks (1987, 1993) suggests that for physicians, an HMO may be attractive because it affords them relatively normal working hours and work weeks once they become "partners" in the Physician Partnership. On the other hand, for the security, predictability, and normalization of working life, physicians have made significant trade-off's: "loss of control and autonomy in scheduling and management, the necessity to 'practice in a goldfish bowl' and be subjected to constant peer and director review, the necessity to treat 'bureaucratic clients' perhaps not of the doctor's choosing, and less income than might be gained in private practice, especially by specialists" (Hendricks: 1987, pp. 629-630). Until recently, Kaiser Permanente doctors were often subjected to "pariah status" in the larger medical professional community. Hendricks described the worst period of Kaiser Permanente's pariah status as a period as "medical McCarthyism." By the early 1990s, however, the HMO administrators and doctors with whom I worked believed that they were positioned as a model for "managed competition." The rise of managed care entities and the dominance of corporate medicine (Starr: 1992) were perceived as limiting

physicians' options for traditional independent clinical practice. The HMO model of salaried employment, group practice, and organizationally structured work organization joined the mainstream of medical practice, no longer a marginal alternative.

A 1967 federal study pointed to Kaiser Permanente's "industrial orientation" as a defining characteristic. The National Advisory Commission on Health Manpower commended Kaiser Permanente for its achievements along these lines:

> [I]ntroduction of large-scale, industrial, management capabilities and techniques into the health care system... Coordination of professional and nonprofessional manpower, extensive physical facilities and large amounts of consumable material to serve patients with needs for health care... [and] conduct of the entire enterprise in an economically self-sustaining manner that generates enough income to permit amortization of large-scale commercial loans, replacement of facilities, and an average growth of 10 percent per year [in the middle 1960s]" (National Advisory Commission on Health Manpower cited by Hendricks: 1987, p. 638).

The term "HMO" was coined in 1970 as a "conceptual" step towards the federal HMO Act of 1973 which legitimized prepaid corporate health plans such as that of the HMO. When he coined the term "health maintenance organization," Paul Ellwood, physician director of the American Rehabilitation Foundation envisioned a "health maintenance industry that is largely self-regulating" (Starr: 1982, p. 395). Self-regulation is an ideal of

physicians in individual practice as well as health care companies, but one that was quickly superseded by regulatory activism regarding cost-containment and quality assurance, the rise of the patients' rights movements, and the activism of employer coalitions in devising benchmarking measures. During the same period, for-profit entities adopt—and adapt—many of the managerial and administrative (self-regulatory) mechanisms of the original non-profit models of HMOs. Taken together, Starr translates these into his working concept of *corporate medicine* which I will discuss in relation to the emerging *managed care package* for which clinical information systems such as the EHR system-in-the-making provide infrastructure and new tools.

In Starr's historical analysis, the handful of early non-profit HMOs represent "a rational model" within the United States health care industry. In the climate of skyrocketing hospital costs, the HMO gained the attention of policy-makers when, in 1977, the HMO reported a hospital utilization rate of 349 hospital days compared to the national average of 1,149 per 1,000 people. "The record of [the HMO's Hospital Administration] suggested it was possible to provide high quality prepaid health care at 20 to 40 percent lower cost than fee-for-service medicine" (Starr: 1982, p. 383).

When they were established in the 1950s, prepaid health plans were a peripheral development, an alternative at the margins of the health care

system. As late as 1979, only four percent of the United States population received care from HMOs. Governmental projections at the time estimated that HMO enrollment would remain less than ten percent by 1990 (Starr: 1982, p. 415). Instead, HMOs proliferated from 33 in 1970 to more than 650 in 1987, and the number of people receiving care from HMOs increased from approximately seven million in 1975 to more than fifty-five million by 1995. Federal and state policies in the 1970s and early 1980s laid the basis for the growth of HMOs and for-profit managed care; these policies, promulgated in an anti-regulatory political climate, were meant to promote market competition as a means to rationalize health care costs. In the mid-1980s, this segment of the health care market expanded rapidly, particularly with the entry and formation of for-profit managed care entities. "In the decade between 1985 and 1995, HMO enrollment nationally nearly tripled from a low base of about 20 million to nearly 60 million" (Institute for the Future: 1997, p. 71). In California, it is estimated that 40% of the state's residents receive health care from HMOs, the primary organizational model of managed care. In 1990, the HMO's patient membership represented 65% of California residents enrolled in HMOs. However, HMOs represent only one segment (a 30-35% share) of the expanding managed care market that includes independent practice associations (IPAs), preferred provider organizations (PPO), and

point of service (POS) networks (Institute for the Future: 1997, p. 94). Once private insurers are allowed entry into health care delivery, the highly competitive and volatile market includes managed care entities that are health care and insurance conglomerates, such as Aetna Life and Casualty, that challenge the HMO's scale and capitalization. The changes in the HMO and managed care market affect the HMO's management profoundly. For the first time in its history, the HMO moves to contract with non-Physician Partnership physicians and non-Hospital Administration hospitals.

> The partnering with Alta Bates [for women's health care services including labor and delivery] represented the first time [the HMO] had ever relinquished control over the hospitalization of its patients, an historic shift for the organization that pioneered the closed-group, fully integrated system of health care delivery" (Institute for the Future: 1997, p. 98).

In the 1990s, the HMO found itself at an historic juncture in a much changed health care marketplace, in effect having lost control over the model it initiated half a century earlier. At this crossroads, shifting from relative insularity to openness to market forces, the HMO is both subject to and open to the larger health care market in new ways. Thus my characterization of the HMO's transformation from pariah to model to losing control over the HMO model when it is coopted by political conservatives and generalized in the health care market by for-profit corporations.

The HMO offered a model for health care reform, during the optimistic period of the 1970s, that is appropriated by conservatives in the 1970s to become a prototype for managed care and corporate medicine. Whereas for-profit corporations were "antithetical to the traditional advocates of prepaid group practice," for-profit entities were welcomed by the Nixon administration. "The conservative appropriation of liberal reform in the early seventies opened up HMOs as a field for business investment. ... Pressure for efficient, businesslike management of health care has also contributed to the collapse of the barriers that traditionally prevented corporate control of health services" (Starr: 1982, p. 428).

> Prepaid group practice was originally associated with the cooperative movement and dismissed as a utopian, slightly subversive idea. The conservative, cost-minded critics of medical care had now adopted it as a more efficient form of management. They had substituted a rhetoric of rationalization and competition for the older rhetoric of cooperation and mutual protection. The socialized medicine of one era had become the corporate reform of the next (Starr: 1982, p. 396).

The first three large prepaid plans—the HMO in California, Health Insurance Plan (HIP) of New York, and Group Health Cooperative in the Pacific Northwest--began with different relationships with physicians and radically different modes of organizational governance (Starr: 1982, pp. 326-327). Of the three, Starr characterizes the HMO as "corporate capitalism" and points out that the HMO did not give its subscribers any role in governing the

plan.[48] Whereas Group Health Cooperative established the relationship with physicians as that of employees, HIP physicians contracted their services with the independent medical group practices of physicians who were free to have both fee-for-service and prepaid patients. The HMO's Health Plan contracted with physicians through the Physician Partnership groups, in a manner similar to HIP but with an important difference, the exclusive relationship of the HMO's physicians with the Health Plan. "... [The HMO's] doctors could not see their own private patients and did not have title to the facilities." The exclusivity agreement can be seen as a trade-off in exchange for the degree of co-management the physicians have. In Starr's estimation, although the Physician Partnership physicians "enjoyed some collective autonomy in judging each others' performance and determining salaries and promotions, they were not as independent in their command over resources as were HIP's physicians" (Starr: 1982, p. 326).

A physician boycott in 1948 indicates that conflicts over clinical decision-making between physicians and health plan managers are not entirely new. In 1948, approximately 1,000 San Francisco physicians who were participants in a service-benefit plan for city employees (originated in

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[48] It is not clear whether Starr is referring to employers or patient members when he refers to the HMO's "subscribers." Until the 1990s, patient enrollment in the HMO was solely mediated by employers; it is only recently that an individual can enroll directly, as an individual, outside a contractual relationship between one's employer and the HMO.

1938) boycotted the plan *en masse*, challenging a requirement that a physician must consult the plan's director before hospitalizing a patient (additional issues included dissatisfaction with the plan's fees and discomfort with being associated with "compulsory insurance" (Starr: 1982, p. 323). All but ninety physicians resigned from the plan. Starr contrasts these early conflicts with the "environment of constraints" and associated managerial control strategies that direct service, group practice health plans can create and exert.

> ... [D]irect service, group practice plans have broader, more effective, and less intrusive means of influencing physicians than do service-benefit plans. ... The San Francisco program was plunged into crisis when it tried to limit professional sovereignty (that is, to review doctors' decisions about hospitalization). The group practice plans, on the other hand, can create an environment of constraints, such as a fixed supply of hospital beds, which are then taken as given in day-to-day medical decision making. The plans can also provide incentives to encourage the physicians to identify with the organization's needs and participate in keeping down its costs. [The HMO] and other prepaid plans have had relatively low rates of hospitalization, in part because they can influence their staff without compromising the physicians' sense of their own authority and autonomy (Starr: 1982, p. 326).

Within the HMO's day-to-day culture and discourse, the people I worked with distinguish its character as a *health maintenance* organization from the *managed care* entities that now dominate the health care marketplace in the United States. The HMO is distinguished from most managed care

organizations in significant ways. First, the HMO's Health Plan is credited with originating the model for health maintenance organizations that has since been appropriated (partially) and distorted by for-profit managed care corporations. The Physician Partnership in co-management of the company positions the HMO's physicians differently than physicians in most managed care corporations.

Second, the HMO was founded as and remains a non-profit corporation (a non-profit trust), distinguishing it from its for-profit managed care competitors. Two notes on the HMO's non-profit status are warranted. Within the tri-partite governance of the HMO, the Health Plan and the Hospital Administration are non-profit entities while the Physician Partnership groups are constituted as for-profit entities. This does not change the overall non-profit status of the company. Of greater significance are challenges to the HMO's non-profit status raised in the early 1990s, pointing to the company's expansionist behavior, underwriting expansion into new regional markets with revenues earned from its base in California. Although a non-profit corporation, the HMO earned net revenues of approximately $800 million in 1992, the year before I began the field research, and would have been among the top 100 corporations in the Fortune 500 if the

company were a for-profit entity and if its federation of regions were consolidated into a single corporate entity.

A third importance difference between the HMO and its competitors is that the HMO is unionized, a rarity among private sector health care organizations and even more rare among its direct competitors in the HMO and managed care market segment. The HMO's workforce is significantly unionized and a significant base of its patient population are employees of large unionized private sector companies and public sector organizations. Two additional points underscore the importance of the HMO's unusual relationship with unions during its formative years, and during the 1990s, as it navigates the volatile health care market transformed by for-profit managed care. Historically, the HMO owes its contested emergence from the group of industries established by its founding industrialist (steel, aluminum, shipbuilding, the Western dams) into the general consumer market during the post-war period to the support of the unions in large unionized companies in aerospace, longshore, heavy industry, and retail sectors, and in public services, notably the teachers union and California state employees. Turning to 1997, the HMO, the AFL-CIO and fourteen health care unions negotiated a labor-management accord regarding new unionizing efforts within the HMO as the company pursues expansion. The labor-management accord is an

acknowledgment by the unions of the model for health care that the HMO represents.

The health care plan began as a necessary service for workers employed by the group of companies run by the founding industrialist to work in large scale public works projects such as the dams in the West, and shipbuilding for the United States Navy during World War II. On-site or close-by health care services were necessitated by accidents, injuries, prevention of the spread of infectious diseases, and "health maintenance" in isolated work settings in the case of the first dam project in the desert, and accelerated wartime production in the case of the shipyards in northern and southern California, and associated facilities such as the company's steel mill

Table III.1: Historical Periods: Pariah to Model

1938-1940s	1950s-1960s	1970s	1980s	1990s
• The Health Plan is founded for employees in the founding industrialist's companies. • Health care is extended to workers' dependents by 1968.	• Post World War II, the HMO enters into the public health care market. • Period of "medical McCarthyism" ensues. • 2 million patients in the Health Plan by the end of the 1960s.	• HMO Act. • HMO term coined. • The HMO has 6 regions (federally qualified). • 4 million patients in the Health Plan by 1981.	• Period of corporate medicine. • The HMO has 12 regions. • 6.5 million patients in the Health Plan by 1990. • Rapid rise of managed care sector.	• Generalized mangaed care package. • 65% of California's HMO patients are enrolled in the HMO Health Plan (1990). • 9 million patients nationally estimated by the HMO (1997).

Sources: Hendricks (1987, 1993); Facts Book 1994-1995.

in southern California. Health care services were then extended to workers' family members, thus establishing principles of family medicine along with the integration of occupational medicine with health maintenance. In addition to the integration of occupational medicine, health maintenance, and family medicine, the founding physicians brought a strong orientation towards preventive care based on both medical (public health, social medicine) and economic (cost benefit) grounds and an epidemiological orientation supported by the size and relative cohesiveness of particular working populations experiencing similar environmental and occupational exposures and living conditions.

After the war, in the 1950's, the decision was made to extend the HMO's Health Plan from its base within the founding industrialist's group of companies into the general public and health care market. The political climate of the 1950's and the structure of the United States medical community at the time were such that the HMO was met with severe opposition by the American Medical Association (AMA), the professional association for physicians. Hendricks describes this period as one of "medical McCarthyism." During this period, the HMO is not only criticized for practicing "industrial medicine," and its physicians criticized by implication as "company doctors"--they are also accused of being "socialistic" or even "communistic" and for allegedly proselytizing "socialized medicine."

According to Starr, the HMO and HIP, as the first large HMOs, "aroused deep anxiety among private practitioners in California and New York [respectively]" (Starr: 1982, p. 324). AMA leaflets warned patients: "Retain your family doctor," "Don't be a captive patient." AMA chapters in Northern California sought to sanction a number of the HMO's leading physicians for "unethical" behavior; the HMO's physician founder was suspended from the AMA. A handful of Physician Partnership physicians were accused publicly or through whispering campaigns of being members of the Communist Party. Fundamentally, this was a struggle over entry into the health care market of a large scale prepaid group practice and preventive care model in a context in which the model for patient care was that of a personal one-to-one relationship with a family physician in private fee-for-service practice. The period that Hendricks characterizes as medical McCarthyism ended officially in 1955 when the release of a report of an AMA committee, known as the Larson report, "ended official sponsorship of reprisals against prepaid group practice." The committee found "no evidence of any lay interference in medical decisions in [the HMO] or other prepaid plans, and it indicated that free choice of medical plan was an acceptable substitute for free choice of physician" (Starr: 1982, p. 327). Starr notes that attacks on Physician Partnership physicians by local AMA chapters persisted unofficially for many years. Early unease and allegations persist to this day in more diffuse

perceptions of HMOs as "assembly line medicine" and the caricature of the HMO as "the K-Mart" of the health care industry.

In 1936-1937, a Committee of Physicians for the Improvement of Medicine issued a statement of "Principles and Proposals" signed by over 400 physicians whom Starr characterizes as liberal academic physicians. Although the proposals of the Committee for Physicians were not adopted, they represent dissent from the AMA and they foreshadow reform issues with which the AMA must come to terms in the years to come.

> ... [T]he group recognized that health was a 'direct concern of the government' and called for the formulation of a national health policy. They urged that public funds be used to finance medical education and research; laboratory, diagnostic, and consultative services in hospitals; preventive and public health work; and medical care for the 'medically indigent.' By no means a radical organization, the committee did not declare in favor of compulsive health insurance, though some who signed the committee's statement supported it. The distinguishing feature of the group's position was its emphasis on education, research, group practice, and hospitals in contrast to the AMA's celebration of the individual practitioner (Starr: 1982, p. 274).

Among the active participants and spokespersons for the Committee of Physicians, about which Starr writes, was John Peters of the Yale School of Medicine Peters trained a number of physicians who joined the HMO in its early years. The same physician was the father and grandfather of a father and son pair among the physician founders of the Software Company. From the beginning, I was told that the HMO was a desired health care

organization, an intended client and partner for the Software Company's electronic health record development because of its social history and the model it represents.

The HMO was able to enter the general health care market through contracts with large unionized employers in aerospace and other industrial enterprises, unions and associations of public employees, and unionized retail clerks. For example, it is the Los Angeles-based local of the Retail Clerks Union with 22,000 members, one of the largest union locals of supermarket and associated clerks in the United States, that is decisive for the HMO Health Plan's foothold in Southern California beyond the founding industrialist's inland steel mill (represented by the United Steel Workers of America) and the greater Los Angeles harbor and shipyards (represented by the International Longshoremen and Warehousemen's Union). The unions' advocacy of a health care provider with a successful track record of providing integrated care to union workers and their families made it possible for the HMO Health Plan to continue in the post-war period, and to expand within Northern and Southern California and the Pacific Northwest, and to Hawaii (1958). From the late 1960s to the mid-1980s, the HMO establishes regions in nine additional states and Washington, D.C.

Since the early to mid-1980s, the health care industry has undergone considerable change in market structure, and in employment structures and

relationships as a consequence of changing organizational forms and market structure. The managed care sector of the health care industry expanded dramatically from the mid-1980s into the 1990s (see Table III.2). The shift

Table III.2: Health Care Market Changes: Growth of HMOs

1929--1950s	1970s	1980-85	1985-1990s
• First HMOs established: Ross-Loos, Kaiser Permanente, FHP, HIP, Group Health Cooperative.	• HMO Act. • HMO term coined. • 4% of U.S. population in HMOs by 1979.	• Patients in HMOs rise from 10 million (1982) to 20 million (1985). • Rise of for-profit managed care begins.	• 60 million patients in U.S. are in HMOs. • 40% of California residents are in HMOs (1990s). • Managed care predicted to comprise 75% of U.S. health plans by 2000.

Sources: Institute for the Future (1997); Starr (1982).

among physicians towards employment in salaried positions is related both to the influx of women physicians in recent decades and to the rise of managed care entities. Union activity and other forms of self-organization among physicians are responses to managed care impinging on clinical decision-making and professional autonomy in patient-physician relationships (see, e.g., Greenhouse: 1999).

The rise of managed care, particularly for-profit managed care, as a percentage of market share is important but the rise of *managed care practices* is of greater significance than the role of managed care as a fast-growing segment of health care delivery. Writing in the early 1980s, Starr emphasized the permeation of the ideas and practices of *corporate medicine*. Starr pointed to "the rise of a corporate ethos in medical care" (Starr: 1982, p. 448) that includes a pervasive "marketing mentality." By the early 1980s, physicians were "no longer steadfastly opposed to the growth of corporate medicine" (Starr: 1982, p. 445). He defines "the growth of corporate medicine" in the United States broadly: "... the change goes beyond the increased penetration of profit-making firms directly into medical services. By the growth of corporate medicine, I refer also to changes in the organization and behavior of nonprofit hospitals and a general movement throughout the health care industry toward higher levels of integrated control" (Starr: 1982, p. 429). The pervasive introduction of standardized management procedures and administrative

rules governing decisions challenges physicians' authority and the autonomy of clinical judgment. "Perhaps the most subtle loss of autonomy for the profession will take place because of increasing corporate influence over the rules and standards of medical work. Corporate management is already thinking about the different techniques for modifying the behavior of physicians, getting them to accept management's outlook and integrate it into their everyday work" (Starr: 1982, pp. 447-448). We might think of managed care as a *package* of concepts and techniques (following Fujimura: 1997) in order to understand its far-reaching influence. Managed care practices have been introduced into non-profit sectors such as the United States military theater's health care services (Katzenberg: 1997) and primary care clinics in Sweden (Sjöberg: 1996), to give two examples of extensions of an emerging *managed care package* of practices and technologies.

Starr asks why, historically, physicians succeeded in eluding hierarchical subordination when other groups were brought under controls. He suggests that the logic of physicians' relationships with health care institutions and, importantly, with patients, differs from the industrial logic of relationships between factory workers and industrial employers. "In the twentieth century, medicine has been the heroic exception that sustained the waning tradition of independent professionalism" (Starr: 1982, p. 420).

> The physician had a resource that the ordinary worker lacked. Patients develop a personal relation with their physicians even when medical care takes place in a hospital or clinic. In this respect, hospitals and clinics are fundamentally unlike factories. The doctor's cultural authority and strategic position in the production of medical care create a distinctive base of power. If, as often happened in group practice, the doctor threatened to leave, he might take his patients with him (Starr: 1982, p. 217).

The claim to intimate, private, on-going relationships between doctors and patients and families was a powerful argument against state intervention in the conduct of patient care and medicine. That medical research requires autonomy as a condition for scientific inquiry was another. "These various elements were now combined to constitute a powerful case that public aid should not bring public control" (Starr: 1982, p. 351). But reliance on the self-regulation of the medical profession and health care institutions will give way, first to oversight measures and controls in the name of cost-containment, and subsequently to a combination of governmental regulatory measures for quality assurance, patient care standards, and patients rights, and market-driven performance measurement and quality of care evaluation through benchmarking criteria and periodic surveys developed by consortia of employers, and consulting entities that conduct quality assurance evaluations for government and industry.

The emergence of corporate medical enterprises and the practices of corporate medicine in the late 1970s and early 1980s "jeopardize the

profession's control of markets, organizations, and standards of judgment" (Starr: 1982, p. 421). Because health care institutions will always "require the active cooperation of physicians," doctors are not likely to become "proletarianized." However, corporate medicine heralds "a profound loss of autonomy" compared with individual practice. Starr predicted that: “There will be more regulation of the pace and routines of work. And the corporation is likely to require some standard of performance, whether measured in revenues generated or patients treated per hour" (Starr: 1982, p. 446). Writing at the beginning of the 1980s, Starr argued that physicians' loss of control over the organizational forms and decision-making of patient care and clinical work will have ramifications throughout the health care system, intensifying the fault lines of its contradictions. "The prospect is not simply for the weakening of professional sovereignty, but for greater disunity, inequality, and conflict throughout the entire health care system" (Starr: 1982, p. 421). Relationships between physicians and health care institutions are important for the contested boundary between medical and business decisions. In this regard, Starr points to the degree of collective autonomy that the physicians in the HMO’s Physician Partnership exercise.

> New distinctions will need to be made among owning, managing, employed, and independent physicians. ... If the managers are accountable to doctors organized in medical groups, the profession may be able to achieve some collective autonomy within the framework of the corporation (as they do in [the HMO]). Another key issue will be the boundary between

> medical and business decisions: when both medical and economic considerations are relevant, which will prevail and who will decide? Much will depend on the external forces driving the organization. Thus far, conflict has been muted by affluence. A regime of medical austerity will test the limits of professional autonomy in the corporate system (Starr: 1982, p. 447).

C. Dimensions and actors: clinical, technical, managerial

Above, I have introduced the general concept of incomplete utopian projects. In the following discussion of clinical, technical, and managerial dimensions and actors, I describe the substantive content of the *incomplete utopian project of EHR invention* as particularized in the EHR Prototype Project. Each of the three broad dimensions of the incomplete utopian project of EHR invention--clinical, technical, managerial--is constituted by heterogeneous and conflicting utopian projects internal to the respective dimensions. In other words, heterogeneity and contradictory motivations are not only characteristics of the inter-animation of the three broad dimensions but also characterize the internal dynamics of each dimension as I have conceptualized them.

How did the imagined logic of the design of the EHR system-in-the-making become visible to me? How did I conceive the incomplete utopian project of EHR invention as a partial explanation and as a concept for thinking about these questions? I constructed the incomplete utopian project of EHR

invention as an organizing concept for thinking about sociohistorical context, resources of imagination, and argumentation, heterogeneity, and dilemmas. Clinical, technical, and managerial dimensions of EHR invention are constituents of the incomplete utopian project of EHR invention generally and of the EHR Prototype Project in particular ways. Whereas I schematize actors and perspectives along these three dimensions–clinical, technical, and managerial--for analytical purposes, in reality they are of course interrelated; their delineations are not meant as bounded definitions. As I introduce the clinical, technical, and managerial dimensions in this chapter and deploy them in the analysis of case examples in Chapter IV: Changing Patient Care, their inter-animation and cross-traffic will be clear.

My understandings and descriptions of the three dimensions are ethnographically grounded, based in my experiences in this particular EHR/CPR development effort. There are vast literatures about each of the broad areas and the subtopics that comprise them. I represent them in a highly selective and preliminary manner here. I develop the clinical dimension more fully than the technical and managerial dimensions because, within the EHR Prototype Project, I was situated in the clinical use domain. The technical and managerial dimensions are areas I intend to develop further, beyond the representation of these two dimensions that I can provide in this dissertation. My goal for now is to provide a sketch of the larger

landscape in which the case study is situated, and suggest desires that motivate its imaginative power.

The discussion of dimensions and actors proceeds as follows. I will briefly introduce the substantive content and motivating desires of the incomplete utopian project of EHR invention along three intertwined dimensions: clinical, technical, and managerial. Each of these schematized dimensions comprises long-standing and new utopian projects in their respective domains; the domains also cross over into each other. The clinical, technical, and managerial dimensions (each comprising utopian projects) inter-animate one another and infuse EHR invention with considerable heterogeneity and argumentation, reflecting and enacting contradictions in the activity system of patient care. The *clinical dimension* includes the desire to overcome the clinical sorrow of mistakes that are inevitable in the error-ridden activity of clinical work (Paget: 1988; Strauss et al.: 1997 (1985)). It also includes the movement for *evidence-based medicine* and *evidence-based practice* (e.g., Eddy: 1996; Sackett et al.: 1997) that extends the projects of epidemiology and population-based care, and, more broadly, the utopian project to make medicine and clinical practice scientific and rational (e.g., Berg: 1997a). EHR invention holds together co-existing patient care models and modes of care that coexist in states of argumentative tension: the medical model, nursing models, patient-centered models (increasingly emphasizing self-care), and,

more recently, consumer models. The *technical dimension* includes among its utopian projects the strong structured content design strategy in medical informatics to take the reinvention of clinical and medical language as standardized terminologies and as clinical objects "to the atomic level," building a comprehensive clinical information infrastructure, and the creation of "the object world" as a thorough-going transformation from structured analysis to object-orientation considered by the HMO clinical and information technology leaders of the project to be both highly risky on such an industrial scale and absolutely necessary in order to thread together clinical documentation through the organization's patient business data model. The *managerial dimension* includes the projects of scientific management, and management engineering (strong Taylorist traditions in the HMO's organizational regime and culture), the new capabilities of the continuous electronic audit of the EHR to extend monitoring of performance measurement, evaluation and continuous quality improvement, monitoring of work practices, clinical actions, and the status of orders and outcomes through real-time visualization of data and actions taken and to be taken (visibility of the in-progress status of orders and tasks, visibility of closure for many actions that are now indeterminable or "open"), and enforcement of adherence to standards of care and service, to clinical practice guidelines, and to clinical and organizational protocols. The HMO is known for its long-

standing and thorough commitments to continuous evaluation including but not limited to annual clinical strategic goal-setting, multi-level quality assurance for internal and external regulatory purposes, and individual as well as team and departmental (clinical service) performance evaluation and measurement (including measurements of physicians' performance along an expanding number of parameters).

Clinical, technical, and managerial utopian projects inter-animate one another. I briefly synthesize certain of the desires and motivations that coalesce in the clinical, technical, and managerial dimensions. How do heterogeneous and conflicting desires from distinct histories and visions of the future come together in the imagination and invention of this particular electronic health record? How are they inter-related in ways that make it possible to enroll the participation of diverse actors required to launch and sustain the EHR Prototype Project undertaken by the HMO and the Software Company?

I use heterogeneity to refer to multiple perspectives, with connotations close to rhetorical argumentation, and to point to diversity among human actors and ideas, concepts, models, going notions--altogether, resources of collective imagination. My use of heterogeneity follows Keller's principled emphasis on multiplicity and Bakhtin's concepts of heteroglossia and polyphony. Heterogeneity stands in contrast to homogeneity, and to

perceptions of united or singular purposes and interests among participating human actors. In analyses of computer systems design, my use of heterogeneity follows Bødker's emphasis on diverse viewpoints as sources of conflict and creativity in design (Bødker: 1991), and the emphasis on argumentation in design processes and argumentative design strategies in the writings of Sjöberg and Timpka (Sjöberg: 1994, 1996; Sjöberg and Timpka: 1995; Timpka and Sjöberg: 1994). Furthermore, I am especially interested in moral values, intellectual projects, and artistic, technical, and scientific ideas. In the construct of an incomplete utopian project, I use heterogeneous and heterogeneity quite narrowly compared to uses of the terms by Berg, Verran, Star, and others who explicitly include non-human actors in heterogeneous ensembles. That I circumscribe heterogeneity as human, discursive, and imaginative herein marks my discussion and conceptual language as different particularly from those of many theorists in critical science studies and actor-network theory in which non-human actors and actants are directly included. I appreciate the inclusive and broader uses of heterogeneity in critical science studies and by actor-network theorists, and I believe that conceptualizations along such lines will open up further interpretations of this case study, as well as further development of the concept of incomplete utopian projects.

Actors in the EHR Prototype Project include clinical, technical, and managerial participants in a multitude of project teams and the clinical

practitioners participating in EHR prototyping within the HMO; the product design, software engineering, clinical informatics, and client services teams within the Software Company, and an array of collaborating external partners. Among these participants are physicians, nurses, administrators, business analysts, management engineers, researchers, systems designers, clinical consultants, computer scientists, specialists in information and communication technologies, and internal and external business consultants. Participants may have two or more overlapping roles and identities among these categories; for example, many managers and administrators are physicians or nurses, many product designers in the Software Company are clinicians (nurses, physicians, licensed clinical social workers, pharmacists). Two of the vice presidents of the Software Company are physicians (for Product Design and Clinical Informatics), and a third vice president (for Client Services) is a nurse educator and administrator. In the HMO, two high level managers are also senior nursing and hospital administrators, while physicians hold numerous administrative and project leadership positions. Many business analysts in both the Information Technology department and the Physician Partnership are nurses with advanced degrees, as are most of the HMO's Clinical Informatics staff. In clinical information systems projects such as the EHR Prototype Project, there is no clean divide between "clinical" and "technical" staff; what divisions there are tend more often to fall between

clinical and non-clinical perspectives. The HMO has a multi-tiered governance system of advisory bodies and steering committees which develop, approve, coordinate, and monitor strategic and operational plans, and to which project teams provide in-progress and summary reporting. The advisory bodies extend the representative participation of clinicians, information technology specialists, strategic planners, and administrators both horizontally (within and across the geographic regions and among clinical services and specialties) and vertically (to higher echelons of decision makers who report to the HMO's senior management in the national headquarters offices). The roles of external consultants include but are not limited to significant roles in strategic planning and project management structures by several of the multinational accounting firms and the consulting services arm of a multinational software company. In the arena of EHR/CPR development, external partners include other health care organizations, EHR/CPR and specialized medical informatics software design companies, consortia of institutions involved in the development of controlled medical terminologies funded in part by the National Library of Medicine (the institutions include but not limited to Stanford, Harvard, Columbia, and the Mayo Clinic), SANDIA National Research Laboratory, the Computer Patient Record Institute, and standards-setting bodies for a host of issues from standardized medical and clinical terminology development, technical

protocols, and the security and secure transmission of patient data. The Software Company is among the EHR/CPR companies in a consortium receiving funding support from the United States Department of Defense and State Department. Among controlled medical terminologies, EHR Prototype Project leaders favor SNOMED for its ability to represent clinical context and potential comprehensiveness. The HMO has on-going relationships with IBM and other major computer software companies, as well as new partnerships for the national clinical information infrastructure building efforts.

For me, the incomplete utopian project is a way to think about the sheer scope and complexity of this large scale project in its relation to the early ethnographic research with the first two patient care teams. Although EHR prototyping began in two patient care teams, comprising approximately thirty-five clinical practitioners, the prototyping was always oriented towards organization-wide intentions and strategic goals. How do we hear and see history and the longing for a future vision expressed and enacted in the present activity of patient care? How are imagined future scenarios generated in the work of designing and developing the EHR system with intentions to "improve patient care?" How are future time horizons invoked to shape perceptions of present realities? How do both history and the future participate in the construction of reality in the present? The concept also provided me with a way to think about the organization's carefully crafted

vision statements about the EHR and improving patient care and the tensions they contain. Beyond my experience of the EHR Prototype Project, I became interested more generally in how to break up the glossiness of tightly composed corporate vision statements, to recover the argumentative, heterogeneous, and contradictory interests and voices contained, sublated, suppressed, silenced, or acting silently within and through them. Sociohistorical analysis led me to appreciate deep desires that inspire many people involved with electronic health record innovation whose intense motivation and commitment take on quest-like, even quasi-religious, qualities. How does creating the electronic health record system become "the search for the Holy Grail," "a mission, a quest," "God's chosen instrument to transform health care"? Technological innovation and invention are frequently characterized by fervor, inspiration, and belief beyond worldly boundaries while channeled into worldly pragmatic activities; often hyberbolic or frenzied but nonetheless pragmatic (e.g., Noble: 1998).

C.1. Clinical utopian projects

Among many possible ways to describe the clinical dimension of EHR invention, I discuss three areas: (1) clinical logic(s), their meanings, and the profound challenges they pose to "the beautiful logic" of the EHR's system design; (2) the inevitability of errors and mistakes in clinical work, and the

powerful desire to overcome them; and (3) the project of evidence-based medicine and evidence-based practice, as it informs the design logic of the EHR system-in-the-making, and as it extends the projects of epidemiology and population-based medicine.

I began to think of EHR invention as a story of two logics as a result of analyzing video documentation of exam room consultations in which the first version of the prototype was used, and for which on-line templates were built and used. The system design logic of the EHR and its interactive templates is distinct from the logic of patient-care provider interactions, patients' presentation of problems, and the choreography of clinical teamwork. For the first three versions of the EHR prototype in clinical use, difficulties documenting for complex and multiple problem patients and being able to document (partially or fully) during patient-care provider interactions in the exam room presented core design problems constraining use of the EHR and confronting its designers. For certain of the project leaders, it was a goal that clinical documentation with the EHR should be completed during the exam room consultation to the greatest extent possible--"in real time"--but this was not a universally held view. The HMO prioritized a requirement that the Software Company must achieve a design that can "support the flow of patient-care provider interactions in the exam room."

C.1.1. Clinical logic(s)

"I've seen the demo's [of the EHR] and it's a beautiful logic," a physician director of clinical research for the HMO region told me, "but it's not how physicians think. I'm a clinical researcher, it's how *I* think, but it's not how physicians think. It means intellectual changes, changes in practice, a magnitude of changes that are hard to think about." The story of two logics that I offer—the logic of EHR design, the logic of patient care interactions and clinical work practices--is a way to explore the tensions between them and the difficulties that confront the imagined logic of the EHR system-in-the-making, the inner logic of the particular EHR design strategy, in clinicians' experiences with use of the earliest versions of the prototype, given the logic of clinical practices constituted through patient care interactions and the patterned but ultimately infinite variability of clinical cases as they progress.

Suchman's (1987) critique of plans (formal logics) and the logics of situated actions (practices and interactions) broadly frames the tensions between clinical logics and the logics of EHR systems design. Berg refers to a tenet of Suchman's and the ethnomethodological perspective in developing his critique of decision analytic tools and protocols as exemplars of "the Formal": "explicit 'rules' are not the foundation of action: they are post hoc, contingent, situation-dependent derivatives of concrete action" (Berg: 1997b, p. 131, following Suchman). The logics of tools and practices differ in important ways, particularly in their relationships to rules and uses of rules

as resources. "Formal tools operate by processing pre-set, definite rules. In medical work, on the other hand, criteria are often fluid: they are readjusted to concrete situations, and they are explicated only when the flow of work is halted. Such explications, moreover, are always situation-specific; their relevance for a current situation can and often has to be reassessed" (Berg: 1997b, p. 144). Berg's larger project is to develop analytic tools for "a sociology of the Formal" in order to achieve an understanding of the generative power of such tools which does not attribute mythical capabilities to either tool or human work.

> ... [T]he gap between the formal representation (the map) and the actual sphere of work (the terrain) is not crossed in one step. Rather, we see a chain of representations (Star: 1989; Bowers: 1992): a series of intermediate, representational activities performed by materially heterogeneous entities. At each step, input from the territory is condensed, elaborated and transformed until it matches the abstract level of detail of the map (Berg: 1997a, p. 144).

Berg proposes "logics" as a strategy to overcome dichotomies between physicians and their tools in his analysis of decision-analytic tools. "... [T]hese logics constitute discernible patterns that cut across the categories of 'tool' and 'human practice' and can be debated as such (Moi, forthcoming; Law: 1994). ... The different logics' notions of rational medical practice and its obstacles ... pre-structure the way in which specific practices, 'problems,' and 'needs' are approached, conceived, and structured (Agre: 1994)" (Berg: 1997a, p. 177).

Patient management is distributed over a heterogeneous ensemble of human and non-human actors and entities that include "[p]hysicians, nurses, medical records, the dispensary guide, the pre-packaged blood tubes ..." (Berg: 1997a, pp. 137-138). The image of the physician as "the captain of the ship" is illusory or folkloric; rather, "the physician is a resource." Furthermore, clinical decisions are temporally distributed, as Strauss et al. (1997 (1985)) also emphasize. Because clinical work entails iterative planning and ad hoc articulation and rearticulation--*continual permutations of actions* (Strauss: 1993), "there is no longer any place for a notion of medical work as consisting of single-moment, cognitive decisions" (Berg: 1997b, p. 155). People anticipate futures and adjust plans in far more flexible ways than tools. "The tools perform tasks by going through a fixed sequence of intermediate steps, demanding the completion of one step before the next can be made. In medical work, on the other hand, next steps to take are often anticipated, and current activities are often adjusted accordingly" (Berg: 1997a, p. 144). In practice, diagnosis and treatment actions are interwoven. The "real time" emphasis on computing at the time of interaction with a patient misses the importance of "... the simple passage of time" including "creative indecision" which, although frequently decried in the decisionist culture of medicine, often contributes to synthesis of information in the

process of diagnosis and determination of plans of care (Szolovits and Pauker: 1978 cited by Berg: 1997a, p. 70).

The Migraine Project provides another example (Buchanan et al: 1992, 1995; Forsythe: 1995, 1996; Forsythe and Buchanan; 1992). The Migraine Project was a demonstration project for the development of clinical information systems for chronic illnesses. In a project to develop an interactive program to help people living with severe migraine headaches, every patient whom the anthropologists interviewed experienced intense fears of death (many thought they could die from a brain tumor) but not one had discussed the fear of death with his or her neurologist (Forsythe: 1996). In the Migraine Project, Forsythe found, in some instances, that the advice generated by the artificial intelligence-based system, based on its computational and combinatorial power, was wrong for the patient, in other words, it was medically erroneous advice regarding treatment. Such errors in the system represent failures in the ethical relationship with the patient that may also be interpreted as instances of the inability of systems either to emulate the "cognitive blending" physicians describe or to fluently support patient-care provider relationships unless used judiciously and actively related to the specific clinical contexts and lifeworlds of individual patients.

In Social Organization of Medical Work (1997 (1985)), Strauss et al. describe a triad of new and changing phenomena as the foci of their study of

hospital work and their analysis: (1) the prevalence and complexity of chronic illness in contrast to acute illness (previously the prevalent type of medical problem treated in hospitals); (2) the proliferating role of technology and "machine work" in medicine and patient care (biomedical technologies, diagnostic devices, monitoring devices, life support devices, and the full spectrum of general "technologies" including, for example, drugs and new means for packaging and administering drugs); and (3) the modern hospital with its increasingly complex divisions of labor, acceleration of specialization in medical work hand-in-hand with rapid technological development, and the complexity of "chronic illness trajectories." Trajectories of chronic illness in fact combine chronic illnesses and acute problems; more often than not, a patient lives with multiple chronic illnesses. Noteworthy among technological changes is the greater importance of drug-drug interactions for people living with multiple chronic illnesses. Altogether, these present difficulties for coherence and continuity in the care of a patient and require further articulation work and coordination across divisions of labor to accomplish medical work, thus generating problems for communication, coordination, and collaboration amongst the staff and with the patient and his or her significant others.

This triad of structural changes has put considerable pressure on "tender loving care," traditionally at the heart of nursing identity.

> What is important to grasp is that the hospital setting and the trajectory work done there, together, complicate the comfort work almost beyond belief as compared with comfort work done during the pre-chronic illness era. Giving tender loving care (the centerpiece of traditional nursing identity) has so many novel features that it warrants being awarded the status of genuinely new “news.” The questions for the analyst, then, pertain first of all to how a triad of structural changes have affected the context and nature of today's comfort work. These changes have occurred in medical specializations and their associated technologies, in the chronic illness trajectories, and in the hospital's organization in tandem with the first two changes (Strauss et al.: 1997 (1985), p. 100).

Among organizational changes, Strauss et al. briefly allude to a range of "soft technologies"--“technology based on knowledge drawn from both the biophysical and social sciences”--introduced in response to critiques of medical approaches as dehumanizing patient care. "This technology pertains to appropriate ways of interacting with and taking care of patients and their bodies so as to increase physical comfort and to give encouragement to patients in their own management of discomfort" (Strauss et al.: 1997 (1985), p. 104). Among the influences that have been or are being institutionalized are alternative medicine approaches and changing conceptions of dependence and independence that contribute to the shift towards self-care and emphasis on life-styles.[49]

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[49] See Billig et al. (1988) for a critical discussion of the ideology of health as individual responsibility and the medicalization of individuals' life-styles, and the ideological dilemmas with which these social and medical trends confront us in daily life.

To understand patient care interactions, clinical work practices, and clinical cases, Strauss et al. introduce the concept of *illness trajectory.* The concept of *trajectory* "is above all a means for analytically ordering the immense variety of events that occur--at least with contemporary chronic illnesses--as patients, kin, and staffs seek to control and cope with those illnesses." Thinking of trajectories is a way of thinking about the evolving nature of work and interactions, both work relationships and patient-care provider interactions. While the concept of trajectory is generalizable to all work settings, Strauss et al. keep in focus two features that distinguish patient care (along with certain other types of intensely interpersonal and contingent work). One consists of the unexpected and often difficult to control contingencies that stem not only from the course of an illness, but also from a host of work and organizational sources as well as from biographical and life-style sources pertaining to patients, kin, and staff members themselves. A second and crucial feature of work in health care is that it is "'people work.' ... Two things follow: (1) the patient can react and so affect the work; (2) the patient can participate in the work itself, that is, be a worker" (Strauss et al.: 1997 (1985), p. 9). Among the consequences of these distinctive characteristics of patient care are that they undo common notions of "management" and "patient management," and that the emotional and psychological experiences

inherent in patient care (what I have called the interiority of experience) affects care providers as well as patients and their significant others.

> ... [T]he interplay between control and contingency challenges the very idea of illness (and trajectory) management per se. As a term, "management" does not catch anything like the full complexity of this work, its medical outcome, or the consequences for all who are working at it. For that reason, we need to add to management two other ideas. One is that "managing" the problematic trajectories is better understood as "shaping" them, that is, handling the contingencies as best one can, although being far from fully in control of the trajectory. ... The second idea is that trajectories are also experienced. Unless we are inclined to think only of the social and psychological impact on patients and kin, it is necessary to recognize that staff members can be affected profoundly by their work on particular trajectories. Together the three terms, managing, shaping, and experiencing, give a much more adequate picture of what happens when trajectories are complex and problematic (Strauss et al.: 1997 (1985), p. 20).

C.1.2. An error-ridden activity

One goal of EHR systems is to prevent mistakes and reduce risks to patients and to health care institutions. One of the first "intelligent" capabilities of these systems is the ability to identify drug-drug interactions in order to reduce medication errors (see, e.g., Anderson: 1994). To prevent mistakes and to control risk are as fundamental to EHRs / CPRs as it is that they provide some means for the use of standardized codes for diagnoses and procedures. Malpractice stories are archetypal war stories in design discussions that turn to discussions about managing medical risk. Reference to malpractice war stories--real and hypothetical--was an obsessive marker in

EHR design discussions; risk of malpractice allegations lurks in stories about clinical work told by physicians. Research colleagues confirm that malpractice is frequently a point of reference in design discussions in other clinical informatics efforts. Discussions of errors and mistakes also translate into the language of *risk* with multiple meanings: potential risks (harm) to patients and institutional risk (liability). These are discussed below among constituents of the managerial dimension of EHR invention (Section C.3.). Conceptions of risk exemplify cross-overs between dimensions, in this case between clinical and managerial dimensions.

It is assumed that the EHR system being designed will provide and support intelligent tools for the management of complex patients and multiple clinical protocols, for disease management, and, generally, for management of patients whose care is shared by multiple providers at spatially, temporally, and geographically dispersed points of care within the same institution or in networks.[50] The triad of changes in hospital work described by Strauss and his colleagues can be projected across the spectrum of all modes of care (primary care, secondary care, hospital care, home care,

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[50] I use the term *network* generically. Networks may be constituted within the same institution or they may involve partners external to the institution with which a patient has the primary relationship. Among inter-organizational networks in health care, the 1980s and 1990s have seen the proliferation of "provider networks" including networks of primary care physicians and specialists. These act as referral networks under contractual arrangements with health care institutions. For a discussion of these trends, see Institute for the Future (1997).

self-care) as they are affected by organizational and structural changes in health care delivery systems, markets, and work organization. Given the impossibility that any single physician, nurse, or other individual can be "the captain of the ship" for a complex patient trajectory, we can then see the need for and the powerful appeal of new clinical information tools that can visualize a shared longitudinal picture of a patient's care and health and that can eventually visualize such overviews for patient populations. There is a need for tools that can help care providers manage increasing complexity and coordinate their actions and interactions with each other and with patients. But can clinical information tools "eliminate mistakes?" To understand the utopian desire of clinicians to overcome errors, mistakes, and risks to their patients and themselves requires an appreciation of the endemic nature of mistakes and ubiquitous risk in the activity of patient care.

I concur with Marianne Paget's analysis of the error-ridden nature of medical and clinical practice. In The Unity of Mistakes (1988), Paget describes "the sorrow of clinical work" that never leaves physicians [sic]. She begins her phenomenological study of medical mistakes by quoting Nietzsche on the unfolding of the "thing-in-itself" over time.

> How could anything originate out of its opposite? for example, truth out of error? or the will to truth out of the will to deception? or selfless deeds out of selfishness? or the pure and sunlike gaze of the sage out of lust? Such origins are impossible; who ever dreams of them is a fool, indeed worse; the origin--they cannot be derived from the transitory, seductive,

> deceptive paltry world, from the turmoil of delusion and lust. Rather from the lap of Being, the intransitory, the hidden god, the “thing-in-itself”--there must be their basis, and nowhere else (Nietzsche quoted by Paget: 1988).

The "unity of mistakes" refers to mistakes *becoming* mistakes as they "unfold over time." Paget discusses "the time structure of mistakes," the meaning of "making mistakes in time as it unfolds," and the attribution of a mistake, in the context of clinical work.

> A mistake is a complex relation between a person, a physician, who is mistaken, and something mistaken, a patient’s illness. Its complexity arises because of the many dualities of the relation; “mis” meaning *miss*, “mis” meaning *wrong*, “mis” meaning *take wrongly*. It is also a complex relation because of the many dualities in its construction, the movements and transitions in the misfortune of illness and the misfortune of mistaking human illness in time. A mistake is not normally conceived of as a complex relation constructed in time and action. It is thought of quite simply as an event, a slip in the execution of a routine activity, like addition. A mistake is, however, a complex dialectic about a discoverable reality, and a misapprehended reality that requires discovery (Paget: 1988, p. 121-122).

In an exemplary interview, a physician utters a phrase that serves as a refrain throughout Paget's analysis: "the errors are errors now, but weren't errors then" (Paget: 1988, pp. 35-36).

> Time references here [in the physician's discourse about mistakes] are signs of a complex paradox: mistakes are known always *after* they are made, that is to say, they are known now rather than *then*. ... ”Then,” in “the errors are errors now, but weren't errors then,” or in the phrase “I didn't think it was a mistake then,” is paradigmatic: it captures the essence of the paradox of error. In these phrases, “then” does not mean just

> *then* as opposed to now. It means *then* when an act or a sequence of acts was becoming, emerging in time" (Paget: 1988, pp. 44-45, original emphasis).

Patient care is an "error-ridden activity," and, at the same time, a special kind of work situated in ethical relationships. "*Clinical action* doesn't intend a materialization, an artifact, or, exclusively, a performance. Rather, it intends a therapeutic effect. And it is mediated by a social relation out of which it develops and to which it responds" (Paget: 1988, p. 56). Commitment is at the heart of clinical work. "The particularity of medicine, however, is its complex relation to the life process and especially to personal suffering. Its unique contribution to the construction of the human world lies here" (Paget: 1988, p. 23).

Diagnosis and decisions about treatments are processes of discovery and hypothesis: "... medical work is discovered in action. *Discovering* is not like seeing or observing. Patients do not wear their illnesses as they wear apparel. One apprehends, one infers, one tests, one experiments, one tracks, one follows the course of events in order to disclose the nature of illness and affect it" (Paget: 1988, p. 19). Yet, "... the intent of diagnosis is not testing a hypothesis but right action" (Paget: 1988, p. 33). The trial and error of clinical actions intended to do the best for a patient occur within "the obligation to care for sick people, even and especially those whose problems are not clinically resolvable" (Paget: 1988, p. 49).

That one is compelled to act on behalf of each patient, as Paget describes, is what nurses call "a covenant of care," an expression that evokes Florence Nightingale's writings about compassionate caregiving and empathy (see, e.g., Gordon: 1997). Among the nurses I came to know in the EHR Prototype Project, "a covenant of care" referred to the ethical and compassionate commitment between a caregiver and a patient.

Paget's analysis stands in contrast to sociological descriptions of medicine as applied knowledge, as expertise, or as defined by its professions and occupations. She argues for an interpretation that departs from "the language of blame and the rhetoric of expertise, social knowledge, and technical skill" (Paget: 1988, p. 57). To Paget, and to Strauss et al. (1997 (1985)) as well, Friedson exemplifies the rhetoric of blame in the castigatory sociological critiques of medicine and physicians. Instead, in Paget's writing, "... medical work is described as a process of discovery and response, of risked action and error ... an 'error-ridden activity'" (Paget: 1988, pp. 17-18).

Paget's focus is on mistakes that are implicated as part of routine rather than exceptional clinical work: her interest is in mistakes that are "inevitable ... an intrinsic feature of medical work" (Paget: 1988, p. 5). She interprets interviews with physicians in which she asked two questions: "How do you deal with other people's mistakes?" and "Do you have a different response to your own mistakes?" For most mistakes in clinical practice, one

doesn't know a mistake until it becomes a mistake. In medical quality assurance investigations that trace back through a case that has resulted in death or injury, it is difficult to determine when and where a mistake began. How can this be the case? Paget explains this in the following way. The work of diagnosing illness and devising treatment plans begins with something being wrong in the health and life of a patient. There is a commitment to act, to help the patient, to fix what is wrong. The medical response may be to order more tests to find out what is wrong; at the same time, there is a commitment to relieve suffering, to alleviate symptoms, and to devise a plan of care or to contribute to an existing plan, in order to set or sustain the patient on a course of treatment. Diagnoses and decisions about treatment are matters of approximation, albeit highly trained approximation: a clinician usually does not know what is really wrong in a given moment. Given that an assessment of what is wrong is an hypothesis, what to do on behalf of a patient is, then, also an hypothesis or a series of successive hypotheses. Yet, whatever the state of understanding of a patient's problem(s), there is an ethical commitment to act, to do something on the patient's behalf. Patient care is an inherently error-ridden activity.

The utopian desire to "eliminate mistakes" is fed from two streams: a desire to heal that often translates into a desire to practice perfectly in the face of the inevitability and consequences of error, and the organizational,

professional, and individual obsessions with malpractice and malpractice allegations and their very real damage and costs to the lives of patients and clinical practitioners. Regarding the first, Paget develops three pictures of mistakes as they occur over time in diagnostic and therapeutic processes: "the evolution of mistakes in action, the identification of mistakes in reflection, and the complex sorrow of mistakes" (Paget: 1988, p. 148). Regarding the second, Paget explains that the interviews for her study were conducted before the explosion of malpractice cases in the United States, making it possible to analyze physicians' discourse about medical mistakes that are intrinsic to clinical practice as distinguished from egregious acts of malpractice. As Paget writes, "... negligence is neither the most 'common' mistake nor the most revealing of the character of clinical work. Irreparable and unavoidable mistakes are more revealing of the character of medical work" (Paget: 1988, p. 19).

What Paget calls "error-ridden," what others call "medical mistakes" in the literature, can also be conceived as "risk." From the perspective of health care institutions, patient care is an activity whose essence is risk. Risk is everywhere, in the bodies of patients. There is risk to the patient from whatever is wrong, and there is risk in treating a patient with approximate knowledge about what is wrong. Paget and Strauss et al. suggest that historically, errors have become more frequent and consequential, given the

increasing complexities and interdependencies of changing medical knowledge, specialization, divisions of labor, and new technologies being integrated into diagnosis, treatment, and care. "Not only has the range of potential errors increased in the new therapeutic world of medicine, but the deleterious effects of errors have also grown enormously" (Paget: 1988, p. 54). Furthermore, time pressures and workload are significantly implicated in mistakes, as a doctor interviewed by Paget explained.

> "... I think a lot of doctors make mistakes because they're too busy, and they're ... they may have twenty-five patients in the hospital--they just don't ... they just don't have the time to really go over the charts of the patients or the patients themselves; and I think sometimes that's how they make mistakes, that's how a lot of the good doctors make mistakes" (Paget: 1988, p. 120).

Regret over mistakes, failures, death, and injury constitute the sorrow of clinical work in which all care providers are joined. When Paget writes of "the complex sorrow of clinical work," she also writes of "the anguish of clinical action and ... the moral ambiguity of being a clinician." "It is the experience of not only being wrong but of also being irreparably wrong that marks medical work; it is a universal clinical experience" (Paget: 1988, p. 77). "Action ... contains the attributes of risk and invention. ... A clinician's action risks the world of others" (Paget: 1988, p. 7). Clinical practice is "a practice of choice, conflict, and sorrow"; "action-becoming-wrong" is a complex sorrow.

Mistakes are complex sorrows of action going wrong. Complex sorrows are not unmediated expressions of grief. They

> are hemmed in by thinking about the character of action in time and very often by highly analytic thinking. They are intellectualizations of action, situated in periods of reflection, between a multiplicity of other clinical acts, other patients, other problems, and other thoughts about the work and the problems of the work. Unlike more elementary expressions of sorrow, which are spent in periods of grief, they are too common, too endemic, to be released" (Paget: 1988, p. 97).

Paget points to the concept of *error-work* conceptualized by Strauss et al. (1997 (1985)). "*Error-work* comprises the activities that prevent, minimize, define, detect, cover up, and rectify mistakes" (Paget: 1988, p. 66). Error-work is carried out by clinical staff and by patients and significant others. Paget and Strauss et al. emphasize the organizational aspects of work that generate errors and require extensive iterative reparation of clinical work given the unpredictability of clinical cases. Understanding clinical work as a process of discovery contributes to the systemic view that characterizes inquiry into medical mistakes and errors within the medical profession and within health care institutions.

> The work process in medicine is a discovery process. And the progressive discovery of the meaning of an experience of illness leads often to the discovery of errors in the work process. What is wrong medically, then, can be expressed, not as a problem, but as an error in diagnosis or management of a medical problem. The work process requires these acts of discovery: error is itself an instrument of understanding and knowing, a self-conscious use of knowledge to redo an act.
>
> Errors corrected and uncorrected, reparable and irreparable, are identified in ward conferences, teaching rounds, autopsy reports, suicide reviews, morbidity and mortality

> conferences, clinical pathology conferences, and medical audits, although they are not often called errors (Paget: 1988, p. 79).

Within the medical profession, systemic analysis of errors is a long-standing tenet of talk about errors: "... blame is not the central issue in an inquiry into an 'error' in an error-ridden activity; *understanding what went wrong is.* Inquiry accounts not for an error, but for an activity that has gone wrong" (Paget: 1988, p. 90, original emphasis). The underlying motivations--to eradicate errors, to obviate mistakes—are similar in this regard in change projects such as EHR/CPR development and implementation as for systemic analysis motivated directly by tragic mistakes, especially those that seem inexplicable. Because the clinical experience of making mistakes is at the core of the clinical project, it is "a source of many of the social forms that organize the work: the conference, the autopsies, the audits, the professional reviews, the curb-side consultations, the ubiquitous and relentless talk about medical problems, and also the duplicity in the work" (Paget: 1988, p. 95). How will these social forms change with use of EHR/CPR systems? How will use of new clinical information tools change talk about errors, mistakes, and risks? How will electronic health record systems change processes of diagnosis and treatment?

One must live with one's own mistakes and learn to work with each other's mistakes, or leave the profession of medicine. Paget's message is that

mistakes do, indeed, haunt clinicians but that a degree of distance from sad and tragic outcomes is a necessity for one to continue practicing, in order not to become immobilized or otherwise frozen from acting. In his study of training to become a surgeon, Bosk quotes the surgeons' code: "forgive and remember" (Bosk: 1979). In the academic hospital in which Bosk conducted his study, surgeons' training emphasizes learning from mistakes and how one treats the patient and family in the wake of a mistake's occurrence, the interactional aspects or interpersonal relations of handling mistakes. Bosk distinguishes mistakes in surgery that could happen to any surgeon at any time from *normative mistakes* that involve a violation of trust with a patient or his or her family, a violation of the Hippocratic Oath, or other violations of the injunction to "do no harm." Normative errors, instances of malpractice among them, may warrant expulsion from the profession of surgery, whereas many normative errors are disciplined internally within the profession. From this analysis of problems in the authority of the powerful profession of physicians in general and surgeons in particular, Bosk advocates institutionalization of greater accountabilities to public responsibilities. "The collectivity needs to promote the structural changes that will build stronger accounting mechanisms into everyday practice" (Paget: 1988, p. 192). To the average citizen, many of the mistakes that Bosk and Paget describe as

forgivable or acceptable within medical and clinical communities are unforgivable and inexplicable.

The analysis of hospital work by Strauss et al. (1997 (1985)), underscores how mistakes unfold over time as the result of sequences of actions or inaction by many care providers and non-clinical staff responsible for a patient. Mistakes are implicated in the uncertainties and unknowns of diagnosis and treatment, the variability of the course of an illness (or multiple illnesses) for unique individuals, and the non-predictability of patients' responses and decisions—altogether, the non-rationalizability of a patient's trajectory. Strauss and his colleagues point out: "The entrance of the patient is what makes medical work *fundamentally* nonrationalizable" (Strauss et al.: 1997 (1985), p. 154, original emphasis). Patients construct their own perspectives and decisions about what their problems are and what to do or not do about them (Hunt et al.: 1989).

Work and the "intricacies of 'mistakes at work'" are focal interests for Strauss et al. "*Analytic consideration of mistakes begins with the central activity itself* ..." (Paget: 1988, p. 242, original emphasis). The focus on work--as the central activity--stands in contrast to much of the literature from conventional perspectives that focuses on "occupations, professions, or organizational structure" rather than work per se. Writing in 1997, Barley reminds us that this is still the norm (Barley: 1997).

Important aspects of the context and framework for the analysis of patient trajectories and mistakes in Social Organization of Medical Work (1997 (1985)) include:

> ... collective or organized work done within organizational settings; work done along a time line, with consequences for workers that in turn affect the line of work (i.e. trajectory); changing contingencies that alter the trajectory and its implicated work; problematic trajectories and trajectory phases as well as routine, expectable trajectories and phases; types of work entailed in doing the trajectory work, their relationships, their conditions and consequences; work done on reacting objects (clients); work done on persons who may do some of the trajectory work themselves rather than merely responding to others' work; work affected by arena disputes and by the ideological positions of the workers themselves (Strauss et al.: 1997 (1985), p. 230).

Strauss et al. are emphatic in the contention that mistakes are inevitable and endemic to clinical work and therefore ineradicable. "Error work can be viewed as the mirror image of trajectory work. ... Mistakes are inevitably, or at least probably, made by someone, at some time, during the carrying out of every single task" (Strauss et al.: 1997 (1985), pp. 243-244). Along with an emphasis on work as the central activity, two other principles put forward by Strauss et al. regarding the analysis of mistakes at work are important for this discussion. First, that: *"An especially important property of any trajectory which affects error work is its relatively problematic or standard character"* (Strauss et al.: 1997 (1985), p. 243, original emphasis). And second, that: *"Different levels of work along the total arc entail different task structures (tasks,*

sequences, relationships, and implicated organizational resources for carrying out the tasks); hence error work will vary by level" (Strauss et al.: 1997 (1985), p. 244, original emphasis). In this context, levels refer to: planning, designing, redesigning, overseeing the total arc of work (usually the responsibility of physicians); articulating operational work (usually the responsibility of nurses); and carrying out operational tasks (performed by all involved in the clinical case). Errors anywhere along the arc of work are consequential for patient interactions, in other words, mistakes always interact dynamically with other tasks and work. "Error work can have multiple types of consequences, differently viewed by various workers or bystanders" (Strauss et al.: 1997 (1985), p. 245). Therefore, mistakes become the subject of argument given different priorities for assessment and judgment among actors. Error work is, then, an area for debate that contributes to the on-going structuration of work. "These are not merely debates, for they become woven into later sequences of work as conditions which affect that work" (Strauss et al.: 1997 (1985), p. 245).

The expression "mistakes at work" comes from the paper entitled "Mistakes at Work," published by E. C. Hughes in 1951, in which Hughes argued that mistakes are inevitable and to be found in all occupations. Hughes' interests are in how mistakes are defined and who can judge mistakes; "that work is an object of moral rule, or social control in the broadest

sense" (Strauss et al.: 1997 (1985), p. 239-240). Strauss et al. criticize sociological critiques that follow in this social control and occupational control perspective, notably the work of Friedson, Bosk, and others, these analyses are concerned with "showing contemporary deficiencies in the control of bad work" rather than with understanding the "intricacies of 'mistakes at work.'" Among the differences between these frameworks--the former, focused on professions and occupations, the latter, focused on work--are that the work of Friedson and Bosk begins with physicians rather than considering all members of patient care teams; that mistakes are conceived as moments of cognitive decisions (diagnosis, treatment) rather than being considered as situated in medical, clinical, and social processes (illness trajectories, patient care interactions, patients' lifeworlds); and that the impacts of mistakes are conceived as "client-to-society safety only" rather than as consequential along multiple dimensions for all actors involved and affected (Strauss et al.: 1997 (1985), p. 241). To Strauss et al., analyses from the social control perspective, oriented as they are towards assigning blame, are "so entwined with political and moral considerations" that they generate recommendations that overlook detailed analysis of the processes of work in such a way that the recommendations themselves can become implicated in the generation of further errors.

The error-ridden nature of patient care and the resulting sorrow of clinical work are motivating constituents of the incomplete utopian project of EHR invention. In the EHR Prototype Project, clinician project leaders insisted that the goal "to reduce error" must be restated: "To *eliminate* error, not reduce. *Eliminate mistakes*." This is a utopian expression, not possible in reality. Paget, for example, speaks of "reduction of errors," never of their elimination. Elimination of errors is an impossibility given the analysis of medical work as error-ridden activity and analyses of the inevitability of mistakes at work. Rather, it is striking as a utopian expression, in the starkness and clarity of its impossible mission, based in heroic motivations of physicians and nurses whose lives are devoted to the daily realities of patient care.

C.1.3. Evidence-based medicine to evidence-based practice

Medical informatics and information and communication technologies provide means for the project of evidence-based medicine in two ways: as elements of clinical information infrastructure, and as constituents of the basis for creating new tools to realize the utopian project of evidence-based practice. Such tools are at once clinical, technical, managerial, administrative, and regulatory. A regional administrator, a non-clinical manager responsible for the development of clinical practice guidelines within the HMO region, grasped the logic of the physician leaders of the EHR

Prototype Project well: "When I saw the demo of this system, I was convinced that if we let the physicians have what *they* want, if they are happy and they use this, then all of *our* needs will be met, too."

Evidence-based medicine is a rational scientific model that extends the projects of epidemiology and population-based medicine. Why and in what ways is evidence-based medicine important in constituting the incomplete utopian project of electronic health record invention? The epidemiologic project has been expressed in efforts to create, hone, institutionalize, and maintain standardized medical terminologies such as the International Classification of Diseases (ICD) and other controlled medical terminologies (CMTs) that prove problematic in practice and in systems design (discussed in Section C.2.1. below). Evidence-based medicine aims to put epidemiology--clinical epidemiology--into practice--as *evidence-based practice*. Evidence-based medicine and evidence-based practice, and the tools to achieve them, represent strategies and mechanisms for the long-term intention of the EHR system to build a clinical research feedback loop into daily practice.

David Eddy (1996) and David Sackett et al. (1997) present contrasting models for evidence-based medicine and evidence-based practice. Eddy is influential as an advisor on health care policy. He is especially well-known for his leading work on clinical practice guidelines. Sackett et al. emphasize

the integration of patient values, preferences, and expectations, and the judgment of individual front-line clinicians as the constituency for their pocket guide to evidence-based medicine. Although Eddy often points to the importance of physicians' control over clinical decision-making given the complexity of medicine, he positions physicians' roles within organization-wide purposes and managerial agendas. Patient preferences are an element in Eddy's schema for evidence-based but they are subsumed to the goals of implementing clinical practice guidelines and institutionalizing evidence-based medicine in practice in order to render clinical practice rational and scientific.

Evidence-based medicine heralds significant changes in clinicians' practices. Eddy writes explicitly about changing—"steering"—physicians' practices. As he points out, evidence-based medicine is not only meant to support individual physicians but, more broadly, to facilitate managerial and organizational agendas. He repeatedly refers to costs, cost-effectiveness, and the scarcity of resources as anchors for his argument. Clinical information infrastructures that integrate on-line templates for clinical practice guidelines and other tools of evidence-based medicine also provide the basis for mechanisms that align an organizational regime with the market, particularly through benchmarking, and through the extension of accounting practices into qualitative aspects of care.

It is worth noting how advocates of evidence-based medicine create imperatives for evidence-based practice and clinical practice guidelines. Sackett et al. create the basis for imperatives by appealing to danger to patients and "the slippery slope of clinical entropy." For Eddy, evidence-based medicine has the markings of the Enlightenment project itself: bringing secret, suspicious, subjective knowledge into the light of day for scrutiny that will free practitioners from the "dangerous tautology" of judgment based on one's individual clinical (empirical) experience. The mandates for explicitness and for rendering patient care quantitatively measurable and thereby accountable are reinforced by Eddy's refrains regarding high costs and scarce resources. It will be "a tragedy" if something is not done to move evidence-based medicine and clinical practice guidelines forward. Eddy proposes formulae for aligning quality of care and cost-containment through the institutionalization of evidence-based medicine and clinical practice guidelines, by shifting to a population basis for calculating costs and benefits, and by introducing economistic terms such as "value." Through these shifts in the methods by which and the grounds on which clinical decisions should be made, he establishes a moral imperative for clinical practice guidelines.

Rhetorically, Eddy frames evidence-based medicine and the outcomes-based approach as "natural"–these practices and concepts are already implicit in medical practice, they just need to be made explicit, and

now tools exist to make them explicit. But rendering clinical decision-making explicit changes practices, as making work visible changes practices through new forms of objectification. In the context of clinical information systems such as the EHR system discussed here, systems which provide on-line clinical practice guidelines and protocols in the form of interactive templates or otherwise structured formats for documentation of minimum data sets, such explicitness heralds changes in control over clinical decision-making.

What is utopian about evidence-based medicine and evidence-based practice? Why do I include them among utopian projects constituting the vision for EHR invention? Eddy proposes the clinical practice guideline as the instrument for creating the clinical world anew, what Latour would call "a funnel through which the world changes" (an obligatory point of passage). Eddy outlines the rationalization of medicine as he sees it by laying out a rational progression to the outcomes-based approach. Yet in 1990, he acknowledged that there were no guidelines in existence that met his methodological criteria of scientific evidence and explicitness. Futhermore, based on an experience with focus groups of patients exploring their preferences in order to contribute to a clinical practice guideline, Eddy had to acknowledge that patients and patient care do not necessarily conform to his concepts of rationality.

It is also utopian to pose an unproblematic grafting together of evidence-based medicine and patient perspectives, as Sackett and his colleagues do, leaving the tensions between these two perspectives silent. Sackett et al. elide the difficulties of aligning evidence-based medicine with clinical work practices, as well. They gloss changes in practice as a relatively straightforward matter of time-management, discipline, and commitment to continuous self-improvement, from which they suggest that it is easy to make critical appraisals and other evidence-based medicine tools available in 'real-time' clinical practice. But elsewhere they acknowledge how much time is required and how rare experiences with practicing evidence-based medicine are.

The desire for evidence-based medicine is a desire to extend what can be known, to narrow the circles of uncertainty and ambiguity that are part of illness, diagnosis, and treatment. The more that is known--through new evidence--the more there is to be done, and by doing so, the more there is to know once again. Medical knowledge of diagnoses and treatments changes over time. Diabetes provides an example of changing knowledge of an illness and its treatment, while rheumatology provides an example of rapid change in a medical specialty. People at risk for diabetes and people diagnosed with diabetes represent a very large population of patients for whom there is now an early indicator, microalbumin. Microalbumin was previously interpreted

as a predictor of diabetes but is now understood as a sign of the illness. This change in understanding, which is also a change in medical concept and representation, has consequences for earlier detection of diabetes and hopes to prevent its progression to a state of illness. New knowledge about diabetes significantly expands what can be done for the at-risk population, people who have family histories of diabetes, in addition to the undiagnosed population of people living with (undetected) diabetes which is already estimated as 15% to 30% greater in number than the population of people diagnosed with diabetes (already identified as living with diabetes and in treatment for it).

In rheumatology, many diagnoses have been identified or differentiated during the past two decades alone. Because many rheumatology problems involve chronic pain and diagnoses are often consequential for a person's disability status, re-evaluations are often stressful for the patient and the specialist(s). Conclusions are frequently contested between specialists or between a patient and one or more specialists. When rheumatologists are asked to re-evaluate diagnoses, re-evaluations require combining new consultations and retrospective chart reviews. In paper-based patient records systems, it takes a concerted and time-consuming effort to track down a patient's charts in order to search for relevant longitudinal information. Retrospective reviews require access to portions of older patient charts for longitudinal review of lab tests and x-rays (objective data, medical

data) and progress notes (clinical data, subjective data). Re-evaluation may mean that a diagnosis is changed or ruled out, and that treatment plans are therefore changed. A rheumatologist comments on a re-evaluation:

> [A] patient came to see [me] with a diagnosis of Lupus, basically aches and pains, [she had been] on disability for years. [I] got all [the] old records, reviewed everything, reviewed all the [previous] blood tests and the current blood tests and the clinical grounds [that] this diagnosis was made on. [The patient] never had the diagnosis. People have a lot of diseases that they don't really have. But the only way of really knowing that is going back through old charts and records and seeing how this diagnosis was made in the first place.[51]

Evidence-based medicine is utopian in its motivation to conquer uncertainty, as uncertainty is a fact of life in clinical work. It is implicated in other utopian projects of rationalization, both in science and in management. Evidence-based medicine is aligned particularly with mathematization, with quantitative objectification of qualitative experience and interactions, and with technological and managerial quests to scientize medicine and clinical practice.

C.2. Technical design projects

Several technical design projects comprise the technical dimension of the vision for the invention of this electronic health record. These include but are not limited to medical informatics, object-oriented programming (bringing

about "the object world"), and building a comprehensive clinical information infrastructure (client server, network, and open architecture based). The design problems the Software Company and the HMO are trying to solve are informed by both practical technical requirements and technical utopian projects in medical informatics and the structured content strategy, controlled medical and clinical terminologies, object-oriented programming, and information infrastructure building.

My discussion of medical informatics is selective. I discuss *the structured content* and *templates first* strategies of the Software Company, standardized clinical vocabularies and controlled medical terminologies, and the significance of formal, explicit tools such as protocols embedded in on-line templates. On-line interactive templates are technological means for protocols and clinical practice guidelines. My discussions of object-orientation and "the object world" and clinical information infrastructure building are necessarily limited. In the EHR Prototype Project, my access was in the context of clinical use, in the HMO. I did not have access to the context of design per se nor to the EHR system designers in the Software Company other than in the EHR prototyping field sites, in joint meetings between HMO and Software Company staff in which I occasionally participated, and in the

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[51] Interview, 1996.

interviews conducted as part of an evaluation of templates initiated by the HMO in 1997. Nor did I have significant access to the HMO's Information Technology department, other than my exposure to the Information Technology department staff's priorities, problems, and interests as they were reported in the project meetings in which I participated. My understandings of the technical issues are limited for these reasons. My aim in discussing object-orientation and clinical information infrastructure building is to acknowledge these exacting technical efforts as they constitute EHR invention together with the clinical and managerial dimensions.

C.2.1. Medical informatics

Medical informatics generates supporting technologies for evidence-based medicine and genres of formal tools, particularly decision-analytic tools, for which aspects of clinical, technical, and managerial projects are inextricably combined. Medical informatics applies artificial intelligence (AI) to the medical domain, including the development of decision support systems and expert systems (e.g., Ball et al.: 1988; Berg: 1997a; Collen: 1995; Lindberg: 1979; Reggia and Tuhrim: 1985). The quests for the realization of artificial intelligence and expert systems in particular remain powerful constituents and inspirations for EHR/CPR development.

C.2.1.1. Structured content design strategy

The Software Company's strategic focus is on progress notes, the most general and narrative, and least structured form of clinical documentation and therefore the most elusive for review, retrieval, and analysis. Whereas early medical informatics mainly focused on expert systems, decision support systems, and other applications of artificial intelligence concepts to specialty domains (for example, cardiology, oncology),[52] the Software Company chose as its focus clinical documentation across the spectrum of clinical domains from primary care through the specialties, “the 80% of the chart that usually consists of handwritten or transcribed documentation" (Software Company brochure). In 1992, one of the physician founders of the Software Company explained the start-up company's view of the relationships between electronic health record and development of expert systems. The following passage is from my field notes.[53]

> [He] told me that their view is now that expert systems “aren't going to happen” in viable ways out in clinical settings for three to five years yet. [The Software Company]'s view is that “data needs to be collected for two to three years in the field, the real world environments of [pilot sites],” in order to

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[52] The computer-based record (CPR) was once referred to as "the step child" of medical informatics compared to more glamorous expert systems and decision support systems informed by artificial intelligence concepts.

[53] My ability to represent the originating ideals of the founders of the Software Company is limited. In 1992, when I approached the Software Company as a site for my dissertation field research, I was told by a member of its management team that "our attorneys advised us not to put anything in writing," a precautionary measure to protect the company’s intellectual property rights.

> develop what they consider to be “knowledge systems” prior to expert systems development. ... [The Software Company] has designed its architecture to support expert systems capabilities three to five years down the road, but, other than that, they see expert system development as a separate stage. I asked if he would say that they had “un-hinged” expert systems augmentation from the design process and he said yes, it's no longer something they see themselves doing concurrently. ... [T]hey've deferred expert systems as untenable until they've fully designed, tested and implemented their computer system in clinical environments. ... The Software Company group is also very skeptical about algorithms or rule-driven systems. ... He sketched an example on the blackboard to graphically dramatize the depth of his skepticism as a physician about what expert systems can and cannot do to help improve diagnostics of complex cases; that where you need the help of such programs, their utility drops off (Fieldnotes, August 26, 1992).

Through structured documentation, patient summaries are to be "automatically” generated as a by-product of clinical documentation. The Software Company's strong structured content documentation strategy aims for an elegant solution to a number of long-standing pragmatic problems that confront clinical practitioners daily, including: the illegibility of handwritten notes and / or the lack of clarity or indecipherability of idiosyncratic "cryptic" and "telegraphic" notes; time-consuming searches for critical information and gaps in timely availability of information; incompleteness of clinical documentation; redundancies of paper-based documentation; fragmentation of patient information across many separate records from different sources and sites of care; patient charts in which salient data are buried among many pages of notes and data that are unimportant or no-longer-important to the

clinical focus at hand; and additional documentation responsibilities that are driven by multi-layered quality assurance reviews, external regulatory requirements, and clinical, financial, and other organizational reporting requirements. The Software Company's design strategy to generate patient summaries from structured content documentation is engaged with utopian projects that are converging: the creation of comprehensive clinical documentation along continua of care (from all sites of care) that better supports both the collective and specialized information needs of members of multi-disciplinary multi-professional patient teams and networks (whether co-located or spatially, temporally, and geographically dispersed); the integration of a clinical research feedback loop into daily practice and the integration of the epidemiological project into general clinical practice; the realization of evidence-based medicine in evidence-based practice, including but not limited to the development and introduction of clinical practice guidelines and protocols; the ability to practice population-based management, particularly for patients living with chronic illnesses; and disease management guided by disease algorithms, critical paths, and care plans. The Software Company's strong structured content documentation strategy is thus positioned at the crossroads of converging clinical utopian projects and technical design projects.

The HMO, the Software Company's primary client and co-developer of the electronic health record, identified primary care as the testbed for the EHR. Primary care is the modus operandi of the HMO, its "bread and butter." According to the HMO, nearly sixty percent of its physicians are primary care physicians. The strategic plan for EHR prototyping agreed upon by the HMO and the Software Company was to begin in primary care (family medicine), add secondary care (specialty care in internal medicine, cardiology, nephrology and continuous ambulatory peritoneal dialysis treatment, rheumatology), then add hospital-based care (telemetry in critical care). EHR prototyping starts in outpatient primary care as the broad base of clinical practice and from that base will integrate outpatient and inpatient care.

Although the EHR design is clearly intended for the full spectrum of care, the physician founders of the Software Company began with a distinct (if implicit) orientation to emergency medicine as the practice metaphor for EHR development. Physician consultants to the Clinical Informatics team of the Software Company, the team responsible for creating and developing the structured clinical content knowledge base, practice in venues that include emergency medicine and hospital-based specialty care, as is common for physicians working in medical informatics who wish to keep their clinical skills current. There were on-going tensions between HMO and Software Company principals over the differences between the HMO's explicit

pragmatically-grounded primary care and philosophically-grounded preventive care orientations and the Software Company's implicit emergency medicine and hospital-based specialty care orientations. In the bi-weekly EHR Prototype Site Medical Center steering committee meetings of the HMO's regional and medical center clinical and technical staff, it was often said that "[the Software Company] does not understand primary care." For the Software Company, the HMO was "a demanding partner" representing an opportunity to develop the EHR design for integrated comprehensive care on a large scale. The most significant difference between the primary care and emergency medicine / specialty medicine perspectives lies in the on-going relationship with a patient in primary care and the preventive care model of the HMO which translates to different information needs regarding the picture of the patient's history (for example, broader content for the patient summary) and different kinds of responsibility for the patient beyond an episode or event than is typically the case for an emergentologist or consulting specialist who has a specific role for a finite period of time but does not necessarily know the patient before their interactions or in the future beyond the period of responsibility. This is clearly a simplified account, meant to point to a difference in perspectives between the HMO and the Software Company that required on-going negotiation throughout the EHR prototyping period.

The orientation of the Software Company's physicians towards emergency medicine and specialty care is not unusual within medical informatics. Designers of decision analytic tools typically select specialized clinical domains because they are already considerably defined and narrowed, and thus relatively "manageable problems." What is unusual about the EHR Prototype Project is that it begins with the vast terrain of primary care, considered far more difficult than the specialty domains. As a physician leader in the HMO explained, "we're going after the rate-limiting steps here--progress notes and primary care." The rationale is that solving "the rate-limiting step" of building an inclusive clinical database is a prerequisite for the genres of decision support tools and intelligent systems to work in clinical practice.

The "problem of physician data entry" becomes pivotal for organizations trying to implement EHRs/CPRs. There are commercially available computer-based patient record applications that address "the problem of physician data entry" in more modest and less demanding ways. But, during the early prototyping period, the leaders of the EHR Prototype Project consistently expressed desires to "go for the golden ring" and to fulfill "the dream," "the mission of the EHR."

To address "the problem of physician data entry," an important aspect of the technical design projects of EHR invention is to achieve a breakthrough

in user interface (UI) design so that the use of the EHR is as "easy to use," "familiar," and "transparent" as word processing. Usability is often defined at the level of user interface design. At the level of the user interface, usability encompasses ease of use, user-friendliness, familiarity and consistency of UI conventions, and aesthetic dimensions of design. The merger of aesthetics and practicality includes whether a system has an "intuitive" feeling, a reference to the intuitiveness of both the interface and the underlying philosophy of design; whether the documents one is able to create have requisite readability, clarity, even "beauty"; and whether there is some pleasure, excitement, or enjoyment in using the system. From its conception, the software application under development for the EHR Project has been highly regarded in the software industry and by the first clinicians to use it for its "beautiful," "elegant," and "intuitive" user interface. While the overall sensation was perceived by many clinicians as "intuitive," matching their 'visions" for what they imagined an EHR might be like, the particularities of the user interface design were subjected to intensive scrutiny and revision between prototype versions to improve usability at the most basic, practical level of a clinical user's experience using the application. For the EHR designers, an important technical design project is the effort to make the supra-ordinary demands of the system (relatively) transparent, to make the experience of using the EHR as intuitive and seemingly natural as possible, to

remove the burden of its conceptual and supra-ordinary representational structures from the perceptions of the clinician users of the system.

The Software Company's design strategy combines object-oriented programming with structured content as the mode for clinical documentation. Structured terms used for documentation come from the system's clinical content knowledge base and all structured documentation accumulates to the electronic substrate intended as a database for the queries of third party decision support systems, desktop queries from clinicians and administrators, and future outcomes analysis, among analytic capabilities. *Interactive templates* that are designed to facilitate structured content documentation are considered to be pivotal by the Software Company's clinical and technical staff. The Software Company expresses a "'templates first' strategy, [as] the paradigm for EHR design and use that templates ... become the primary interface [as the presentation layer and composing mode] for care providers."[54] *Templates first* refers to templates as a central feature of the EHR's user interface design meant to make structured content documentation viable in the time pressures of clinical work. Templates are described by members of the Product Development team as "the only way [the EHR] will ever be used clinically" because "without templates, [the application] can never be

[54] Quotes in the discussion of templates are from templates evaluation interviews, 1997, unless otherwise indicated.

time neutral." *Templates first* has a second meaning in that it refers to templates as the primary tool to facilitate and guide clinical documentation of minimum data sets using structured clinical content terms. "I think [the template] is the tool to facilitate standards of documentation and standards of care, by providing that instrument of [patient data] collection. And the instrument allows us to do process review, because you can look at the standard and the variance from the standard. That is really the heart of the matter ... that benchmarking and capture." Templates are "expressions of concepts" that interact with the structured clinical content knowledge base, tools "to build instruments for capturing information in a predictable way, and in an analyzable way." As one of the physician founders says of the relationship between templates and the clinical content knowledge base: "Our text has this certain life in it, it knows where it came from, it knows where it is going." Asked about the relationship between EHR templates and clinical practice guidelines and protocols, another Software Company physician responded:

> I see it as the same thing. You just carry it on, for the practice guideline. The good template *is* a practice guideline. It is tighter than the guideline. ... I would be pretty careful about putting required fields in to start out with. ... I would like to have it so that when somebody said, “We would like to have these required fields,” that we could say, “Well, sure, that is simple, you can do that.” But you do not want to turn people off right away. A protocol or a practice guideline, they are the same thing as far as I am concerned.

The Software Company and HMO clinicians struggle with the question: how can templates be created that will be usable in everyday practice? The initial design of the clinical content knowledge base, early EHR templates, and proposals to ensure that templates and clinical informatics content are up-to-date and authoritative share a common problem, as was frequently expressed: "They're book smart but how can we make them operational?" The question of how to create templates that will be usable for physicians in everyday moment-to-moment practice is similar to the question of how to create protocols and clinical practice guidelines that physicians can and will use. Templates share the technical dilemmas and problematics of formal decision analytic tools in relation to the logics of clinical practice. One of the creators of a decision analytic tool for cardiology acknowledged that "the program is outstanding on the core set of anticipated applications, but degrades rather ungracefully for problems just outside its domain of coverage" (Szolovits: 1982 cited by Berg: 1997a, p. 110). Regarding the possible extension of protocols to physicians, Greenfield et al. (1974) found "[t]he tight, direct, and encompassing control of the protocols for physician extenders was utterly unacceptable to physicians" (Greenfield et al.: 1974 cited by Berg: 1997a, p. 65). As for evidence-based medicine, the problems of continual integration of new knowledge and how to privilege canonical knowledge--given an ever-changing canon–present dilemmas for designers,

health care organizations, and clinical practitioners. One of the Software Company's physicians fervently advocates establishing a system of expert editorial reviews for templates developed from the clinical content knowledge base. Expert editorial reviews for templates would be modeled after the development of clinical research protocols and clinical practice guidelines.

C.2.1.2. Standardized clinical terminologies

Among controlled medical terminologies, the EHR Prototype Project is oriented to the Systematized Nomenclature of Medicine – International, known as SNOMED (e.g. Coté et al.: 1993; Rothwell: 1995), rather than the ICD (see, e.g. Gersenovic: 1995; ICD-9-CM: 1993) or Read Codes (e.g., O'Neil et al.: 1995). SNOMED is favored as more dynamic than the static ICD codes (see, e.g., Campbell: 1997; Chute et al.: 1996; Chute and Yang: 1995; Henry et al: 1993). Goals for the development of the Unified Medical Language System known as the UMLS (see, e.g. Cimino: 1995; Lindberg et al.: 1993; McCray and Nelson: 1995) and the General Architecture for Languages Encyclopedias and Nomenclatures in Medicine known as the GALEN consortium (see, e.g. Rector et al.: 1995), and SNOMED, the Nursing Interventions Classification known as the NIC, and certain of the other standardized terminologies are to bring into being tools and infrastructures that fluently map detailed clinical terms while preserving their relationships to the context of clinical cases. The architecture

of the EHR in the present is being designed in anticipation of these future developments. In its early use, however, it must evince its practicality without the imagined environment yet fully existing.

To understand the difficulties that standardization of clinical languages and the structured content design strategy encounter in practice, the history of the ICD by Bowker and Star is instructive (Bowker and Star: 1994). The ICD was initiated nearly one hundred years ago and is administered today by the World Health Organization. The ICD is the most widely used medical nomenclature as well as the most long-standing. In the early years of creating the ICD, physicians, epidemiologists, and urban statisticians argued for conflicting conceptual categories to suit their respective needs. In 1927, the chief medical statistician wrote:

> So-called administrative statistics have no value in the eyes of practitioners, who as a result are completely uninterested in it; whereas unless these practitioners provide exact data, then the scientific value of administrative statistics has to be called into question.[55]

> In particular, doctors saw the work of collecting data as trading off against clinical resources; statisticians wanted as much accurate information as possible. The task of filling in the death certificates falls on the doctor. She or he does not necessarily see the value in filling in a complex form to the

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[55] Societé des Nations, Organisation d'Hygiene, Commission d'Experts Statisiciens, CH / Experts Stat. / 1-43, 1927, communication du Chef de Service de la Statistique Médicale au Ministere Polonnais de l'Intérieure, quoted by Bowker and Star (1994).

> degree of accuracy required - after all, this patient is dead, and is the time not better spent on the living?[56]

The "residual categories"–"other diseases," "unknown or badly defined diseases"--were applied to nearly half of all causes of death in Paris in 1900. Contemporaneous analysts as well as Bowker and Star suggest that physicians were reluctant to name socially sensitive causes of death and that they left cause of death undefined to limit the time demands involved in filling in complicated forms.

There is significant heterogeneity in localized medical vocabularies as represented in medical records. Within a specialty, one pulmonologist may use the term "COLD," for "chronic obstructive lung disease," while a colleague in the same clinic may prefer "COPD," "chronic obstructive pulmonary disease," whereas a third colleague may insist on avoiding these non-specific terms altogether in favor of using more specific terms such as "chronic bronchitis," "emphysema," or "reactive airways disease," "RAD."[57]

Vocabularies, practices, new concepts and terms of communities and their members develop over time. It has been estimated that there are over

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[56] Ibid.

[57] Parts of the discussion of standardization of clinical languages, controlled medical terminologies, and the structured content design strategy appeared in Gregory, Mattison, and Linde: 1995. I am indebted to John E. Mattison, M.D. for our discussions of the local variability and dynamism of clinical vocabularies and the issues entailed in the development of controlled medical terminologies.

8,000 new terms added to the medical lexicon annually. Incorporation of new terms will always proceed more slowly than the evolution of the terms themselves. The available strategies for updating and managing the translatability of evolving, living language require exacting editorial review processes. Considerable time is required for consensus building and canonization of the myriad medical terms. These efforts involve identifying and filling in gaps in existing terminologies as well as identifying correlations between differing terminologies and concepts (see, e.g., Campbell: 1997; Chute: 1995; Henry et al.: 1993). Furthermore, the granularity to which canonization of terms is taken will vary significantly within and among different domains. For software developers and editors of controlled medical terminologies, an essential requirement is that the *architecture* is conceptualized and designed to support translatability between controlled medical terminologies and interoperability between clinical information applications and systems. To summarize, EHRs need to be designed with architectures open to on-going development of controlled medical terminologies that are moving targets at the same time that EHRs / CPRs are also moving targets. And all the while, the meanings of clinical documentation need to communicate between care providers.

Within and between controlled medical terminologies, a balance needs to be maintained between canonization and heterogeneity--with

sufficient control to ensure comparability and openness to ensure dynamic development. This conceptual balancing act raises a set of interrelated questions. How may a balance be struck between the need for shared vocabularies controlled for conceptual coherence and comparability and the need for localized and new terms and concepts? How will controlled medical terminologies and EHR systems accommodate variations among diverse clinicians guided by heterogeneous conceptual models for diseases and patient care? How will controlled medical terminologies handle the expansion of terms and concepts needed to discuss emerging knowledge of syndromes, illnesses, and modes of care?

Bowker and Star summarize lessons from the history of the ICD regarding "the management and use of information technologies in very large multinational organizations" that are also relevant to the HMO and EHR development.

> - [F]irst, there is a permanent tension between attempts at universal standardization of lists, and the local circumstances of those using them;
>
> - second, this tension should not, and cannot, be resolved by imposed standardization, because the problem is recursive;
>
> - third, rather, from the point of view of coordination, ad hoc responses to standardized lists can themselves be mined for their rich information about local circumstances, in turn, information technology might be tailored to support those needs, not subvert them;

> - fourth, this type of list is an example of the sort of object which must satisfy members of communities or organizations with conflicting requirements. In its creation, and later in its use, the complex list is a kind of knowledge representation, particularly useful for coordinating distributed work, which often contains requirements of this sort.
>
> ... The problem here can be seen as generic to all such efforts where diversity is the central issue in representing information (Bowker and Star: 1994).

They conclude that multiple perspectives and diversity should be actively supported, and that classification systems need to be realistically designed for degrees of uncertainty and ambiguity as well.

> ... It is unrealistic and counter-productive to try to destroy all uncertainty and ambiguity in these sorts of infrastructural tools. By their very nature, classification systems need appropriate degrees of both in order to work - only in a totally uniform world would it be even conceivable to try to impose total precision. Rather than root out all instances of ambiguity, analysts of standardized lists should instead seek clearly and consistently to define the degree of ambiguity that is appropriate to the object in question (Bowker and Star: 1994).

Structured coding of some kind for diagnoses, problems, and assessments is a crucial design feature for virtually every EHR/CPR system coming onto the market. Diagnostic coding is associated with billing and cost-containment. In the United States, coding of diagnoses and procedures is associated more frequently with hospital environments than with outpatient care, and with fee-for-service private practice more than with prepaid health care. Furthermore, coding is tinged by its association with Diagnostic Related Groups (DRGs) linked to ICD codes, used for billing purposes in fee-for-

service private practice and for cost containment rather than as meaningful indicators of clinical care (Gerst and Hardesty: 1992 cited by Bowker and Star: 1994). For these reasons, many care providers working in the HMO, in prepaid comprehensive care emphasizing preventive care and primary care, perceive codes for procedures, treatments, interventions, problems, and diagnoses as administrative, revenue-driven intrusions or burdens for clinical documentation of patient care encounters, rather than regarding coding as structured documentation of clinically relevant information about a patient's status and treatment that will be helpful to the clinician and his or her colleagues when the patient is next seen, and analyzable for future outcomes analysis.

Physicians who are committed to the future goals of outcomes research may well find themselves faced with both practice and ideological dilemmas (Billig: 1988) when trying to integrate use of ICD and other codes for structured documentation of medical problems in computer-based records within the constraints of everyday practice. In my pre-study, I found that "coded diagnosis" presented itself as a computer design issue in the view of clinicians learning to use computer systems that extend the use of standardized codes into outpatient or ambulatory care settings. Searching for the right ICD term to ascribe to assessments, problems, and diagnoses presented unexpected obstacles for new users of the rudimentary computer-

based record system[58] in the conversion between two CPR systems in the primary care clinic that I observed in early 1993. These difficulties presented an acute dilemma for a primary care physician who was intent on assigning codes for problems, diagnoses, and assessments in the new system exactly because the physician understood the importance of such coding for long-term values to be derived from clinical documentation. The physician, working in an outpatient clinic of the HMO, explains this dissonant first encounter with ICD codes as a feature of EHR/CPR software:

> It's not done with the outpatients, it's done for inpatients. So, I haven't dealt with that personally and that's something that's considered part of a fee-for-service and we're glad to avoid that, along with billing and all that goes along with it. I've always thought of it as being the business side of medicine which I don't want to deal with and which is why I chose ... an HMO.
>
> I think that, probably in the future, this will become important. I think it is becoming important in research ... and so the basic principle I have to agree with. I do think that we have to force ourselves to use the diagnoses.
>
> ... Our diagnoses were not the exact terminology that's used in that coding, so it was basically learning a new system. But having to do it at the same time that you're seeing patients and have the time constraints of fifteen minutes and all the other paperwork and phone work that one needs to do was frustrating

[58] The software application that I discuss in my 1993 pre-study of conversion between computer-based patient record systems is a different application developed by a different company than the EHR being co-developed by the Software Company and the HMO in the EHR Prototype Project.

> because it was so time-consuming ... trying to match up learning [ICD-9 codes in the system].[59]

Natural language processing (NLP) is considered to be an alternative strategy to structured content documentation in that (generally) physicians' *free text* documentation practices--electronic text typed into a computer or by dictation into a digital medium—continue and the burden of analysis shifts post hoc as analysis of narrative text (see, e.g., Sager et al.: 1995). The contrast between the two perspectives regarding *whether* and *how* clinicians' work practices should be changed emerges, then, as a strong point of difference between advocates of these two strategies. What appears most likely, however, is that EHR/CPR systems will provide software tools for both approaches and leave decisions about how these tools are deployed or combined to health care organizations and care providers. Ultimately, natural language processing and structured content strategies share a common set of problematics and dilemmas for design and use of EHRs/CPRs that are meant to generate analyzable data. A central dilemma arises that goes roughly like this: Analyzable clinical documentation requires changes in physicians' work practices yet should not be forced upon physicians--but physicians will not change their practices unless they are required or induced to do so.

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[59] Interview, June 1993.

The strong structured content strategy of this electronic patient record animates the incomplete utopian project of EHR invention as an historical carrier for a powerful set of unrealized ideals for medicine and health care whose trajectory, historically grounded in the initial proposals and ideals of founding physicians, researchers, and systems designers, is given new momentum and a new degree of imaginative power by a constellation of technological breakthroughs (or the belief therein) that make it possible to garner capital investments required for such efforts. The technological bandwagon of electronic health records and the structured content design strategy coincide with the managed care package emerging as the dominant mode of patient care organization and health care delivery in the United States.[60] Clinician inventors of EHRs / CPRs are creating tools that are part of this larger package. Among the forces contributing to the coincidence of EHR invention and the emerging managed care package are market changes and changes in policy that disrupted health care delivery systems, rendering *un-stuck* much that was taken for granted before; breakdowns of existing clinical information systems in the face of new demands generated by health care restructuring--expressed in the widely circulated statement that "the medical records system is broken"; and the emergence of new modes of care

[60] By "bandwagon" and "package," I am adapting Joan Fujimura's uses of these concepts in "The Molecular Biological Bandwagon in Cancer Research: Where Social Worlds Meet" (Fujimura: 1997).

associated with evidence-based medicine, one of the medicine-as-science projects. Some of these forces are linked to breakthroughs in medical, scientific, and clinical research (virology, genetics, accelerated clinical trials and the development of new treatments, therapies, and medications based on discoveries in virology and genetics), and some are made possible by evolving clinical information systems and informatics tools such as neural network analysis, artificial intelligence-based methodologies, and "intelligent" user interface tools.

C.2.1.3. Protocols and templates

What is my rationale for discussion of protocols in the technical dimension of electronic health record invention? I have discussed clinical practice guidelines as tools for the project of evidence-based medicine as a constituent of the clinical dimension clinical dimension. Protocols, clinical practice guidelines, and other decision analytic tools are interrelated with one another, and each of these genres of formal tools is important to medical informatics. On-line interactive templates are technological means for institutionalizing and extending their use. The design of templates, guidelines, and protocols are inextricably bound together. Protocols and templates in an EHR system are simultaneously technical and clinical artifacts. As a founding physician of the Software Company put it: "The good

template *is* a practice guideline. It is tighter than a guideline. ... A protocol or a practice guideline, they are the same thing as far as I am concerned."[61] What is new about protocols as decision analytic tools of medical informatics is not that protocols are new as resources for clinical practice, but how the genre of decision analytic protocols aim to extend and formalize clinical action in pursuit of the quests to scientize medicine and rationalize clinical practice.

How did physicians go from being archetypal experts to being inadequate to make the clinical decisions that confront them without the aid of decision support systems? How are the authority and expertise of physicians diminished, and how and where is the power of physicians then delegated? Berg (1997a) tells the history of protocols and decision analytic tools as a history of changing metaphors of physicians' practices that are recast as problems to be solved (rationalized) by the tools that co-construct the metaphors and thereby generate both the problems and the techniques for their rationalized solutions. In doing so, our understandings of medicine, physicians, and medical practices are transformed.

> ... The statistical tools or expert systems were not called upon to fix some pre-given, long-since-recognized flaws in physicians' performances. Rather, these tools provided the metaphors for the working and failing of the physician's mind in the first place. Nor was the protocol 'invented' as an answer to

[61] Templates evaluation interview, 1997.

> medical practice's problems. ... The view of medical practice as a scientific process of distinctive, clear-cut steps is the inseparable counterpart of the notion of the protocol as an organizer of stepwise actions, as the fulfillment of medical practice's scientific character. ... With the construction of the solutions the specific shape of the problems was co-produced (Berg: 1997a, p. 77).

Of the family of formal decision analytic tools, the protocol is the most generic. Berg characterizes the role of protocols in "capturing the clinic." "Research protocols attempt to replace the contingent flow of reactive activities with clear-cut, inter-institutionally comparable, standardized actions." In doing so, protocols introduce "'reproducibility and standardization' that will make a true science out of medical practice" (Berg: 1997a, pp. 60-61). In his analysis of decision analytic tools and their role in rationalizing medical work, Berg highlights the ubiquity of protocols and the multitude of types of protocols employed in clinical research and patient management, particularly in specialty domains such as oncology. For Berg, *protocol* is an umbrella term:

> ... a category of tools drawn upon to rationalize the practice of medicine [that] includes an array of techniques which go by a plethora of names: guidelines, algorithms, practice policies, standards, statements, protocols. ... All these tools, however, have in common that they are or can be read as a set of *instructions* telling medical personnel to do a certain thing in a certain situation. ... They may be elaborately designed as a flow chart containing great detail, or they may consist of a number of rather vague and general recommendations, but they all guide medical personnel through a sequence of steps. It is as an

> umbrella term indicating this feature that I use the term "protocol" (Berg: 1997a, p. 52, original emphasis).

Berg emphasizes the *coordinating* and *accumulating* roles of decision analytic tools, whether protocols, expert systems, or decision support systems. Protocols are archetypal in that a protocol extends coordination over time and space and amongst actors.

Protocols and on-line templates in EHRs / CPRs are examples of the ways in which technology creates new activities, new tasks, and changed practices. A clinical research protocol, or a clinical practice guideline, increases complexity by providing new means to coordinate complex activities and extends patient care networks.

> The highly complicated oncological treatment schedules, for instance, are only possible through the protocol's core role: its coordinating function makes the elaborately sequenced chemotherapeutical combinations and the highly differentiated diagnosis schemes practicable. ... A coordinating tool, in other words, is a means to increase the complexity of a local network and / or to extend this network in time and space (Berg: 1997a, pp. 138-139).

The use of formal decision analytic tools changes practices. Processes of diagnosis may shift further towards medical logic according to a formal tool's privileging of medical data over clinical data.

> Delegating tasks to a formal tool *transforms* the nature of those tasks. The introduction of a decision-support tool generates a propensity to refocus medical criteria on the elements that behave in predictable and easily traceable ways. Formal tools contain a predisposition to build *simple, robust*

> *worlds*, without too many interdependencies or weak spots where contingencies can leak back in.[62] In doing so, in selecting the measurements and indications that best fit its prerequisites, the breast cancer protocol *redefines* what eligibility for bone-marrow transplantation denotes--and, thus, what "potentially curable disseminated breast cancer" is (Berg: 1997a, p. 99, original emphasis).

The utopian character of EHR technical design projects also lies in the desire "to build *simple, robust worlds*, without too many interdependencies or weak spots where contingencies can leak back in." What Berg writes about the advocates of formal decision analytic tools, I found to be true of clinical and non-clinical EHR / CPR developers. "To them, the tools are like faithful, objective maps: representations of optimal practice that lead medical personnel toward supreme performance. They are windows on a perfect world" (Berg: 1997a, p. 169).

While Berg uses *protocol* broadly, I use it more specifically (other than in direct references to Berg's analysis of protocols), following its common uses in the talk of the EHR Prototype Project. As for the term *template, protocol* defies singular or fully articulable meaning; its meaning is nuanced according to context (what it refers to within a specific instance of patient care interaction or clinical narrative) and voice (who uses it, whether a nurse, a physician, an appointments clerk, an administrator, a systems designer whose background

[62] "This simplicity, it should be clear, is a consequence of the work performed to achieve this robustness..." (Berg: 1997a, p. 192, footnote 25).

is clinical, or an administrator or technical specialist without clinical background). For now, I wish only to point out the difference between Berg's inclusive use of the term in contrast to its meanings in the everyday discourse of the HMO and the EHR Prototype Project, in which clinical practice guidelines, medical-logical algorithms, and standards were regarded as specialized and distinct from protocols. The clinical research protocol, the particular type of protocol from which Berg generalizes, is a specialized category distinguished as such in discussions in the HMO; clinical research protocols are far more closely binding that any of the other categorical types mentioned above.

In the context of the EHR Prototype Project and the primary care settings to which I was exposed, “protocol” had two seemingly contradictory meanings. First, protocol had the functional meaning of a set of clinical procedures, organizational rules, or clinical-operational procedures and rules to be followed and adapted to the specifics of a clinical case and its circumstances. This is closer to the description of protocols by Strauss et al. (1997 (1985), discussed below). Secondly, when I heard "protocol" used as a generic term, protocol retained a principled meaning (often abstract and implicit) referring to the expert use of medical and clinical knowledge, principles in determining diagnosis, actions to be taken and their sequences,

and organizational know-how about resources to be called upon, and degrees of urgency required. The first, more specific meaning was apparently clear in joint discussions among clinical and non-clinical project participants and leaders, in which “protocol” typically referred to written or otherwise explicit protocol(s) associated with a specific organizational policy or procedure, standard of care or service. This sense comes closer to Berg's use of protocol as a "set of instructions." The second, more abstract and principled meaning of protocol was frequently used by clinicians to refer to knowledge learned and embodied, what may appear to be implicit knowledge to an observer; this sense of protocol often eluded shared understanding.

For a protocol or another decision analytic tool to work, to be usable and useful in practice, requires considerable work of alignment in design and use (Berg: 1997a; Katzenberg: 1997; Katzenberg et al.: 1996; Strauss et al.: 1997 (1985)). Design, use, and alignment are all iterative processes. Protocol development requires extensive participation from the ground up. Furthermore, protocols must be perpetually revised, as Strauss et al. emphasize.

> The nurses develop protocols of nursing care wherein hazards, actions, and resources are identified. These protocols become part of standard operating procedure. The development of these protocols and procedure manuals takes time, because a great deal of discussion is required and the input of many persons (nurses and others) may be involved. However, their revision is required for maximum clinical safety because of the rapid development of new knowledge, the

> introduction of new technology, and the constant appearance of new organizational contingencies. ... Nurses continually apprise each other of new information. Periods of slack in the work often are used to refresh infrequently used skills, to upgrade protocol and procedure manuals, to teach novices who are unfamiliar with risky procedures, and so on (Strauss et al.; 1997 (1985), pp. 86-87).

Berg characterizes protocols, literally, as "cookbook medicine."

> This tool does not primarily focus on a physician's decision but on the standardization of a sequence of actions. ... What is crucial is that the protocol does not intervene at any one point in time but stretches out across a whole period ... the 'decision' is not made 'elsewhere,' inside some black box (a computer, or, more figuratively, some statistical formula). There is no realm where this tool momentarily retracts itself. The protocol grasps physician by their shoulders and leads them here right, there left. Physicians may or may not understand why, but the path is laid out in front of them, on the piece of paper containing the recipe (Berg: 1997a, pp. 76-77).

He writes: "Protocols deny physicians the flexibility they require when problems become difficult--when, in other words, there is a need for a decision-support tool in the first place" (Berg: 1997a, p. 71). In arguing for this characterization of the leading role and power of protocols and the interests that protocols represent, Berg exemplifies the apprehensions of many physicians regarding the uses to which the increasing ubiquity and explication of protocols, facilitated by medical informatics, may be put. In the EHR Prototype Project, protocols, clinical practice guidelines, indeed, any type of mandatory requirements--including required fields in on-line

templates--were discussed with caution in deference to physicians' concerns over clinical decision-making--and in deference to physicians' power.

As I explain above, I heard an additional, clinically nuanced meaning to the use of protocol that was not reduced, and not reducible, to the fixed programs of action that the project of cookbook medicine implies. Rather, in the discussions of EHR prototyping, these issues were taken up as problems for decisions about the EHR system's design and its clinical and organizational use that were framed as a set of inter-related questions about automaticity versus judgment. How the genres of decision support tools--protocols, clinical practice guidelines, disease algorithms--may be designed to provide the flexibility required by the realities of clinical practice was regarded as a multi-faceted design problem concerning highly variable clinical cases and the HMO's practice model, and the EHR system and user interface design strategies. Berg writes, aptly, that: "Research protocols attempt to replace the contingent flow of reactive activities with clear-cut, inter-institutionally comparable, standardized actions" (Berg: 1997a, p. 161). Yet this represents only one side of the irreducible balance between *automaticity*–what can be delegated to computer-based tools and decisions about what they should do--and *judgment*--what clinical practitioners must decide to do from among possible actions that include whether or not a protocol and its sequence of actions are appropriate resources for addressing

a particular clinical instance in its interpersonal, temporal, operational, organizational, and historical circumstances. In another interpretation, Katzenberg (1997) regards protocols positively, as a potential shared resource between patients and care providers, for example in treatment for breast cancer, to support collaboration and coordination of exacting care plans that span extended periods of time.

In telephone triage conducted by registered nurses in Cardiology and Internal Medicine, protocols (implicit / trained and explicit / written) used by the nurse are important embodied and inscribed resources organizing telephone triage practices. Telephone messages to and from patients and telephone assessment and medical advice occur in a continuous stream of communication variously in between, following up or as precursors to in-person patient care encounters. Patient calls and messages are prioritized according to the acuity (severity) of the problems presented, including the registered nurse's judgment of degrees of risk in the context of the patient's overall health status. Registered nurses are qualified to provide medical advice within the scope of nursing practice and to determine and expedite referrals to a physician (a cardiologist or an internist) or to an urgent care or emergency service. Protocols and legacy systems are intermediaries organizing relationships between signs, symptoms, illnesses, and actions to be taken, between the patient, the registered nurse, the patient's cardiologist

and other physicians, other nursing staff, the appointments clerks, the chartroom personnel, and the patient's chart(s) and records in which previous signs, symptoms, illnesses, and actions taken are represented as histories that also co-construct these relationships. Processes of information infrastructure building and standardization are implicated in clinical information systems development generally and in the design strategy for this particular electronic health record system. Translating written protocols and embodied knowledge into on-line protocols in interactive templates is of special interest to the designers and developers of the EHR system-in-the-making. Transforming protocols cannot be accomplished locally but requires alignment with regional decision-making bodies and reviews by clinical, administrative, and operational practitioners; technical design and designers; communication media, technical protocols, and standards; existing and continuously evolving clinical and medical knowledge; signs, symptoms and their interactions with medical problems; disease algorithms and clinical practice guidelines; clinical and non-clinical organizational staff; domain experts for particular problems; medical records committees and medical records forms and their contents; and controlled medical and clinical vocabularies in electronic health records systems. Imagining a future scenario in which a nurse works with on-line interactive protocols, the medical problem presented by the patient must also be actively translated and

enrolled by the protocol, yet a particular medical problem presented by a particular individual can easily elude the formal medical-logical design of a protocol. In addition, a protocol may be developed for one disease whereas patients live with multiple problems; this is especially likely for a patient diagnosed with a cardiac problem and / or already assigned to an internist or sub-specialist for care (someone who is already an internal medicine patient is by definition living with higher acuity of one or more illnesses).

Citing critiques of medical logic tools by Feinstein (1967, 1987), Berg points out that the logic of independent variables in Bayseian and other statistical reasoning models for decision support and expert systems "... can be obtained only if clinicians ignore the epidemiologic realities of human ailments: many people have ... [undiscovered] disease, and many people have multiple co-existing diseases" (Feinstein: 1967 cited by Berg: 1997a). Because diagnosis and treatment plans are often interwoven,

> ... statistical goals often conflict with clinical goals ... threatening to further dehumanize medical practice. Moreover, and crucially, Feinstein (1987) argues that the 'decontextualized' nature of the statistical tools is unacceptable and utterly unscientific in a clinical context: 'The mathematical goals are aimed at eliminating details, using standardized models, and producing maximum reductions of variance in the available data ... [If] the clinician wants to preserve details, observe direct evidence of relationships, ... and arrive at conclusions that are clinically both cogent and consistent, the conventional mathematical goals will not always be satisfactory' (Feinstein (1987) quoted by Berg: 1997a, pp. 55-56).

Among the variations in clinical domains and settings that decision analytic tools encounter are differences in clinical databases due to different types of patients and patient populations, different definitions of medical problems, and regional or cultural differences in the presentation of some diseases. Clinical databases reflect specific populations and relationships within local communities and communities of practice. Combined with variations in the terminologies by which they are represented in patient records and other clinical data, these differences together constitute a problem of "non-transferability of databases." "This is more than the usual problem of physical portability of a program: it also involves resolving differences in medical definitions, varying standards of practice, and differences in patient population" (Reggia and Tuhrim: 1985 cited by Berg: 1997a, p. 107). Implicit in implementing a system whose logic requires use of standardized terminologies and documentation methods is that physicians and other clinicians must be "trained anew" to ensure consistent meanings of clinical and medical terms.

Medical expert system builders "embrace a clinical logic" in the course of development that requires immersion in the multiple logics of clinical practice in which "rationality is flexible, intelligent reasoning" (Berg: 1997a, p. 74). With an appreciation of clinical logics and the necessity of localization of decision analytic tools, expert system builders come to

understand that "medical practice's raison d'être lies in its pragmatic, substantive nature--and this should be strengthened, not replaced" (Berg: 1997a, p. 76). It is in this sense--when expert systems and protocols "embrace a clinical logic"–that they are then criticized by strong proponents of the projects of statistical inference and the clinical trial as ideals. To Eddy, as a leading advocate for evidence-based medicine, localized protocols rest on a "dangerous tautology" in that "they conflate what physician *should* do and what they *are* doing" (Eddy: 1990, original emphasis). Eddy is consistent in pointing to national bodies as the preferred position in policy hierarchies from which clinical practice guidelines should be promulgated. Seen from a situated practice perspective, however, reciprocal modification of design and use is the path to viable clinical use.

On-line protocols built into EHR/CPR templates are implicated in new possibilities for changes in divisions of labor amongst clinical staff, particularly among nursing staff (registered nurses, licensed vocational nurses also known as licensed practical nurses, trained clinical assistants also known as medical assistants, and "physician extenders" including but not limited to physician assistants, clinical nurse practitioners, and midwives. Efforts to change clinical divisions of labor are not new, nor are attempts to use protocols to extend the scope of physician extenders within the realm of practice of physicians, and of licensed vocational nurses and non-licensed

nursing personnel such as clinic assistants in the realm of practice of registered nurses. The development and use of a protocol in the early 1970s illustrates the dynamic by which protocols are conceived as means for extending the scope of practice of clinical staff who do not themselves have the qualifications of clinicians. The rationale for use of a protocol by physician extenders in this case was that "... the decisions about data-base collection and disposition are not made by the health assistant. They are made by the protocol, derived from local experience and peer consensus" (Greenfield et al.: 1974 cited by Berg: 1997a, p. 60). In the HMO, for such extensions to occur, the actions of physician extenders and nursing staff other than registered nurses are still carried out under the licensure and thus accountabilities, first, of the responsible physician(s) and lead nurse(s), next, of the physician-in-chief and administrator for the clinical service, and ultimately, on up the organizational chain of command to the local medical director and nursing administrators and the regional and corporate committees of chiefs of clinical services and administrators, and medical-legal counsel and departments.

For the HMO and other health care organizations, protocols are not necessarily perceived as tools for physicians but more often as tools that can extend the abilities of non-physicians and non-registered nurses to carry out certain activities that now require more qualified clinical personnel (licensed

staff who have the required clinical training to conduct assessment and give medical advice). The utilities envisioned for EHR templates as on-line protocols coincide with re-divisions of labor, particularly pressures that registered nurses are already facing (see, e.g. Gordon: 1997). EHR templates and on-line protocols are tools that can be extended to "virtual medicine," types of "telemedicine," and "distance care," including shifts towards self-care in which patients follow protocols. On-line protocols embedded in interactive templates in computer systems such as the EHR open up new degrees of extensibility--not only farther reach but also the extension of new forms of closure and monitoring of in-progress status of actions, managerial, administrative, and regulatory oversight, measurement, and evaluation.

With standardized medical and clinical terminologies and information classification systems, EHR invention shares the utopian technical and managerial projects of rendering documentation (languages) and work practices (clinical practice) "uniform, stable, and predictable" (Berg: 1997a, p. 92). The work of rendering practices visible, measurable, and traceable also renders practices and information amenable to their representation as components. These processes of standardizing clinical languages and objectifying practices change the ways that medical problems and clinical work are imagined, organized, and evaluated.

Many of the problems raised in the critiques of decision analytic tools also delimit disease management, population-based medicine, and evidence-based medicine models with which they are co-constructed. These models, threaded through the design logic of the electronic health record, contain and represent internal tensions in the EHR Prototype Project, in addition to the interplay of tensions between medical-logical models and the logic of situated clinical practices and interactions.

On-line templates and protocols exemplify crossovers between managerial, technical, and clinical utopian projects in that templates are constructs for carrying--circulating, distributing, encouraging, institutionalizing, and possibly enforcing--implicit and explicit organizational standards of care and their documentation. Recall the words of one of the Software Company physicians, that a template, a clinical practice guideline, and a protocol can be seen as "the same thing. ... The good template *is* a practice guideline." Furthermore, templates are regarded as potential means for changing divisions of labor amongst clinical personnel, especially between clinically credentialed and un-licensed nursing staff. Interactive on-line templates are important tools in the managerial projects of organizational alignment and asserting degrees of control over clinical decision-making.

C.2.2. The object world

Close to the end of the time I spent in the EHR Prototype Project, I became aware of tensions among some of my colleagues in the HMO regarding transitions to object oriented programming (see, e.g. Booch: 1994; Object Management Laboratory: 1996). Object-orientation is taken for granted by Software Company personnel and by HMO clinicians involved in defining clinical objects in clinical informatics efforts. In the fall of 1996, an in-service training session on object-orientation and client server and open architecture environments was conducted for the clinical systems development team in which I was a member. The seminar pointed to some of the ways that object-orientation is a different mode of conceptualization, a different kind of technical imagination, requiring different training and tools than the structured analysis traditions assumed to be standard practices among many of the technical specialists in the HMO until recently. Emphasis in structured analysis is on defining linear, sequential steps and breaking up activities into components (decomposition). Object-orientation also emphasizes components (objects), but emphasizes more dynamic, multi-variate, multi-directional processes, interactions, and relationships. By defining attributes and inheritance relationships between objects and classes of objects on a multi-directional or "360 degree" basis, object-oriented modeling can create the semblance of dynamic processes engaging multiple relationships between classes of objects based on the attributes and behaviors they inherit.

The transition from structured analysis to object-orientation also means historical and cognitive transitions between the traditions of structured analysis in its associations with scientific management and Taylorist approaches to work analysis and organization (see Agre: 1997). Whereas forms of object-orientation are well established standard practice in software design, it is not necessarily established as part of the information and communication technology infrastructures of large companies in general industry. In the EHR Prototype Project, I was told that object-orientation has never been implemented in an organization as large in scale as the HMO; to carry through object-orientation was perceived as both risky and necessary.

In the context of the EHR Prototype Project and the HMO's national clinical information infrastructure building efforts, object-orientation was described as the only path for linking or threading standardized medical and clinical terminologies--translated into clinical objects--from clinical documentation via structured entry--especially progress notes that are the narrative "glue" between data elements comprising patient records and charts--to clinical databases (for the intelligibility required for analysis) and "service masters" (standardized classificatory lists of orders--requests for service--that specify all types of laboratory tests, medications-dosage-route-frequency, diagnostic tests of all kinds, and other procedures and interventions)--and then through patient business objects in the HMO's organizational data

models. The HMO's data models are not based on object-oriented methodology, although it is believed that they can be "translated" into objects, in other words, objects can be modeled from the existing data models, and then taken through to the enterprise model as well. Technically, clinical objects are seen as the pathway for all of the goals of improving patient care via structured, standardized, and analyzable clinical documentation: evidence-based medicine and practice, development and use of clinical practice guidelines and protocols, assurance and monitoring of standards of care, and creating a clinical research feedback loop into daily practice. At the same time, objects are also seen as the pathway for linking business-financial-resource utilization-accounting attributes and criteria with clinical objects (in other words, complex clinical objects that also represent billable services). Objects are thus conceived as hybrid clinical-patient business objects. Furthermore, objects are seen as translators between the HMO and external entities such as external health care partners and networks of care providers. The achievement of *the object world* in which "my software can talk to your object" would mean, it is imagined, that "all this re-representation"—coding aligned with standardized and controlled terminologies for structured content documentation–will no longer be necessary. Commenting on the relationships between object-orientation and templates, the Software Company's architect expressed the vision of the future object world perceived

by participants in the EHR Prototype Project involved with clinical object modeling.

> ... [T]he thing that is going to be the most problematic for us is that we are going to have to be able to bring in all kinds of data that is not very structured. Re-represent it in a format that basically fits what we do. And put it out, too. The other side of this is that we are going to have to serve up information in any of a variety of formats. At least until the industry gets sort of standardized. I am looking ahead again, another year or two, maybe three before CORBA Med and the OMG and all the players that are trying [to define] what really are the clinical objects? ... *I see a point where we do not deal in codes at all. Here is a problem object. It has got a well defined set of attributes and values. That is exactly the form you deal with it in. You do not have to do all this re-representation to move it around. My software can talk to your object and vice versa.*
>
> The nature of the design is that templates are very free in the way they let you express what you want to do. Their intent, going forward, is that we want to create the ability for small templates to be more easily bound into and used in large templates. *Looking for more of an object-oriented model in the template space itself.* The idea of this is then that high quality single sentence templates can be built, certainly things like the [pharmacy] formulary, service master items, common diagnoses can be built and then it becomes possible to pull those together into collections.[63]

Creating the object world is an important utopian project. In the object world, "... we do not deal in codes at all. ... You do not have to do all this re-representation to move it around. My software can talk to your object and vice versa." The suggestion is that, in the object world in the near future

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[63] Templates evaluation interview, 1997, emphasis added.

(the architect predicts by 2002), many of the problematics of standardized clinical and medical terminologies will no longer matter. One begins to sense the advent of a state of rapture in which the troubles of the material world fall away.

The proponents of the structured content strategy say that they want to “go to the atomic level" of medical and clinical vocabularies and clinical objects. For now, I offer only a few comments on the nuances evoked by the clinicians' desire "to go to the atomic level" of clinical objects. The expression is powerfully scientizing and naturalizing at the same time. The *atomic level* regains invisibility (to the naked eye un-aided by scientific instrumentation and conceptualization) thus proposing transparency (or, further, a kind of equivalence in composition and substance), for example, between diabetes and diabetes as a complex clinical object composed of atomic components (clinical objects) in the hierarchy of classes, parents and children, their attributes and inheritance relationships.

Object-orientation and the creation of *the object world* warrant further discussion, however, that is beyond the scope of this dissertation. What does it mean to imagine diabetes as a clinical object? What does the translation of illnesses, clinical processes and actions, patient care business processes, and their interactions into the object world mean for changes in the imagination of diseases and patient care? What changes are entailed in transitions from

structured analysis to object-orientation and what differences does object-orientation make in the ways work practices are imagined, organized, and redesigned? What does it mean to go to the atomic level of clinical objects? How does the utopian "search for a perfect language" recur in desires to reinvent clinical language and create the object world? In future discussions and analysis, I intend to explore these questions.

C.2.3. Clinical information infrastructure building

> It's not about care providers, it's not about patients. It's about system, and infrastructure.[64]

For the HMO, the invention of the EHR is part of a national clinical information infrastructure building effort that includes the parallel development of several other clinical information applications to be integrated with the electronic health record, with each other, and with non-clinical information systems.[65] Creating the electronic health record system entails the transition from paper-based patient charts and records to on-line patient records in a distributed computer-based system. For the Information Technology department staff, the overall effort involves not only a transition from paper to electronic patient data and translations from structured analysis

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[64] Software Company physician, interview 1997.

[65] For critical discussions of information infrastructure building, see e.g., Hanseth and Monteiro; Monteiro and Hanseth: 1995; Monteiro, Hanseth and Hatling: 1996; Star and Ruhleder: 1996.

to object orientation, but also transitions to a client server, open architecture environment (to be able to "plug and play" specialized third party applications), and broad-band high resolution multi-media information and communication technologies. In the technical design projects of clinical information infrastructure building, models of interactions between patients and care providers in a client server environment are schematized as "one to one, many to one, one to many, and many to many" (reminiscent of the history of telecommunications broadcasting). For the HMO, with more than twenty hospitals and more than 250 ambulatory clinics in states across the United States, these changes entail numerous transitions that are necessarily intricate and large-scale at the same time.

In 1993, when the HMO had twelve geographic regions, there were at least as many EHR/CPR projects in progress. In 1995, the national corporate headquarters mandated "convergence" to one electronic health record system as part of building an organization-wide clinical information infrastructure. The consolidation of the regions was mandated at approximately the same time. Even so, one region remained outside the integration mandate for a singular EHR/CPR system because the exempt region had successfully implemented a different, commercially available system, in other words, a computer-based patient record application that did not entail prototyping.

I have pointed out above that it is an enormous undertaking for an organization to accomplish a transition to object-orientation as the principle mode of analysis, systems design, and programming from an existing infrastructural investment in structured analysis. By infrastructure, I mean not only existing technical systems but also the practices of business analysis and the tools and conventions for conceptualizing analyses of clinical work and systems design. It is not only that clinical staff need to be "trained anew"--training throughout an organization is an important aspect of creating its information infrastructure. Writing about the finance industries, Adler points out that in settings in which new technology is introduced for information-intensive work, managers must contend with the “fragility” of fully on-line systems and the concomitant “concern for data integrity,” and “a pressing need for training of lower-level personnel, not only in basic computer literacy, but also in the nature of the overall computer processing system and even in the logic of the accounting procedure” (Adler: 1986, p. 10).

C.3. Managerial and regulatory projects

Up to this point, I have sketched a brief history of the HMO and the relationships between the EHR Prototype Project and clinical and technical utopian projects, particularly those that are manifest in medical informatics. In the discussion below, I offer a description of the managerial dimension of

EHR/CPR invention. The organizational regimes that comprise the managerial dimension add to the definition of "patient care" and "improving patient care" by incorporating the demands of organizational, inter-organizational, and external managerial and regulatory perspectives and agendas. The "beautiful logic" of this particular EHR design strategy--and to whom it is beautiful--cannot be understood without an appreciation of the managerial dimension; all three dimensions inter-animate the incomplete utopian project of EHR invention. None of the three broad dimensions--clinical, technical, or managerial--ever stands on its own; they are schematized analytically, disentangled in order to discuss how they interact in the interplay between the logics of the activity of patient care and imagination of improving patient care, and the logics of the EHR system-in-the-making and imagined future scenarios of patient care with its use (discussed in Chapter IV: Changing Patient Care).

Calling this dimension "managerial" may be a misnomer. Measurement purposes may be better redefined as managerial, administrative, regulatory, and market-oriented (as for benchmarking surveys). These may be internal (organizational), external (governmental or market-oriented), or all of the former. A 1994 report to the United States General Accounting Office categorized multiple documentation requirements for administrative, financial, and clinical purposes that are defined as

informational requirements for computer-based records. These include quality assurance (QA), information for consumers and providers, and policy development. Health care information systems are expected to improve the quality of data, the quality of care, and the cost effectiveness of care.

Management agendas are important to the incomplete utopian project of EHR invention. These include: control over clinical decision-making; industrial efficiency and Taylorist work organization; the use of continuous electronic audits to monitor, measure, and evaluate performance; and downward pressures on divisions of labor. Understanding the organization of work in clinical settings of large scale enterprises in the United States health care system helps to explain what appear to be surprising, even illogical, dilemmas encountered in efforts to incorporate structured content documentation to generate coded patient profiles into daily clinical practice, on the one hand, and what seem at first to be incongruous or antithetical rejections of long-term goals of EHRs / CPRs regarding the implementation of clinical guidelines and outcomes research, on the other.

Institutional managerial, administrative, regulatory, and benchmarking processes and agendas powerfully shape patient care activities, clinical documentation practices and content, and work organization. In the activity of patient care, one need only think of the ever-present role of time--keeping on schedule, managing the choreography of

clinical and ancillary personnel and their actions (orders, approvals, appointments, tests, procedures, records, reports)--to appreciate how administrative and managerial work are inseparably intermixed with patient-care provider interactions and caregiving. Such work includes individual, interactional, and institutional accountabilities for planning, evaluation of the consequences of clinical actions, use of resources, continuous learning and integration of information regarding changing clinical and medical knowledge, iterative development of protocols (clinical, clinical-operational, and organizational), use of clinical practice guidelines and other models for managing diseases and their treatment, development of new ways of working, incorporation of changes in business processes, changes in divisions of labor, and integration of new and revised rules and regulations.

C.3.1. Measurement mandates

Among *measurement regimes* that contribute to the managerial dimension of EHR invention, three broad types of purposes for measurement, monitoring, and evaluation can be described: (1) managerial and administrative purposes within a particular type of health care organization, in this case a large non-profit HMO and integrated care environment; (2) regulatory quality assurance oversight and monitoring processes, whether internal or external mechanisms of public scrutiny by responsible governmental bodies; and (3) benchmarking surveys by payers of health care

services, market-oriented and cost-benefit evaluation mechanisms. Each of these managerial, administrative, regulatory, evaluative, and benchmarking activities translates into informational requirements for the EHR system-in-the-making, and all are continuous quality improvement processes. The three strands of the managerial dimension--managerial and administrative, regulatory quality assurance oversight, and benchmarking for health care payers--are inter-related but distinct. They have different origins and they pull in different directions. Ensuring standards of patient care is the intention of quality improvement measures. Performance measurement is a primary means for influencing work practices in health care as well as in general industry. The "measurement mandate" arises during the 1970s, when cost-containment efforts were established to abate soaring costs (see, e.g., Millenson: 1997). During the same period, reform proposals, including proposals to create HMOs and to encourage health care team approaches as ways to broaden access to health care services, were coopted by political and business conservatives, and, on the other hand, patients' rights movements joined generalized movements for the rights of social groups including consumer movements (Starr: 1982; Strauss et al.: 1997 (1985)). In the 1970s, planning and regulation were linked and the U.S. Congress mandated that health planning agencies "not only to control costs, but also to improve the accessibility, acceptability, continuity, and quality of services. 'Scientific

planning with teeth' had been the motto..." (Starr: 1982, p. 415). The oversight practices and the expression--"scientific planning with teeth"–signify cross-overs between the managerial, regulatory, and clinical utopian projects in that they are motivated not only by desires to rationalize health care organizations and control costs but also by advocacy of patients' rights to quality care, to the protection of clinical research subjects' rights, and to privacy of confidential patient data. Evaluation and monitoring has moved rapidly, and continues to move apace, from its original focus on hospital-based care to the outpatient care environment for which criteria and measurements need to be translated and specified in relation to the diverse spectrum of ambulatory clinical services.

In the third year of my work in the EHR Prototype Project, I was asked to develop a conceptual "evaluation framework" for the EHR prototype. In collaboration with the clinician leaders of the EHR Prototype Project, we drafted a multi-dimensional approach in principle (a conceptual proposal) to evaluate the prototype in relation to the HMO's on-going methods of measurement and evaluation for defining and achieving corporate strategic goals and accountabilities. In addition, the EHR evaluation framework proposed ways to assess new capabilities that the EHR system is expected to provide over time given its design logic. Principle among the latter are new clinical information tools to help visualize longitudinal pictures

of a patient's health and care by multiple providers across diverse care settings and modes of care (primary, specialty, and hospital care; physical, rehabilitative, and psychological therapy and counseling; education courses and training to help a patient integrate complex care plans into his or her life). Clinical information tools that can be used to create virtually integrated pictures that are shared among care providers offer new kinds of overviews and visualizations of patient trajectories. Two statements in the proposal for EHR evaluation underscore these hopes and intentions for the future EHR system.

> Providing new tools to enhance and support patient participation in plans of care and shared decision-making and active patient collaboration with care providers and teams is a key concept for EHR design and use; longitudinal evaluation will address patient health status, functional status and quality of life in relation to plans of care.

> As a new clinical information system the EHR will provide qualitatively different data that connect patient-provider interactions to episodes of care, i.e. beyond office visits or single encounters, including virtual encounters, thus contributing to analysis of continuity of care across diverse sites of care within [the HMO]'s integrated health care delivery system.

The conceptual proposal provides a sense of the layers of evaluative measurement already institutionalized by the HMO as these are translated into reporting requirements and capabilities of the EHR system, and the anticipated integration of the EHR's capabilities with on-going organizational, regulatory, and market benchmarking mechanisms. The proposal for EHR

evaluation comprised five dimensions: (1) patient satisfaction and service to the HMO's patients; (2) clinicians' and patient care teams' satisfaction and performance; (3) quality of care and clinical strategic goals; (4) reporting capabilities for clinicians, patient care teams, administrators, and clinical researchers; and (5) operational analysis including work flow, information systems integration, and resource utilization. For each dimension, qualitative as well as quantitative evaluation research was proposed. To give an example of the content of a dimension, in the schema of the proposal the dimension of EHR reporting capabilities includes: meeting the purposes of regulatory reporting requirements; supporting quality assurance requirements and processes (for which there are five levels from reviews of clinical documentation in samples of patient charts to a clinical audit required upon a patient's death in hospital); monitoring clinical strategic goals and development and implementation of clinical practice guidelines and protocols; supporting outcomes analysis, clinical research and epidemiological data collection; providing capabilities for desktop queries by clinicians to manage patient populations (for example for patients diagnosed with coronary artery disease), and by administrators to conduct chart reviews for quality assurance; and management and reporting capabilities to assess frequency and patterns of EHR use and to assess EHR design for clinical use..

We recommended a set of guiding principles to conduct evaluation of an innovation in a principled manner: to keep a solid grounding with clinicians and patients as the primary constituencies; to insist on a multi-dimensional approach employing both qualitative and quantitative methods, irreducible to single points of quantification and without privileging any singular measure or dimension; to treat the evaluative indicators and measures themselves as iterative and open to change--*to prototype the evaluation*--in order to follow the EHR prototype as "a moving target"; and to ensure active participation of health care practitioners using the EHR in evaluation of its design and use.

The EHR prototype evaluation framework was developed primarily with clinician leaders (physicians and nurses) within the HMO; thus, it reflects the perspective of the Physician Partnership. As a conceptual framework that suggests the alignment and integration of the EHR system with on-going organizational processes, the proposal is a statement of the vision of physician and nursing leaders who launched the EHR Prototype Project. The conceptual framework reflects elements of the organization's managerial philosophy and philosophy of design for the EHR system. One of its assumptions is that strategies for organization-wide use of the EHR will "combine software functionality design and operational analysis for redesign and improvements." The criteria for evaluation of the EHR are to be aligned

with the HMO's national and regional strategic goals and "simultaneously aligned with strategic goals including local Continuous Quality Improvement targets, for the ... Medical Center, Clinic, Department and Modules" where the EHR is in clinical use. The proposal identifies team-oriented care as integral to the "design philosophy of the EHR": "In keeping with the design philosophy for the EHR, the evaluation categories are designed for multi-professional and multi-disciplinary clinical teams and organizational networks including ancillary services."

One of the assumptions of the evaluation proposal is that the EHR will generate new types of information. A few of the EHR physicians believe that such new information has the potential to change the ways that physician productivity is measured, for example towards a care team basis, patient panel basis, and / or population basis (the health status of the population of patients cared for by the care providers in a team and / or department). The HMO is unlikely to change its productivity measures in the near future.

One way to understand an organization's desires and expectations for a new technological system is to understand how the new system is to be evaluated and what kinds of information and reports it is expected to generate. Establishing and meeting annual clinical strategic goals and integrating clinical research and feedback on outcomes and treatments are prominent goals among the HMO's managerial and administrative projects. If

we consider processes of evaluation as constituents of the managerial dimension, this proposal and plan for comprehensive evaluation of the EHR prototype can be understood as an expression of managerial as well as clinical criteria for the new system. The evaluation framework also suggests the relationships--the mapping, alignment, and integration--between monitoring and reporting capabilities to be built into the EHR system– translated as information requirements and data analysis capabilities--and the on-going evaluation, performance measurement, quality assurance, clinical research, and continuous quality improvement processes that the HMO region already has in place. The proposed plan was never carried out but served as a conceptual framework for evaluative research towards the end of the EHR Prototype Project based in the regional Physician Partnership, before absorption of EHR development into the national clinical information infrastructure building efforts managed by the Information Technology department of the corporate headquarters.[66]

Through the work on the EHR evaluation framework, I gained understandings of the array of on-going evaluative, managerial, regulatory,

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[66] The EHR Prototype Project was originally championed by the regional Physician Partnership group and the regional Information Technology department. Subsequently, the locus of control of all clinical information systems efforts moved decidedly from the regional Physician Partnership groups to the HMO's corporate administrative offices, also the organizational home for its Information Technology departments. The approach toward evaluation of clinical information systems veered sharply towards performance measurement as a primary method for influencing, changing, and enforcing clinical work practices.

quality assurance, and quality improvement processes with which the electronic health record is to be integrated within the organization, the HMO's "technologies of accountability" (Suchman: 1991). The monitoring and evaluation practices that comprise the managerial dimension of EHR invention can also be seen as an example of the extension of accounting practices into new areas (e.g., Miller, P.), particularly the movement of quantitative measurement as the primary mode of evaluation into areas of qualitative experience--here, patient care interactions, clinical decisions and work practices, and the health and quality of life of patients.

The HMO has a more developed internal apparatus for management and administrative oversight than most health care organizations (Starr: 1982; Institute for the Future: 1997). As for its competitors in the United States managed care market, it is subject to the exigencies of external regulatory oversight and monitoring from the public domain, and market benchmarking evaluations demanded by consortia of employers who are health care payers. Historically, however, the HMO has also been a *source* for methods of managerial measurement, continuous quality improvement, and operational analysis. Within the HMO, internal and external evaluative means are continuously integrated, aligned, consolidated, concatenated, and translated

into common methods and data elements (components, objects) where possible.

Quality of care has different nuances depending on context, variously referring to standards of care (establishment and enforcement of quality standards), or to management of patients' health risks (protecting patients from preventable risks) and risk management (protecting institutions from risk liabilities), or to a general concept of quality of care experiences and expectations of patients. Consumerist concepts also enter into competing concepts of quality care, as is evident in the HMO's attempt to formulate a unity between evidence-based medicine and "personalized" care. "Affordability" and "value" are market-oriented expressions of quality of care derived from cost-benefit analyses that are factored into benefits plans for health care coverage negotiated between employers and the HMO.

The concept of quality of care includes continuous quality improvement through the integration of new knowledge and through the iterative development of practices based on the feedback loop of evaluation of states of the practices and the high and low markers within an organization measured across points in time. Systems of governmental regulatory oversight are meant to ensure clinical and ethical responsibilities through the concept of quality of care. The market-driven benchmarking mechanisms are established by consortia of large employers that are the payers of health care

in the United States system. Market-oriented surveys and governmental and organizational mechanisms influence each other. Employers and business consortia emphasize "affordability" as do the managers of health care institutions. Commodification of patient care is further reinforced through comparisons with competitors' practices.

The elaboration of the managerial and regulatory systems and techniques contributes to the phenomenon of "the disappearing patient" in purportedly patient-centered clinical information systems design, somewhat ironically given the rhetoric of patient-centered models. Another path along which the patient disappears is through the data matrices of medical-logical models that are archetypically in pursuit of formalisms and mathematization exemplified by disease algorithms and the calculative rationality of evidence-based medicine.

Managerial utopian projects also point towards the commodification of patient care: rule-setting and definitions of clinical responsibilities according to interpretations of the boundaries of available "evidence"; cost-benefit analyses of clinical outcomes of particular treatments in relation to states of illness and patient populations that also translate into parameters negotiated and defined in health benefits packages; the development of ever more fine-grained means to account for financial costs and uses of resources; and inclusion of the consumer model in partial and often confounding ways.

Such business and managerial interests must always be negotiated with clinical obligations and ethical commitments of patient care. Two cornerstones of the HMO's approach, its orientations to comprehensive care and its preventive care philosophy, are also conceived as ways to combine cost-effectiveness and ethical commitments. Following these principles, for example, the HMO region has received acclaim for the care of people living with end stage renal disease (ESRD).

C.3.2. Continuous electronic audits

Clinician leaders in the EHR Prototype Project frequently expressed an intense desire that clinicians should control EHR development and deployment; that clinical information tools should, first and foremost, serve clinicians and clinical goals. Following this emphasis, administrative goals and financial accounting should follow, not lead, EHR development. It is the EHR physicians' (utopian) hope that "financially and administratively relevant terms can be *derived* from clinically relevant documentation rather than *vice versa*" (Gregory et al.: 1995, original emphasis).

An electronic audit gives the impression that everything can be made accessible and / or visible, that everything one needs to know can be rendered as traceable data. As a senior administrative physician said, and as was often said when discussion turned to managerial and regulatory accountabilities, "to measure something, first it must be made visible." The act of making

something visible in order to be measurable is an act of *rendering*;[67] the act of rendering involves conceptualizing--re-imagining--the phenomenon to be measured. The movement of methods of quantitative representation and measurement into further reaches of qualitative phenomena--here the complex interactions of clinical narratives in the changing contexts of the lifeworlds of patients and members of patient care teams and organizational networks--is consequential in shaping how patient care is perceived--what is seen or not, how these are valued or not--and how these renderings are translated into clinical and non-clinical databases.

The HMO's organizational culture is shaped by its traditions of management engineering, motion-time-measurement (MTM), work sampling, and other methods employed by its management engineering and operational analysis departments. From this long tradition, the HMO has a tendency to "measure everything that moves." Yet there are also clinically meaningful purposes that motivate audits of clinical work, certain kinds of monitoring for

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[67] Following are selected definitions of *render*. *Rendere*, to alter, derives by analogy from *prendere*, to take, and from *reddere*, to give back. Among its many nuances, to *render* means: "(1) to cause to be or become; make; (2) to do; perform; (3) to furnish; provide; (4) to exhibit or show...; (5) to present for consideration, approval, payment, action, etc., as an account; ... (10) to represent; to depict, as in a painting; ... (12) to bring out the meaning of by performance or execution; interpret, as a part in a drama, a piece of music, etc.; ... (19) to provide due reward; ..." Synonyms for *render* include "give, supply, contribute, afford, demonstrate, cede, yield." A *rendering* evokes rich and active meanings: "(1) an instance of or the act of interpretation, rendition, or depiction, as of a dramatic part, a musical composition, an idea, etc.; ... (2) a translation; ... (3) a representation of a building interior, etc., executed in perspective and usually done for purposes

evaluation of clinical work and for establishing tracking systems to know the status of patients or the in-progress status of clinical orders, actions, and efficacy of treatments. For example, registered nurses conducting telephone triage with cardiology and internal medicine patients devised paper-based tracking systems in order to follow the status of messages, responses to patients, and, in certain instances, actions taken (closure). The nurses began keeping a handwritten list to follow up on whether patients advised to go to the emergency room did so, what happened at the emergency room, and the patients' health status. The ability to view the in-progress status of physicians' orders and the respective responsibilities for action by clinical and non-clinical staff are desirable capabilities of the proposed design of the EHR's on-line worklists, orders, and "to do" lists. The continuous electronic audit, a technical by-product of an EHR/CPR system, makes it possible to address some problems but raises new difficulties at the same time. On-line worklists and orders extend the visibility of actions and performance monitoring capabilities, as use of EHR/CPR systems inevitably requires an individual log-on for the security and confidentiality of patient data and generates a date and time stamp automatically for each entry. Breaches of confidentiality become traceable via individual security log-ons, yet concerns

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of presentation; ..." Webster's Encyclopedic Unabridged Dictionary of the English Language: Gramercy Books, Dilithium Press, Ltd., Random House, NY: 1994.

regarding patient confidentiality are heightened by the spectre of ubiquitous computer-based patient records.

New auditing capabilities of the EHR system are created "by design" (Noble), not only created by the audit trails that generally result from computer use. Particular software functionalities, tools, and capabilities are being elaborated and designed. Detailed on-line orders, worklists, and "to do" lists are welcome ideas to many practitioners, yet these quickly threaten to create "redundancy problems." As an extension of the HMO's performance measurement regime and its desire to institutionalize evidence-based medicine, HMO clinical and technical leaders of the EHR Prototype Project aim to measure "auto-conformance" of EHR use, for example, for "optimal use" of structured content documentation, completion of minimum data sets, and use of institutionally developed templates for clinical practice guidelines and protocols. Attributes of clinical objects can also define relationships to resource utilization and financial costs and billing.

C.3.3. Risk and risk management

If clinicians have a desire that an electronic health record could mean an end to mistakes, managers have a desire never again to be liable. In their discussion of chronic illness and hospitalization, Strauss et al. make a distinction between *risk* and *danger* that is useful for thinking about risk as liability. "For purposes of clarity, we are going to refer to the hazards of

medical intervention as 'risk,' reserving the term 'danger' for those arising from the illness itself and from various contingencies arising to threaten the clinical safety of the patients" (Strauss et al.: 1997 (1985), p. 70). *Risk* has another common usage in clinical language (and in the clinical content of the EHR) as *risk factors* for illnesses. Risk factors may be medical, for example high blood pressure or high cholesterol, or they may be related to family history, for example a family history of breast cancer, or they may be risk factors related to social history, for example smoking or alcohol or drug abuse. In the discussion of risk from a managerial perspective, I use risk to refer to liability in the context of risk management. Starr attributes the managerial impetus to scrutinize mistakes and manage risk more aggressively to the rise of corporate medicine. "Under corporate management, there is also likely to be close scrutiny of mistakes, if only because of corporate liability for malpractice" (Starr; 1982, p. 447).

If and when such clinical information tools are successfully created, how will EHRs/CPRs weigh into risk assessment and identification of risk for patients? In complicated and contradictory ways, in which the development of clinical information systems, their uses, organizational and local contexts, and specific clinical contexts interact in practice. The EHR is being designed to make it possible to see which individuals in which teams in which departments did or did not do what, when, and where. A member of the

Software Company's product design team used the gestural image of a scale progressively tipping towards the clinical practitioner to explain how responsibilities are shifting. Software design and health care companies will devise means to insulate themselves institutionally from liability. One way to do so is to institutionalize policies (protocols) regarding clinicians' use of formalized decision support tools such as clinical practice guidelines. From an institutional point of view, whether a clinical practitioner uses such a tool and how he or she makes use of it are extensions of risk management and allocation of risk as well as matters of disciplining a practice and disciplining powerful practitioners.

Physicians will have the additional responsibility of thinking about the consequences of what and how they document for an EHR's "accumulating task" (Berg: 1997a). They must learn something of the logic of clinical information tools and how to "continually gloss their activities in terms of the repercussions this intervention will have within the formal system (Suchman: 1993)" (Berg: 1997a, pp. 149-150). Just as electronic documentation can be used as evidence of "the rational and standard character of [physicians'] actions'" (Berg: 1997a), it can be used to demonstrate deviations from standards as well

C.3.4. A culture of alignment

EHR Prototype Project leaders with whom I worked took pride in describing the HMO as "a culture of alignment." This is one reason that they believe that the HMO is positioned to institutionalize new clinical information systems such as the EHR system throughout the organization more readily than other health care organizations. The institutional culture is powerfully oriented towards best practices with a long tradition of management engineering and, now, re-engineering. The company employs cadres of management engineers, business analysts, operational and work flow analysts, and internal and external consultants. Frustrations were frequently expressed over the difficulties of finding the best way to organize an activity. Aspects of activities to be addressed through re-engineering include how to streamline delivery of a service, how to reduce redundancies of documentation and steps required, how to capture all revenues associated with services, how to take advantage of economies of scale, and how to define divisions of labor among types of health care providers (including primary care physicians, sub-specialists, "physician extenders" such as physician assistants, nurse practitioners, and midwives, and case managers, registered nurses, licensed vocational nurses, clinic assistants, therapists, social workers, dietitians, and other clinical ancillary services providers). Management engineering traditions coexist with the orientation of many of the EHR Prototype Project leaders towards local practices as sites for innovation.

This is a corporate culture of ever tighter alignment between enterprise-wide strategic goals and local work practices. The HMO has institutionalized an intensive performance measurement regime. Based on my experience in the clinics and the headquarters offices, I perceive the culture as time-pressured and intensely measured with performance goals tightly aligned with institutional strategic objectives. These hierarchical organizing principles may seem to contradict the emphasis on localized work practices. In total quality management (TQM) or continuous quality improvement (CQI) strategies, however, local work teams represent sites for spawning innovations as well as sites that must absorb change initiatives to align their practices with organization-wide re-engineering and restructuring. The balance to be struck is common to continuous quality improvement efforts: what degree of autonomy, flexibility, or breathing space must there be in order to encourage the generation of ideas and innovations from the grass-roots? How do innovations from below come about and how are they then integrated within an overall system of alignment? Leaders in the EHR Prototype Project also expressed a commitment to local care teams as sites for innovative work practices that represent important variations and degrees of local autonomy to be accommodated and supported by an EHR system. Countervailing views were expressed informally.

The HMO is inclined to "measure everything that moves," as the saying goes. The HMO has an extensive system for tracking statistical measurements--time-keeping, numbers-keeping, resource utilization and cost-accounting–for physicians, for appointments clerks, and for administrators. Statistical measurements and “objective reports” of physicians' work are regularly generated. A physician who came to the HMO from a private fee-for-service clinic sees this--"practice in a goldfish bowl"--as distinctive to practice in an HMO. In private practice, colleagues do not usually see information regarding one another's performance. In this physician's view, "it is much easier for a bad physician to hide" in a private practice setting than in the HMO. This system of statistics, how they are kept and how they are employed, sets boundaries that all practitioners must abide; staff refer often to "staying on schedule" and to reports "that will come back to haunt us" if the clinical team diverges too far from schedules and measurable rules and policies.

In the clinics, physicians talked often about what the "objective" reports about their work do and don't mean. Many of the physicians I worked with routinely kept their annotated appointment schedules in their desks for months, in case they needed to contest their objective reports. There are many ways that the HMO's measure for physician productivity in outpatient care--the "through-put" calculation of the number of patients seen per clinical half

day--is problematic. The through-put measure does not fully account for follow-up work and telephone consultations, nor for variations in the time required for encounters, nor even for all unexpected (unscheduled) "walk-in" patients. The composition of physician panels varies, for example for demographic distribution and for the mix of illnesses and clinical acuity. A primary care physician renowned as having one of the largest panels in a metropolitan medical service area pointed out that there is a difference between having one of the largest panels and being one of the busiest doctors. "It's all in knowing how to play the numbers."

C.3.5. Managerial agendas in health care

Sociohistorical context includes managerial regimes and management science projects that also constitute new technologies. Changes in the social, regulatory and legal, political and economic arenas influence how patient care is organized and how clinical information systems are designed (see, e.g., Sjöberg: 1996; Gärtner and Wagner: 1994). Legal, regulatory and organizational standards for quality of care are translated into information requirements in EHRs / CPRs as data fields, analyzable data elements, and minimum data sets, for example. Societal changes, occurring independently and concurrently, are reflected in changes in documentation practices and in EHR / CPR design and use.

Efforts to establish management regimes in health care institutions began as soon as hospitals became large organizations. "... [C]apitalist rationality supplied the habits of mind that evolved the methods used in these hospitals... From William Petty to contemporary cost-benefit analysis, there have been attempts to apply the logic of rational calculation to medical care and public health" (Starr: 1982, p. 229). An ideological change occurred in the transition to the modern bureaucratic hospital. "The old rhetoric of charitable paternalism was superseded by a new vocabulary of scientific management and efficiency" (Starr: 1982, p. 161). However, hospitals remained "at an earlier stage of industrial development" than United States corporations at the turn of the century.

> Hospitals remained incompletely integrated, both as organizations and as a system of organizations--a case of blocked institutional development, a precapitalist institution radically changed in its functions and moral identity and only partially transformed in its organizational structure.
>
> This same pattern of blocked development was evident throughout the medical system. Integrated organization was limited in public health and almost entirely absent from what we now call “ambulatory” care. The rise of bureaucracy has been taken as an inexorable necessity to modern life, but in America the medical profession escaped, or at least postponed its capitulation (Starr: 1982, p. 179).

The goals of early efforts to introduce forms of standardization in hospitals are modest when viewed in retrospect. "The early efforts to reform hospitals mounted by the American College of Surgeons had the goal of

'standardization': the imposition of minimum requirements for medical record keeping, the performance of autopsies, and various other aspects of hospital organization" (Starr: 1982, p. 177). From these beginnings, the goals, content, and techniques of standardization efforts extend their reach internally into the workings of medical and clinical practice, and extend externally into expanded networks of employers, consortia for business benchmarking, government regulatory bodies, clinical research institutions, associations of consumers, and alliances of patients' rights advocates.

A number of changes open the door to corporate medicine. Government policies set contradictions in motion that haunt the United States health care industry. "Aiding medical research and facilities construction, without providing for primary care, set off an imbalanced expansion that became increasingly costly and irrational" (Starr: 1982, pp. 337-338). In the 1970s, cost containment efforts are launched to bring down rapidly rising costs of health care. The health care crisis proclaimed in the 1970s was "first and last ... understood to be a crisis of money" (Starr: 1982, p. 381). The crisis of rising costs coincides with a "stunning loss of confidence" in physicians and the efficacy of the care they provide, "deepening ambivalence about medicine in the entire society" (Starr: 1982, p. 393). "Yet controlling expansion meant redrawing the 'contract' between the medical profession and society, subjecting medical care to the discipline of politics or the market or

reorganizing its basic institutional structure" (Starr: 1982, p. 380). When Medicare was introduced, it contained measures with far-reaching impact regarding the organization and financing of health care. In the 1970s, hospital-based practices become regulated but office practices are excluded. The extension of regulatory oversight to ambulatory clinical practices begins later and is actively underway today. Employers, payers of health insurance benefits for their employees, exert greater influence and third parties become more powerful. Local business coalitions began to form in the early 1980s to "encourage containment of medical costs" through utilization review and review of capital spending by medical institutions, functions previously handled by federal and state oversight bodies. Business coalitions of private and public sector employers evolve into influential consortia that systematically evaluate and rank HMOs and other health care providers.

Starr describes the fall from grace of medicine and physicians as an important constituent of the crisis of health care in the United States. Since the 1970s, there is "a diminished faith in the efficacy of medicine and increased concern about its relation to other moral values" (Starr: 1982, p. 380). The spectacular scientific achievements of modern medicine no longer have center stage; instead, the economics and morality of medical institutions and actors are questioned and found culpable. "Once a hero, the doctor has now become a villain" (Starr: 1982, p. 392). Physicians and champions of the heroic role of

modern medicine bitterly resent this wave of criticism and mistrust; physicians suffer their fall from grace in daily regret. This turning point, in which medical institutions and physicians come under public scrutiny and are found no longer able to be entrusted with self-regulation, presents the pivotal opening towards new managerial, regulatory, and market-oriented regimes of oversight, extensions of rationalizing technologies, and quantitative measurement into patient care.

The 1970s are also characterized by conservative cooptation of reforms such as prepaid group practice and HMOs, health teams, and health planning. The context for these concepts, once regarded hopefully by social reformers, also changes as the health care system enters the era of managed care and corporate medicine. "By using paramedical workers, keeping surgeons working full time, and monitoring physician performance, HMOs operate successfully with significantly lower ratios of doctors to patients than did the United States as a whole ..." (Starr: 1982, p. 422). Divisions of labor among care providers and clinicians will become increasingly contested terrain. Regarding divisions of labor, Starr speculated in the early 1980s that if physicians had not had the power to protect the boundaries of the profession as they did, rationalization of divisions of labor and struggles over control over clinical decision-making that are evident now would have occurred sooner.

> ... [T]he subordinate occupations, such as nursing and laboratory work, became more hierarchically stratified than did medicine. The medical profession resisted any division into two classes; the nurses divided themselves into three (registered nurses, licensed practical nurses, and nurses' aides).
>
> Had medical care become a corporate enterprise [in the 1970s and early 1980s], the medical care firm (even if run by doctors) would have had an incentive to seek greater flexibility in its use of personnel. It might have tried to substitute the cheaper labor of ancillary workers for physicians in many areas that physicians insisted on retaining. ... As in other industries, the management of the enterprise might have sought to take away from the workers control over the division of labor, which physicians retained through the system of professional sovereignty (Starr: 1982, p. 225).

HMOs and managed care meant dramatic changes in the roles and employment status of physicians. The HMO is unusual in that it is co-managed by its physicians. The Physician Partnership is one of three entities in the tripartite management structure of the company.[68] In the HMO, a newly hired physician has the status of "pre-partner" for two to three years before he or she is voted upon by physician colleagues to become a partner, a full member of the Physician Partnership. That physicians identify themselves as *partners* and thus co-managers of the HMO is a significant although ambiguous alternative to identifying as *employees*. The question of identity--employee or owner?--comes up frequently. It is not uncommon for the same physician to argue vehemently in one discussion that "we're partners, not

employees" yet comment subsequently to the opposite effect that "after all, doctors are employees here," and, at another time, react in surprise to a colleague's insistence that he or she is not an employee but a partner and co-manager. In 1997, the physicians formed a national management entity and hired a Chief Executive Officer to represent them in negotiations with the HMO's corporate managers in the Health Plan and Hospital Administration. The fundamental issue repeatedly expressed by the physicians is the "autonomy of clinical decision-making by physicians."

Rationalized forms of work organization in patient care are not unique to physicians nor to HMOs and other managed care settings. In her study of front-line clinical nurses at Beth Israel Hospital in Boston, Suzanne Gordon recounts the history of efforts to reorganize the work of registered nurses along the lines of functional task oriented organization and forms of work redesign that entail re-divisions of labor among nursing personnel between licensed registered nurses and registered nurse practitioners and non-licensed clinical assistants and medical assistants (Gordon: 1997). Gordon describes attempts over the years to break up the activities of nursing staff and reassign tasks from registered nurses to less qualified staff. Yet dis-integrating whole activities into component tasks cause losses of continuity

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[68] As explained in the abbreviated history of the HMO (Section B), the other two entities are its Hospital Administration and Health Plan.

for registered nurses who are responsible as front-line clinicians and caregivers for in-hospital patients. The whole picture of the patient becomes fragmented and early warning signs of a problem may be missed if a less qualified care provider lacks the requisite training in clinical observation and assessment that a registered nurse has (Gordon: 1997). The primary nursing movement at Beth Israel Hospital came into being as a response to the resulting decomposition and fragmentation of the skills of registered nurses as front-line clinicians and care givers. Both Paget (1988) and Gordon (1997) note that registered nurses are more likely than physicians to identify in-hospital medication errors and other potential treatment errors because a registered nurse has observational continuity throughout an eight-hour hospital shift in contrast to physicians' intermittent observations during hospital rounds.

C.3.6. Taylorist trajectories

"One best way," "post-industrial society," "knowledge-based (information) society," "total quality management"--these utopian proposals, ever unfulfilled, prove far more resilient than any single invention. They powerfully organize how developments regarding work and technology are seen, particularly shaping perceptions of technological imperatives.

Taylorist trajectories related to the incomplete utopian project of EHR invention include: industrial efficiency regimes, scientific management and

Taylorist work organization (Banta: 1993; Braverman: 1974; Kanigel: 1997; Taylor: 1967 (1911)), monitoring and performance measurement; perpetual downward pressure on divisions of labor; and extensions of rationalization and extensions of control over decision-making. Adler (1993) describes the intensification of work in combination with forms of reintegration that taps creative contributions of workers. The continuous audit trail created by an EHR / CPR system introduces an electronic panopticon into clinical practice (Banthem: 1969; Foucault: 1977; Zuboff: 1988). An account of Taylorist trajectories and contemporary directions in management science can begin with the long-standing concern with "the knowledge in the minds of workers"—how to extend management's reach beyond craft knowledge and know-how to tap more intricate intellectual resources per se, including more intimate "interior" resources of imagination.

Resources of imagination are the new terrain for the utopian project of scientific management. In In the Age of the Smart Machine (1988), Shoshanah Zuboff, following Daniel Bell, sets as one of her goals the utopian quest "to fulfill the lofty promise of a knowledge-based society" (Zuboff: 1988, p. xiv). Zuboff's analysis can be read as a description of how a driving principle of scientific management—"control over work through the control over the decisions that are made in the course of work"—is extended through specific designs and uses of information and communication technologies. In

Zuboff's study of computer-mediated work in continuous process paper mills, "the process of the imagination of the worker" is significantly reinstated, no longer "only as a process in the imagination of a special management staff." There is a shift in form away from managerial "monopoly over knowledge to control each step of the labor process and its mode of execution"—monopoly is replaced by "universal access" to on-line information described in terms of a merger of interests. Universal access to the explicit knowledge represented in an electronic text is assumed to mean that information is commonly (if not equally) shared. Zuboff's vision of universal access to a common electronic text means an end to the "exclusive knowledge"--"unique craft knowledge"--of individual crafts people. She reminds us that Frederick Winslow Taylor sought to unite managers and workers "in a bond of common interest," a tenet often forgotten, given the divisiveness of Taylorist practices, or regarded only as a rhetorical prop (see, e.g., Kanigel: 1997; Taylor, F. W.: 1967 (1911)).

The critical importance of the "subjective side of the coin" continues to be a key "problem for management" (Braverman: 1974). The importance of eliciting the "knowledge in people's heads" is greater than ever, given the subordination of scientific and theoretical knowledge to capital and the diffusion of "intelligent technology." Braverman pointed out, in the early 1970s, that, by transforming all information into universal form as data,

computer systems have the potential to re-unify the labor process but instead there is a tendency to recreate outmoded divisions of labor, particularly a "technical subdivision of labor, in even more pernicious form" (Braverman: 1974, p. 328). Braverman argued that automation [sic] retains its ideological power as a "theoretical ideal" deeply inscribed in capitalism's organization of the labor process. Similarly, Shaiken argues that Fordism and Taylorism as ideologies are ultimately undisturbed by surface changes in forms of work organization (Shaiken: 1984). With the reintegration of work in computer-based work settings in the 1980s and 1990s, the phenomenon of "the detail worker" can no longer be considered such a salient feature. Integration of work--in many instances, re-integration of tasks--is perceived as key to the reversal of the dysfunctionalities of fragmentation that are one of Taylorism's legacies.

What Braverman called "the problem of management" has proven fertile territory for innovation. More advanced forms of "intelligent technology" make it possible for managers to bring *resources of mind (resources of imagination)* under more comprehensive control. Zuboff's concept of *interiority* then can be understood to represent new territory to be mined; the expansion to be accomplished here is the incorporation of the inventiveness of

workers into the ongoing project of managerial science.[69] The expansion of techniques, tools, and resources takes a somewhat different cast, as the inclusion of knowledge workers and intellectual work under managerial regimes. In health care, the more thorough-going inclusion of physicians under the scrutiny of measurement regimes and managerial methods to exercise control over decision-making are manifestations of the direction of the scientific management project. The design intention of EHR/CPR systems is that they will bring state-of-the-art clinical and medical knowledge and up-to-date organizational knowledge to the clinician's desktop in his or her office and exam rooms. EHR/CPR systems provide new means to ensure standards of care and promote disease management. At the same time, on-line systems provide new mechanisms to enforce standards of care by exerting influence over clinical decisions through electronic monitoring of physicians' "auto-conformance" in their use of structured clinical content for minimum data sets and institutional templates for clinical practice guidelines and high priority protocols. Clinical realities and logics, practices and sensibilities provide a counter balance to powerful desires for standardization.

Joan Fujimura (1997) writes of the importance of “the package of oncogene theory and recombinant DNA technologies” in the "molecular

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[69] By this analysis, ethnographers conducting ethnographies of work practices within corporate settings are positioned in (conscious or inadvertent) roles akin to "midwives" for the extension of managerial projects.

biological bandwagon" of cancer research. Such a standardized package brings together concepts (theory) and techniques. Adapting Fujimura's concepts to the context of electronic health record invention, there is a *managed care package* emerging from the United States with which EHR invention is associated. The managed care package brings together concepts and techniques: structured data that can be compared across health care settings and institutions, clinical strategic goal setting, information and communication technologies, criteria for oversight, measurement and evaluation, and managerial techniques and forms of work organization.

D. The incomplete utopian project of electronic health record invention

The imaginative power of the incomplete utopian project of EHR invention derives from the inter-animation and cross-overs between clinical, technical, and managerial dimensions and actors, and the desires that motivate the heterogeneous and argumentative utopian projects that comprise each dimension. Deep desires drive the persistence of utopian projects over time. The imaginative power of electronic health record invention also derives from abilities to traverse time horizons in the work of imagining alternative possible worlds.

The power of the EHR Prototype Project vision to focus on a future time horizon while overriding present reality was evident regarding documentation of patient profile data elements with the first EHR prototype. In the EHR, structured content documentation for diagnosis, problem, or assessment is critically important to the practical basis for the design logic of the system. In an evaluation of the first year of clinical use of the EHR prototype, the physicians reported that they were using "free text" entry "nearly 100%" of the time to document diagnoses, problems, and assessments because it was too slow, too time-consuming, too cumbersome to document easily and quickly finding and using structured content terms from the clinical content knowledge base of the system. Structured content documentation of diagnoses, problems, and assessments drives the logic of the system because, to a great extent, the chains of relationships between objects (terms) rely on a problem-oriented[70] basis for interactions between data elements to occur systematically and reliably.

The difficulties that the physicians had in using the first version of the EHR prototype fueled the determination of the Software Company's staff to "solve that problem" along several dimensions of design: the user interface, templates design, and the architecture of the clinical content knowledge base. The Software Company strives to achieve a particular breakthrough in

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[70] "Problem-oriented" in this context refers to medical problems, diagnoses, or assessments, as

relation to this problem: to allow multiple jump points to a structured content term or template from anywhere in the (clinical) context of the consultation with a patient and documentation of progress notes. As the EHR designers and software engineers move towards realization of a design strategy conceived in nascent form, and incorporate elements of user interface design made familiar by Microsoft, the Internet, and the World Wide Web, the questions of practical use of the strong structured content strategy for clinical documentation remain.

The prototyping period of an innovative system, in this case the EHR Prototype Project, has a special character of openness, creativity, and unpredictability required for experimentation and invention. The character of the prototyping phase will contrast with the implementation phase that follows more or less sharply depending on an organization's implementation mode (the balance between institutional mandates, flexibility, local variation) and the scope of an implementation (prototype, pilot, roll-out). Three versions of the EHR prototype were in clinical use between 1994 and 1997; the fourth version of the EHR system was implemented in the fall of 1998. The installation of each version of the electronic health record entailed considerable organizational learning and planning--before, during, and after the training and learning processes required for care providers to use the

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in problem-oriented progress notes.

application viably in practice--by the staffs of the Information Technology department and the Software Company and by local and regional (and later national) project managers and administrators in the HMO responsible for patient care. A prototype's consolidation as a stabilized electronic health record application signals the change from the prototyping to the implementation phase. As the EHR application moved toward the implementation phase, an explanation given by a physician leader of the EHR Prototype Project anticipates the implementation mode of the HMO: "We have permission from senior management to show a physician the door if he [sic] doesn't want to use [the EHR]. We can tell him, 'If you don't want to practice this way, you can practice somewhere else.'"

I have described heterogeneous motives that animate the invention of the EHR system-in-the-making. Among these are the pursuit of social medicine ideals and industrial efficiency techniques; desires to eradicate mistakes, to realize evidence-based medicine, and to rationalize clinical practice; desires to realize the "beautiful logic" of the strong structured content design strategy, to standardize clinical and medical terminologies as clinical objects, to realize "the object world," and to build a comprehensive clinical information infrastructure; desires to align concepts and techniques of measurement, evaluation, and continuous quality improvement with managerial, administrative, quality assurance, and regulatory accountabilities

and market benchmarking, and to extend managerial agendas to control clinical decision-making through means offered by new clinical informatics tools, systems, and infrastructures; and the pursuit of business plans for simultaneous downsizing and market expansion. Certain of these conflict openly while others contribute to deepening contradictions in the activity and work of patient care. Through the specific instances presented in Chapter IV: Changing Patient Care, I illustrate how the larger sociohistorical context shows up in daily patient care interactions and as design problems for electronic health record invention, and how heterogeneous incomplete utopian agendas animate the imagination of future scenarios of patient care with electronic health record use.

CHAPTER IV: CHANGING PATIENT CARE

Stop, for, lo!
All the measure
Of thy treasure
Now is right!–
Ah, I see it! woe, oh woe!
I forget the word of might.

Ah, the word whose sound can straight
make him what he was before!
Ah, he runs with nimble gait!
Would thou wert a broom once more!
Streams renew'd for ever
Quickly bringeth he;
River after river
Rusheth on poor me!

Now no longer
Can I bear him;
Knavish sprite!
Ah, my terror waxes stronger!
What a look! what fearful sight!

Oh, thou villain child of hell!
Shall the house through thee be drown'd?
Floods I see that wildly swell,
O'er the threshold gaining ground.
Wilt thou not obey,
Oh, thou broom accurs'd?
Be thou still, I pray,
As thou wert at first!

The EHR Prototype Project has as explicit goals to improve patient care by creating new tools that better support patient care, and, at the same time, support a number of organizational practices devoted to continuous

evaluation and reporting. The joint object of the patient care team participating in EHR prototyping and the HMO's EHR Prototype Project involves not only fulfilling the daily responsibilities of patient care but improving patient care throughout the organization. In this chapter, I introduce the activity of patient care by presenting case examples of baseline (pre-EHR) clinical work practices in the outpatient Family Medicine Clinic. I then describe the teleological object of improving patient care through the imagination of future scenarios in which clinical work practices are re-imagined (imagined to change) in relation to use of the electronic health record.

The discussion proceeds as follows. I provide a general introduction to the baseline environment of paper-based patient records and changes in practice metaphors for EHR/CPR design from hospital to outpatient care. I present three exemplars from among pre-EHR primary care encounters video taped as part of the field research for the EHR Prototype Project. I discuss a practice dilemma represented in exemplar #1, a pediatric immunization encounter, followed by a sketch of the imagined future scenario for the encounter. Presentations of exemplars #2 and #3 are each followed by descriptions of the imagined future scenarios with EHR use. I then discuss the data presented in exemplars #1, #2, and #3 regarding clinical work practices in the baseline patient care encounters and how clinical work

practices are imagined to change in the future with use of the EHR in relation to practice and design dilemmas, difficulties that confront the utopian vision of the EHR Prototype Project in practice, and deepening contradictions in the activity system of patient care in the HMO.

This chapter introduces patient care, clinical teamwork and work practices in the Family Medicine Clinic through three baseline (pre-EHR) exemplars of office visits representative of the daily work life of one primary care patient care team (how patient care is imagined now), then walks through them again as in imagined future scenarios in which the Electronic Health Record is used (how clinical work practices are imagined to change). I discuss what the inner logic of the new system demands in terms of changes in current work practices in order to realize its logic.

To understand the object of improving patient care requires an appreciation of present clinical work practices. By *clinical work practices*, I refer to the communication, coordination and collaboration required among members of a patient care team in their interactions with the patient and whoever accompanies the patient, with each other, and with other staff (clinical and non-clinical) within the HMO as required to accomplish the work at hand for outpatient encounters. I use *practice* and *practices* to refer to clinical work practices, following the *practice perspectives* expressed in activity theory, the anthropology of work, and situated action. I focus on the externalized

joint activities that constitute the teamwork of the patient care team required to carry out the activity of patient care.[71] From activity theory and labor process perspectives, the patient care team's collaborative work practices provide an ethnographic basis for considering collective skills and expertise, work organization and divisions of labor, and how these are changing.

Among my responsibilities in the EHR Prototype Project, I led the development of a core set of graphic representations as visual means for communicating the field research to the multi-disciplinary project teams, particularly to create a bridge between the HMO and Software Company staffs. The graphic representations emphasize interrelated activities, roles, processes, systems, and interactions.

Figure IV.1: A Module Point of View for EHR Design is a summary graphic representation that depicts patient care activities in the primary care module participating in EHR prototyping in relation to core functionalities of the EHR design (orders, worklists, results, alerts and messaging), benefits to practice of the first version of the EHR prototype as perceived by members of the primary care team, and future EHR design directions and requirements. The physical space of the module is referenced by the floor plan at the center.

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[71] Generally, I will not address the diagnostic decision-making of clinicians other than through the representation of cognitive processes evidenced within an encounter (in exam room consultation and interactions among care providers) and in documentation to a patient's chart.

Encounter types are listed briefly (to the left). Diverse points of care (where primary care physicians and the physician assistant also practice) and collaboration with other care providers (specialists, for example) are referenced (to the right). Types of messaging activities are highlighted in-between and among other processes (along the bottom). Reference to an initiative to improve message-handling led by the registered nurse, indirectly related to the EHR Prototype Project, is included (lower left).

A. Imagined future scenarios with EHR use

How is it possible to present sketches of imagined future scenarios? The orientation to clinical work practices and patient care activity lays the basis for an initial understanding of the difference in logics between the logics of patient care work practices and patient-care provider interactions and the inner logic of the EHR system. To represent the object of improving patient care with a degree of concreteness, I re-visit the video taped exemplars of patient care activity from the baseline (pre-EHR) period. Through this, we enter an imagined future scenario of improved patient care with the electronic health record as a tool and as a constitutive element of the changed environment that will structure (restructure) the activity system of patient care in a module of the Family Medicine Clinic as a *nucleus* for thinking about

Figure IV.1: A Module Point of View for EHR Design

transformation of patient care in the HMO. The future scenarios enact the imagination of what the new tool will do and what clinicians, care givers and others will do with it. The imagined future scenarios point to the kinds of changes in work practices required for this particular electronic health record system to perform according to its inner logic and design. We also gain insights into practice dilemmas, differences in logics between patient care interactions and the EHR systems design, and design problems that confront users, designers, and organizations.

When walking through the imagined scenarios, a general caveat is important: the imagined future scenarios describe aspects of the conceptual design and organizational change rather than physical realization of these concepts in a fully developed EHR system in clinical use. Furthermore, the imagined future scenarios are based on assumptions that are in and of themselves major accomplishments yet to be fully achieved: integration of all current information systems (clinical and non-clinical legacy systems), and reliably confidential means for electronic transmission of patient data (including broad-band communication technologies that can handle multi-media records and images and encryption or other means to send patient data securely). Data conversion in clinical information systems must be as close to perfect as possible. It requires exacting work by the HMO's Information Technology (IT) department and partnering software companies to maintain

the integrity of critical information in conversions from one system to another, when interfaces between systems are built, and when software applications are upgraded from one version to another. Conversions between EHR prototype versions entail persistent, vexing difficulties that became known as problems with *upward compatibility* of progress notes, on-line templates, and patient summary data based on the EHR's evolving structured content knowledge base, technical platform, and design concepts. These are not one time problems that can be solved upfront; these problems do not go away quickly but rather carry through from one time and version to the next.

The sources for my descriptions of imagined future scenarios of EHR use include my readings of EHR requirements, specifications, user manuals, and other documents during the period of five years, participation in user training sessions (as a trainee) and observation of clinical user training sessions, review of logs of design ideas, problems and "bugs" reported by clinical practitioners using the EHR prototype and summaries of problems and bugs identified by laboratory testing of alpha and beta versions of the EHR by the HMO's many technical teams, content logs of the bi-weekly EHR Prototype Medical Center Steering Committee meetings (1993 through 1996), occasional participation in joint design discussions between HMO and Software Company participants, discussions during the series of seminars I developed for Software Company representatives (1995-1996) to help bridge

the contexts of design and clinical use, exposure to Software Company presentations, exhibits, and demonstrations of the EHR by Software Company and HMO leaders at national symposia for medical informatics and clinical information systems and for internal audiences within the HMO, project-related interviews with project participants from the HMO and Software Company including baseline and evaluative interviews with clinician users of early versions of the EHR prototype (1993 through mid-1998) and a series of interviews about EHR template design and implementation strategies (1997), *in situ* comments and occasional *ad hoc* interviews, and my participation in daily project work.

Figure IV.2 highlights four core functionalities of the future EHR as they were articulated in 1995: alerts and messaging, orders, worklists, results and flow sheets (clockwise in yellow at the four corners). In the graphic representation, the EHR's core functionalities frame schematized clinical processes involved in patient care encounters in the primary care module, suggesting approximately which processes may be most affected by use of the new tools of the EHR. In practice, the core functionalities work together rather than sequentially, as is also true for concurrent clinical processes. In addition to the core functionalities that are highlighted, important tools of the EHR system include its patient profile (an interactive patient summary) and

Figure IV.2: EHR Core Functionalities, 1995

on-line templates developed from the system's structured content knowledge base. (These are referred to in Figure IV.1.)

As Agre points out in his critique of the *surveillance* and *capture* models of privacy, computer systems require changes in social practices. Less familiar to the general public but more deeply embedded in computer design, the capture model "... has deep roots in the practices of applied computing through which human activities are systematically reorganized to allow computers to track them in real time" (Agre: 1994). The concepts for walking through each of the three baseline primary care exemplars a second time in order to sketch the re-imagined future scenarios take Agre's point to heart, in combination with analytic frameworks articulated in theories of situated action that stress social interactions (e.g., Suchman: 1987) and activity theory. Concepts that inform the imagined future scenarios for exemplars #1, #2, and #3 include: changes in clinical documentation practices, patient-care provider interactions, clinical teamwork, work organization and divisions of labor; changes in media for communication, coordination and collaboration among members of patient care teams and networks; changes in modes of care and delivery systems for patient care; practice dilemmas and design dilemmas; difficulties that confront the clinical, technical, and managerial utopian projects that comprise the vision of the future of the EHR Prototype

Project; emerging activities in EHR prototyping; and contradictions in the activity system.

The story of the two logics--the activity of patient care and the EHR system--is a story of contrasts between informal interactions, work practices, and contingencies and formal policies and practices, between interpersonal and electronic interactions, between implicit and explicit representational conventions, between non-articulable tacit knowledge, intuition, and collaborative expertise and articulable, partial formalisms, between social ethical relationships and the relationships of clinical objects and patient business objects. Clinical expertise itself develops in collaborative, iterative activity. Expertise in patient care involves more than expert medical reasoning. Clinical team members' knowledge of patients and their families over time, prospects for a patient's active participation in treatment plans, the holistic nature of memory and recall of clinical narratives--all of these inform clinicians' intuitive perceptions of anomalies as well as common patterns. And all of these are informed by and communicated through the dynamic creation and circulation of patient records and clinical information, handwritten, electronic, and spoken communication with patients and among team members. My construction of the two logics is informed by Suchman's analysis that social interactions and improvisation are the sense-making activities of situated action in the contingencies of daily practices. There are

no perfect plans or perfect instructions to follow rules and design formalizations; rather, plans are resources used dynamically and creatively in situation action (Suchman: 1987), what Bardram calls *situated planning* (Bardram: 1997). My construction of the story of two logics is further informed by Bødker's analysis of the partiality of articulable knowledge of work practices (what can be made explicit) and the non-articulability of lived practices and tacit knowledge (what remains implicit) (Bødker: 1991), the analysis by Middleton that informal talk at work that seems incidental to the accomplishment of work, notably gossip amongst co-workers, contributes to the collective memory and collaboration of teams (Middleton: 1992; Middleton and Edwards: 1990), analyses by Orr (1996) and Wynn (1979) that social conversation, including storytelling and small talk, is the medium of work and should be supported rather than diminished by computer systems design, and analyses by Gordon and others regarding the holistic nature of patient care (Gordon: 1997), among others.

Although I particularize my discussion to the design and use the EHR and its strong structured content design strategy, the differences in logics between the activity of patient care and the electronic health record system are not unique to the particular electronic health record I describe. During my pre-study, after the training session for the new computer-based patient record (CPR) application, a physician commented succinctly: "They showed

us how the system works but we need to know how a patient care encounter works [with it]."[72] In the primary care module of the pre-study, the CPR system to which the module converted entailed minimal structured content documentation: the only structured elements were ICD (International Classification of Diseases) and CPT (Current Procedural Terminology) codes for problems and procedures respectively. Yet the physicians and nursing staff pointed to these, particularly ICD codes, as obstacles to use of the system. They rejected the new software within two weeks of its implementation and returned to the computer-based record system they had been using for more than four years. Both systems in the pre-study were regarded as rudimentary computer-based records, "glorified word-processing" compared to the state-of-the-art design and elaborated conceptual vision of the EHR Prototype Project. Yet the differences between "how the system works" and "how it works with a patient care encounter" are common threads in the dialogue between EHR/CPR design and clinical use.

A.1. Changes in metaphors[73] for EHR/CPR design

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[72] Physician after a computer-based patient record software training session, May 1993.

[73] In this discussion, I generally use *metaphor* to refer to *practice metaphors*, practices and practice models conceptualized as the basis for design. My use of metaphor differs from the meaning Agre gives *design metaphors* in his discussion of critical design practice (Agre: 1997) and differs also from the subset of design metaphors that are called user interface metaphors.

The design of electronic health records systems continues to shift from the early metaphor of designing for an individual physician--the design of a "physician workstation"--to the metaphor of a patient at the center of multi-professional, multi-disciplinary teams and networks of care providers and associated non-clinical ancillary services providers as well as clinicians. The HMO has strong *clinical team* and *organizational teamwork* orientations for development of the EHR system. New clinical information systems are tools for computer-supported collaborative work, whether teamwork among clinical staff immediately present in one encounter or the same members of care teams when they are not co-located spatially and temporally, or extension to intra-organizational or inter-organizational networks of clinical and non-clinical personnel who altogether coordinate their efforts to accomplish the work of patient care.

Changes in metaphors for EHR/CPR design follow changes in models of patient care. EHR design reflects deliberate changes from conceptualization of physician-centered clinical practices to conceptualization of practice models based on multi-disciplinary multi-professional teams and networks. EHR/CPR systems development efforts are intertwined with change agendas of managers and policy-makers of health care institutions and regulatory bodies. Clinical information systems are designed concurrently with changes in multi-professional, multi-disciplinary collaboration; the

introduction of new information systems reorganizes clinical work practices and forms of coordination, communication and collaboration.

Questions often asked of EHR design and development include: Why is it hard to put patient records into a computer system? Why hasn't electronic health record design and implementation already been accomplished? Wouldn't it be easier and quicker simply to recreate what exists on paper in computer templates? Barbara Katzenberg (1997) provides a longitudinal account of the difficulties of achieving alignment among clinical participants in the design of templates for care plans and multi-disciplinary summaries to support coordinated care management in a Breast Care Center. Over a period of months, oncologists, surgeons, and radiologists negotiated agreement on the content of the patient summary, struggling over the order (should clinical stage be at the top of the form?) and whether to include anatomical graphics (should physicians be allowed to draw?) among other questions. The design of the software application was implicated in significant changes in coordination, communication and collaboration among these distinct specialists, the dedicated Breast Care Center staff of registered nurses, physical therapist, psychologist, licensed clinical social worker, scheduling clerk and others--and vice versa, the administrators of the medical center envisioned changes towards patient-centered modes of care implicated in the design of the care management software application.

In discussions with the Software Company, HMO project leaders emphasized what they called a *module point of view* for design defined as "an organizational philosophy of design that concretely links EHR requirements to the practice needs of a module clinical team."[74] As the core organizational form for teamwork in outpatient clinical settings in the HMO, a module also provides a nucleus for systemic comparability across practice settings, a generalizable model in relation to which local variations and innovations in teamwork practices can be distinguished. During the early EHR prototyping period, a module point of view was proposed as "an essential cornerstone for EHR development" with dual connotations, evoking both the HMO's form of work organization and care providers' experiences with use of the EHR in the modules participating in prototyping.

HMO project leaders stressed that "this is a production environment" and that the EHR system must be usable in "the real time, real world" patient work flow of the Family Medicine Clinic. Care providers--doctors, physician assistants, nursing staff, nurse practitioners--struggle constantly "to stay on schedule" for the sake of patients and for each other's sake. I was struck by the relentless fast-paced stream of patients in the clinics where I spent time. On my first day in the Family Medicine Clinic, the registered nurse, who had

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[74] EHR Prototype Project, Confidential Report, October 1996.

worked for years in critical care before transferring to the clinic, explained that in an outpatient clinic, "rule number one is to keep the patient rooms filled, that's what the physicians want. Next to nursing procedures, that's the most important thing." As I was advised on the first day I spent in an outpatient clinic: "You can talk to the doctors, they have some time, but you can't talk to the nurses--they're too busy."

Physicians describe outpatient and inpatient care as distinct experiences. "In the clinic, if you get behind, it feels like being in jail," an internist recently assigned to a dedicated hospital position told me. "In the hospital, you're assigned two or three more patients, you have another cup of coffee, you're inspired--it's a challenge, it's exciting! I don't know why it's so different when the clinic is busy but it is." Interactions (social relations) with patients are experienced differently. Early one Sunday morning while I accompanied a family medicine physician on hospital rounds, he sighed and said: "I should have become an emergentologist. In the ER [sic] or the hospital, when you help somebody, they love you for it. When you can't help them, they die and that's the end of it. In the Family Medicine Clinic, no one is ever happy with you. You can do everything you know how to do but it you can't help them, they blame you, they complain, it just goes on and on. You feel like you can't win."

That HMOs practice "assembly line medicine" is a long-standing allegation of critics of HMOs and managed care who decry the loss of the private physician relationship as the preferred mode of patient care in the United States. Apprehensions about assembly line medicine express fears about impersonal care without the continuity of a personal doctor who knows you, your problems, and your family over time. The assembly line and the industrial division of labor of a factory are also colloquial metaphors of work in the HMO. In the first EHR prototyping module, nursing staff explained that they try to avoid the feeling of being moved along an assembly line by assuming one-to-one responsibility for a patient throughout the visit and keeping hand-off's to a minimum. They try to treat patients as they want to be treated, taking one-on-one responsibility for patients when possible to minimize hand-off's between staff. The HMO's employees are also its patients and they know the assembly-line feeling first-hand.

The present is not a simple picture of independent craft and autonomy of physicians and other practitioners as is sometimes evoked. Squeezing out physicians' time is not new, as Paul Starr points out (Starr: 1982). However, productivity pressures and pressures on work organization and divisions of labor motivated by cost-cutting have escalated as for-profit managed care changed the health care market. The volatility and pressures of

market competition given the rise of the managed care segment intensify commodification of patient care services.

David Eddy, a mentor to the EHR Prototype Project and advocate for evidence-based medicine, asserts that: "All [evidence] confirms what would be expected from common sense. The complexities of modern medicine exceed the inherent limitations of the unaided human mind" (Eddy: 1990 cited by Silverman: 1998). If we accept Eddy's assertion, how did this become so? How is it that the expertise of clinicians is no longer sufficient for everyday clinical practice? In his analysis of the discourse of decision support and medical informatics, Marc Berg provides an historical perspective on how physicians are redefined as incapable of practicing without the help of intelligent systems such as the EHR proposes to be (Berg: 1997a). The new common sense to which Eddy points as a given fact is constructed sociohistorically.

The responsibility to keep up with evolving clinical and medical knowledge has intensified as ever more finely-grained diagnoses, new syndromes, new treatments, in-progress clinical trials, and clinical research findings are publicized in ever shorter time cycles on the World Wide Web as well as by traditional means of circulation in professional journals. Changes in the HMO's patient population include the aging of its patient membership and the inclusion of Medicare and MediCal patients, most of whom have not

previously been cared for under the HMO's regime of preventive medicine in an integrated care environment.

Care providers complain frequently about "drowning in paperwork" and the redundancy of paper-based records-keeping requirements. The vision of a computer-based system in which information is entered once and instantly distributed to everyone who needs it is powerfully appealing. The future is imagined as one in which physicians "can spend less time on paperwork and more time with the patients." To be able to spend "more time with patients, less time on paperwork" is a mantra for the EHR expressed by care providers seeking relief from the competing pressures they face. Clinical documentation does not solely represent what happens in patient care encounters but also serves as a database for evaluation of quality of care, analysis of performance measures, regulatory reporting, institutional indicators and cross-institutional benchmarks used for market comparisons, and analysis of resource utilization and productivity. To be traceable and analyzable, data for these measurements must be recorded either in clinical documentation by physicians and other HMO staff, or as alpha-numeric data from which proxy indicators can be abstracted, for example, insulin levels in the laboratory system that identify a patient as diabetic.

Patient summaries at the front of patients' charts represent a means for prompting documentation of important data elements and for ensuring that a

set of priority elements of patient information are easy to find (a type of minimum data set). In the paper-based environment, paper-based tools (templates) for patient summaries have been developed to remind physicians to document patient data elements considered to be most important for quality assurance standards and for ready access to historical and current patient information. In the EHR Prototype Medical Center, the form at the front of a patient's chart is called a Health Maintenance Record (HMR).[75]

To promote the quality of patient care, a system of quality assurance (QA) tools and methods have been developed (e.g., Wirtschafter and Mesel: 1976) and continue to evolve. These include surveys and periodic internal and external reviews by the National Commission on Quality Assurance (NCQA) and the Joint Commission on Accreditation of Health Care Organizations (JACHO). One of the EHR Prototype Project physicians

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[75] For Adult Health Maintenance, the elements are: Medical, Surgical, Ob / Gyn; "Imprint Card Here" (patient's card with medical record number, gender, date of birth); Family History (Father, Mother, Siblings, Grandparents: Maternal, Paternal); Social History (Occupation, ETOH (alcohol consumption, dependency), Smoking, Stop Smoking Info (Date); Recreational Drugs); Allergies; Chronic Problem List (Date for each entry); Chronic Medication List (Start Date for each entry) ; Health Maintenance CXR (Chest x-ray); Lab; Clinical Breast Exam; Mammogram; Self Breast Exam / Education; Pap / Pelvic; Flex. Sig. (Flexible Sigmoidoscopy); Rectal / Prostate; Hemoccult; Immunization; Other); Member Education (Environmental Risks, Date; Seat Belts, Date; Diet, date; Exercise, Date; Contraception, Date; Self Examination, Date). The Pediatric Health Maintenance Record has the following fields: Allergies / Reactions; "Imprint Card Here" (Name, Medical Record Number, gender, date of birth); Immunizations / Tuberculin Screening: DPT (diphtheria-pertussis-tetanus vaccine), Date; D-T (diphtheria-tetanus immunization), Date; Oral Polio, Date; MMR (measles-mumps-rubella vaccine), Date; HIB (Haemophilus influenzae type b vaccine), Date; TB (tuberculosis) Screening, Date; Other (e.g., Hepatitis B), date; additional "Other" fields; Chronic Problems (Dates); Medications (Start Dates); Significant Acute Problems; Medications.

described five levels of quality assurance to me: QA on the level of charts (are required elements of information documented in a patient's chart, in the expected areas of the chart, and are they easy to find?); QA on the level of quality of patient care (for particular patient care indicators, both for preventive care and for problems associated with risk for a patient, does the chart documentation show that the right actions are being taken on behalf of the patient?); QA on the level of medical practice (for a set of problems that involve *prima facie* risks--problems for which there are QA "screens" (conceptually akin to “red flags”)–and for patients who die while in hospital or otherwise directly in the care of the HMO's staff, cases are reviewed by a medical quality assurance committee of physician peers and administrative staff responsible for QA); QA for medical legal inquiries (when malpractice is alleged or suspected, also reviewed by the medical QA committee and additionally by HMO Medical Legal staff and counsel, as required); and QA for regulatory requirements and periodic external reviews by governmental bodies and non-governmental review commissions such as the NCQA and JACHO (in addition to information entailed in the preceding levels, these inquiries encompass issues of credentials and other forms of professional accreditation of staff, and they rank health care organizations in relation to each other according to the QA indicators defined and agreed upon as

benchmarks for quality of patient care, in addition to ease of finding patient information). The patient information associated with each of these levels translates into informational requirements for the design of electronic health records and computer-based patient records systems.

A.1.1. Hospital to clinic: *open doors* to *closure*

In recent years, patient care in the United States has shifted quite dramatically towards outpatient, ambulatory (literally "walking around") modes of care. Hospital stays are shorter and censuses in hospitals are down in many locales (whereas emergency rooms remain crowded). Public health analysts have noted concurrent shifts in health problems encountered in primary care in the United States and elsewhere, with physicians reporting increased acuity of cases, complex psychosocial problems, and multiple chronic conditions (e.g., Saarelma: 1992). As another sign of this change, at the 1993 Symposium on Computer Applications in Medical Care (SCAMC), the annual conference of the medical informatics community in the United States,[76] the majority of participants identified outpatient care and primary care as priority concerns.

Hospital care provided both the general model of patient care and the practice metaphor for many early patient information systems. Following

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[76] The SCAMC was since renamed as the fall symposium of AMIA, after the sponsoring body, the American Medical Informatics Association.

inpatient care, one imagines the presence of the patient, his or her body prone on a bed in a hospital room. Nurses, physicians, therapists, technicians, and aides attend to the patient at bedside or nearby in the surrounding ward (unit) or "on call"; the hospital contains all of the services required by the patient and clinical staff (pharmacy, laboratory, radiology and other diagnostic imaging, medical records, dietary services, psychiatry, social services, discharge planners, educators). When a patient is hospitalized, clinical staff can ascertain whether and when each doctor's orders have been carried out. Actions have a high degree of closure. There is, generally, a high degree of control; the patient is in a controlled environment in which stabilization of an illness is a clinical goal. The responses of a patient to interventions are reasonably knowable through biomedical monitoring, test results, and other forms of observation. Results from extensive, specialized diagnostic tests are available STAT or as soon as possible–"in real time"--for many others. The patient is accessible to the members of the patient care team and, broadly speaking, members of the care team are accessible to the patient, visiting family members, and significant others. The patient, assumed to be at risk warranting hospitalization, is under watchful care.[77] In hospital, risk is

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[77] An adult patient can, of course, decline treatments, tests, procedures, or leave the hospital "against medical advice." A patient who leaves against medical advice may be referred to as "a LAMA." LAMAs must be documented in the patient's records as the patient is willfully

already defined by problems that lead to admittance and by thorough medical evaluations during the hospital stay and at discharge.

Inpatient charts and medical records are organized according to the bounded definition of each *event* as an instance of hospitalization is described. In inpatient records, an event has a clear-cut beginning (admission), duration (the hospital stay), and ending (discharge). Ideally, upon admission, the patient's outpatient chart(s) are brought to the admitting physician, and information from the patient's outpatient history is reviewed and incorporated into the admitting History and Physical. In-hospital documentation is structured, detailed, time-stamped, multi-disciplinary and explicit for many entries (for example, status, start and stop dates for medications) that are often left implicit in outpatient documentation. Many inpatient medical records forms are paper-based templates that guide documentation for specialized purposes, for example, Doctor's Orders for a cardiac patient. The discharge summary is sent to the patient's primary care physician and a post-discharge outpatient visit is scheduled for on-going care with the patient's primary care physician.

Outpatient care has different patterns. It is often said that outpatient

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declining the course of action advised by a clinician based on assessment of risks to the patient. When I was a volunteer in an emergency room, one of my responsibilities was to try to deter LAMAs, in this context referring to patients who needed to be seen by a physician according to a triage nurse's assessment but who are about to give up waiting.

care is characterized by "open doors"--one does not know what actually happens once a patient leaves the Family Medicine Clinic. Did he or she follow the plan of care? Did the patient make it to the diabetes education class? Was a cat scan scheduled by the Radiology Department? Did the patient go to Radiology for the cat scan as scheduled? Open-endedness, uncertainty about closure, and worries about things that may "fall through the cracks" are facts of life. As one physician explained to me, "you hand things off to the system, but if the system is not working, you have no way of knowing." While he identified particular worries about important cancer screening tests such as flexible sigmoidoscopy results that could "fall through the cracks," he added that there is no way of knowing what else might fall through the cracks because there is no easy way of knowing about an absence of information from existing systems. You might find out more than a year later, as he did, that the results of an important test were mis-routed; his copy of the results, as the ordering physician, "went into a black hole" as the saying goes.

Contrasting hospital settings and ambulatory care settings, the differences can be schematized as shifts from closed to open, from controlled to uncontrollable, from a passive to an active patient, from compliance to frequent non-compliance, and from a medical model to holistic models of care. "Compliance" and "non-compliance" are older terms, still commonly

used but frowned upon in the official discourse of the EHR Prototype Project and the HMO in which it is more common to speak of whether or not a patient is "following the plan of care." The language of compliance and non-compliance is officially taboo in light of movement towards a model of collaboration in which the patient is conceived as an active partner, a member of the care team. The changes in terms for *computer-based records* from *electronic medical records* to *electronic health records* and *electronic patient records* also reflect objections to "the medical model" vocalized by nurses and others. The shift from the medical model towards holistic and patient-centered models of care is also a shift from the implicit metaphor of medical decision-making by an individual physician towards team-based collaboration as the leading activity.

A.2. Integration of patient records and data

The vision for the EHR system is that it will make the comprehensive continuum of care visible for all staff involved in a patient's care. The integration of patient information across diverse points of care in outpatient and inpatient care settings is an important aspect of the vision of the EHR system design. One of the HMO's criteria for selection of a software partner was a systems design that integrates inpatient and outpatient information. Among final contenders for the EHR contract, the Software Company was distinguished as a company founded with a commitment to integration of

patient information along the continuum of care in contrast to companies dedicated to either outpatient or inpatient settings.

The development strategy for the EHR Prototype Project was to integrate primary and secondary care and then to integrate outpatient and inpatient care. The second clinical setting was a Cardiology and Internal Medicine patient care team located on the main campus of the Medical Center in the medical offices tower, the outpatient specialty and sub-specialty services provided by the cardiologists and medical internists. The Cardiology and Internal Medicine team included the Medical Center's nephrologist and Continuous Ambulatory Peritoneal Dialysis (CAPD) treatment team. The Medical Center's rheumatologist joined the Cardiology and Internal Medicine module in 1996. After electronically linking the Family Medicine and Internal Medicine care teams, plans called for an inpatient critical care unit to be selected for EHR prototyping. Meanwhile, the EHR system is to be gradually integrated with the HMO's legacy information systems through interfaces built for ancillary service departments such as medical records (chartrooms), laboratory, diagnostic imaging, pharmacy, social services, and quality assurance.

A.3. The primary care team participating in EHR prototyping

The first clinical setting for EHR prototyping was that of a patient care team in an outpatient Family Medicine Clinic located approximately twenty

miles from the main Medical Center campus. The care providers in this team were the first to use the EHR prototype in clinical practice, beginning in August 1994. During the period of the video documentation discussed in this chapter, the Family Medicine patient care team comprised eight care providers: three physicians, one physician assistant (PA), one registered nurse (RN), two licensed vocational nurses (LVNs),[78] and one trained clinical assistant (TCA).[79] Typically, additional on-call ("float") nursing staff (RNs, LVNs, TCAs) and *per diem* physicians are contingent members of a module, assigned on an as-needed basis. By agreement with the unions representing nursing staff, the nursing staff for the Family Medicine module team was stabilized to the greatest extent possible during the early EHR prototyping period and the physician-nurse ratio was slightly lower than usual. The number of patients scheduled per clinical half day was modestly reduced in order to accommodate the added demands of participation in EHR prototyping.

The trained clinic assistant, registered nurse, physician assistant and two of the physicians are involved in exemplars #1, #2, and #3 discussed

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[78] Licensed vocational nurses (LVNs) are also known as Licensed Practical Nurses (LPNs) in other parts of the United States.

[79] Trained clinical assistants (TCAs) are also known as medical assistants (MAs). The terms are used interchangeably within the HMO.

below. Their working relationships are important. The trained clinic assistant, the physician assistant, and the physician whom I call Dr. A opened the clinic together five years earlier. "We've worked together since day one," as the trained clinic assistant told me the first day we met. The trained clinic assistant and the registered nurse were known as the "anchors" for the module. The trained clinic assistant has worked for the HMO for more than twenty years. While I was there, she received an award for responsiveness to patients because she had received more commendations from patients for exceptional service than any other member of the Family Medicine Clinic's nursing staff. The registered nurse for the module served as one of the clinical liaisons from among participating clinical practitioners for the EHR prototyping effort from the beginning in the fall of 1993. Before transferring to the Family Medicine Clinic from critical care nursing at the Medical Center (in the Intensive Care Unit and other services), she served as the nursing union's shop steward for three years, representing all registered nurses throughout the Medical Center and its off-campus clinics. While working at the Medical Center, she was one of a group of nurses trained as "super users" to contribute to iterative development of the HMO's on-line laboratory results system. These experiences give her an unusual breadth of representativeness on behalf of registered nurses and prior experience participating in clinical systems development. Before joining the HMO, the physician assistant

worked in the United States military services. He is well-liked by the nursing staff for his willingness to take "add on" patients, patients who have walked into the Family Medicine Clinic without scheduled appointments, and for his willingness to see patients with any kind of problem within a physician assistant's scope.[80] The physician in exemplar #2, whom I call Dr. A, was the principal clinical liaison for EHR prototyping from the primary care module. He serves as the Physician-in-Chief for the Family Medicine Clinic and therefore has many administrative and leadership responsibilities in addition to seeing patients. Working with Dr. A is unusually strenuous for nursing staff: Dr. A's style is to provide "one stop service," to take care of everything possible within the encounter whether it is related to the reason for the visit or preventive care he determines is due for the patient. I refer to the physician in exemplar #3 as Dr. B. Dr. B's style differs from Dr. A's "one stop" approach. To stay on schedule, Dr. B usually addresses selected problems and then schedules another appointment for additional problems when possible rather

[80] Clinical scope is defined by state law, licensure, and organizational policy, and the expertise of one's training and credentials. Care providers also speak of practicing in one's "comfort zone" as a boundary for competency and confidence in one's practices. In other words, a practitioner may have the formal training and credentials required but if certain skills are rarely used, they may be beyond the comfort zone. An RN who is comfortable practicing a broad range of clinical skills as an independent practitioner, as a clinician, may be described as "strong in his / her practice," connoting an *independent* rather than *dependent* nursing role (a role dependent on a physician).

than deal with everything at one time. In this regard, Dr. B is more representative of the HMO's primary care physicians than Dr. A.

Dr. A and Dr. B also have contrasting documentation work practices. Prior to the introduction of the EHR prototype, Dr. A completed 90% of his documentation in the exam room in the patient's presence, in his words, "with the patient as a resource." It is an ideal for this physician, as for several of the EHR Prototype Project leaders, that the EHR should be fully usable for documentation during the exam room interactions between the patient and physician, as fluently usable as handwritten documentation to the paper-based chart. Dr. B typically documents subjective and objective findings and updates a patient's health maintenance record (HMR) during the exam room consultation (to the greatest extent possible), then completes his progress notes at the end of the clinical half day (documenting assessment, plan of care, additional diagnostic or treatment information obtained from other clinicians or ancillary clinical services, additional annotation to the HMR or notes). From my observations in the HMO's outpatient modules, Dr. B's pattern for when and where he documents progress notes--approximately half in the exam room (subjective and objective findings), half in the physician office (assessment and plan)--is more representative than Dr. A's strong preference for completing all documentation (subjective, objective, assessment, and plan) in the exam room.

A.4. Methods and rationale

In the HMO outpatient clinical settings, I identified the instantiation of patient care in the office visit as a core encounter type for the analysis of teamwork interactions, patient-care provider interactions, and the dynamic use and creation of patient records to support and document these interactions. Rather than focusing on physician-patient interactions in the exam room, for which there exists an impressive body of research and analysis (e.g., Arborelius and Timpka: 1990a, 1990b; Arborelius, Bremberg and Timpka: 1991; Arborelius, Timpka and Nyce: 1992; Engeström, R.: 1995; Fisher and Todd: 1983; Frankel: 1990; Heath: 1986; Luff and Heath: 1998). I designed the video documentation to follow the use and creation of patient records in relation to the patient path through the office visit from intake and vital signs at the nursing station to the exam room consultation[81] with the physician or physician assistant to closing interactions related to the plan of care and instructions at the nursing station. Pre-exam room chart review and

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[81] What I call an *exam room consultation* may also be referred to as a *medical interview*. In the EHR Prototype Project, the general terms *exam room visit* and *exam room encounter* were frequently used. I prefer the term *exam room consultation* for two reasons. It is more comprehensive than *interview* which carries the connotation of the history-taking aspects of patient-physician interactions (subjective findings, history of present illness, family history, social history, past medical history). It is more discrete than characterizing the exam room interactions between patient and physician as the *visit* or *encounter*; for me, the visit or encounter includes patient interactions with nursing staff and interactions between clinical staff on behalf of the patient in addition to the patient's interactions with the physician in the exam room which have too often been taken to represent the essence of an encounter or an encounter as a whole.

post-exam room documentation in the physician or physician assistant office were video recorded as were any activities carried out by nursing staff concurrently with the exam room consultation or the completion of documentation in the physician or physician assistant offices. Following the patient's path through these outpatient encounters, video cameras were set at three locations: at the nursing station (intake, vital signs, carrying out orders and following through for the plan of care, explanation, education and/or instructions for the patient), in the exam room (patient-care provider consultation, physical examination, nursing interventions, explanation, education and/or instructions for the patient), and in the physician/physician assistant office (pre-exam room chart review, post-exam room completion of documentation). At each of these points--nursing station, examining rooms, office--two cameras were used, one with a wide angle lens for an overall view of interactions and the other set for a close-up view for handwritten documentation (exam room, office) and/or use of computer-based information systems (pre-EHR on-line information systems accessed at nursing stations and in physician/physician assistant offices for appointments, patient chart requests, immunization tracking, lab results). The video taped encounters go beyond the capabilities of individual observers and single points of observation, showing simultaneous activity by clinical

team members in different work spaces and activities dispersed over time, work spaces, and among team members.

As part of the baseline (pre-EHR) field research for the EHR Prototype Project, we video taped thirty-six primary care office visits during a two week period at the end of February and early March of 1994; among these, the video documentation was reasonably complete for twenty-four patient visits. Two half clinical days were recorded for each of the three physicians and the physician assistant, working with one or more members of the nursing staff. The video taped patient visits proved useful as initial windows onto the activity of patient care in an outpatient setting. Video documentation vividly demonstrates the interactive and distributed nature of teamwork among care providers, and illustrates variations in providers' medical records practices with the current paper-based chart. The video taped patient care encounters highlight the collaborative nature of clinical expertise in seemingly simple encounters and for routine actions that are often taken for granted. The video taped patient visit exemplars provided scenarios for exploring the design of the EHR in relation to the everyday realities of patient care and the communication, coordination, and collaboration that it requires.

The twenty-four video taped patient care encounters illustrate typical patterns in outpatient primary care. The case examples include pediatric and adult preventive, acute, complex, multiple problem visits. Primary care is a

"port of entry" or "doorway" for any and all problems whereas in specialty care, the domain and range of problems are already narrowed. Patients are often accompanied by family members or significant others. Appointments are scheduled in a continuous stream at intervals of 10 or 15 minutes per patient (depending on the clinic) but the actual lengths of encounters vary considerably. In the United States, the average length of an exam room consultation is said to be seven to eight minutes whether with a family practice physician or a neurologist, whether in an HMO or in private fee-for-service practice. The traditional emphasis on the physician's time in the exam room under-represents attentional demands on other members of clinical teams as well as time outside the exam room spent reviewing charts and completing medical records documentation. The video documentation of office visits provides an expanded picture in which members of the patient care team interact with the patient and the patient's records for twenty to thirty minutes cumulatively for the most routine of encounters and fifty to fifty-five minutes or longer for complex patient visits. The video documentation remains a partial "slice of reality" in that it represents a single encounter and the perspectives of the immediate patient care team but it does not represent the efforts of clinical staff in ancillary services throughout the Family Medicine Clinic and its parent Medical Center.

On any clinical day in the Family Medicine Clinic, the patient care team struggles to balance differences in time required for types of office visits. The averages of ten to fifteen minutes scheduled for an office appointment subsume considerable variations between time spent for a routine or an acute problem and time spent for complex patients and patients with multiple problems. The time spent for a routine acute problem such as a sore throat might be as short as three minutes; a procedure such as a flexible sigmoidoscopy is scheduled for 30 minutes; a complex problem requiring tests, radiology or other consultations, and follow up encounters before the problem can be determined can easily require fifty minutes or more. The lengths of scheduled appointments also vary for encounter types and clinical practices. In outpatient specialty care, for example in Cardiology and Nephrology, forty minutes are allocated for a consultation and follow-up office visits are scheduled for twenty minutes.

Obviously, it is essential to analyze patient care beyond single encounters in order to design for continuity of care within and between a patient's episodes and events, for disease management, and for complex patient paths. Graphic representations, data flow diagramming and patient care business process modeling are used within the HMO to analyze and model comprehensive organizational teamwork. Eventually, the EHR system is meant to integrate and support the practice needs of all clinical personnel--

not only physicians and nurses but all technicians, dietitians, social workers, midwives, trained clinical assistants, and others involved in patient care. The extensibility of design was always kept in mind: the clinical work of the primary care and the specialty care teams participating in EHR prototyping was analyzed for its generalizability for EHR design and development. An exemplary outpatient encounter is conceived as a nucleus to which greater complexity will be added. How is the EHR design that supports clinical documentation practices in the primary care module extensible for the multi-disciplinary documentation of the nephrologist and continuous ambulatory peritoneal dialysis (CAPD) team for patients living with kidney failure and for the extensive reporting required for patients diagnosed with end stage renal disease (ESRD)?

For any round of video taping of clinical work practices, criteria were developed to identify *exemplars* (exemplary case examples) in accord with EHR Prototype Project needs. The preliminary criteria for identifying exemplars among the baseline patient visits are listed in Table IV.1.

Three exemplars from among the twenty-four baseline video recorded case examples are discussed. Exemplar #1 is a pediatric immunization visit for which the reason for visit is a DPT (diphtheria-

pertussis-tetanus)[82] injection for a young boy accompanied by his anxious mother and sister. Exemplar #2 is a complex patient visit for which the chief complaint is "numbness in the face." The patient is a woman in her mid-60s who lives with several chronic illnesses. She is accompanied by her husband. Exemplar #3 is an example of a multiple problem patient, a woman in her mid-70s seen for a routine appointment, a "6 months checkup."

[82] A DPT injection may also be known as DTP (diphtheria-tetanus-pertussis).

Table IV.1

Preliminary Criteria for Exemplar Selection

1. Encounter types of interest, both "routine" and complex problems and visits

2. Dynamic and intensive medical records use, chart review and creation of progress notes

3. Completeness, illustrating sequences of key activities, teamwork, interactions

4. Clinical teamwork, exemplifying coordination, communication, collaboration among clinical staff, with patient and significant others

5. Design implications--case examples providing springboards for discussion of how today's practices and learning could be better supported and/or improved

6. Uniqueness of video documentation and video analysis for EHR Prototype Project needs--activities that could not be "seen" without video as resource for analysis combined with records

What do I mean by the terms "complex" and "complexity" in the context of the clinical work practices of primary care? What do I mean by complexity in a seemingly simple pediatric immunization visit? The case examples of primary care encounters and teamwork presented below are mundane. Exemplars #1, #2, and #3 were selected for their ordinariness. The "trouble scenario" that unfolds in exemplar #1 is valuable, not because it isextraordinary but because it is so ordinary that it would normally be taken for granted. The activities, encounters, and problems I discuss are not exceptional, nor do I propose that either the patient care team or the Family Medicine Clinic participating in EHR prototyping is exceptional. The outpatient office visits are clearly of a routine or simple nature when compared to in-hospital and emergent clinical cases and complex cases for which determinations of diagnoses and courses of treatment are intellectually exacting. Yet I do not regard the clinical work practices I observed as "simple" when they are conceived as collaborative activities constituted through social interactions rather than as task components in partial, formalized schema. I regard patient care as complex in the intimacy of social interactions, ethical relationships, and imagination of a patient's lifeworld required to fulfill covenants of care. The work of patient care involves working through real situations with tools and constraints, institutional and system rules, interactional resources and communicative means to address requests for

help presented by patients. To accomplish the work at hand requires improvisations that fall in-between formalized plans, policies and procedures.

Within the EHR Prototype Project, the video taped exemplars of clinic work practices were discussed with members of EHR Prototype Project teams. They were shared resources from which problematization of practices and interpretations of changes in clinical work practices could be jointly developed. The EHR Prototype Project discussions of the video exemplars can be regarded as interaction analysis sessions. Interaction analysis (IA) is a method that draws on the multiple perspectives of participants in an interaction analysis session to gain deeper understandings of video taped research materials (Jordan and Henderson: 1994). Although discussions of the video exemplars within the EHR Prototype Project were not the structured and guided discussions one would experience in an Interaction Analysis Laboratory (Jordan: 1978; Jordan and Henderson: 1994), they had the spirit of interaction analysis, provoking animated discussion among multi-disciplinary participants with diverse perspectives offering multiple interpretations on the same research materials.

I comment occasionally on the ways that the field research contributed to formulations of design problems taken up by the co-developers of the EHR in the Software Company and the HMO. From the

perspectives of EHR Prototype Project leaders and various teams, the video documentation of patient visits generated resources for three general purposes: as *resources for design requirements* highlighting clinical teamwork and a "patient-centered view" of patient care encounters; as *resources for reflection* about current practices and how they may change; and as *resources for planning* to anticipate changes in work practices and potential disruptions in transitions from paper records to an electronic system. In what ways might patient care teamwork and current medical records practices be better supported by the new tools and functions of an EHR system? Which informal conventions, local work practices and organizational habits of working are likely to be disrupted or otherwise changed by the ways in which formal requirements, formal conventions, policies and standards, and formal boundaries between licensed and unlicensed staff governing scopes of practice are embodied in or enforced by the EHR? What do these understandings contribute to iterative electronic health record design and development (design questions) and to planning for organization-wide implementation (use questions)?

Minimal transcription conventions are followed in the transcripts of patient visits. Overlapping conversation is indicated by "/ /." Interruptions are indicated by "--" (without a space between the word preceding or following "–") latched between speakers ("–" at the point of interruption by

the interrupted speakers and "--" preceding the statement by the interrupting speaker). A pause is indicated by " -- " ("--" with space preceding or following "--"). Pauses and actions are indicated in brackets, for example: [pause while the registered nurse documents at the counter]. Abridgment is indicated by "... " Inaudible or unintelligible speech is indicated as such, for example: [Inaudible].

For exemplar #1, I provide a detailed bird's eye view of the encounter in order to establish an initial description of the complexity of the clinical teamwork and work practices involved in a seemingly simple office visit in the Family Medicine module. Exemplar #1 provided an initial nucleus for design and it was a springboard for discussion of outpatient orders which present a practice dilemma and a design dilemma. These are discussed immediately following presentation of the patient care encounter. Presentations of exemplars #2 and #3 are more abbreviated and each is followed immediately by the respective imagined future scenario with EHR use. The last section of the chapter presents a discussion of all three exemplars and imagined future scenarios.

B. Exemplar #1: Pediatric immunization visit

Exemplar #1 is a pediatric immunization visit, an important *encounter type* at the heart of preventive care. This is a "plain vanilla" encounter that

occurs frequently ("high volume") and is a preventive care and public health priority ("high value"). The encounter illustrates distributed teamwork, in this encounter among the physician assistant, trained clinic assistant, and registered nurse, including a hand-off to the registered nurse for an intervention (the immunization injections). Although, in the HMO, a routine immunization visit is an encounter type that does not require the direct involvement of a physician, non-physician encounters remain the ultimate responsibility of the patient's primary care physician. The encounter involves multi-media records-keeping systems in multiple paper formats and electronic systems within the HMO and public health reporting requirements and records external to the HMO, in this case immunization records for the child's school's tracking system. The encounter indirectly reflects the general iterative development of protocols and clinical information systems. The protocol for pediatric immunizations was revised shortly before this encounter occurs. A new on-line immunization system was scheduled for implementation Region-wide in July 1994.

Regarding dynamic medical records practices, immunizations involve multiple records-keeping systems (an on-line tracking system undergoing change), internal and external accountabilities and reporting requirements (to the clinic, school, family, community) and multiple media and forms (documentation to the paper-based patient chart and to school

records, documentation of new data and "back data" to the on-line tracking system, orders written onto the "injection card" given to the patient's mother, documentation to the billing form). A new on-line immunization tracking system was scheduled for implementation in July 1994. Immunizations entail protocols for the sequence and time in-between injections. The HMO's protocols for immunizations were changed shortly before the patient visit. All of these characteristics qualified the encounter as an exemplar for electronic health record design and development.

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Exemplar #1: Pediatric immunization

2:54 p.m.

The nursing station closest to the physician assistant (PA) office

When the patient, his mother and sister arrive in the waiting room, the patient's chart has not yet reached the module. The trained clinic assistant (TCA) has the registration and billing form (hereafter "the billing form") and HMO member card. She looks up the patient's appointment history in the on-line outpatient appointment system. In the computer, the TCA sees that the reason for today's visit is noted as "DPT injection."

The patient's chart did not arrive at mid-day with the charts ordered from the chartroom the previous afternoon. In fact, eight of thirteen of the charts for the PA did not arrive before the afternoon clinic begins. This is

unusual because the Family Medicine Clinic has its own chartroom on the first floor of the two-story building; by contrast, the Medical Center's Outpatient and Inpatient Medical Records Departments serve the five-story Medical Offices building, the five story Hospital that includes the Emergency Room, and a single story building for Family Medicine and ancillary services. The HMO estimates that 15% of its outpatient encounters are conducted without the patient chart. Routine chart requests are generated automatically (within the appointment scheduling system) two days prior to scheduled appointments. In response to STAT requests by the nursing staff and with concerted efforts by the chartroom staff (and some luck that the chart is not buried on a physician's desk), the missing charts will be delivered "just in time" before the patients' visits, while an encounter is in progress, or soon after a patient leaves. In the HMO, physician assistants typically have "Same Day schedules" in which all appointments are scheduled for the next morning or the same day on which the patients call requesting appointments. Charts for same day visits are ordered at the end of the previous afternoon, during the morning of the day of the appointment, or between the time an appointment is scheduled and the patient arrives at the clinic. Charts required in less than two days may need to be requested "STAT" (immediately), as soon as possible or according to other remarks added to the

chart request to specify timing and reasons for requests to expedite delivery of the chart.

In the absence of the chart, the TCA searches the computer system for the child's appointment history. While the TCA reviews the appointment history for the pediatric immunization, she and the PA talk about another patient whose chart has not yet arrived. The computer screen shows a history of "no show" appointments for the child scheduled to have the DPT injection. Both are marked "DNK" for "Did Not Keep [Appointment]." Within the past five months, the mother failed to keep two previous appointments for the same purpose. The child is therefore behind schedule for the immunization series. That more than one appointment was not kept--marked "DNK" for "Did Not Keep"[83]-- suggests reluctance or ambivalence on the mother's part. When the chart is delivered STAT (while the encounter is in progress), previous documentation includes a "red flag"--"NO PERTUSSIS" in capital letters–and notes important for understanding the mother's fears: the mother's assertion that pertussis--the "P" in "DPT--"caused epileptic seizure" for the

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[83] The on-line appointment history displays appointments not kept--DNK'd appointments–as well as those kept. A DNK'd appointment is one of few clues as to whether an outpatient is following a plan of care (whether there is "compliance" or "non-compliance" with a plan of care). A DNK can be translated as a "no show," distinct from a cancellation by a patient (although a patient may call in so late that his or her appointment could be categorized as a DNK appointment). Generally, the category DNK is reserved to signify a "no show" without notice or explanation. When an at risk patient DNKs an appointment, it takes on greater importance.

patient's sister. The mother's belief that a pertussis injection caused an epileptic seizure for her daughter is documented in the chart as per the mother rather than as a medical conclusion as per a doctor or other clinician.

The TCA pulls up the computer screen for a chart request and enters the order while concluding the discussion of the other patient with the PA. The screen reads:

Screen: Chart please.

STAT STAT for appointment now please

Send chart to PA [name]

The telephone rings. It is the chartroom with good news: the chart that the TCA and PA were discussing has been found. As she finishes keying in the STAT chart request, the TCA tells the Chartroom Lead by telephone that the new chart request is for an imminent appointment. Then she takes a Clinical Progress Record (hereafter "progress notes page") and stamps it with today's date and the PA's name, paperclips it together with the HMO member card and the billing form, and goes to the waiting room to call the patient.

The boy is accompanied by his mother and his older sister. Before proceeding to the nursing station, the TCA weighs the patient on a scale in an alcove nearby the waiting room door. The TCA's nursing notes indicate that the boy is five year old and weighs 62 pounds. As per the mother, she notes

"NKDA," "no known drug allergies," in the left hand margin of the progress notes page under the vital signs.

TCA Now, do you have [patient name]'s card with you or not?

Mother Yeah, I do. His member card or his shot card?

TCA Yes. Both, actually. I'll take both!

While she chats with the older sister, the TCA uses an addressograph to imprint the HMO member card onto the progress note page. She arranges the yellow school immunization records on top of the progress notes with the billing form. The billing form (a duplicate carbon page) was generated when the patient registered at the clinic's central appointments desk on the first floor. Unlike progress notes and notes that document telephone messages, the billing form is not a medical legal record; it will not be filed in a patient's chart. During patient visits, module team members use the billing form as an informal means for physicians and physician assistants to quickly communicate orders to nursing staff while the physician or physician assistant retains possession of the patient chart in which he or she will formally document orders in the plan of care section of progress notes for the encounter. At the end of the visit, the patient turns in the billing form to the appointments staff who quickly peruse it to determine whether the orders jotted onto it mean that the patient owes more than the $5 co-payment paid at the beginning of the visit.

TCA Okay, now what's [patient name] here for?

Mother He needs to get his last DPT injection. But I just want him to have DT. I don't want him to have the pertussis.

TCA Okay.

Mother He needs it for the school. He's had three ... He needs [to update] to keep the records straight. To have his fourth injection.

At the top of the progress note where nursing staff note the chief complaint or reason for visit according to the patient, the TCA writes "DT injection," in other words she drops the "P" from "DPT." The media had recently reported instances of pertussis associated with severe seizure reactions in children.

Mother [To son] How much do you weigh? 62 pounds.

TCA 62, uh huh.

Mother [To nurse] Would you write that on the back, please?

TCA Sure.

Mother The date and then how much he weighs now.

TCA Sure.

The HMO and the schools participate in the public health initiative promoting 100% immunization for children. The mother hands the immunization school records to the TCA. The TCA has the yellow school

immunization records in front of her. She studies them and then writes the information onto the HMO member's carbon copy of the billing form so that the mother has the information required for the school records. The TCA studies the school records brought to the Family Medicine Clinic by the patient's mother to ascertain the status of the immunization injections to date; subsequently, the PA will review the school records before the exam room consultation. As part of the community-based public health campaign, immunization injections can be given in the community at large. For these reasons, the school record carried by the child's parent serves as a central point of chronological information about a child's progress through the immunization series. It is possible for a child to be up-to-date for immunizations although the patient chart and on-line tracking system do not yet reflect the up-to-date status. This was not the case for the child in exemplar #1, however. He is significantly behind schedule, according to the protocols for pediatric immunizations.

The mother confirms that her son already had a physical at school, so he does not require a physical examination today. For today, the mothers explains again, he only needs "the DT." The TCA takes the boy's temperature (by the ear), completes documentation of the vital signs and asks his mother, has he been sick recently? (No.) Again, she arranges the yellow school

immunization records on top of the HMO member card, progress notes page with her nursing notes, and the billing form.

3:00 p.m.

The TCA takes the family into one of the examining rooms. Once she has "roomed the patient," she puts the paperclipped records and card on the corner of the PA's desk. This is a physician assistant's or physician's visual cue that a patient is in the exam room and ready to be seen.

PA office

Each physician and physician assistant organizes his or her desk and office differently. In the PA's office, we see the boy's records on the lower left hand corner of the desk. Charts with progress notes completed by the PA and ready to be "mentored" by a physician (reviewed, approved and co-signed by the mentoring physician, or returned to the PA for amendment or clarification of important data) are stacked in an outbasket at the upper left corner of the desk, open to today's notes. The PA's Same Day appointment schedule lies to the right in the middle foreground of the desk.

Throughout the day, in-between each appointment, each care provider marks up the patient appointment schedules, annotating "S" for "show" and "NS" for "no show," updating which appointments are completed, checking the appointment times for remaining patients. An important aspect of the team's work through the day is the struggle to *stay on schedule*

culminating in a race to end the clinical half day approximately on time. The appointment schedule acts as a coordinating point of reference for the team. The appointment times in the schedule differ considerably from the real start times and duration of office visits (when patients actually arrive, when they are seen, how much time is required for varying encounter types); yet, it is the appointment schedule by which productivity is calculated organizationally (as "through-put" of the number of patients per clinical half day).

Everyone has family and other responsibilities after work. Members of the nursing staff have rotating responsibilities to work in Triage (the clinic's walk-in urgent care service), the Allergy clinic, seasonal clinics for flu injections and school physicals, and to provide coverage for each other. The registered nurse and one licensed vocational nurse have union responsibilities and the other licensed vocational nurse is completing courses for a registered nurse degree. The physicians and physician assistants have rotating responsibilities one or more afternoons or evenings each week including coverage in the Urgent Care and Walk-In Clinics at the Medical Center.[84] If a physician is late leaving the Family Medicine Clinic, it means a

[84] The physicians also have rotating responsibilities on the weekends for the Urgent Care and Walk-In Clinics, in addition to hospital coverage, mentoring residents at the hospital, and overnight coverage in the Emergency Department. Patients seen at each of these points of care are followed up by their primary care physicians; there are often time lags or gaps in patient records.

late start at the next care setting, patients and staff waiting, frustrated, anxious or angry. And another struggle to adhere to an expected schedule.

The physician assistant is usually able to stay "on schedule." He works frequent shifts in the Urgent Care or Walk-In evening clinics and he often needs to leave promptly to drive to the Medical Center. He is known for working fast: "I greet 'em and treat 'em."

The PA enters his office and begins to review the boy's school immunization records when a chartroom clerk walks in with the other chart requested STAT. After reviewing the other patient's chart, the PA turns his attention back to the immunization records, leafing through the school record, pointing to parts of it with his pen, then counting while tapping relevant information in the records with his pen. He reads over the TCA's nursing notes and writes orders onto the billing form and signs it. He gathers the HMO member card and records and goes to the exam room.

Exam room

The boy, his mother and sister stand around the examining table which the PA treats as a counter. The PA explains the series of injections, what will happen today, and what needs to be done to get the child back on the immunization schedule according to protocol. The protocol was recently changed. The revised immunization schedule is a table showing six different vaccines (DPT, Heptavax, MMR, TB, Hib, OPV) and the dosage for each

according to a child's age (at birth, at two months, at four months, at six months, at nine months, at twelve months, at eighteen months, at twenty-four months, at forty-eight months, five-six years, twelve years and over). Certain immunizations are marked as "optional," "if needed," "if not given at nine months," and intervals from the initial injection are listed for children twelve years and over (initial #1, one month #2, six months #3).

PA So we've got three vaccines... And what we do, we'll give one today. One in a month, and then six months down the road we'll give the third one, okay?

Mother Okay. That's for the Hep--that's for the DPT?

PA That's for the Heptavax. And so what we do, we'll [go ahead with] the DT today. And then he's going to need another one, probably in a month. That way we'll catch him up.

Mother Okay, good.

PA That way, he'll be caught up. [Reviewing the school immunization records] He's already had his two measles vaccines and that's good.

Mother Yes.

PA And he's up to date on his [TB] so he's alright there.

Mother Um hum.

The PA documents and signs the school records.

PA That way, he'll be up to snuff on everything.

Mother Yeah.

PA Now, if you want to -- I think all the kids, they have the hepatitis B vaccine, and what you can do is you can just check back in for a nurse visit and then they'll -- give this to the nurse and she'll put dates and stuff there. And so -- just check in "per nurse visit," and then [we'll do all this] hepatitis vaccine...

Mother Okay.

PA [To the boy] Okay, you wait right here and the nurse'll be in. Are you gonna be brave?

PA office

The PA enters, places the progress notes page on top of the appointments schedule and adjusts the stack of charts with progress notes to be mentored. The PA documents brief progress notes for the encounter. Typically, the PA writes prescriptions and orders in the exam room but does not document to the patient chart until he is in his office. He writes progress notes immediately after the encounter, "all of a piece," after determining the problem focus. The PA is a "SOAP note" writer, as are most of the physicians in the Family Medicine Clinic. The acronym SOAP stands for the four major

areas delineated in outpatient progress notes: (S) subjective findings; (O) objective findings; (A) assessment (assessment, problem, diagnosis); and (P) plan of care (plan of care and orders for the plan of care). A SOAP note is a problem-oriented note (see, e.g., Weed et al.: 1976), an important innovation in progress notes documentation introduced in the 1970s. The PA's clinical documentation of the pediatric immunization is not a SOAP note (there was no physical exam) but an adaptation of one: "O discussed" (objective findings discussed). It takes him about thirty seconds to complete the note. He adds the boy's chart to the stack of the day's progress notes for mentoring by a physician at the end of the day or the next day.

A gap in time ensues between the PA's exam room consultation with the family and the availability of the registered nurse to carry out the injection orders. Meanwhile, the family waits in the exam room for approximately ten minutes.

The "hand off" of orders to the registered nurse for the immunization injections[85] occurs in the hallway off camera. We hear the registered nurse ask the physician assistant for further explanation outside the exam room door.

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[85] Interventions such as injections (by convention any intervention that requires puncturing the skin) require a registered nurse. Although on-line protocols may extend the ability of nursing staff other than registered nurses to carry out certain orders and activities, many interventions will remain the domain of RNs and other licensed clinicians.

RN Okay, I need more information here. What do you want me to do here? [Pause] A-cellular pertussis.

PA [inaudible response]

RN There's one, two, three–is it a series or what?

PA [inaudible response]

RN You want her to have a injection card for the rest...

Exam room

The registered nurse enters the exam room, places papers on the counter and turns towards the mother to explain the injection. She is not prepared for the mother's request that her son should not have pertussis ("No P"). The patient chart with the red flag--"NO PERTUSSIS"--is in the physician assistant's office.

RN Now what he's going to get, he's gonna get the A-cellular--[to patient]--right up here at the edge with your legs hanging down, okay? --[to mother]--it's called A-cellular DPT–

Mother –I don't want him to have the P. I told them that: "No P."

RN [Putting on gloves] The--

Mother –No pertussis. ... Because that's how she got epilepsy. From DPT... I never-- ...because she [got it when] she was a baby and she has epilepsy now because of it. ...

The registered nurse explains the DPT immunization mixture to the mother. Although the registered nurse's explanation is neither wholly accurate nor clear (as the RN and others note upon viewing the video tape), the registered nurse succeeds in reassuring the mother who relents her objections and allows the injection.

RN They can't get [pertussis]. But it's still mixed, it's just mixed a different way. They use a different type.

Mother Hmm.

RN ... Because we don't give the regular DT to little kids. [Preparing the needle at the counter] So [walks over to the patient on examining table and sterilizes his arm] -- 'cause it's just a different combination. [Pause] [To patient] Now you get one here and one here. Are you pretty tough?

Patient [No response]

RN You don't know? [Laughs]

The mother laughs a little.

Sister I think he is.

RN For most kids, sometimes they still get soreness at the site from any injection.

Mother Yeah.

RN So, you know, he can have Tylenol. Now he's gonna get a total of three hepatitis for the series, to get the whole series.

[To patient] Okay, you look over that way, okay?

The registered nurse administers the first injection. ...

Mother Three hepatitis injections?

RN He gets a total of three, not all today.

The mother and the RN change sides of the table to get ready for the second injection to the child's other arm.

RN But he'll get one in a month. [Writing at the counter] So in about a month, they'll do those down in Triage on the first floor. Have you been there before?

Mother I think so.

RN It's down by the Lab. They'll give him the second dose of hepatitis. [Crosses the room again] [To patient] You were great! [To mother] Boy, you trained him well. And then, um–

The nurse prepares an injection card.

Mother Will you call to remind me or do I have to call?

RN No, I'm gonna give you a card.

Mother Okay.

RN And they do those from 8:30 to 11:30 and 1:30 to 4:30. [Shows injection schedule on the card to the mother] So the second hepatitis will be due on the 24th of March, and then the last one will be due on August 24th. And, you know, if it's a week late, that's okay.

Mother Okay.

RN [To herself] Let's see. [At the counter, reviewing the PA's orders on the billing form and writing]

Mother Okay. Good. [Begins to put the card in her purse] Because I've had hepatitis myself before.

The RN asks for the card again after reviewing the PA's orders.

RN Okay, let me see that [takes the card from the mother] ... He says he also wants him to have--and we'll just put [adds to the injection card, writing at the counter]--

Mother I know what it's like to have it.

The mother joins the RN at the back counter while the RN writes additional injections to the card. The RN talks aloud.

RN This will be DT number five. [Pause] So actually, he's gonna get two on March 24th. 'Cause I guess he needs one more, the tetanus [shot]. [Pause] Now, is he allergic to any medications?

Mother No.

RN Not penicillin or anything like that?

Mother No.

RN All right, mom. You're all set there.

Mother [Reviewing school records] He's had all his tetanus injections.

RN Yes, well this is--you know, the tetanus is mixed in with the diphtheria. The DPT, that's the tetanus in there, too.

Mother Oh.

RN It's all mixed up. But -- [separating the patient's copy of the billing form] Okay, that goes to you out front where you checked in. [Gives copy of the billing form and HMO member card to the mother] There's his card. So, this is what you bring back on March 24th [shows injection card to the mother]. And then he'll get another, he'll get basically what he got today again. And then the third time he comes in, or the second time he comes in August, he only needs to have one. Okay?

Mother Okay.

RN Okay? So you just keep that in your wallet.

Mother Okay. [Puts the injection card into her purse]

The RN advises the mother again that the son may experience soreness at the site of the injection.

3:22 p.m.

The RN, mother, son and daughter leave the exam room. After they leave the exam room, the RN gives the mother literature about immunizations and potential reactions to injections (patient education materials are at hand in vertical displays on the walls in the hallways between the exam rooms and the nursing stations). At the nursing station, she gives stickers to the little boy (stickers are the 1990s replacement for lollipops).

4:17:51 p.m.

Nursing station later in the afternoon

The TCA is at the computer keyboard with the billing form in front of her on the counter. The RN reaches for a pile of records behind the TCA, looking for the chart for the DPT visit to update the on-line immunization tracking system. They look through the patient records and charts on the counter together and divide up the paperwork.

The TCA enters another STAT chart request into the computer for a chart needed first thing in the morning.

5:30 p.m.

Central nursing station after the Clinic is closed for the day

The RN and the TCA were granted permission to work overtime to catch up on messages and paperwork. The RN asks aloud where two charts are that she needs for documentation to the immunization records system.

The TCA looks for the charts among the charts in the *Out* slots where charts are placed when they are ready to be returned to the chartroom. She finds the two charts and brings them to the RN who picks them up and moves in front of the computer monitor. The RN sits at computer screen entering immunization data into the computer-based tracking system. She reads dates aloud to herself. The computer screen shows that she is entering back data from 1993 forward, looking back and forth from the patient chart for the pediatric immunization encounter. ... The RN keys in the fifth entry for the child's immunization history, then the sixth and seventh entries, looking back and forth to and from the chart. She turns to the next page in the chart, entering records chronologically forward up to today's encounter, then saves the electronic record and tosses the chart back into the *Out* slot in the central table behind her, for the chartroom to pick up in the morning.

A new immunization tracking system is scheduled for implementation throughout the Region in July, one of the "fast tracked" clinical information systems. The more data is up-to-date in the current system, the more will be automatically converted to the new system. Once implemented, there are many complaints about the clumsiness of the user

interface of the immunization tracking system. However, it generates the basic information the HMO requires: the number of immunizations of different kinds given to patient populations (children, adults up to 70 years old, senior adults) and percentages of patients who have been immunized. Before the immunization tracking system was implemented in July 1994, these basic statistics were unknown and unknowable.

5:33:08 p.m.

End of encounter and documentation

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B.1. Discussion of exemplar #1: a trouble scenario

Exemplar #1 was presented to three of the EHR Prototype Project steering committees whose representatives included clinical and non-clinical administrators, care providers, Regional physician leaders from each medical center, Information Technology department project leaders, and project team members. In addition, the video taped patient visits were reviewed and discussed informally amongst core EHR Prototype Project staff. My discussion incorporates comments from these interactive analysis sessions. A pediatrician cautioned that regional protocols for immunization series need to be maintained carefully in a situation such as this in which a child is behind and a care provider is anxious to "get him caught up." Injection series must be administered within specified time periods and time intervals between

each injection in a series must be adhered to, in other words each injection must be given according to the protocol or the series must start over from the beginning. An administrative physician commented that, based on the patient's appointments history, the injection could have happened within a prior encounter for an acute problem (a toe injury): "This visit should not have happened." Most importantly, it became clear in the discussions that what seemed at first to be a routine immunization encounter was "a trouble scenario" that contained a "near miss." The mother's request for a "DT" injection that did not include pertussis was not communicated to the RN who was responsible for giving the child the injection. The child was given a DPT injection rather than DT as directly requested by the mother, and it was possible that the wrong injection was administered from a medical point of view given the risk of an adverse reaction based on the mother's report of the sister's adverse reaction (family history). Exemplar #1 thus presents a potential medication error, a "near miss" in the context of a routine outpatient encounter and everyday clinical work practices.

Medical center policies and procedures regarding orders are clear cut. When exemplar #1 was discussed in early planning discussions for the implementation of the first version of the EHR prototype, the Clinic's administrator commented, "I can tell you that [an] RN [in the Family Medicine Clinic] will not give a injection without seeing it the chart written by the

doctor." "It has to be written in the chart to be given," explained the Outpatient Medical Records Administrator. A registered nurse with administrative responsibility for Medical Center nursing staff commented: "The licensed staff go looking for the blue sheet [the legal medical record] like for the child's immunization and everything because that's the official [order]." Yet formal policies and informal localized practices coexist uneasily. Discussion of video exemplar #1 highlighted the difficulty of crafting a path between the present state of uneasily acknowledged informal practices for outpatient orders and the practice and difficulties posed for clinical team communication by formalization of policies and practices in electronic health record design for outpatient orders.

Analysis of the immunization visit identified a *systemic gap* between typical chart paths, patient paths, and clinical activities given the constraints of current clinical information systems. The immunization encounter revealed a practice dilemma related to outpatient orders practices. Whereas medication errors are associated with inpatient settings, the encounter displayed how easily a medication error could occur in an outpatient setting through customary day-to-day routines of clinical teamwork to work around systemic gaps in access to critical information. Figure IV.3: Systemic Gap Between Patient Path, Chart Path, Clinical Activities is a schematic diagram of the immunization visit that shows the systemic gap between the chart path of the

singular paper-based patient chart, the patient path, and clinical activity paths at the time of interventions (injections) administered by an registered

Figure IV.3:

Systemic Gap Between Patient Path, Chart Path, Clinical Activities

nurse after patient-physician / physician assistant interactions in the exam room but before orders are documented and signed in the chart.

The problems observed in exemplar #1 point to the systemic nature of such gaps, incompleteness and uncertainty, and potential risks of clinical work practices, for example the risk of medication errors. These typical informal practices for teamwork and communication will be changed--disrupted, better supported, or both--by the formalization of policies and rules structured into electronic health record design as to clinical scope, signed orders, and date and time stamps and signatures on all documentation.

Why does the systemic gap that surfaced in discussions of the immunization visit matter? How does it constitute a practice dilemma between formal policies and clinical work practices? How does the systemic gap translate into a practice dilemma for registered nurses working in ambulatory settings? The systemic gap identified in exemplar #1 is multiplied many times over in care settings throughout the organization. Time-pressured care providers bridge the gap via verbal orders or by jotting orders

onto available forms such as the registration and billing form.[86] Not having

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[86] Each patient care team in outpatient care requires some informal means to bridge the systemic gap between points of patient-care provider interaction and points of clinical documentation when signed written orders in a singular paper-based chart cannot be available to more than one clinical staff member at one time unless they are co-located. In the second EHR prototyping

ready access to the signed medical record can easily become problematic if a nurse needs to confirm the details of orders when interventions are urgently required. In inpatient settings, where orders policies and records are more explicitly elaborated, verbal orders are frowned upon, to be avoided when possible.[87]

The billing form is an ephemeral form that is not an official medical record and therefore does not become part of a patient's chart. The billing form provides the patient, the Clinic, and the HMO with a record of services billed.[88] The form is generated when a patient registers at a central appointments desk. Each registration and billing form is numbered and each is imprinted with a code for the HMO member's benefits coverage in addition to his or her medical record number, name, address and telephone number. The form is given to the patient to carry to the module where it is presented to

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module comprising Cardiology and Internal Medicine outpatient care teams, I observed another informal practice for in-progress orders. The physicians often jotted orders onto the carbon copies of chart requests that accompany a patient's chart from the chartroom. The chart order slips are ephemeral forms outside the medical legal records of patient charts, as are the registration and billing forms used for intra-module communication by the Family Medicine team.

[87] In most circumstances, signed orders provide clearer communication, but there are urgent and complex situations in which it is necessary and/or more effective to give verbal orders first, backed up by written orders as soon as possible.

[88] During the time that I worked for the HMO, an initiative was launched (with mixed success) to add ICD and CPT codes for common diagnoses and problems to the billing form. Checkboxes for common diagnoses and reasons for visits are marked up by physicians, then the data is entered to a centralized computer database by clerks.

the nursing staff at the beginning of the encounter. At the end of an encounter, the patient carries the billing form back to the appointments desk where billing codes are assigned, as needed, for each office visit. All numbered forms generated for the day must be accounted for and reconciled with payments collected from patients. The forms are retained for two weeks and then thrown out.

For the patient care team, the billing form served as an important informal communications vehicle for conveying the physicians' and physician assistants' orders for those elements of care plans, orders and instructions that involve nursing interventions such as injections and on-site ancillary services such as lab tests and X-rays during an encounter. It was used as a communication tool within the patient care team to convey orders in the fast-paced tempo of outpatient visits. Patient care team members need to give each other information quickly, often without a chance to communicate in person. Rather than waiting to catch a moment in person, the billing form can be dropped off at the nursing station or handed to one of the nursing staff with a few words. According to the module nursing staff, the chart is often not available at the time that interventions are carried out. A nurse may take the time to seek the ordering physician or physician assistant to clarify orders or he or she may seek the patient's chart in the physician or physician

assistant's office in order to have the legal medical record available when an intervention is carried out. But there is often little or no time to do so given the pace set by the work organization. The billing form serves as a "proxy" or short-term "stand-in" for the plan of care that the physician or physician assistant documents in his or her progress notes in the medical legal patient chart. Information on the billing form may or may not be backed up by verbal orders from the physician or physician assistant; conversely, verbal orders may or may not be backed up by written notes. Whereas clinic administrators believed that discrepancies between orders jotted onto the billing form and orders documented in the plan of care in the patient chart--sometimes considerably later in the day--were rare, Clinic nurses estimated that differences between the non-legal billing form and the medical legal chart occurred as frequently as "30% of the time."[89] A discrepancy may result from the need to add to or change orders and plans of care, lack of detail or lack of clarity of "telegraphic" notation of orders, or ambiguities about "defaults" and "norms" in varying clinical contexts for the up-to-date substantive content of order sets such as lab panels.

Again we may ask, why does it matter whether the members of the patient care team employ the informal practices of verbal orders and use a

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[89] EHR Prototype Project, Confidential Report, 1994.

non-medical record (the registration and billing form) for communication of outpatient orders? Analysis of the video documentation brought to the surface the potential for unexpected risks in routine outpatient encounters. Policies and procedures for orders practices are motivated by the underlying concern to eliminate risk of errors or discrepancies that may pose harm to the patient. Outpatient settings are conceived as "low risk" in comparison with hospital settings. In hospital, registered nurses either work from written and signed *Doctor's Orders* or have direct personal communication with physicians when verbal orders are given in time-urgent circumstances as in an Emergency Room, during "codes" and other emergent events. Greater acuity in outpatient care represents a change in the sites and patterns of patient care, including more frequent care of "at risk" and “high risk” patients and the movement of more complex procedures from hospital to ambulatory environments. Indirectly, the issue of "verbal orders" in outpatient settings, problematized in discussions of exemplar #1, contributed to a larger and complex design problem: how to design the core functionality of orders into the electronic health record system in such a way that orders practices will be consistent across care settings. Orders are "a wicked problem" (Rittel and Webber: 1973) for electronic health record design and clinical use.

B.2. Exemplar #1: Imagined future scenario

Existing patient records systems, based on the concept of singular medical legal patient charts and comprising patient records in diverse media from diverse sources, are fragmented, labor intensive, and, even with the best efforts, uncertain. In the imagined future scenario, the electronic health record integrates all media and streamlines records, eliminating redundant documentation and fragmentation. Patient records from different sources are all available in common in electronic charts.

The electronic health record alerts care providers to risks identified in a patient's family history and to the concerns of a patient or family member, for example, the mother's concern about adverse reactions to pertussis in exemplar #1. In the imagined future scenario of exemplar #1, the TCA, PA, and RN see the mother's concern about pertussis right away and whether a family history of adverse reactions to pertussis is medically verified. To respond to the mother's concerns, the PA and RN can review the medical evaluation of the patient's sister's seizure reaction to pertussis in the daughter's on-line chart.

Alerts and *reminders* are among the core functionalities of the electronic health record design. The EHR system provides alerts, proactive reminders for health maintenance procedures, and prompts to follow protocols that change over time. "Smart" reminders interpret the individual patient's history in relation to a protocol, for example, quickly establishing where the child in

exemplar #1 is in relation to the immunization series, and then let care providers know what actions should be taken (which immunizations need to given and when). The EHR system then sets up reminders for the child's and mother's return visits. In the imagined future scenario, the HMO manages protocols centrally through the electronic health record system and clinical information infrastructure. When a protocol is changed, for example, the protocol for immunizations, the on-line reference file is updated electronically. An object must be modified "by hand," then all its children inherit the modified attributes and all of the object's relationships are changed accordingly. The HMO notifies every care provider responsible for immunizations that there is a new protocol by sending a message to his or her "to do" list in the electronic health record.

In early EHR prototype use, emerging use of reminders that must be acted upon is evident in the automatic generation of DNK (Did Not Keep appointment) notifications to the physicians' and physician assistants' on-line "to do" lists for disposition and documentation to the patient chart. The DNK notifications are generated electronically as a result of the interface built between the electronic health record and the on-line appointments system. Systematic disposition and documentation of every appointment not kept (every DNK'd appointment) represents a change in clinical work practices, an explicit accountability where before it was left to each care provider's

discretion whether to follow up on a missed appointment or not. The consequences of this change are greater in specialty care settings, such as the Cardiology and Internal Medicine module that participated in EHR prototyping, where patient acuity is higher and the failure to keep an appointment may mean that a patient's health is put at risk or at higher risk. As imagined, the EHR system provides distributed on-line access to authorized staff for in-progress orders during an encounter as well as patient records already documented in electronic charts. The EHR system provides care providers with much more information--feedback signals including proactive reminders, clinical alerts, electronic audit trails--about the status of actions. EHR design introduces new elements into the operational work flow outlined in Table IV.2: EHR Design Introduces New Elements in Clinical Work Practices. Because orders are elements of plans of care in outpatient settings, a *signed plan of care* represents a strategy for ensuring that nurses have *signed orders* to execute. On-line orders are supported by worklists that display the status of actions required (what, when, by whom, for whom). With future EHR use, it becomes possible to monitor the status of orders and actions, to know in real time when an action has been completed by another care provider (doctor, nurse, dietitian) or by another department (laboratory, radiology, diagnostic imaging, cardiology, pharmacy, appointments center). Ordering physicians and nursing staff can look up the status of complex

orders that involve multiple clinical staff and orders that require sequences of steps that may be conditionally related.

Table IV.2: EHR Design Introduces New Elements in Clinical Work Practices		
Clinical work practices	Pre-EHR baseline	Imagined EHR use with on-line Orders and Worklists
Orders given by MD / PA as part of plan of care	• Informal practices include verbal orders and orders jotted onto billing form	• Formalized, explicit EHR orders and worklists
MD / PA progress notes	• Written care plan within in-progress (unsigned) progress notes in the chart	• Written, signed plan of care in the EHR
Verification of orders	• If plan of care is not yet written and signed, via verbal orders and / or jotted onto billing form	• New tools that allow nursing staff to work against signed, documented orders
Execution of orders	• The chart is often not available when RNs carry out procedures and interventions • It may be difficult or time-consuming to ascertain the status of orders in progress	• Signed orders are available in a signed plan of care (electronic, printed hard copy) while an encounter is in progress • On-line worklists show the status of in-progress actions pending completion of orders (new form of closure)

Clinical documentation	• Plan of care documentation is often completed after the encounter (considerably later in the day) • Discrepancies between the documented plan of care and orders jotted onto the non-medical billing form are frequent • Nursing documentation of actions taken is often partial, incomplete	• Nursing documentation is more complete for actions taken per MD orders (closure) • Verification of verbal orders in nursing documentation with MD co-signature • On-line process documentation displays status of team members' notes for an encounter until the encounter as a whole is complete • Electronic audit trails are generated for on-line orders and worklists • "Redundancy problems" may occur between clinical documentation, orders, worklists
Note: The requirements for on-line orders and worklists were developed jointly by the HMO and the Software Company but neither of these two core functionalities were included in the first three versions of the EHR prototype in clinical use.		

It is imagined that the future integrated EHR system will make new kinds of information available to monitor actions by patients (as well as actions by clinical staff), making it possible to move from *open doors* towards *closure* to know, for example, whether the mother followed through on the immunization series ordered for her child in exemplar #1. In an early design discussion, a physician suggested that orders for lab tests and prescriptions could soon be handled as "E-tickets" (electronic tickets) are by airline companies.[90] Through interfaces with the computer systems for ancillary services departments, the electronic patient record tells a care provider that a patient has followed the course of action outlined in a plan of care--by getting a prescription filled, by going to the lab to have blood drawn, by showing up for diagnostic imaging tests--by generating an electronic message indicating an action completed (closure). In the E-ticket scenario, a failure to follow through within a certain period of time, for example if the child in exemplar #1 does not have the next DPT injection within the time interval specified in the protocol, generates an electronic message indicating a "no show" by a patient. Certain accountabilities between a patient and care provider become visible in new ways. While it may at first seem that the responsibility shifts more clearly to the patient, an explicit accountability is also created for the

[90] Physician participant in EHR design discussions, 1995.

care provider in that he or she is now responsible for taking a new action regarding a "no show" by the patient in many instances where previously there were no feedback signals.

The EHR system as imagined intensifies contradictions of the activity system of patient care in the HMO. In the imagined future scenario, the electronic health record displays proactive reminders of a patient's and family member's health maintenance and on-going care needs in addition to alerts, reminders and prompts related to the reason for the day's visit. Each alert, reminder, or prompt requires some action: act or assign, or defer and schedule. A physician, physician assistant, or registered nurse practitioner and the patient care team are presented with additional actions to be taken for the patient, particularly interventions and procedures that are proactive in nature and related to preventive health principles. Each of these requires attention and time (even if the action is to defer and schedule for a later time), but the visit is allocated the same amount of time according to the regime of work organization reinforced by productivity measurement in the HMO. Pursuing the clinical utopian project of realizing social medicine ideals, clinician inventors imagine the electronic health record helping care providers to do more for the patient proactively, maintaining health, eliminating preventable illnesses, controlling risks and diseases while simultaneously expanding clinical knowledge about how best to do so. Pursuing managerial

utopian projects, the electronic health record promises to enable health care providers to "[treat] more patients in less time for less cost"[91] and senior managers of the HMO assume that the EHR will enable each primary care physician to see 20% more patients per clinical half day than now. Given the interpersonal interactions at the heart of patient care, how can care providers do more for each patient, document more thoroughly, and monitor the in-progress status of actions without more time? It is in these ways that exemplar #1 is a nucleus for electronic health record design and for the contradictions of the incomplete utopian project of the EHR Prototype Project, to which exemplars #2 and #3 add complexity.

C. Complex patient visits, multiple problem patients

In addition to the broad base of general primary care patients and encounter types, complex patients and multiple problem patients were prioritized for electronic health record design and development. The criteria for identification of complex patient visit scenarios were defined by EHR Prototype Project physicians and nurses. These are shown in Table IV.3: Criteria: Complex Patient Visits. These criteria provide an initial description of interactions and characteristics that constitute encounters deemed complex by practicing clinicians.

Table IV.3

Criteria: Complex Patient Visits

1. Complexity of case over time
2. Complex problem presented during encounter
3. Complex encounter, involving either one complex problem or multiple problems
4. Complex psychosocial interactions
5. Complex psychosocial problem(s)
6. Complex sources of information
7. Complex collaborative teamwork required for patient care
8. Complex hybrid features (combining two or more of the dimensions above)

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[91] Software Company brochure.

Exemplar #2 is a complex patient according to several criteria. The patient carries several chronic diagnoses and, in this encounter, presents a new problem that requires diagnostic tests (the problem cannot be diagnosed from the signs and symptoms presented within the encounter). Interactions with the patient and the patient's spouse are complex in that communicating is effortful. The physician considered it difficult to discern and explain salient medical information and meaningful relationships between points of information raised by the patient.

Whereas exemplar #2 represents a *complex patient*, exemplar #3 represents a *multiple problem* patient. A multiple problem patient lives with on-going multiple problems, variously acute or chronic, which may or may not be inter-related. Exemplar #3 is representative of a typical encounter type and an important subset of senior members of the HMO. EHR Prototype Project participants in the HMO and the Software Company assume that electronic health record systems will provide clinicians with new tools to help clinicians more quickly diagnose and determine dispositions for actions to be taken. For diagnostic complexity, the concept is that decision support through medical logic modules (developed by specialized design companies) will be integrated with the EHR system through its open architecture strategy and thus delivered to the desktops of physicians.

C.1. Exemplar #2: complex patient, complex encounter

Exemplar #2 is a complex patient visit by a long term patient of the physician who is also the primary care physician for both the patient and her husband. The patient is a 65 year old woman who lives with multiple chronic diagnoses for which she takes numerous prescribed medications. She is cared for by multiple physicians and ancillary care providers. As is common for spouses, family members, and significant others, the patient's husband accompanies the patient and is actively involved in assisting his wife in following the schedules of multiple plans of care ordered by various care providers. This encounter offers a window onto linkages with the Medical Center since the patient is being seen by specialists for chronic problems. In the HMO, a patient's primary care physician is "the captain of the ship" for the patient unless this role is explicitly assumed by a specialist caring for the patient.

The patient gives "numbness in face" as the reason for the day's visit and the TCA documents her words as the chief complaint in the nursing notes. A second reason for the visit is offered by the patient: "if [Dr. A] wants to revisit my medications." There is uncertainty regarding the new problem the patient presents. The physician examines the patient for Bell's Palsy and documents his assessment as "doubt Bell's Palsy." At the back of the patient's chart, a problem list letter written by Dr. A in 1992 reads: "To Whom It May Concern: [Patient name] is a long-standing patient of mine who carries the

following diagnoses: fibromyalgia, osteoporosis, degenerative joint disease, Raynaud's Phenomena, history of ischemic colitis. If you have any questions, please contact me at the address below. ..." The patient had a cat scan in mid-1993 for a different problem, was recently seen by a neurologist for a another problem (dizziness), and recently received physical therapy for a third problem. Dr. A orders a cat scan of the brain and initiates a neurology consultation for the new problem, and orders further physical therapy for two chronic problems (fibromyalgia and osteoporosis). The cat scan order is completed by the TCA based on queries to the patient. The TCA also completes as much required information as possible for the two consultation requests initiated and signed by Dr. A. After the TCA follows through on the doctor's orders at the nursing station, the patient's husband requests a blood pressure check. The blood pressure check is the equivalent of a nursing visit added onto the patient's scheduled appointment. The encounter lasts approximately fifty-five minutes from the time the patient and spouse come into the module from the waiting room until they leave (not including the time they spent in the waiting room).

The patient's chart does not have a Health Maintenance Record (HMR), a type of "face sheet" at the front of a chart. The HMR is meant to provide a *patient summary,* a summary of important patient information. The HMR is a patient summary form introduced throughout the EHR Prototype

Medical Center and Family Medicine Clinic during the previous year. Face sheets and patient summaries vary among the HMO region's twelve medical centers. Changes in standardized forms over the years mean that there are co-existing generations of officially approved medical records, varying from chart to chart depending on the year a patient became a patient of the Clinic. The charts of a long-term patient of the HMO contain a veritable archeology of attempts to improve medical records and to keep up with escalating requirements for quick access to data important not only for medical chart reviews but also for evaluations of Regional clinical strategic goals, regulatory reporting, and market benchmarks such as the Health Plan Employer Data Information Set (HEDIS) measures and the National Commission on Quality Assurance (NCQA) and Joint Commission on Accreditation of Health Care Organizations (JACHO) reviews. The paper-based HMR is one of a variety of attempts to facilitate the creation of a patient summary for each patient that meets as many as possible of these overlapping purposes. The HMO's efforts to reform patient records require that physicians devote time to documenting each patient's summary.[92] At the time

[92] The Mayo Clinic employs a different strategy: charts are continuously culled for clinically significant information to keep patient summaries current and salient and to eliminate non-essential information from charts. To do this requires the clinical qualifications and judgment of registered nurses, a significant investment on the institution's part that Mayo Clinic administrators and physicians feel is repaid many times over in benefits to clinical practice, according to remarks by Christopher Chute at the IMIA Working Group Symposium, Geneva, 1995 (Chute: n.d., 1995).

of the video documentation, it was estimated that the HMR was at least partially documented in one in three charts.[93]

In paper-based patient charts, chart review and searches for specific critical information often prove difficult and/or unsuccessful. There are only a few places in an outpatient chart where an important summary record such as the problem list letter is sure to be noticed: at the very front or at the very back. Whereas there is a standard chart format for the organization of each outpatient chart, according to Medical Records policy, in reality chart organization is not consistent. Sections and records are often intermixed; important information is contained in handwritten progress notes. Progress notes and patient summaries are particular targets of the electronic health record system being designed. In the imagined future scenario, the EHR system is designed to automatically generate patient summaries that include problem lists, medication lists, adverse reactions, immunizations, procedures, family history, social history, and patient education.

* * * * * *

Exemplar #2: complex patient, complex encounter

11:51 a.m.

Nursing station closest to Dr. A's office

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[93] Contemporaneous estimate by the administrator for the Family Medicine Clinic, 1994.

The RN and TCA confer, planning how to cover the remaining number of Dr. A's patients and when they can take lunch breaks. Dr. A is running late, as usual. Dr. A takes his time with each patient and he is strongly oriented towards "one stop service"; as a result, he is nearly always behind schedule. His exam room consultations often last fifteen or twenty minutes. On some days, Dr. A's orders represent 50% of all orders given by the module's three physicians and physician assistant. The TCA and the RN are among the few nursing staff who can keep pace with Dr. A's intensity and frequency of orders.

Nursing intake

During the intake for the patient, the TCA reviews the chart for vital signs over time, known allergies and adverse reactions. In response to concerns expressed by the patient and her husband, the TCA reviews previous progress notes for changes in the patient's weight and blood pressure by quickly turning the pages going chronologically backwards.

TCA	Okay, so you're allergic to codeine [documenting].
Patient	[...], codeine, iodine.
Husband	Quinine.
Patient	Quinine.

The TCA documents the chief complaint in the patient's words: "Numbness in face." She picks up the chart, HMO member card, and billing form and takes the patient and husband to one of Dr. A's exam rooms.

11:48 a.m.

Physician office

The TCA places the patient chart with the HMO member card and billing form on top of a pile of records at the left front corner of the physician's desk. About fifteen minutes later, Dr. A returns to his office, drops off the previous patient's chart on top of a pile of charts and records on the upper left corner of his desk (sometimes on the floor) that the TCA will pick up and sort. Are actions required or can the chart be sent to the chartroom for filing? Is a record ready to be sent to the chartroom or should it be sent to Radiology or to a specialty care department? Dr. A picks up the patient chart for the patient with "numbness in the face" and goes directly to the exam room.

Exam room

The exam room consultation lasts approximately twenty-two minutes. The physician sits with the chart open on his lap, facing the patient who sits on the examining room table. Her husband sits on a chair near the door. Dr. A turns to the current progress notes page and documents subjective findings ("S" notes) while the patient talks.

Dr. A Okay, well, how can I help you today?

Patient At six in the morning, my sister passed away.

Dr. A The 16th of February?

Patient 15th of February. And uh, all of a sudden, this [indicates the location on her face] felt like there was an ant. No pain involved. We went like you suggested to the Medical Center. We waited three hours. / /

The patient recounts the experience of going to the Emergency Room at the Medical Center. The Emergency Department encounter was inconclusive. The patient's Family Medicine Clinic chart includes the Appointment Center message on which Dr. A documented his advice to go to the Emergency Room. Messages are medical records that are included in patient charts and therefore they are not to be tossed out (although sometimes they are). The primary care physician's copy of the Emergency Department record reaches the off-campus Family Medicine Clinic on delay via inter-office mail. But the HMO's patients generally assume that their primary care physicians know everything that happened in Emergency Room encounters; the HMO is, after all, an integrated health care institution.

Dr. A reviews previous progress notes in the chart in chronologically backwards order, starting with the most recent progress notes. He reviews recent data in the results section of the chart.

Patient ... because sitting here, it went from this side – it came up as far as my lip. It came across here and to my lip.

Dr. A How far across the chin did it go?

Dr. A returns to the current progress notes page and resumes documenting while listening to the patient.

Patient All right. It came up to here. If you'll notice, see this line? It's coming longer. It was never this long before this all happened. And I didn't have [pauses while the physician writes] --

Dr. A Go ahead.

Patient – the marks. I've always had this coming down, because I took that swine flu and this is the symptom that happened when I took the swine flu. Okay, it had stopped for a while, there as far as my lip. Right now, it is up to here on my cheekbone. There is no pain involved, it comes and it goes.

Dr. A Okay.

Patient When it's at its worst, that's when it swells up.

Dr. A So the numbness is still coming and going?

Patient Oh yes. I can just –

Dr. A – [Touching the patient's face] You can't feel that.

Patient No, sir.

Dr. A So do you have permanent numbness / / there? / /

Patient / / No. / /

Dr. A / / Or does that come and go?

Patient No, it comes and goes. ... But today it is the highest.

Dr. A Did you have trouble closing your eyelids?

Patient Nothing. No trouble.

Dr. A Did you have forehead problems or anything?

Patient No. Nothing.

Dr. A Did you have any speech changes, numbness, tingling or weakness elsewhere?

Patient No.

Dr. A Headaches?

Patient That I always have.

Dr. A But nothing new.

Patient No.

Dr. A recalls that the patient had a cat scan some months ago. The patient does not recall when she had a cat scan but the physician finds it easily in the chart. He notes the cat scan, performed in July of the previous summer, in today's progress notes. Dr. A returns to the cat scan record in the results section and reads the record over again. The patient continues to

explain her problem and the physician continues interviewing the patient and documenting subjective findings. He asks a number of questions to ascertain the frequency and duration of the instances of numbness.

Patient Could it be nerves?

Dr. A You tell me. Does it occur when you're anxious or nervous?

Patient No. Especially it occurs when I'm in cold air. When I'm walking the dog.

Dr. A How often do you get it?

Patient I'd say just about every hour, but each time it's another spot! It's never--

Dr. A –Where else? / / [overlapping voices] / /

Patient / / No, sir. It's from here. / /

Dr. A / / It's another spot on the face.

Patient Yeah.

Dr. A Yeah.

In the excerpt below, Dr. A asks about duration again but he and the patient have trouble communicating clearly. At the very end of the encounter, Dr. A discovers that he misunderstood what the patient reported regarding duration of the current instance.

Dr. A How long does it last?

Patient I've never really timed it, to be honest. I just don't pay attention to it. [Pause while Dr. A documents]

Patient You know, it's--

Dr. A –I mean, does it last seconds or minutes?

Patient Oh, I'd say in minutes. / /

Dr. A / / Five, ten? / /

Patient / / This thing, we left the house at ten fifteen, so this thing started about quarter to ten, and it's still there.

Dr. A Okay. Okay.

The patient asks if the new problem could be related to another problem she has with her jaw for which she was seen by an ENT (Ear, Nose and Throat) specialist.

Patient Now [husband's name] mentioned my jaw. I was getting an ear ache and the ear doctor told me to chew bubble gum. And I heard a crack in there. ...

While the patient talks, Dr. A writes marginal notes, annotating the patient's on-going medications in the margin of today's progress notes so that he has them in view during the encounter and for his documentation of the plan of care. He turns to the medication review next. The patient has brought a bag of pill bottles which she hands to Dr. A. The prescription bottles give the physician precise dosages. Dr. A adds information to his marginal notes,

creating a short current medications list to guide the review. Estrogen was prescribed by another physician. Dr. A asks the patient: "Does he think it helps?" The patient asks questions regarding this or that medication: Should I keep taking this? Should I be taking this or that dosage? Should I begin taking this now?

It is difficult to establish reliable, comprehensive, up-to-date information about a patient's medications. In the HMO, Pharmacy records are not interfaced with other on-line systems. But on-line prescriptions for the Family Medicine Clinic and Medical Center would provide only a partial picture. Establishing an overall picture of prescriptions ordered, picked up, and refilled is complicated by the array of numerous pharmacies within the HMO and outside pharmacies that a patient can choose from to fill prescriptions, combined with the far-ranging commuting patterns of the Southern California population.

The patient had physical therapy recently and wishes to have further treatment--but she cannot remember the therapist's name. The Medical Center chart has the physical therapist's documentation but there is no information in the Family Medicine Clinic chart. Patient records systems are fragmented. On average, each patient has three charts. Physicians in the Family Medicine Clinic may request that particular records are faxed to them (when information is urgently needed) or photocopied and sent via inter-office mail

to include in the Family Medicine Clinic. Such requests require prior knowledge to specify which records are to be requested. When I accompanied physicians on hospital rounds at the Medical Center, if time permitted and the need for critical information warranted it, a physician went to the Medical Records Departments (Outpatient and Inpatient) to review and copy particular records to take back to the Clinic. On other occasions, a physician went to the Radiology Department to review x-rays and other diagnostic imaging tests that had not yet reached the Family Medicine Clinic or for which the results report (the radiologist's interpretation) was not yet available.

Physical exam

After the physical exam, the physician explains signs and symptoms that lead a clinician to suspect Bell's Palsy.

Patient Could it possibly be Bell's Palsy?

Dr. A [Turns around] That was one of my thoughts, I'll talk to you about it. [Turns around]

Patient I do, if I get very nervous, my eyebrows itch. I personally didn't think this had anything to do with my sister. Because it was something we knew was happening.

Dr. A [Turns] But your forehead–

Patient –Maybe you didn't poke it hard enough. ...

Dr. A Bell's Palsy affects the primarily the motor function, and you can certainly raise your face up, and your eyebrows are fine.

Dr. A continues documenting at the counter. There is silence while he writes. Dr. A explains why he is ordering another cat scan and then asks if the patient was seen by a neurologist. She was but neither she nor her husband can recall what the neurologist "ruled out." The neurologist's consult report is available in the main Medical Center chart but not in the Family Medicine Chart. This simple instance reflects the fragmentation of current systems and the difficulty--sometimes fruitlessness--of searching for critical information. Practitioners say that, for their purposes, if information cannot be readily *found* in a chart, the information is *not available* in the chart. The time required to search for critical information is a common criterion for evaluation of clinical information systems.

Dr. A The first thing to do is to make sure your brain's okay. The cat scan in July was mainly done --

Patient For my dizziness.

Dr. A – for that. I want to see if there's any change in that. Did you see a neurologist at all?

The patient and husband cannot provide the physician with any meaningful information about her recent neurology consult: "... I think I

wasted her time and ours. ... I don't think I was in her examining room more than two minutes." "She ruled out -- ?" "I don't remember what she was talking about." In this encounter, the patient is an uncertain source of information. The physician goes over the rationale for his orders for tests.

Dr. A Okay, well, the other thing to do is to send you to a neurologist. I don't think these are strokes, you know, small strokes.

Patient Then, fine.

Dr. A But I can't explain what they are. And if you're having them every hour, –

Patient It's constant. It's constant. / /

Dr. A / / -- you know, for more than two weeks, it'd be very very unusual, without any other progression. So let's get a--

Patient –'Cause I think I wasted her time and ours, to tell you the truth. I don't think I was in her examining room more than two minutes.

Husband She ruled out --

Patient Whatever. I don't remember what she was talking about.

Dr. A Okay. Let's get the cat scan of the brain started. I don't want you to take Aspirin until I know that the cat scan of the brain is okay.

Dr. A completes his notes, closes the chart and turns around, holding the chart and referral request forms under his arm, signaling the end of the consultation but he soon realizes that he did not understand the patient's report correctly as to duration of the current episode.

Dr. A [Continues] If this ever progresses to where it stays there, you know, for more than a half hour, start making your way to the emergency room. And see, because if it's still there when you get there, I want -- if this gets worse--.

Patient –Oh, but this is since, like I said, since quarter to ten, this part.

Dr. A Oh, I thought you said it lasted a few minutes on and off.

Patient No, sir, this one is since this morning.

Dr. A Okay. So, so it's been lasting [looks at his watch] hours.

Patient Yeah.

Dr. A opens the chart again, while standing, to amend his notes. He opens the chart and amends the notes, annotating immediately below and to the right of the original notes in very small print next to his original documentation. In the paper chart, this is a very simple matter that takes a

few seconds, and does not require a second signature. The amendment is easily integrated into the note because it is located adjacent to the original statement. This will change with electronic health record use.

Dr. A takes down a Neurology referral from a rack of forms on the back wall of the exam room. He partially fills in and signs the referral request which he will hand off to be completed by the TCA at the nursing station. At the end of the exam room consultation, the patient and her husband request a physical therapy referral for two chronic problems: fibrositis and osteoarthritis. Dr. A takes down another referral form and fills it in for the physical therapy requested. When he has completed the fields that a physician must fill in in the two referral forms, he ends the consultation and all three exit the exam room. Filling out the consult requests is quite time-consuming. It takes approximately three minutes of the physician's time while in the exam room to initiate the two referrals which are then completed by the TCA.

It is now nearly 12:30. Once this encounter is completed, Dr. A still has two more patients to see from the morning's scheduled appointments. The TCA will continue working with Dr. A through the scheduled lunch break.

12:30 p.m.

Nursing station

TCA Okay -- oh wait, he also wants you to have a cat scan of the brain.

The TCA opens the cabinet and pulls out a form which she stamps with the patient's HMO member's card. She stamps another form with the card, then begins writing. Papers are arrayed on the counter while she fills out the request form for a cat scan. This involves asking the patient a series of questions including a question about allergic reactions also asked at intake. The question is now asked in a different context: contrast media for a cat scan. In this case, the patient already gave the information at intake--she has an adverse reaction to iodine. The question, "Are you allergic to any medications?" is often characterized as redundant, a question frequently asked in part because there is no reliable patient summary available to all clinical personnel who need the information. Indeed, a patient is asked the same questions upon admission to a hospital as he or she was asked only hours earlier in the emergency room in the same medical center. The mother of the child in exemplar #1 responds that the child has no allergies and the TCA documents "NKDA"--"no known drug allergies"--in the chart. The mother's concern about the possibility of an adverse reaction to pertussis is categorized differently. The RN asked the question again in the context of the immunization injections for good reason: the same question asked in a different context may elicit further information.

TCA Okay, you've had x-rays before?

Patient Yeah.

TCA Have you ever had a cat scan?

Patient Yeah. That's when they had to give me Benydril. Because of that. ...

TCA Have you ever had allergic reaction to the contrast media? The iodine?

Patient Yes. That's why they give me the Benydril with it. ...

TCA Okay, now you'll hear from the Medical Center regarding your cat scan, physical therapy and neurology appointments. [Gives the patient the HMO member card and billing form]

12:33 p.m.

Nursing station

At the end of the patient's encounter, the patient's husband asks the TCA to take his blood pressure and to document it to his blood pressure card. The TCA does so and also provides him with a new card, since the blood pressure reading fills the last entry on the card.

Husband Two of the medications [I've begun taking] should lower it.

TCA 120 over 70, loud and clear.

Husband Good. I'll give you my card to mark it. ... So that's the last space. Both the Hytrine and Isordil have side effects that could [cause a] drop in blood pressure so [the doctor] told me occasionally to have it checked.

TCA Oh! Did you want another card?

Husband Yeah, I guess so.

I describe this blood pressure check for the husband as a "nursing visit" because it is equivalent to a nurse-only encounter in a Nursing Clinic on an unscheduled, walk-in basis. Intermittent blood pressure checks and a series of injections such as the orders listed on the injection card for immunizations in exemplar #1 can be handled by nurse-only encounters once ordered by a physician.

The TCA prepares a new blood pressure card and gives it to the patient's husband. They say good-byes and the couple leaves.

12:44 p.m. approximately

End of encounter and documentation

* * * * * *

C.2. Exemplar #2: imagined future scenario

In the imagined future with EHR use, a computer screen displays all of the module's appointments for the day (conceived as a census following inpatient conventions). The patient list can be instantly sorted into separate

lists for each physician and physician assistant by clicking a "list by" button and choosing the display setting from a pull-down menu. Each physician also keeps a personal list of patients who are frequently seen, who require special attention, or for whom test results are expected or other follow-up actions are pending (chart review, responses to telephone messages, and so on).

Clinical staff review longitudinal vital signs (blood pressure, weight) and laboratory results in tabular or graphical formats. During an encounter, a longitudinal record, table or graph can be shared easily with a patient, displayed on screen to go over results together or printed for a patient to take home. Interactive chart review through the EHR patient profile links the data elements of the profile--assessments / problems / diagnoses, adverse reactions / allergies, medications, prescriptions, procedures, immunizations, family history, social history--to the progress notes or other patient record from which they were automatically generated as by-products of structured clinical documentation. Whereas Dr. A wrote a note about the previous cat scan into today's progress notes. with EHR use, he cites the cat scan from the list of procedures in the patient profile rather than redundantly documenting it. Citing the cat scan from the EHR patient profile accomplishes two things at once. It quotes the original data with associated details (when, why, by whom it was performed, and summary results). Citing establishes the link between

the progress notes in which a new cat scan is ordered and the previous cat scan which is in turn linked to the progress notes in which it was ordered.

In the electronic chart, the progress notes from the Emergency Department encounter for the patient in exemplar #2 are immediately available on-line. Important records for which the primary care physician is "cc'd" (carbon copied) in the paper chart environment are instantly posted electronically to the physician's "to do" list for review in the desktop workspace of the electronic health record. At the same time, new records are added to the cumulative electronic chart. Through the "to do" list in the electronic health record, the system keeps track of whether a new record has been reviewed. Through an interface with the laboratory data system, on-line results review helps the HMO meet a requirement to ensure that each result is reviewed and signed by the ordering physician.

The EHR delivers the intelligence of specialized decision support systems to the desktops of physicians to assist them with medical interviews and thereby lead to assessment and diagnosis more quickly. What diagnoses are suggested by the new problem "numbness in the face"? What else should a physician ask? What are the relative probabilities of hypothesized diagnoses (differential diagnoses)? For a complex patient, what acute and chronic problems may be inter-related? What diagnostic tests and / or courses of treatment should be ordered according to state-of-the-art knowledge?

When a diagnosis is determined, where is the individual patient in relation to the disease algorithm (if there is one)? What are the HMO's protocols, guidelines and standards of care for a particular problem? Decision support systems prompt and guide physicians' diagnostic queries to the patient, then instantaneously interpret subjective and objective findings against the patient's individual history and against signs and symptoms for a vast array of common and rare illnesses. Multiple problems may or may not be related; the interrelationship between physiological systems is the expert domain of internal medicine. By assisting primary care clinicians in determining if problems and treatments are inter-related, the electronic health record expedites referral to the relevant specialist for evaluation and care. In turn, decision support systems in the electronic health record system assist specialists and sub-specialists.

The technological capabilities of the EHR system are thus imagined as extensions of multiple clinician selves. One of the physician founders of the Software Company explained to me that the idea is for the electronic health record system "to read between the notes," in other words, to read between the progress notes in a patient's records. In this image of the future, while clinicians are engaged elsewhere, the computer system continues its interpretive work, finding connections between data documented to the chart from diverse sources by many authors. The system then presents newly

meaningful elements of the clinical case, bringing to the surface clues to possible dangers lurking "between the notes" by synthesizing dormant, previously disparate annotations, for the individual patient and then, by extension of interpretation through databases, for affected populations of individuals. Thus it is imagined that the EHR system extends clinicians' abilities to avert dangers, points more quickly to diagnoses and their cures, and opens onto the epidemiological project, shedding light on areas of the unknown in medical and clinical knowledge. Multiple intelligent automata become assistants engaged in perpetual analysis. With the EHR system and its intelligent agents continuously perusing patient data, one is able to see patterns and connections that were previously unseen or hard to discern--or that simply "fell through the cracks" by virtue of gaps and limits in people's and organizations' everyday physical and temporal working abilities.

In the imagined future scenario, using the electronic health record during exam room interactions is seamlessly synchronized with the flow of patient-physician interactions. The future electronic health record fulfills desires expressed by physician participants in EHR prototyping: "It needs to think the way we think." "It needs to support the flow of patient-care provider interactions in the exam room." "It needs to think across the boundaries [of a patient's problems, of physical systems]. It needs to help physicians with the kind of cognitive blending they do." These expressions suggest that the EHR

is imagined as an extension of the self, a thinking tool that can extend one's thoughts and collaborate in one's own "cognitive blending." The electronic health record is imagined as an unobtrusive partner joining the exam room consultation.

Instead of scrawling prescriptions on a separate prescription pad and then documenting medications in the plan of care in a patient's chart and updating the medication list in the HMR, prescriptions are entered on-line and a printed copy of the plan of care, including prescriptions, is provided to the patient. The same act of entering a prescription transmits it to a Pharmacy of the patient's choice so that the prescription is ready when the patient arrives there. Medication orders written in prescriptions and those in the plan of care are *perfectly redundant* (without discrepancies) because they are entered once to the electronic chart and disseminated to the patient and the pharmacist. Because structured clinical content terms are selected to document medications, the medication list and prescription list automatically update the EHR patient profile without any additional effort by the physician.

The EHR medication list has medication information across the continuum of care, from hospital admissions and all ambulatory points of care. The TCA, Dr. A, the physician who ordered estrogen, and the Emergency Department staff all have access to the same data. However, they may be interested in different subsets of information. In the imagined future

scenario, the electronic health record provides flexible display of medication lists, according to filters selected by a clinician and applied to sort the same underlying cumulative data. Filter settings enable display of current (active) medications or the historical record of all medications ordered including those that have been discontinued. The concept is that all relevant information is available at a glance, not only detailed information for dosage and instructions but also identification of the ordering physician for each medication and when and why it was ordered (the indication for the order). Through interactive chart review, Dr. A looks up the context of the medication order for estrogen by selecting estrogen in the medication list and going to the associated progress notes documented by the ordering physician. For a discontinued medication, a clinician can ascertain if the discontinuation was due to an adverse reaction, interaction with another medication, or if it is otherwise counter-indicated.

In the electronic health record, all knowledge of critical information is posted to the EHR patient profile. Clinical information is verified and cited from the profile rather than being asked redundantly of a patient each time he or she is seen. Improved cumulative knowledge of the individual patient streamlines documentation and promotes the HMO's service goal of conveying an image of personalized care to its members.

The EHR patient profile includes a *provider profile*, so that everyone can easily see a list of all care providers who are caring for and have cared for the patient. The provider profile establishes instantly who the physical therapist is for the patient in exemplar #2 and which neurologist examined the patient previously, information about which the patient and her husband are uncertain. Exemplar #2 illustrates the design rationale for interactive chart review through the EHR patient profile. Because the electronic chart includes all clinical documentation, it is easy for the primary care physician to look up the neurologist's consultation report, the progress notes of the physical therapist, the clinical rationales for the estrogen prescription and the ordering physician's assessment of its effects. The *indication* for each element of a plan of care or course of treatment is an expression of the clinical rationale: the indication links the plan of care to a diagnosis, problem, or assessment. The significance of explicitly associating an indication with each element of plans of care lies not only in the potential to improve communication among clinical colleagues (such improvement is certainly desirable), but also in the impending requirements of insurance companies and other health care payers for information to justify reimbursement. Association of indications with treatments is also implicated in clinical research data collection and analysis. Problem lists and medication lists are

transformed from tools for individual physicians and other clinicians[94] into tools in EHR patient profiles that are clearly designed to be shared among multiple providers and cadres of administrative and research analysts.

Because the electronic health record integrates previously fragmented clinical information entered by multiple providers to multiple charts at diverse points of care, redundant documentation is eliminated in the imagined future scenario. In exemplar #2, the neurologist's consultation report was available in the Medical Center chart (twenty miles away) but not in the Family Medicine Clinic where the patient's primary care physician practices. In the imagined future scenario with EHR use, geographic distance and differences in hours of operation between the Emergency Department, the Medical Center, and the Family Medicine Clinic no longer pose obstacles to access to important information when it is needed.

The electronic health record replaces time-consuming and redundant duplicate or triplicate forms for referral requests with interactive on-line templates. With future EHR use, the consultation referral initiated by Dr. A in exemplar #2 for a neurology consultation is entered to the EHR and transmitted electronically to the neurologist who examined the patient previously. The structured content contribution to preparation of requests for

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[94] As most physicians perceive them to be even though they are thoroughly accustomed to the institutionally shared nature of patient charts of the HMO group practice.

specialist consultations lies not only in on-line access to reliable patient histories but also in the documentation of *minimum data sets.* By specialists' accounts, referrals from primary care physicians often lack important information which the specialist must search for in the chart (with uncertainties about its timely availability) or elicit from the patient (with uncertainties about the patient as a source of information). A specialist acting as a domain expert for the EHR Prototype Project considered this to be the referring physician's responsibility and a poor use of a specialist's expertise and more costly time. A subset of referred patients do not in fact require a consultation with the specialist to whom they are referred: a patient may require the expertise of a different specialist, or, the problem presented may not require specialty care.[95] By enforcing documentation of a domain-specific minimum data set in a consultation referral, salience, completeness, and accuracy of patient information are improved and the specialist's time is used more effectively.

The problematics between *free text* and *structured content documentation* exemplify tensions regarding intentions towards standardization. How can a balance be struck between degrees of standardization of terminologies, documentation, and clinical practices and the autonomy of clinicians and

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[95] Specialist participant in EHR design discussions, 1995.

other care providers? How and when does standardization become antithetical to practitioners and to clinical logics? It is generally understood that it will be organizationally difficult to enforce standardized use of the tools of the electronic health record system such as structured content documentation of patient profile elements that are essential to the system's logic, especially diagnoses, problems, and assessments. As elements of minimum data sets, the designation of *required fields* is envisioned as a means to enforce the completeness of documentation, whether for a specialty care consultation request or for documentation of a high priority illness such as coronary artery disease. Required fields are data fields in on-line templates that must be filled in before a template is considered complete and can be signed and saved. Until a document is complete and signed, it remains in the desktop workspace of the EHR user interface, not yet saved to the *chart*. Required fields in EHR templates are understood to be controversial because they will constrain physicians' documentation practices in order to compel standardization. In practice, there will be instances in which required fields cannot be filled in because requisite medical information is not available when documentation must occur. Required fields are foreseen in the imagined future scenario of EHR use in order to enforce completion of minimum data sets and "auto-compliance" with other elements of structured

content documentation required for the logic of the system to serve the array of analytic purposes (as well as primary care purposes) that constitute the vision of the electronic patient record.

On-line orders and *worklists* are among the core functionalities of the electronic health record. As discussed above, exemplar #1 prompted an early EHR Prototype Project discussion of how signed outpatient orders in a patient's plan of care may be made available to authorized clinical staff while an encounter is in progress. *Process documentation* describes the overall design strategy for in-progress multi-professional, multi-disciplinary team documentation of encounters as well as in-progress documentation of orders. The monthly team-based evaluation of each End Stage Renal Disease (ESRD) patient by the Continuous Ambulatory Peritoneal Dialysis (CAPD) team's nephrologist, RNs, social worker, and dietitian is an example of multi-disciplinary documentation and needs of diverse clinical practitioners to review the same patient's chart simultaneously for which the concept of process documentation is designed. Complex orders entail many actions, some that must occur in fixed sequences; actions may be conditionally based on results and other information determined as the component orders and tasks are carried out and reported by responsible staff. A transesophageal electrocardiogram (TEE) is an example of complex order for which process documentation in the electronic health record is meant to provide new tools

for in-progress communication, coordination, and clinical documentation. A TEE is a cardiodiagnostics procedure that requires prior chart review by a cardiologist to approve the appropriateness of the procedure on a patient-specific basis (Is the procedure warranted by clinical assessment of the patient?), a pre-procedure evaluation (Can the patient handle the stress of the procedure? Are any modifications to the standard procedure required given the patient's state of health?), monitoring of the patient during the procedure by an RN in addition to a cardiodiagnostics technician and a cardiologist on an as-needed basis (according to the clinical status of the patient before and/or during the procedure), post-procedure observation by another RN in a neighboring department (Gastrointerology), and interpretation of results by a cardiologist.

An on-line consultation request provides a common straightforward example of how on-line orders are imagined as tools of the future EHR system. In exemplar #2, Dr. A initiates consult referral requests by filling in fields that must be documented by a physician and signing the form. The referral forms for a neurology consultation, a cat scan of the brain, and physical therapy are handed off to the TCA to complete. A request for service, whether a request for a specialist consultation or an order for a cardiodiagnostic test, may require additional time to complete. Additional information may be required such as pending test results, further information

from the patient or significant other, information from another care provider, historical data in archived paper-based or electronic records, or information from records external to the HMO. Clinical staff (within a module and between departments) routinely help one another to complete forms in flexible, localized ways. Process documentation in the electronic health record entails changes in clinical work practices that are potentially disruptive to these working relationships, depending on how the HMO chooses to implement the capabilities of the EHR system, for example, whether or not to mandate required fields.

At the very end of the exam room consultation in exemplar #2, Dr. A amends his progress notes when, after several unsuccessful attempts to establish duration during the interview with the patient, it becomes clear to him that the patient's episode of numbness in the face has lasted for hours, "since quarter to ten ... this one is since this morning." In paper-based and electronic records alike, clinical documentation may be corrected or otherwise amended but not removed from the medical legal record. In the paper chart, amending a note may take a matter of seconds and does not require a second signature (unless the amendment is a correction). Dr. A's handwritten amendment regarding the duration of instances of numbness in the face was added alongside the original statement and easily integrated into the progress notes. With EHR use, the steps required to amend a note change due to the

persistence and fixedness of electronic clinical documentation combined with the requirement of a signature with automatic date and time stamp for every instance of clinical documentation. In documentation to the electronic health record, a physician can no longer simply write next to the original text. Instead, he or she creates an amendment note, a new document, that exists separately from the original text to which the amendment refers. For instances of errors, a physician can no longer simply strike through an error, initial and date the strike through, then write, sign and date the correcting statement contiguously, as is the convention in paper-based patient records. In the early versions of the EHR prototype, the original text stands un-amended on first reading because the amendment note is spatially separate (in a different document); although electronically linked, the amendment is no longer co-located with the amended text.

The need to amend progress notes occurs in the everyday practice of physician mentoring of physician assistants, registered nurse practitioners and other non-physicians whose clinical documentation must be reviewed by the mentoring physician within twenty-four hours. In present practices, the mentoring physician can inform his or her mentored colleague of amendments required by attaching a yellow "sticky" with handwritten notes or finding a moment to talk if an issue warrants discussion. He or she may document additional notes on the same page below the mentored colleague's

progress notes. In the electronic health record, the mentoring physician may write, sign, and send an amendment note that is posted electronically to the "to do" list of the mentored physician assistant or registered nurse practitioner, to be reviewed and co-signed. (The mentor can of course communicate outside the EHR system to advise the mentored colleague.)

The changes in clinical documentation for amending notes do not rest primarily on the additional steps required by the electronic health record system in order to amend one's own clinical documentation, or to add or suggest an amendment to the notes of a colleague one is mentoring, nor does it rest only in the textual dis-integration of notes. The textual fragmentation of clinical documentation into a number of separate notes was considered to be a temporary problem of the early EHR prototype by the Software Company, remediable by concatenation of multiple notes that are substantively linked, and development of an electronic feature restoring the ability to strike through and correct text *in situ*. The deeply embedded change of an electronic health record system is the electronic traceability of every instance of communication, data, and documentation entered into it. There is no true corollary to a yellow "sticky" within an electronic health record or computer-based patient record. E-mail might be used for informal communication to a colleague but e-mail is non-confidential and, furthermore, it creates its own electronic audit trail. The changes in clinical work practices for amending

notes point to the difficulty of preserving a space for informal communication within the electronic health record due to the continuous electronic audit it generates in the context of the medical legal and confidential nature of patient records and communication regarding clinical cases.

The electronic health record, it is imagined, will ease the burdens of paperwork on nursing staff as well as physicians. At the end of exemplar #2, the TCA stamps all of the forms necessary to execute the physicians' orders with an addressograph, completes the referral forms with essential information of a non-clinical nature (patient address, telephone, medical record number) and information that is clinically relevant (any known allergies, adverse reactions to contrast media used in a cat scan), and prepares a blood pressure card that will go with the patient's spouse. At the end of exemplar #1, the RN carefully writes out an injection card for the pediatric immunization series that effectively hands off the PA's orders to the patient.

There is an unremitting physicality and redundancy to the paperwork activities that punctuate the beginning and end of each encounter and the work of acting on orders and, to give another ubiquitous example, following through on dozens of telephone messages handled each day by physicians and nurses. The future EHR system, it is imagined, replaces duplicate laboratory order slips and referral forms with on-line orders and worklists so that each order is communicated to the nursing staff electronically when the

physician or physician assistant documents the order on-line. On-line worklists enable the TCA to look up the date that the cat scan is scheduled, to ascertain the status of the consultation requests to the Neurology and Physical Therapy departments, and to see the names of the clinical staff responsible for handling the referrals in the respective consulting departments. The electronic health record system introduces new forms of visibility, accountability, and closure. But will the new tools of the electronic health record system ease the burdens of redundant documentation and paperwork or will they add new ones in electronic guise? Will these tools relieve or increase productivity pressures and the administrative overhead already attached to clinical work practices?

The contradictions identified in exemplar #1, a preventive health encounter type--between proactive reminders motivated by commitments to social medicine and time constraints driven by industrial forms of work organization and productivity measurements--are more sharply etched in exemplar #2, a complex patient encounter type in which the logics of patient-care provider interactions--particularly patient presentation of problems--and the structured content design strategy of the EHR system collide and on-line worklists supporting orders beyond the encounter come into play. Dr. A's one-stop service approach already exacerbates time pressures in the HMO's productivity regime. Yet, as the Clinic's administrative physician, Dr. A

believes one-stop service is the best path in terms of cost-benefit calculations, as well as social medicine principles, once the total organizational costs of "getting a patient into the Clinic for an appointment" are considered and the costs of unnecessary follow-up appointments are deferred. He and the other original group of clinician leaders of the EHR Prototype Project come to believe that the new data pictures the electronic health record will generate will overturn the HMO's long-standing productivity regime based on simplistic through-put of numbers of patients seen per clinical half day. A physician leader wrote, for example: "Certain metrics such as number of patients seen in the clinic per provider per day serve as poor proxies for true productivity. The ultimate metric is the number of healthy, satisfied members that can be cared for by the provider team and at the lowest cost, reflecting each element of 'the big three': quality, service and cost."[96] The argument of the EHR Prototype Project clinician leaders is that it is not how many patients you see but what you do for them and how healthy your panel of patients is overall. There is something of a catch 22 here: this argument by the visionary proponents of the EHR Prototype Project cannot be demonstrated from data produced by existing systems. Only longitudinal data from the use of future EHR system can concretely support the argument because it requires views of

[96] EHR Prototype Project, Confidential Report, 1994.

patterns of return visits of individual patients over time and the ability to evaluate the health of subsets of individual patients within patient populations over time. The data for such an analysis does not yet exist in the electronic health record nor can it be derived from the HMO's existing information systems. Allusions were made to modeling the argument econometrically but the complexity of variations between encounters types, subsets of patients, and clinical cases is daunting. Furthermore, the argument is enmeshed with the illusive quest for evidence-based medicine and evidence-based practice, both moving targets. Meanwhile, the industrial forms of work organization and productivity pressures remain deeply entrenched in the HMO and intertwined with the utopian vision of the EHR Prototype Project. Indeed, the same physicians who bridle over the current productivity regime are enthusiastic participants in the design of new tools in the EHR system that serve both the scientific management desires and clinical desires that motivate the EHR Prototype Project's heterogeneous utopian vision.

C.3. Exemplar #3: 6 months review

The patient is a 76 year old woman with multiple problems, who is in the clinic for a bi-annual review. From her "laundry list" of questions and concerns, she presents two acute problems: shooting pains at the back of her head which she is afraid may be a brain tumor and "numbness in finger,"

symptoms of carpal tunnel syndrome or impingement syndrome. The patient has questions about a problem--temporal arterioritis--that she recently read about in the newspaper, the need for mammograms for women over 75 years old which she read about in the HMO's magazine, and whether there is an alternative cholesterol medication to one that causes discomforting side effects for her. The patient has a history of heart problems and arthritis and she takes medications for high blood pressure and cholesterol. She has had difficulty tolerating a number of medications previously prescribed.

At the end of the exam room consultation, the patient requests an ophthalmology referral for her husband. It is likely that her concern about whether she has a brain tumor also expresses her concern over her husband's temporary losses of visual field. The patient-physician interaction at the end of the encounter (which takes place at the nursing station) is about the husband. The physician conducts the equivalent of a second-person encounter including interview questions about the history of the present illness (HPI) of the husband's problem (symptoms, duration) and his current medications. Pending the retinal exam and ophthalmology consultation, Dr. B offers an hypotheses as to diagnosis (transient ischemic attacks referred to as TIAs) and provides medical advice to the patient to convey to her husband. The encounter lasts approximately fifty-five minutes from the time the patient comes into the module from the waiting room until she leaves plus the time it

takes the physician to complete the documentation for the encounter in his office. The patient in exemplar #3 was Dr. B's last patient for the morning.

Unlike Dr. A's "one stop service" approach, Dr. B is more likely to focus on one or two problems in an encounter and schedule another appointment to address additional (non-urgent) problems. Doing so helps Dr. B and the nursing staff stay on schedule. However, the nature of this bi-annual review encounter for a senior patient means that all problems and questions that can possibly be handled within the encounter should be addressed.

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Exemplar #3: 6 months review

11:41 a.m.

Nursing station closest to Dr. B's office

The RN carries out and documents the intake for the patient, ascertaining allergies, vital signs, reason for visit. The RN takes the patient's blood pressure.

RN 140 over 78.

Patient Could you write that down for me also?

RN Sure. [Writes onto patient's card] There you go.

11:56 a.m.

Physician office

Dr. B's desk is covered with incoming and outgoing messages, patient records, charts for today's appointments, and charts for review for new patients, inpatients, for the context of test results, and for information required to respond to messages from patients and other physicians. In the middle foreground of the desk, there is a stack of charts open to this morning's progress notes (to be completed). Dr. B has an informal system of colored baskets for his messages, laboratory test results, and prescription refill requests.

Dr. B reviews the patient's chart in his office. He looks over the Health Maintenance Record (HMR) at the front of the chart. The HMR is a paper-based template that supports creation of a patient summary to guide preventive care and to make critical patient information available, particularly a problem list, list of medications, and major procedures including preventive screening (mammogram, sigmoidoscopy). The Medical Center introduced the HMR about a year and a half earlier with the goal that this core set of information should be documented for each patient. Dr. B is consistent in filling in the HMR which he describes as his "Bible."

Exam room

The exam room consultation lasts fourteen to fifteen minutes. The patient brings a list of what she wants to discuss with the doctor and she also

brings a short newspaper clipping. The patient gives the news clipping to the physician but keeps her list even though the physician asks to see it.

Patient Oh, I don't think you can read my stuff. Oh, this I wanted to ask you about, temporal arterioritis. I saw that in the paper. ... I have, lately, the last three weeks, I've had these pains in my head and I mean they're pains. And they shoot up right here, one spot [touching the spot]. Right here at the back of my head.

Dr. B Do they start from the neck and go up? Or from the head and go down?

Patient It's up in the head and goes up to the top of the head, sometimes, all day and all night. I don't know, and I just read that in the paper and I wondered if that's it.

Dr. B No, it's not. This is a special condition, I'll explain it to you.

Patient I don't care about that one. I just wondered what I have. ...

Dr. B Yeah, what else is on your list? / /

Patient / / I thought I had a brain tumor or something.

Dr. B Everyone's worried about that brain tumor!

Twice during the consultation, Dr. B reassures the patient that her fear of a brain tumor is unwarranted, explaining, for example, that a brain tumor does not present with pain but rather with neurological signs and symptoms.

The patient moves on to the next item on her list, a prescription refill. She will return to questions about a brain tumor after a few minutes.

Patient I need a new prescription for Isordil. I'm out of that.

Dr. B Oh, sure. You're out of that? Completely?

Patient Yeah, I took the last one today.

Dr. B reviews the chart, studies the HMR and then takes out his prescription pad.

Dr. B How's your -- any chest pains?

Patient No, no chest pains. So both of those must be alright.

Dr. B And [another medication], you're all right with, too?

Patient Yes, I don't need more of that because I don't use it as often. The Inderal is also for high blood pressure, isn't it?

Dr. B Yes. Isordil lowers blood pressure as well --

Patient I see, cause my blood pressure was 140 over 78 which is okay, I think.

Dr. B looks at the patient's vital signs, then continues writing prescriptions.

Dr. B 140 over 78. That's fine.

Patient Everything is probably fine as far as those things.

Physical exam

Dr. B explains carpal tunnel syndrome and suggests that the problem with the patient's thumb and hand could be impingement syndrome. He explains alternative treatments for carpal tunnel syndrome. He recommends wearing a hand splint and suggests that arthritis medicine might help. When the patient declines the suggestion of arthritis medication. Dr. B advises over-the-counter vitamins as an alternative to medicine, in other words, he mixes an alternative therapy approach with normative medical advice.

Dr. B Then let's give [the hand splint] a try and see what kind of benefit you get from it. Now the other things you usually take are things for arthritis. Arthritis medicine.

Patient Yeah, but if I have this thing every night, I don't want to be on medication, [it's just not] – / /

Dr. B / / The other thing that helps is a vitamin which is over-the-counter, which is vitamin B6, and you get the 100 milligram strength and you take one tablet at bedtime. That seems to help with nerve irritation and nerve conditions, so -- / /

Patient / / Mm hm. / /

Dr. B Don't think of this as a drug, / /

Patient // No. //

Dr. B // think of this as a vitamin.

Patient Yeah, uh huh. Okay.

Dr. B So, we'll try that with the splint and look for improvement.

The physician teaches the patient some exercises to do for her neck.

The patient asks next about mammograms for women over 75 years old. Dr. B explains a bit about screening parameters and risk factors. He emphasizes the importance of self breast exams.

Patient ... Now I read in one of your [HMO] magazines, I think it was the last one we got, something about mammograms for people over 75, like you didn't need 'em any more. Is that – does that mean-- is that [what it said]?

Dr. B Yeah, that's what they're touting.

Patient Oh.

Dr. B Have you ever had an abnormal breast?

Patient No.

Dr. B Ever had to have a biopsy?

Patient No.

Dr. B Any family history?

Patient No.

Dr. B Mom or sisters with breast cancer? / /

Patient / / No. No. No. Nobody.

Dr. B Then you can do away with 'em if you'd like.

Patient Well, you know, maybe three, four years down the road or something, every once in a while [inaudible]. / /

Dr. B / / Yeah, you can certainly stretch it out and do it every other year. / /

Patient / / Yeah, that's what I'm -- 'cause I just had one last year.

Dr. B Okay, that's fine. And what's still more important is still the self breast exam.

Patient Yeah, mm hm.

Dr. B Remember, all these are screening parameters. Does that mean that everybody falls into the screening parameter? No, it doesn't, you know.

The patient agrees with a series of explanatory statements and suggestions the physician offers.

Dr. B Some of the situation is driven by the patient. If you're. if you're very concerned about getting breast cancer and you'd like a yearly mammogram, I'll give you a yearly mammogram. / /

Patient / / Yeah, right, uh huh. / /

Dr. B Um, but, this is all just by studies and recommendations and we try to -- That's why they come out with literature like that.

Patient Yeah.

Dr. B But you have very little risk. If you think about it, you've gone to the 76th year, you've never had any trouble with your breast, you don't have any family history. So that's all under control.

Patient Yeah. That's true. I don't have that.

Dr. B Now, on the down side, one in seven women will get breast cancer--

Patient –I know, it seems like all my friends have lost [inaudible]. / /

Dr. B / / So in the face of all [of that], gee, it means the longer I live, the greater my chances.

Patient Right.

Dr. B And that's true, so it's a double-edged sword.

Patient Well, I wouldn't mind having one, like you say every three or four years. I just didn't think I need one every year --

Dr. B That's fine.

Patient / / If I haven't had [any trouble] -- / /

Dr. B // Certainly ev-- most frequently, it would be every other year. But still, the breast exams, every month.

Patient Yeah.

Dr. B explains temporal arterioritis (the problem in the news clipping) and he teaches the patient some neck exercises for the shooting pains she is experiencing. The patient seems reassured but a few minutes later, she asks about the pain again. Dr. B explains how headaches can result from pinched nerves and muscles. In the sequence below, Dr. B addresses the patient's concern about a brain tumor again.

Patient I never have a headache. ... I'm not a person that has a headache. If I have a headache, I'll call you.

Dr. B [Laughs]

Patient [Laughing] That's how seldom that happens!

Dr. B Everybody worries with head pain about a brain tumor. //

Patient // That's what I told my husband, "I think I have a brain tumor."

Dr. B Brain tumors don't present with pain. ... And if there's a mass growing in there, what happens is suddenly you have something bizarre.

Continuing down her list, the patient asks about an alternative to a medication that causes her discomfort.

Dr. B What else have you got on your list there?

Patient Well, let's see, um. Do we have any other kind of medication for cholesterol except that [Cholastid]? I mean, that won't -- you know, I took Niacin and I got sick from that.

Dr. B Okay.

Dr. B reviews the results section of the chart. The patient explains that she ran out of Cholastid two weeks earlier but decided not to renew the prescription because of the drug's side effects and in the hope that the doctor can recommend an alternative.

Dr. B / / --The first time I met you was with the Niacin, wasn't it?

Patient Yes, yes!

Dr. B And you were throwing up, weren't you?

Patient Oh, I was sick! I had trouble with that.

Dr. B writes the prescription for Nevicore, then searches the chart again for the patient's most recent cholesterol level but he cannot find it. Fortunately, the patient knows her last level: 246. Dr. B discusses the patient's cholesterol level with her, suggesting a goal of 200.

Dr. B / / Your cholesterol is kind of -- [gestures with wobbling motion]--

Patient –Well, it goes up and down, / / [Overlapping voices] / /

Dr. B / / Yeah, it's in a gray zone. It's not really out, off the chart. ... In fact, I'd like to see it under 200, especially with the history of heart troubles.

Patient Yeah, right, uh huh. But that's, I don't even know anybody who has it under 200.

The patient reviews her list, talking quietly to herself, then raises her last concern: her husband occasionally loses part of his field of vision for a minute or two, for example, he loses sight of a quarter or half of the image of a person. Although the patient does not refer to the doctor's statement, Dr. B's expression that a brain tumor may present with "something bizarre" comes to mind.

Patient ... Could you, uh, refer my husband to an ophthalmologist? ... [A]ll of a sudden sometimes, he'll see half a person. This way or that way and so -- He needs his eyes tested and I think he should go to an ophthalmologist and I wondered if you could --

Dr. B Yes!

Patient – refer to one over in, probably in the Medical Center then?

Dr. B Do you have his [medical record] number?

Patient Yeah.

Dr. B Okay, we'll send off for a referral.

Dr. B initiates a referral form requesting a retinal exam for the husband, asking the patient for information for the consultation request.

Dr. B Okay. How old is he now?

Patient Well, he's about 78.

Dr. B And just the left eye?

Patient Oh, well, I'm not so sure, which, exactly which eye. I don't know that it's exactly, if it's always the left eye.

Dr. B And he's losing the left part?

Patient Or the top part or whatever. Usually, he sees just part of a body. Maybe he doesn't see the heads or, you know ...

Dr. B And then it comes back?

Patient And then it comes back. It lasts a minute or two. ...

Dr. B explains that the husband's problems may have to do with the brain rather than with the eyes. He explains TIAs as a possible diagnosis (an hypothesis). They exit from the exam room. Patient-physician interactions continue unusually and unexpectedly at the nursing station.

12:13 p.m.

Nursing station

Dr. B's style is to accompany the patient to the nursing station where he goes over instructions related to the plan of care with the patient, goes over particulars of orders with the nursing staff, or both. In this encounter, however, Dr. B and the patient continue to discuss the husband's problem. Dr. B hands the referral form to the RN. Dr. B remains at the nursing station, with chart and papers, while the nurse fills in the forms. The referral is incomplete but Dr. B asks the RN to send it along, in other words, it is "handed-off" to the Ophthalmology Department, to be completed there. The RN stamps the forms and goes to get a hand splint from storage in another module. Dr. B and the patient continue discussing the patient's husband's problem. Then Dr. B asks what medications the patient's husband is taking. Motrin, [Hydrochlorothiazide], Reserpine, Aspirin occasionally. The doctor explains how Aspirin helps if the problems are TIAs.

Dr. B ... I'll send it off to Opthal [sic], but your husband, if it keeps persisting, have him take one Aspirin a day. ... If it keeps persisting, then I need to see him. Okay?

Patient Okay.

Dr. B [How long has he experienced the problem?]

Patient Um, maybe 6 years, right?

The RN returns with the hand splint, opens it and tries it on the patient. She explains how to adjust it. In closing, she tells the patient that she

will receive a postcard for a return visit to be scheduled two or three months later by the Appointments Center.

12:17 p.m.

The patient leaves the module. She was Dr. B's last patient for the morning. He is scheduled to work at the Medical Center in the afternoon so he needs to leave the Family Medicine Clinic as close to 12:30 p.m. as possible. Before Dr. B turns to the morning's progress notes documentation, the RN requests a prescription that involves differences in dosage policies and formularies between the HMO and the United States military (the employer for the patient requesting the prescription).

While he completes his progress notes from the morning, Dr. B. chats with the PA about cholesterol medications: "Do you know anybody who can tolerate Cholastid?" "Well -- I don't start anybody on it." He characterizes the difficulties of coordinating care with the Cholesterol Clinic: "They follow 'em 'till they're overloaded, and then they send 'em back to lighten their load. And then when they get low, they hold onto 'em longer. It's a little see-saw battle here. ... It would be kind of like us saying, 'Well, we'll follow the patient 'till we get overwhelmed, and then we'll abandon them and then we'll pick 'em up again.'" He completes all of the morning's progress notes, following the sequence of the appointment schedule, places the charts in an

outbasket at the front right hand corner of his desk, and leaves the Clinic immediately to work at the Medical Center for the afternoon.

12:36 p.m.

End of encounter and documentation

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C.4. Exemplar #3: imagined future scenario

"To do" items are posted to the EHR desktop workspace, replacing Dr. B's system of differently colored in-baskets for messages from patients, results, prescription refills, memos, charts to be reviewed, and physician assistant progress notes to be mentored. Instead of ordering a member of the nursing staff to order the patient's chart from the chartroom before responding to a message, Dr. B simply opens the patient's chart in the electronic health record. To discuss the meaning of lab results in follow up to an encounter two weeks before in response to a patient's telephone call, Dr. B establishes the clinical context of the patient by looking up the progress notes in which he ordered the lab tests. He reviews a patient-specific flow sheet that he set up for the individual patient based on the EHR template flow sheet for someone at risk for diabetes. When he reviews the flow sheet, the electronic health record advises Dr. B to order tests for microalbumin (an important indicator of the onset of diabetes), according to the clinical practice guideline for diabetes

given the patient's family history. When he calls the patient, he has the results and the action steps on screen.

Dr. B returns to his office in-between encounters. The progress notes that he partially documented in the exam room are saved as documents-in-progress in the electronic health record. He sees on screen that his last patient of the morning, a 76 year old woman in the Clinic for a bi-annual evaluation, is ready to be seen, waiting in the exam room. He opens the patient's chart in the EHR and reviews her patient profile and his progress notes from the last time he saw her half a year ago. When the patient's chart is opened, the EHR posts reminders to discuss the patient's cholesterol level, ask if the patient has experienced any symptoms of cardiac problems, and discuss the frequency of mammograms because the patient turned 76 years old since the last visit. References for cholesterol control and for breast cancer screening parameters and the HMO's interpretation of clinical evidence to date are appended to the reminders to discuss cholesterol and mammograms.

The patient in exemplar #3 drew on the news media and the HMO's monthly magazine for its members in creating her list of concerns and questions. In the imagined future scenario, these written information sources are joined by on-line information in more than 25,000 health-related World Wide Web sites for patients and clinicians (Silverman: 1998). The patient in exemplar #3 can search for alternative therapies for cholesterol, arthritis, or

carpal tunnel syndrome. The patient in exemplar #2 can look up the latest in clinical research on Raynaud's Phenomenon or join one of dozens of on-line patient support groups for chronic problems such as fibromyalgia and osteoporosis. Clinicians can quickly go to on-line references for the HMO's clinical practice guidelines and protocols or search for the most recent clinical references in Medline, the Grateful Med, the hypertext version of the Physician's Desk Reference, and so on.

In the "object world" of the electronic health record, new data finds its way into the chart and appropriate databases for population management, disease management, and clinical practice guidelines. In the imagined future scenario, when Dr. B proposes goal-setting--" I'd like to see [your cholesterol] under 200, especially with the history of heart troubles"--to control a risk factor for the senior patient in exemplar #3, he and the patient can use e-mail via the HMO's confidential Intranet to communicate in between scheduled appointments to jointly assess progress towards the goal or to identify problems the patient experiences that interfere with achieving the goal (side effects of the new medication, skepticism about whether the goal is realistic: "I don't even know anybody who has it under 200"). Periodic cholesterol results and blood pressure readings from any other point of care, a walk-in Nurse Clinic, a cholesterol clinic, or another encounter, and results from periodic tests to monitor the effects of Nevicore on the patient's liver and kidney

functions are posted electronically. In the on-line chart, a care provider sees the most recent and complete information from home monitoring by the patient and blood levels from tests conducted in any laboratory or emergency room or hospital. As clinical objects, new data for results and vital signs are added to the patient's chart, now jointly available to the patient and the physician so that each sees the longitudinal picture for cholesterol and blood pressure changing for better or for worse. The EHR affords new kinds of in-progress feedback that inform care providers whether or not interventions are working, for example, making it possible to evaluate the efficacy of a new medication more quickly. Reminders can be set for virtual reviews of data, and clinical alerts are triggered automatically if results are abnormal and transmitted to the physician's desktop. Indirectly, the EHR introduces new means of bilateral communication between patients and care providers considered especially promising for patients who need to control risk factors for heart disease and patients living with chronic illnesses such as diabetes.

In the exam room, when Dr. B is ready to review medications, he sets the EHR filter to display only *current* medications and prescriptions. He sees that the patient did not renew her prescription for Cholastid when it should have run out two weeks earlier if it was taken as prescribed. When the patient volunteers this information and seeks an alternative medication that doesn't have the side effects she experienced with Cholastid, he is not surprised. He

resets the EHR filter for the *historical* medication list to review which medications for cholesterol control the patient has taken before. He remembers vividly how sick the patient was from taking Niacin when he first saw her years ago. Now, in the electronic health record, he sees all the medications that she has had difficulty tolerating over the years. Information about side effects is available on-line for the patient or the physician, before, during, or after the encounter.

The EHR system is augmented with decision support systems and other "intelligence" through third party systems comprising specialized knowledge bases and logical rules for medications, diseases, and other specialized domains. When a new medication is entered into the electronic health record, for example when Dr. B changes the cholesterol medication, the EHR system immediately alerts the ordering physician of any counter-indications given the patient's history of cardiac problems. The electronic health record will automatically display an alert regarding any drug-drug interactions between a new prescription and the medications the patient is already taking for other chronic problems, or for any other counter-indication related to the patient's medical history and risk factors. Immediate display of medication and pharmacy information at the time of prescription-writing serves two purposes: first, to reduce risks of medication errors, and, secondly,

to control costs by enforcing an institution's formularies by displaying comparative costs in addition to clinical information.[97]

In exemplar #3, the patient quickly indicates that she does not want arthritis medication for the pain in her hand because "if I have this thing every night, I don't want to be on medication." Documentation that the patient declined the offered treatment is not so significant in this instance but there are several reasons why documentation that a treatment was offered but declined by a patient is considered desirable by physicians and the HMO. Documentation that a treatment was offered but declined is not embedded in electronic health record documentation but rather indirectly related through the confluence of HMO policies regarding standards of practice and performance measures regarding customer service. The situations of greatest concern are those in which a physician believes, from a medical perspective, that a patient is at risk if he or she declines medical advice and/or treatment. The acronym "LAMA," literally "leaving against medical advice," taken from hospital and emergency room milieus, refers to the patient in such instances. In ambulatory care settings, documenting that a treatment was offered but declined by the patient demonstrates that the physician adhered to the

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[97] As for many of the features of the imagined future scenarios with EHR use, display of potential drug-drug interactions and essential medication information is not unique to this EHR system. Such medication systems are well-established in a set of leading institutions including the Reigenstrieff Institute.

standard of an institutional or national protocol, a clinical practice guideline, or a disease algorithm. Documenting that a patient declined a medication or other treatment and why also serves a communication function in that the information is available to other care providers caring for the patient. Standards of care and standards of service are translated into "performance measures" that are monitored throughout the HMO. The EHR system greatly extends what can be measured.

During the exam room consultation in exemplar #3, there is an exchange between Dr. B and the patient in which the physician refers to the evidence-based medicine approach that is a cornerstone of the HMO's practices and policies and the vision of the EHR Prototype Project. The physician refers to breast cancer screening parameters that follow evidence-based medicine principles: "Remember, all these are screening parameters ... this is all just by studies and recommendations ..." But he then counters the cold scientism of evidence-based medicine with the customer service principle of personalized care the HMO seeks to promote as integral to its identity. He assures the patient that the frequency of mammograms, now that she is more than 75 years old, is her decision, a matter of consumer choice. Dr. B intermixes these two contradictory utopian goals of the HMO, evidence-based medicine and personalized care, telling the patient in summary, "it's a

double-edged sword." The principles are not wholly compatible. To construct a corporate identity and marketing message binding these two is a double-edged sword, a mixed message for patients and physicians. Extending population-based medicine, one of the HMO's founding principles, evidence-based medicine is more deeply engrained in the workings of the HMO. Personalized care can be seen as a fairly recent accommodation to the competitive managed care marketplace. It can also be characterized as an example of image management required in human services that Billig implicates with ideological dilemmas between professional expertise and authority and demands for democratization of relationships between experts and clients (Billig: 1988).

In exemplar #3, the incomplete ophthalmology consultation request for the patient's husband is handed off to the Ophthalmology Department. In the imagined scenario of future EHR use, core clinical data for the patient's husband is available in the on-line patient summary to assist Dr. B in preparing the referral to a specialist. The intelligence of the EHR system might indicate that a neurological consultation should be ordered either in addition to or instead of the ophthalmology consultation. If both are ordered, the EHR system is integrated with the Appointments Center so that both consultations are scheduled on the same day. As in the imagined future scenario of the complex patient in exemplar #2, decision support applications

enable the EHR to "read between the notes," interpreting the husband's symptoms against his cumulative patient history, hypothesizing diagnoses that either confirm Dr. B's advice to take Aspirin once a day or suggest additional or alternative advice pending the specialists' evaluations.

After the encounter, the RN asks for Dr. B's help with a prescription for a patient who works at a nearby United States military base. The formularies of the HMO and the United States military services stipulate different dosages for the prescription. In the object world of the future electronic health record system where "my software can talk to your object," the clinical objects of the HMO and its external partners (stand-alone institutions or networks of physicians and health care institutions) can talk to each other, working through the translation efficiently (and autonomously) and presenting human actors with the appropriate options for disposition.

> ... [W]hat really are the clinical objects? ... I see a point where we do not deal in codes at all. Here is a problem object. It has got a well defined set of attributes and values. That is exactly the form you deal with it in. You do not have to do all this re-representation to move it around. My software can talk to your object and vice versa. You want to print it out? Your object knows how to print itself. You do not worry about clicking the sentence in some specific order. Problem, print yourself. That is really where the object model is going. ...Once we are there, ... you do not ever worry about writing a template. You just sort of create some aggregate of objects and away you go. So I would [say] ... 2001. For all of that. To get there.[98]

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[98] Software Company architect, templates evaluation interview, 1997.

D. Discussion of exemplars #1, #2, and #3

What happens between the present and the future vision of the EHR Prototype Project? To realize the imagined future scenario with EHR use, how are clinical work practices imagined to change? How are future scenarios shaped by the heterogeneous desires of the incomplete utopian project? What do care providers' experiences with clinical use of early versions of the EHR prototype tell us about the difficulties that confront the vision of the future from the logics of everyday patient care? What do emerging activities evident in the EHR prototyping period suggest about possible futures unfolding? How are contradictions in the activity system deepened?

In the discussion of exemplars #1, #2, and #3 below, I begin by summarizing selected problems in current clinical work practices. I then describe changes in clinical work practices that the EHR system requires according to the logic of its design, and difficulties that members of the primary care team experience in using the early versions of the EHR prototype. I highlight dimensions of the clinical, managerial, and technical utopian desires that comprise the vision of the EHR Prototype Project and suggest how these heterogeneous desires contribute to deepening contradictions in the activity system of patient care in the HMO. I briefly note

contributions of the field research to electronic health record design and development.

D.1. Problems in practice, practice dilemmas

In this section, I discuss selected problems in clinical work practices that the new tools of the electronic health record are meant to address: practice problems such as outpatient orders practices, time pressures related to needs for simultaneous access to patient charts and records, and difficulties of fragmented and hard-to-find patient records. I discuss instances of open doors that are evident in exemplars #1, #2, and #3 and how the imagined future scenarios illustrate desires to move from open doors towards closure in ambulatory care. In my analysis of changes from open doors towards new forms of closure, it is not my intention to criticize patients or care providers but to articulate important aspects of the imagined future scenarios with use of an integrated electronic health record system.

Analysis of the baseline video documentation pointed to typical informal practices for teamwork and communication and conventions for clinical documentation that will be changed, whether disrupted or better supported or both, by the formalizations structured into the EHR system including but not limited to requirements of signed orders, limits to access to confidential patient information according to clinical scopes of practice and licensure, and changes in representation of patient information. As a trouble

scenario, exemplar #1 identified a gap between policy and practices and the contingencies of everyday clinical practices. The development of the EHR indirectly presented an opportunity to problematize work practices for outpatient orders in relation to the desire to eliminate risk and the design of new tools for consistent practices across all care settings, in this case, consistent practices for orders throughout the HMO's integrated patient care delivery system. To the leaders of the HMO's EHR Prototype Project, it is imperative that the electronic health record improves the timeliness and accuracy of communication, execution and documentation of orders that are perfectly consistent--perfectly redundant--with signed, documented plans of care and documentation of actions by nurses and ancillary departments. The data generated by ancillary departments provide evidence that a patient followed through on the steps of a plan of care as well (indirect evidence of compliance). To attain perfect redundancy in patient records is not only an ambitious goal but an illusory one to the extent that it is contingent on first achieving perfect consistency of documentation practices.

Electronic health record design for on-line orders and worklists portend grand changes in the clinical work practices of individuals and patient care teams throughout the organization. Three years into the EHR Prototype Project, after a "summit meeting" between the HMO and the Software Company over EHR orders requirements in the fall of 1996, the

registered nurse from the Family Medicine Clinic told me that she suddenly "got" EHR orders. She told me that "the orders piece clicked into place" and she was overwhelmed by what she realized (the imagined future scenario before her). "I see it now and it's--it's overwhelming! *Can we do this? Can everybody really do this?* I mean, are we ready to change like this?!" In an interview with a senior member of the Software Company's product development team in the spring of 1997, I asked, what is most difficult about EHR design? He told me that there were a few truly difficult problems from a technical design perspective, "a few things that will not materialize until the next millennium." However, in his opinion, the most difficult work lies ahead for the HMO. "We can deliver buckets of technology, *buckets*, but if [the HMO] hasn't broken the ground for it, we will be raining on cement!"

By re-inscribing formal policies and procedures in the computer system, the introduction of an electronic health record disrupts informal localized habits of working. For example, the earliest versions of the EHR prototype formalized existing policies and legal requirements by dis-allowing viewing of an unsigned medical record (a document-in-progress) by anyone other than its author. The rationale for this is that only the signed note is complete and accurate, having undergone final review by the author. The EHR system is designed with security filters, settings that formalize access to confidential patient information according to clinical scope and licensure.

Clinical teams are comprised of licensed and unlicensed staff in both outpatient and inpatient environments. The rationale is to tighten the boundaries of confidentiality by limiting access to only those personnel who have clinical needs for confidential information. (This is one reason that many EHR/CPR proponents believe that computer-based patient records may improve the security and confidentiality of paper-based patient records despite the ubiquity of electronic data.) Among examples given frequently are that a dietitian or trained clinic assistant need not know all details of a patient's problems but only the clinical information required for the services he or she is to provide. Although governing policies are known to everyone involved, uncertainty about whether this will ultimately be for better or worse--tensions between what is required by law, regulations, and organizational policy and "how people do things in the real world"--was evident in the contradictory nature of discussions of outpatient orders prior to the implementation of the first version of the prototype. Although settings for clinical access were available as part of the security structure of every version of the EHR prototype, limits to access to clinical information were deferred to the future because such a change was deemed too disruptive for the primary care module team to bear.

What will be the consequences of introducing new on-line tools for communication and coordination? Will such electronic means of

communication expand individuals' and teams' capabilities for coordination and collaboration as hypothesized by EHR/CPR designers and developers? Will the on-line tools of the electronic health record attenuate or disrupt communications and interactions?

Certain of the time pressures of today's clinical work practices are related to needs for simultaneous access to the singular paper-based patient chart. The change from paper-based patient charts to electronic health records makes patient information immediately available to many clinical and non-clinical staff at once via distributed on-line computer systems, a profound transformation that it is not fully imaginable or predictable. The rationale of the paper-based patient chart is that it serves as a singular legal instrument in order to protect the patient from errors or risk that might result from clinicians acting on incomplete medical information, discrepancies between medical records that have been updated or amended, differences in orders, care plans, status, and diagnoses over time throughout the course of an event or the history of an illness. Within the primary care team, two or more care providers frequently need access to the same medical record at the same time. At the same time two or more care providers--physician, registered nurse, licensed vocational nurse, clinic assistant, physician assistant--need access to the same medical record at the same time but they cannot have access without waiting. Given the time pressures of clinical work practices, waiting two or

three minutes is stressful when clinic staff are trying to "keep on schedule," "keep the rooms filled," and meet each patient's acute, chronic and preventive care needs. Problems due to needs for simultaneous access to the same chart are magnified many fold for cases that entail greater time urgency for access and a greater number of care providers and interventions for a patient, and more complex coordination among members of multi-professional, multi-departmental clinical teams.

In reality, however, it is an illusion to speak of a "singular patient chart" as it is imagined medical legally. According to the HMO Region's clinical research department, each of its approximately four million patients has an average of three charts. The HMO's institutional policy is to maintain separate outpatient and inpatient medical records. Each patient whose primary physician worked in the Family Medicine Clinic has a chart at the clinic. Although in theory, the Family Medicine Clinic chart should be delivered to the Medical Center when a patient is seen by a specialist or in urgent or emergency care at the Clinic's parent Medical Center, a second outpatient chart is usually created. In addition, an inpatient chart is created each time a patient is admitted to the Medical Center hospital, kept in the ward throughout the hospital stay, then combined into the inpatient chart of record. The longer someone has been an HMO member, the more likely he or she is to have more than three charts. Multiple charts exist at different

medical centers and clinics throughout the Region according to where a patient has lived and worked over the years. Furthermore, because there is considerable turnover among members of the HMO when patients change health care coverage either by choice, as the result of changes in employment, or as the result of a change in employers' choice of health care coverage, HMO members have external charts and records outside the HMO. Even so, the HMO's California regions are unusual as an integrated health care institution; networked health care delivery systems entail records-keeping, communication and coordination between different networks, institutions, and corporations.

A multitude of charts and records from different sources may contribute to uncertainty or significant clinical consequences. During hospital rounds, I observed a physician's struggle to reconcile the medication lists in eleven charts to determine appropriate discharge medications for a patient. There was no single source of entirely reliable or comprehensive information. In the Emergency Department, I watched anxieties build for nearly an hour and a half as the attending emergentologist repeated STAT requests and chartroom personnel ("runners") searched the Medical Center for the outpatient chart of an unconscious patient for whom it was unsafe to proceed without critical information to establish clinical context.

Emerging activities point to early benefits of the EHR to alleviate (to some degree) the sheer physicality of efforts and time spent tracking down information given the current state of patient records systems. Exemplars #1, #2, and #3 offered glimpses of these difficulties of current patient records systems in the context of the Family Medicine Clinic. Figure IV.4: Internal Medicine Cardiology / Rheumatology is a summary graphic representation of the outpatient Cardiology and Internal Medicine module, the second patient care team to participate in EHR prototyping. The specialty care team is larger and more diverse, caring for higher acuity patients. Patient data exist in multiple media including biomedical imaging, anatomical graphics, and audio and video recordings in addition to handwritten and dictated clinical documentation. Extensive local patient records are maintained for immediate, continuous availability of important and up-to-date information. Because high acuity patients are frequently seen, the need for simultaneous access to their patient charts extends to other specialists and primary care physicians throughout the Medical Center. Over time, the EHR system promises to overcome the fragmentation of records systems and to reduce redundancies in

documentation. However, it is my analysis, based on the EHR prototyping period, that *en route* to integration of all clinical information systems in organizations as large as the HMO, clinical practitioners will experience

periods of greater fragmentation during which they work in multiple, hybrid

Figure IV.4: Internal Medicine Cardiology / Rheumatology

environments (paper-based and computer-based, mixed media records) and during which they "live the gaps" between system interfaces and gaps between design concepts and the pragmatic exigencies of work.

Everyday instances of open doors typical of ambulatory care are evident in the three case examples. Re-imagination of these instances in the future scenarios illustrates desired movement from open doors to closure in ambulatory care with use of an integrated electronic health record system. In exemplar #1, there is an open door as to whether the PA's orders for the immunization series will be followed by the mother. An injection card with the immunizations and dates ordered by the PA is given to the child's mother so that the family may more conveniently complete the immunization series "per nurse visit" by going to one of many Nurse Clinics.[99] The injections are documented to the card by the RN who administers them. The card remains with the mother to present the documentation to school officials and to the family's primary care physician at the next scheduled appointment. The open-endedness of non-scheduled nurse visits, outside the centralized Appointments Center scheduling system, lies in the door left open as to whether the child will complete the immunization series according to the

[99] Walk-in encounters in a Nurse Clinic may be preventive in nature such as the already ordered immunization injections or they may involve urgent problems that require assessment by an registered nurse acting as a triage nurse. A patient with an emergent problem will be sent directly to the closest Emergency Room.

sequence required by the protocol, given the child's history of missed (DNK'd) appointments. In current systems, there is no way to easily know that the child did not have the ordered injection within the required time frame and that he therefore fell outside the protocol, negating the efficacy of injections to date and necessitating re-initiation of one or more immunization series. In another video taped patient visit from the pre-EHR field research, an adolescent living with asthma never had the annual flu shot ordered by the physician as a preventive measure to reduce her vulnerability to influenza. The physician's documentation of the flu shot as part of the plan of care ordered during the prior encounter gives the impression that the flu shot was given in a reasonable time. The physician discovered that, due to her extreme fear of shots, the young patient refused to have the influenza injection, only when the patient's mother brought her in months later to renew a medical excuse from participation in sports at school. Clinical documentation of plans of care in outpatient charts implicitly suggests that what was ordered happened when the real status of a plan is unknown.

In exemplars #2 and #3, there is an open door as to monitoring patient responses to medications or other treatments and monitoring vital signs to evaluate improvement or decline. In case examples #2 and #3, another kind of open door is evident in the documentation of each patient's

blood pressure to a blood pressure card carried by the patient in that the longitudinal information is documented outside the patient chart in between scheduled appointments. The presumption is that a member of the nursing staff will immediately report an abnormal reading to the patient's physician(s). Such a card is a tool for a patient to monitor his or her own blood pressure or other vital signs or blood levels. The presumption is that the patient has sufficient knowledge and competent state of mind and cognitive capabilities and/or assistance from a significant other to interpret changes in self-monitored vital signs or blood levels and to alert a physician about problems accordingly. In exemplar #2, the patient's husband explains: "Two of the medications [I've begun taking] should lower it. ... Both the Hytrine and Isordil have side effects could [cause a] drop in blood pressure so [the doctor] told me occasionally to have it checked." The open-endedness lies in how and when the physician who ordered the medications to manage the man's blood pressure will know of significant changes in vital signs and status in between in-person encounters. For a higher acuity patient, for example, someone living with end stage renal disease (ESRD) for whom plans of care are complex, learning to monitor one's vital signs and blood levels for medications at home is considered essential. Clinical information recorded by the patient or his or her significant other plays a more important role; it is included in the chart during monthly evaluations with the multi-disciplinary

Peritoneal Dialysis team in which a patient's significant other usually participates. Because ESRD patients have abnormal results compared to the normative range, a nephrologist looks for abnormal results on a patient-specific basis, in other words how a change compares to each individual patient's usual range of results.

Open doors in ambulatory care are constituted by convention and the practicality of time pressures and resource allocation. Health care providers attend to urgent and emergent cases; where known risk is great, little is left open ended. But open doors are commonplace in outpatient clinical routines for patients whose clinical cases are in the broad middle range where the greatest number of patients are and where risks are as yet unknown. The HMO has a distinctive degree of commitment to this broad middle population because its orientation to preventive medicine is one of its founding principles. Yet getting a patient from primary to secondary care is a problem within the HMO as it is generally within managed care companies. In exemplars #2 and #3, it is desirable to regularly monitor a patient's responses to medications, whether the goal is to control high cholesterol levels, high blood pressure, or another problem that interacts with diagnoses carried by the patient. It is also desirable to periodically monitor the effects of medications on a patient's internal organs and physical systems, for example, to monitor how the new medication prescribed for patient #3, Nevicore,

affects her kidney and liver functions over time. Whereas an adverse reaction or perceptible side effects related to a medication usually occur quickly, other side effects occur imperceptibly over time. Many sought-after improvements become apparent only gradually. Will norms for monitoring in between customary intervals that follow conventions of appointment scheduling change once new clinical information systems such as the EHR include more frequent and fine-grained information about the efficacy and effects of medications and such information is integrated into continuous quality improvement measurements?

Whether or not a patient follows a plan of care--takes medications as prescribed, shows up for diagnostic tests, adheres to schedules for preventive procedures--represents yet another open door. In exemplar #3, the patient tells her physician: "I haven't taken [Cholastid] now for about two weeks because I've been out. ... I thought I'll wait till I come and see you. If there is something else that doesn't have side effects..." In the absence of a direct cause for concern or a direct report from a patient, it is unlikely that a physician will find out that a patient decided to stop taking a medication or, alternately, decided to take a medication too frequently. At the time of the field research reported here, there was no interface between the HMO's pharmacy system and its legacy clinical information systems. It is possible to indirectly interpret a patient's use or abuse of medications by compiling a

"pharmacy profile," a chronology of prescriptions and refills. A pharmacy profile enables one to see that a patient did not refill a medication for a chronic illness (when a refill was expected) or that refills are requested more frequently than expected periodic intervals. But the information is confounded by the simple fact that an HMO member can choose from among many, many internal and external pharmacies anywhere in southern California. The E-ticket concept for the electronic health record system offers some closure--whether and when a patient picks up a prescription or has a laboratory test or procedure. But electronic transaction data leaves unknown whether a patient is taking the medication as prescribed or following instructions to change his or her diet and lifestyle. Nor can electronic systems account for sharing of prescribed medicines, a common informal practice by partners and among friends. Knowing what a patient is or is not doing is a matter of inter-personal communication, rapport and trust.

In outpatient settings, whether medical advice is conveyed in person or by telephone, more often than not whether the advice was followed remains unknown, an open door, until the next in-person encounter. In scenario #3, Dr. B suggests a goal for the patient's cholesterol level (200). The patient's progress towards the goal will be reviewed during the next in-person visit in x months. Joint goal-setting is a form of patient-physician collaboration for managing chronic illness, for example, diabetes and renal

disease, and for controlling risk factors such as weight, diet, cholesterol, and blood pressure. Management of cholesterol, diabetes, and coronary artery disease are among the HMO Region's clinical strategic goals, benchmarks for improving care and enforcing standards of care. Although new tools for joint goal-setting are not designed into the EHR system *per se*, the electronic health record is imagined to enhance patients' collaboration in plans of care if patients and physicians devise ways to use the EHR system jointly in combination with the communication capabilities of e-mail, the HMO's Intranet, and the World Wide Web. The object world of the electronic health record and its semi-autonomous intelligent agents[100] where "my object can talk to your object," heralds possibilities of knowing the in-progress status of indicators for disease management and risk management. The transformation from open doors towards closure in ambulatory care also heralds new waves of electronic information and accountabilities that are automatically generated or automatically binding. Yet certain electronic signals will prove illusory in

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[100] In a recent discussion of intelligent agents in M.D. Computing, Silverman punctuates descriptions of types of intelligent agents with caveats about their state of existence and use. Agents for knowledge capture "are still not widely used in health care, although they are needed." As for "knowledge mediators" among anticipatory decision support agents: "To date, few mediators exist, but one can expect to see many in the future." For situated training agents, there are a number of practical obstacles to be resolved, then "situated tutoring agents will be more widely adopted." Much of the medical informatics literature is written in a hypothetical, conceptual style that implies more widespread use of software than is actually the case. Not all authors acknowledge the difference been imagined use and practical use as Silverman does (Silverman: 1998).

meaning unless they are considered through interpersonal interactions that have contextual continuity.

There is open-endedness in the care of acute and potentially urgent problems as well as chronic illnesses and preventive health maintenance procedures. When the patient in exemplar #3 requests an ophthalmology referral for her husband, she and her husband are responsible to report symptoms if they persist. In this case. the medical advice is given to the spouse as an intermediary. The physician provides preliminary medical advice (take Aspirin) and advises, "If it keeps persisting, then I need to see him. Okay?"--only to find out that the husband has experienced the problem "maybe six years." Registered nurses conducting telephone triage in the Cardiology and Internal Medicine module, where patient acuity is higher, create a tracking system for patients they advise to go to the Emergency Department. The nurses want to know, for example, whether these at risk patients made it to the Emergency Room for help and what happened. The desire to know what happened may spring from combined motivations: human concern for a patient (Is he or she alright?); desire for confirmation of one's judgment (Did I do the right thing for the patient?); or desire for verification of one's clinical skills (Are my diagnostic abilities in keeping with state-of-the-art knowledge? Or do I need to learn more about the problem the

patient presented?). It is imagined that the future electronic health record will provide visible (if partial) responses to each of these questions.

D.2. Changes in clinical work practices

Different dimensions of the problematics engaged in transitions from paper-based patient charts to distributed on-line electronic health records can be distinguished for analytic purposes. In practice, these dimensions are of course inter-related. Problematics confronting HMO and Software Company collaborators in the EHR Prototype Project in achieving their vision of the future can be conceived along four broad dimensions: (1) idealizations of medical concepts, patient data representations, and notational structures in contrast to long-standing colloquial and pragmatic conventions in clinical documentation; (2) cognitive processes that involve synthesizing medical knowledge and holistic knowledge of patient care and clinical histories, essential to clinical expertise and collaboration in contrast to standardized categorization modeled after distinct physiological systems and the structures of controlled medical and clinical terminologies; (3) organizational change and pragmatic constraints; and (4) design limits to fluidly supporting patient care teamwork and communication needs, patient-care provider interactions.

Clinical documentation is always a translation from the patient-care provider interactions in the medical interview and overall consultation comprising subjective and objective findings, hypothesized diagnoses and

treatment plans. Clinicians already share broad domains of clinical expertise and medical logic. Clinical reasoning and decision-making require "cognitive blending" between the boundaries and categories of information received (subjective, objective, new, historical, biological, psychosocial) interpreted against recognized patterns and the clinical context of the individual patient. Structured documentation is a better match for practices that are already quite structured such as physical examinations. The formalisms of the structured content strategy for clinical documentation in the electronic health record system must be learned if clinicians are to follow expected norms for the (implied) sequence and (explicit) selection of standardized terms for clinical documentation that are now atomized into components (objects) of controlled medical and clinical terminologies. To the software architect, the electronic health record's structured content knowledge base is a programming language:

> You are really teaching a programming language. It is non-visual. ... Very non-procedural. It is not at all what you think you are doing, but when you click your way through that to write a sentence, you are really executing an interactive computer program that [the Clinical Informatics] people built. Because every node takes some action. And they have decided how does it look on the screen and when you click it, what does it do? What are its semantics? I do not think that they think of themselves as programmers but in point of fact, that is exactly what they are doing. The [clinical content] knowledge base is a gigantic hierarchical tree structure representing a logic flow.[101]

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[101] Software Company architect, templates evaluation interview, 1997.

These are different logics between electronic health record design and use. The logic of patient presentations of problems and patient-significant other-clinician interactions differs from the logic of the structured content design strategy of the EHR system. The logic of clinicians' and other care providers' cognitive processes involving rapid synthesis across categorical boundaries of systems also differs from the logic of structured content knowledge bases in EHR/CPR systems and other medical informatics software tools.

How and what does a patient actually present in contrast to idealized notions of problem presentation and medication interviews? In exemplar #2, a baseline encounter preceding the introduction of the EHR prototype, the patient-physician interaction in the exam room illustrates differences between the logics of patient presentations of problems and the logic of structured content clinical documentation of problems, diagnoses, and assessments. The sequence of the patient's presentation of the new problem and the patient-physician interactions during the exam room consultation do not fit easily into the expected sequences of structured content documentation in the electronic health record.

Throughout the exam room consultation, the patient and her husband ask, directly or indirectly, is this or that known problem related to the new problem she is experiencing? Is the new problem related to my sister's recent death? Is a previous episode of swine flu related? Could the new problem be related to an ear ache and problem with her jaw for which she was examined by an ENT specialist? The husband offers a comment from their Emergency Room visit the weekend before: "The PA at the medical center thought she might have had a goiter. It's a family trait." After the physical exam, the patient offers, "[I]f I get very nervous, my eyebrows itch." The patient's husband is concerned that the new problem may be related to high blood pressure: "Today her blood pressure was higher than it's ever been." The patient asks "Would my fibrositis have anything to do with it? That has been worse." The questions occur as *non sequiturs* to the physician's queries. To each of these questions, interspersed throughout the encounter, the physician replies, variously: "I don't think so," "I can't imagine," "her blood pressure is fine," "your eyebrows are fine."

The physician examined her for the signs and symptoms of Bell's Palsy, as he partially explains in the excerpt below (he provided further explanation during the consultation).

Patient Could it possibly be Bell's Palsy?

Dr. A That was one of my thoughts, I'll talk to you about it. [Turns around and continues documenting]

Patient I do, if I get very nervous, my eyebrows itch. I personally didn't think this had anything to do with my sister. Because it was something we knew was happening.

Dr. A [Turns toward the patient] But your forehead--

Patient –Maybe you didn't poke it hard enough.

Dr. A turns toward the patient and explains the medical reasoning behind the physical exam in relation to Bell's Palsy.

Dr. A In Bell's Palsy, [it] affects primarily the motor function, and you can certainly raise your face up, and your eyebrows are fine. ... The first thing to do is make sure your brain's okay.

While a patient's questions in and of themselves do not represent disruptions to the physician's medical reasoning (cognitive processes), they are important to the interactions between this patient, her husband, and Dr. A. Patient questions, no matter how relevant or irrelevant from a medical logical perspective, are important to the construction of a joint object through patient-physician conversation during the medical interview (Engeström, R.: 1995). Patient questions represent windows onto the different logics between patient presentations of problems and the interpersonal, interactional work of

interpreting a patient's presentation and responding to a patient's questions, and the logic of clinical documentation, the medical logical representation of the encounter whether recorded in handwritten notes or in a computer-based system.

At the end of the encounter, Dr. A must amend his notes when he realizes that he did not understand what the patient said about the duration of the current episode of numbness in her face. The physician and patient were unable to establish a common understanding of the duration and frequency of the new problem. This clinically significant information is added to the clinical documentation at the end of the encounter rather than in the expected sequence of physician questions and responses by the patient. In the electronic health record, the addition of significant information changes the data which decision support systems interpret. The intelligent assistance that the electronic health record is expected to provide may also occur out of expected sequences following the real sequences of patient-care provider interactions.

The difference between the interactional logic of patient presentations of problems and the logic of structured content clinical documentation was posed (partially) as a design problem: How can the EHR system be designed to support the flow of patient-care provider interactions during exam room consultations? The difference between the phenomenon of cognitive blending

in clinical reasoning and decision-making and the logic of the structured content design strategy was also posed as a design problem: to support the way physicians think, the electronic health record design concept is to create multiple paths into progress notes from different contexts within clinical cases.[102]

In the imagined future scenario of the electronic health record, the EHR patient profile is automatically updated as a by-product of structured documentation. "[The EHR's] innovative technology simultaneously stores literature and logically populates the patient record. So, when clinicians capture this information, they only have to do it once."[103] Without additional effort by clinicians, problem lists, medication lists, and other critical patient data are generated and organized when progress notes are documented. The beauty of the structured content design strategy is its promise to simultaneously meet the combined purposes of clinical documentation of patient care encounters and the creation of an analyzable database for an array of epidemiological and administrative purposes. The non-automatic nature of structured content documentation is of primary importance to an appreciation of changes in clinical documentation practices that the inner

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[102] One of the physician founders of the Software Company commenting on his observations of clinical use of the first version of the EHR prototype in the early autumn of 1994.

[103] Software Company brochure.

logic of the EHR system requires. What is required for the degrees of interactivity and flexible display that are at the heart of the EHR design for patient profiles to work when the chart is opened next? An example of how the inner logic of the EHR system demands a change in clinical work practices from implicit to explicit documentation occurs at the end of exemplar #2. The patient and her husband request a physical therapy referral related to two chronic problems: fibrositis and osteoarthritis. The referral for these two problems and many prescription orders for many of the medications renewed are not linked to the chief complaint of the day's encounter on which the interview and physical examination focus. According to the logic of the interactive chart review through the EHR patient profile, the physical therapy referral and each medication should be linked to the associated problems already listed in the patient profile.

Structured content documentation must be thorough for all of the important informational elements that comprise varying "core data sets" also known as "minimum data sets." The HMR and the EHR patient profile are examples of core data sets for patient summaries. In addition to patient summaries, core data sets are being defined and built into EHR templates for particular diseases, problems, and treatments. In EHR templates, data elements of minimum data sets "prompt and speed the collection and

[accessibility] of specific information"[104] in the structured database for analyzing outcomes analysis, analysis and iterative development of disease management algorithms, clinical practice guidelines, and protocols, and the pursuit of population-based medicine and evidence-based medicine. As for the non-automatic creation and maintenance of patient profiles in the electronic health record, thoroughness of "structured content coverage" (percent of structured documentation of the elements of minimum data sets) and meaningfulness (granularity, lexical and conceptual clarity, context) are prerequisites for running medical logic modules and related computer tools that interact with a substrate of information about an individual patient.

From the perspective of the EHR system, there are optimal steps and sequential processes to structured documentation. In early EHR use, clinical staff inadvertently created duplicate entries to a patient's profile (problem, adverse reaction, medication, other data). Repeating a problem in a problem list is sometimes desirable, for example recu rring instances of otitis media (ear ache) are often distinct instances (episodes), not true duplicates in the redundant sense. But unwanted duplicate postings quickly make a problem list crowded and harder to view quickly given limited user interface real estate. Furthermore, the inner logic of the system requires that the physician

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[104] Software Company brochure.

or other clinician explicitly sets the "status" for each problem, diagnosis, and medication in order to display current or historical information flexibly as desired down the road. The requirement for upfront explicit statusing is one of the ways that the EHR design demands unprecedented forethought to pre-select computer settings for important elements of outpatient clinical documentation that were previously left implicit.

I have discussed some of the changes in clinical documentation practices required for the new tool and new system to work as it is logically designed. Imagination of the design and use of the EHR patient profile is also animated by changes in practice metaphors for design from individual physicians to patient care teams and networks. Potential changes in practice introduced by EHR design are meant to address long-standing problems in clinical documentation practices by introducing new tools for communication, coordination, and collaborative among multi-professional and multi-disciplinary care providers. By informal convention, the personal physician for a patient is usually considered to be responsible for the patient summary. Imagining the collaborative nature of patient care quickly problematizes the patient records practices involved in documenting to a shared patient summary. The electronic health record will change who documents to patient summaries. EHR patient profiles will include nursing diagnoses, patient problems and psychosocial aspects of a patient's problems and recovery (e.g.,

Henry, Campbell, and Holzemer: 1994; Henry, Holzemer et al.: 1994). How will a multi-disciplinary EHR patient profile then be experienced by an individual physician? By an registered nurse caring for the patient, coordinating care with other care providers and departments throughout the HMO? A consulting cardiologist, cardiology nursing staff and cardiodiagnostics technicians? Transforming problem lists and patient summaries into multi-disciplinary tools engages long-standing controversies and negotiations between clinical practitioners who have distinct perspectives of patients and patient care. The EHR designers implicitly take up these issues in their vision for an interactive patient profile that supports multi-disciplinary documentation. But how the vision will materialize can only be worked out in practice over time. How does the new patient profile address problems the Software Company and HMO are trying to solve? What potential new dilemmas are introduced?

D.3. Difficulties in early EHR use

Many difficulties confront the utopian vision of the electronic health record in practice, including difficulties with use of structured content for clinical documentation and the resulting representational forms of progress notes, and the creation and use of the EHR's interactive patient profiles, problem lists, and medication lists. Difficulties in early EHR use vary from problems considered to be temporary and remediable through iterative

prototyping to design problems that are deeply embedded in the EHR's design logic.

Longitudinal review of a patient's blood pressure and other vital signs is imagined to be easier and more flexible with future EHR use, providing a choice between graphical or alpha-numeric display. In early EHR prototype use, however, in contrast to flipping through the paper chart's previous progress notes, it was no longer as easy to review longitudinal vital signs or to review nursing and physician notes together (without taking extra steps to edit the notes together on a single page, recreating the usual presentation of paper-based outpatient progress notes). Outpatient progress are sometimes described as "a sandwich" because they condense and collapse together on one page aspects of documentation that are elaborated on pages of particularized medical records forms in distinct sections of inpatient charts. Because the EHR design re-establishes many of the structured representations of comprehensive inpatient records, outpatient progress notes were disaggregated into components (nursing notes, vital signs, explicit sections by physical system in physician's notes). Automatic concatenation of all related notes by a *team* for an *encounter* was designed into the fourth version of the electronic health record, after the period about which I am writing. Concatenated documentation for team-based encounters provides the basis for multi-disciplinary documentation across care settings, and for linking

together all clinical documentation related to an episode (clinical event). The strength of the design strategy lies in the consistency and flexibility of the design concepts across all settings: teams, encounters, team-based encounters. The immediate problems encountered in clinical use lie in the overhead the concepts impose on the usual patterns of everyday outpatient encounters that involve two or three members of a stable patient care team (physician, nurse, perhaps another member of the nursing staff) in contrast to the more ensemble-like multi-disciplinary teams of emergency medicine and inpatient care and more intensive and complex orders for diagnostic tests associated with specialty care.

In exemplar #2, Dr. A specifies "doubt Bell's Palsy"--Bell's Palsy cannot be ruled out until diagnostic tests are performed and interpreted by the appropriate specialist(s). Difficulty expressing differential diagnoses was among the changes in clinical documentation practices in the early EHR prototype. In free text, physicians often use a question mark immediately in front of or immediately following a problem, for example "? CTS" (“? Carpal Tunnel Syndrome). A physician may flag uncertainty about a diagnosis with "doubt" or "?rule out" or "ddx" (differential diagnosis) followed by one or more diagnoses to alert the consulting specialist and other colleagues to his or her thinking and clinical rationale for treatment. It should be noted that, although these are common informal conventions, the use of "?" and other

non-standard abbreviations such as arrows pointing up or down and delta for change, frequently cause ambiguities of interpretation for others reading the notes that include them. To give one example, "?rule out" may be read as a shorthand request indicating the need for a specialist's expertise, or it may express doubt indicating that the referent diagnosis appears unlikely to the physician author. It should also be noted that decision support systems such as Quick Medical Reference (QMR) and others that are valuable diagnostic tools for the most complex cases and for the medical education of new physicians are rarely usable in everyday general practice. In the earliest versions of the EHR Prototype, expressing differential diagnosis (explicit hypotheses about a problem) proved difficult according to the physicians in the primary care prototyping team. In structured content documentation, the ubiquitous "?" and other common symbols were not available because they interfere with the structured content knowledge base. But the difficulty of affording such seemingly obvious means to clinicians is more deeply embedded in the structured content design strategy due to the importance of analyzability of data. If a diagnosis is negated by the addition of a symbol (?, /, <, >) or an uncoded (free text) descriptor (doubt, not, no) in such a way that the combined expression cannot be parsed correctly by the system, it will cause the combined documentation of a problem to fall outside the controlled (standardized) medical and clinical terminologies. Analysis of the data could

then be misleading, confounding, or even opposite in meaning from the clinical case.

Progress notes, patient summaries, and problem lists are special targets for electronic health record design. In the EHR design, patient summaries become interactive patient profiles. The patient profile is "populated" with patient information in two ways: from structured documentation for summary data elements in the course of writing progress notes (the data elements are automatically posted to the patient profile), and by direct entry and editing to the patient profile fields (a patient profile note type). Patient profile elements are linked to the progress notes from which they were generated. This enables someone reviewing a patient's chart to see the context for diagnosis of a problem, for example, or to see the context for a change in medications. Patient profile elements are linked to each other when appropriate, for example, the diagnostic indication for a particular disposition (the problem for which a medication is prescribed or a procedure performed). The concept is that chart review can be conducted interactively "through" the patient profile. Any element when "opened" shows the links to related documents and data. The EHR patient profile is regarded as a highly valuable new tool in principle but the early versions proved problematic in practice. The registered nurses from the primary care and cardiology modules explained that, for the EHR patient profiles to be useful to them,

they must be sure that the information is reasonably up-to-date and complete. They suggested, for example, that a profile should display the date on which it was last updated and by whom so that nursing personnel can judge the reliability of patient summary data.[105]

In clinical use of the early versions of the prototype, the EHR patient profile relied on explicit selections of status for certain important elements, particularly problems (active, inactive) and medications (start date, current, discontinued). Explicit statusing represents a significant change in practice in that it requires forethought about the structure of the system and what one must do so that the patient profile will display the information flexibly at a later date. This may not sound like such a big change. But these statuses have long been implicit rather than explicit in patient summaries in outpatient environments. Explicit notations of status in paper-based records are usually quick and telegraphic: an uncertain diagnoses has a question mark beside it; a discontinued medication is struck from a medication list.

Display of patient information becomes flexible through the use of filters that sort the underlying structured information differently. The simplest filters are list sorting features, for example, "list by" choices for a

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[105] Registered nurse participants in EHR design discussions, 1995. The two registered nurses served as clinical liaisons from the Family Medicine and Cardiology / Internal Medicine modules participating in EHR prototyping.

medication list: all, current, discontinued. The idea is that one can easily see the current medication list but also easily review the historical medication list (all medications ever ordered), something that care providers have long wanted to be able to review reliably. It is often important to know whether a patient has previously taken a particular medication that was discontinued as a treatment and why the ordering physician discontinued it. Did the patient have adverse reactions? Is there a drug-drug interaction? Is there a counter-indication given another treatment plan for another problem the patient lives with? The filters for diagnoses, problems, and assessments allow one to see the status assigned to a problem: active, ruled out. While a clinician may be most interested in active problems, it is important to know that a diagnosis is being considered or that a diagnosis was ruled out by a consulting specialist or by virtue of further diagnostic tests.

Flexible display of data in EHR patient profiles requires explicit, up front choices by physicians to establish elements of context that are usually implicit in paper-based clinical documentation.[106] Unless each physician sets the status for each patient profile entry--*current* or *discontinued* for each medication; *active*, *ruled out*, *stable*, or *control inadequate* for each assessment,

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[106] As I have described above, the implicit nature of handwritten documentation is frequently problematic, for example, when ambiguities cannot be sufficiently clarified through interpretation of related notes.

problem, and diagnosis--patient profiles cannot display reliably meaningful lists (unless someone takes the time to edit the patient profile data and/or to reset the display settings). Selecting filter settings for display of information is only one example of deliberate forethought the EHR system requires of clinical practitioners; accommodating the logic of the electronic health record requires an appreciation of the computer system's inner workings and integration of the system's logic into one's daily clinical documentation routines to a degree sufficient for it to be able to compute and display information meaningfully at later times: to conduct interactive chart review, to respond to a desktop query of all patients with high cholesterol, to display current medications only, to display diagnoses considered but ruled out. Upfront thought and time commitments are also required for effective EHR templates use, as a principal in the Software Company's Product Management team commented: "The only negative of templates is that [their use] requires upfront thought. ...[T]here is this double-headed idea that there is work on the front end but once you get the work done on the front end, the back end is going to be exceedingly faster than if you don't do any of the work on the front end."[107]

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[107] Templates evaluation interview with a principal member of the Software Company Product Management team, 1997.

The HMR, a paper-based template, is documented to the extent deemed useful by the documenting physician, as Dr. B's devotion to the HMR as his Bible for medication lists for complex and multiple problem patients attests. He showed similar devotion to documenting medications in EHR patient profiles for frequently seen patients (complex and multiple problem patients). In early clinical use of the EHR prototype, it might take twenty minutes to enter the initial medication list for a patient, but he considered the time worthwhile. In the first three versions of the EHR prototype, Dr. B encountered numerous complications in EHR structured content documentation of medications, use of medication templates created for use of the early prototype versions, and his practice needs for different types of medication lists (current medications, historical medications, indications and other context for current and discontinued medications). After the first year of using the electronic health record, he commented: "The problem with [the medication list of the patient profile] was, it was very hard to keep it updated, especially on patients where you're changing the meds [sic] frequently, say for your heart failure patients. ... If you had two meds on the same line and you changed one of them, it just put more steps in to try to keep it organized. After a while [with] a heart problem, their med profile was a mess."[108] Dr. B's

[108] EHR Prototype Project, Confidential Report, 1995.

frustrations with structured content documentation and templates libraries for medications are indicative of problems that confront designers and clinician users of medication lists.[109] How does the EHR patient profile become the tool it is envisioned to be? What does the EHR patient profile need to be like to be as useful as a paper-based patient summary such as the HMR? How could the EHR patient profile become the new Bible for Dr. B?

The paper-based HMR is not a signed, dated medical legal document whereas the EHR patient profile is. Every entry to the electronic health record is automatically date and time-stamped and identifiable by author. Patient summaries and problem lists are integrated into the electronic health record's continuous electronic audit. The patient profile becomes subject to inclusion in medical legal audits; it is transformed from a semi-informal means for quickly communicating critical clinical information to a formal record for which each clinician can be held accountable via the continuous electronic audit trails that EHR/CPR systems create. Interactive chart review is a new tool for conducting chart reviews for administrative, regulatory, and research purposes, and, ultimately, medical audits (as required for every death in hospital). Interactive chart review through the EHR promises remarkable

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[109] I was introduced to a similar set of problems for design of on-line medication lists in a different clinical setting, the design of a decision support system for a county clinic caring for people living with HIV and AIDS.

time and cost savings for these purposes. The EHR patient profile transforms paper-based tools such as the HMR in keeping with the utopian vision for improving collaboration and coordination of patient care while simultaneously creating new degrees of analyzability of data for regulatory, quality assurance, epidemiological, and performance measurement reporting.

Alerts and reminders are among the core functionalities of the future EHR design that figure prominently in the imagined future scenarios. The EHR design includes alerts (clinical alerts) that must be acted upon and proactive preventive care reminders generated by the EHR instantly "reading" the patient's demographics (age, gender, ethnicity) and history (individual and family history, social history, cumulative electronic records) against the HMO's institutional rules for preventive screening, disease management, clinical strategic goals, continuous quality improvement and other benchmarks. The genre of proactive reminders to be established and administered by the HMO and distributed "automatically" through the EHR interface is of special importance to the imagined future scenario and the design logic as it is meant to unfold. Proactive reminders presented by the EHR are imagined as automatic, instantaneous, many of them mandatory in order to ensure conformance to standards of practice throughout the HMO. Institutional reminders are to be automatically generated by the EHR for health maintenance procedures, clinical practice guidelines, clinical strategic

goals, and other standards of care as determined by HMO administrators and physician chiefs of service. The vision assumes the ability to analyze individual physicians' conformance or deviation from conformance not only for responses to proactive reminders and alerts but also for individuals' uses of aspects of structured content documentation, for example, structured content documentation of patient profile elements and minimum data sets for diseases, protocols, and clinical practice guidelines.

In addition to proactive reminders, conditional reminders can be defined for actions to be determined at specific points in time or contingent on the improvement, stability, or decline of a patient's clinical status or response to a course of treatment. In exemplar #2, the contingency of the neurology consultation requested for the patient presenting "numbness in the face" upon the results of the cat scan can be built into the doctor's orders as an "if ..., then ..." statement. A conditional reminder can be set up to proceed contingent on the results of the cat scan. The frequency of mammograms for the woman who became 76 years old is contingent on screening parameters that account for age, family history, patient history, and risk factors, but it is also to be determined by the patient's choice in exemplar #3. If a woman is older than 75 years old, mammograms no longer need to be scheduled annually. Mammograms should be scheduled every x years contingent on the patient's history and risk factors and per the patient's choice. Future reminders can

then be set accordingly for the Appointments Center, the Diagnostic Imaging department, and the patient's primary care physician.

The potential *redundancy problem* that is embedded in the design and in the vision of future electronic health record use is general and ubiquitous, related to core functionalities and tools. On-line worklists attach electronic "to do" items to tasks that comprise orders. Each task remains in the on-line worklist until it is accomplished by an individual (a physician, a registered nurse, a licensed clinical social worker) or group of individuals (anyone on the nursing staff, any technician on the cardiodiagnostics staff, anyone at the registration desk). At the same time, the orders--for which worklists provide guidance, in-progress status, and confirmation of closure--are represented on-line in clinical documentation. Doctor's orders have always been an important part of the medical legal record, but on-line worklists represent a new tool for accountability as they now join the continuous electronic audit of the electronic health record. It is this explosion in visible task accountabilities on-screen reinforcing the accomplishment of actions that are also represented in clinical documentation that the Software Company's EHR designers pointed to when they raised concerns about potential *redundancy problem*s. When a complex or multiple problem patient's chronic problems, acute problems, preventive health maintenance procedures, medications and other treatments are addressed with proactive institutional reminders, alerts,

decision support for differential diagnoses and for potential interactions, on-line orders and worklists, and prompts for completeness of clinical documentation, the electronic health record evokes the spectre of drowning at the hands of tools that have taken on a life of their own, the predicament that nearly engulfed the sorcerer's apprentice.

D.4. Incomplete utopian projects, deepening contradictions

The beautiful logic of the imagined future scenario of electronic health record use assumes not only systematic--consistent and standardized--structured documentation by all clinical practitioners, but also integration of all systems (clinical and non-clinical) and instantaneous speed and access to the underlying substrate(s) of clinical data by means of inference engines that apply rules and algorithms to parse and correlate data meaningfully. The rule of thumb for a physician's tolerance for waiting for information is two seconds. As technical aspects of the EHR Prototype Project, the client server, open architecture, and object-oriented aspects of design are significant challenges for the effort to rebuild the clinical information infrastructure of a health care institution the size of the HMO. During the period of my dissertation research, the Southern California Region, where the EHR prototyping took place, had between three and a half and four million patients. At the time of writing, the HMO estimates its national membership at nine million patients. The scalability issues for the Software Company and

the HMO's Information Technology Department are not only produced by the sheer scale of numbers of patients and electronic transactions per day but also by the technical, clinical, and managerial utopian projects that motivate the EHR Prototype Project and its strong structured content design strategy.

The imagined future scenarios for exemplars #1, #2, and #3 obviously represent only partial sketches of the vision of the EHR Prototype Project. The vision shares numerous ideas and images elaborated in the extensive literatures of the medical informatics, software industry, and clinical communities in which its leaders and multi-disciplinary staff participate. The stance of the HMO leaders of the EHR Prototype Project towards dictation and voice technologies is a notable distinction from the literature and imagery at large. The absence of voice technologies from the vision of the future electronic health record is a marker of the strong structured content design strategy. In the imagined future scenario, structured content documentation is envisioned for many reports and records that are now usually dictated such as neurology and ophthalmology consultations, interpretation of cat scan results, and admitting and discharge summary records for Emergency Department and hospital episodes. Despite advances in the development of voice entry technologies in recent years, the development of dictation capabilities as an integrated part of the EHR was deferred at the HMO's request in order to prioritize and test the strong structured content

documentation design strategy. Because dictation and transcription exist in digital media, they are potentially analyzable by means of natural language processing (NLP), a major alternative strategy to requiring upfront adaptations to structured content documentation by clinicians.[110] Dictation and audio playback capabilities were featured quite prominently in the first demonstration of the multi-media EHR prototype I was given in 1991. The initial training provided by the Software Company to the EHR Prototype Project staff in early 1994 devoted significant time to the dictation software being developed. Why was the priority lowered for development of dictation capabilities?

Dictation is the norm for inpatient documentation of a patient's History and Physical upon admission, reports interpreting the results of major diagnostic tests, consultations by specialists, and discharge reports, among other patient records. While rarely used in Family Medicine, dictation is a typical means for specialists' documentation in outpatient as well as inpatient settings. In the outpatient Cardiology and Internal Medicine module, the three cardiologists, internist, and rheumatologist dictate consultation reports. Their estimates for dictation as a percentage of their

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[110] Structured voice entry is yet another strategy for rapid, analyzable clinical documentation, for example in emergency medicine. As is true for many of the clinical information technologies in development, the time horizon for viable, generalizable use of voice entry technologies shifts perpetually forward from estimates of two to five years to ten to fifteen years.

outpatient clinical documentation range from ten to fifteen percent up to eighty percent, depending on varying percentages of their practice represented by consultations.[111] However, in the HMO, dictation is rarely used for clinical documentation of progress notes in primary care settings, and the HMO does not wish to extend the costly option of dictation for routine outpatient clinical documentation. The stated rationale for the decision to defer development of dictation capabilities was to avoid the delayed turn-around time that dictation incurs. The turnaround time includes the time it takes a medical transcriptionist to transcribe the dictation, to send the transcribed report to the physician for review and any corrections, the time for the physician's review and delivery to the transcriptionist, the transcriptionist's revision according to the physician's review, and, finally, return of one copy to the physician, routing the chartroom copy as the medical legal record to be filed in the chart, and routing copies to the patient's personal physician and other clinicians who should receive the dictated report. Any delay—whether for STAT or routine turnaround times for dictation--interferes with the imagined future scenario of real-time alerts and reminders and other features that are contingent on the electronic health record applying intelligence (rules for protocols, algorithms for disease

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[111] EHR Prototype Project, Confidential Report, 1996.

management, and other types of decision support). In the language of the EHR Prototype Project, "real-time" means at the time of interaction with the patient.

The utopian project of evidence-based medicine and evidence-based practice is an extension rather than a change of the HMO's practice orientation and ideals from its founding years. The electronic health record provides a new set of tools by which evidence-based medicine and evidence-based practice can be pursued. Clinical practice guidelines are among the tools for evidence-based medicine. In the United States, clinical practice guidelines are published by the Agency for Health Care Policy and Research (AHCPR). As exacting as the process of developing clinical practice guidelines is, their implementation and iterative development are considered greater challenges. In one reported study of a clinical practice guideline in use, clinicians decided not to follow the published guideline 30% of the time. When a clinician chooses not to follow a guideline, he or she is to document *variance data*, explaining the reasons for the exception. Variance data are analyzed to iteratively develop the guideline; variance data shed further light on unknown or ambiguous areas of the clinical domain of the guideline. Clinical practice guidelines are always in a state of iterative development in relation to the evolving state of medical and clinical knowledge. As more is known,

more fine-grained differentiations of diagnoses and treatments can be distinguished. The EHR system provides new tools to implement clinical practice guidelines and to collect and evaluate information required to move toward evidence-based medicine and evidence-based practice generally. Although its everyday manifestation in the HMO is its implication in rule-setting and boundary-setting for screening parameters and eligibility for clinical treatments and services, evidence-based medicine is driven in principle by this iterative phenomenon. Movement towards evidence-based medicine is unending.

Evidence-based medicine, population-based medicine, disease management and continuous evaluation of modes of care and efficacy of treatments contribute to the clinical research dimension of the utopian vision of the EHR Prototype Project. The over-arching goal is to build a clinical research loop into daily practice. The instance of cholesterol management in exemplar #3 offers an example of attempted convergence (alignment) of goal-setting as a collaborative tool in a patient's plan of care, the HMO Region's clinical strategic goal (institutional goal-setting for quality of care and for risk management) and participation in public health initiatives, decisions between various cholesterol medications (uncertainties about treatments), and difficulties coordinating care with cholesterol clinics (uncertainties about modes of care). Controlling risks of high cholesterol is a public health goal for

the United States and a clinical strategic goal of the HMO Region. In the HMO Region, cholesterol levels of at risk patients are sampled annually, analyzed, compared and reported for each Medical Center. The cholesterol clinic to which Dr. B and the PA refer in exemplar #3 is part of the HMO's population-based medicine approach for cholesterol management but no one is sure which treatment strategies will prove helpful for which subsets of the patient population with high cholesterol levels. In addition to helping individual physicians and patients, the EHR system is imagined to support coordination between care providers primary care in clinics and those in care centers that focus on a specific problem such as a cholesterol clinic. The electronic health record system is expected to provide new tools for population-based medicine by making it possible for an individual physician to query population subsets within his or her panel of patients. How are all my patients with high cholesterol doing? How are the patients with high cholesterol who are taking the newer medication Nevicore doing compared with those taking other cholesterol control medications? How are the patients I have referred to the cholesterol clinic doing comparatively? By providing desktop query and reporting capabilities, the electronic health record extends certain of the analytic capabilities associated with clinical research and epidemiology to individual clinicians in daily practice as well as to administrators and research analysts. Building clinical research feedback into

daily clinical practice is motivated by the desires of the EHR Prototype Project's incomplete utopian project that the everyday practice of medicine and the epidemiological project become one and that the art and science of medicine become one.

The principles of family medicine and preventive medicine established early in the HMO's history are evident in its everyday clinical practices. In each of the three case examples, at least one other family member is present or otherwise involved in the encounter (by proxy in exemplar #3). As in exemplar #1, pediatric encounters are family matters by definition. In exemplar #2, the patient's husband is integrally involved in helping her keep track of her many treatments. He also informally requests and receives a blood pressure check from the trained clinic assistant. Once patient #3 has worked through her list of her own concerns and questions, she presents a problem on behalf of her husband for which the physician prepares a consultation request. The informal interaction between the patient and physician at the end of the patient's scheduled appointment includes medical advice for the spouse (take one Aspirin a day if symptoms persist). It can be said that exemplars #2 and #3 each involve two encounters in one, the additional encounters occurring informally outside the system of scheduled appointments used to measure productivity and track use of resources. Will these types of informal encounters and interactions be lost when the work

organization of patient care in the HMO comes under greater cost-benefit scrutiny and time pressures?

An early instance that I observed in my pre-study vividly juxtaposed covenants of care, the ethical nature of patient care, and the boundaries of work organization in a managed care environment. A physician telephoned a Filipina patient and asked her and her husband to come to his office in order that he could explain positive results for adult-onset diabetes. This was an informal encounter, not a scheduled appointment, in which the physician temporarily recreated the intimate ambiance of a private physician's office. Afterwards, the physician (Filipino himself) explained why he did so: diabetes is considered to be a "shaming" disease within the Filipino community because the disease is passed on to one's children. The encounter was emotionally difficult, the news was clearly traumatic for the couple. Because living with diabetes involves significant changes in one's lifestyle in addition to taking medications (injecting insulin) and closely monitoring blood levels, it is imperative that a patient and his or her significant other(s) accept rather than deny the diagnosis and understand the steps of the plan of care if the risks diabetes carries are to be brought under control. This encounter occurred approximately during the "telephone time" allotted in each physician's schedule for responding to telephone messages from patients, but it was beyond organizational norms and boundaries of work

organization. Nursing staff in the module remarked that they thought the physician could not maintain such an interpersonal style within the productivity system of the HMO. "You'll see, he won't last." "He'll get burned out and cynical." Will this kind of informal attention to the special needs of patients be squeezed out as a result of the intensification of time pressures on care providers and intensified commodification of patient care?

The contradictions between commodity values and use values of patient care are intensifying in the United States, coming under greater pressure due to the growth of the for-profit health care sector and the kinds of market competition it engenders. The story of two logics--the activity of patient care and the EHR system--schematizes the interplay of these competing logics and contributes to analysis of deepening contradictions between social use values and commodification of patient care. The proliferation of billable services is, to a great extent, contingent on the ability to trace and codify services performed. The construction of patient business objects entails breaking patient care processes into objects comprised of components (themselves other objects) whose attributes and relationships determine how objects interact with each other. The attributes of an object enable a clinician to focus on the disease; the accounting department to focus on what is to be billed, how, and to whom; administrators to focus on resource utilization to focus on which resources (human and capital) are used;

and so on. The ideal of a well-designed object is that it can be all things to all people interested in its "360 degree" sphere of interactions and relationships. EHR / CPR systems introduce new tools to detail costs among the attributes of patient business objects.

D.5. Contributions to EHR design

Iterative prototyping involves reciprocal modifications of design and use. The practice dilemma of outpatient orders was taken up as a design problem. How can the electronic health record be designed to improve the reliability of orders in outpatient as well as inpatient settings in order to reduce (eliminate) errors and risks? How should orders functionality be designed to allow the flexibility to know and act upon doctor's orders from midstream within an encounter while providing better safeguards against potential errors and risks (for which policies require working against a written order) without encumbering the already hectic pace of patient work flow? Outpatient orders are what might be called "a wicked problem" for both design and use of the electronic health record (Rittel and Webber 1973). A wicked problem in design is one for which problematization of work practices is elusive. Sjöberg writes: "Wicked problems were defined as problems with no right and correct solution and planning problems were characterized as wicked. The formulation of a wicked problem was described as non-definitive. ... Knowledge of all possible solutions was claimed to be needed

to really understand the problem and an approach where the image of the problem and the solution emerge gradually among the participants was suggested" (Sjöberg: 1996, p. 18). Furthermore, "*a wicked problem has no stopping rule*. A planner or designer can never say 'now we have the solution.' An even better solution may always be found, but never *the absolute* one " (Sjöberg: 1996, p. 20, emphasis in original).

Because it is an ideal that the electronic health record should be fully usable for clinical documentation during exam room interactions between a patient and physician, an edited video of exemplar #2 was used as a resource for testing the usability of structured content in the first version of the EHR prototype. Ease of interface use, the ability to document during real-time interactions, and clinical viability of the documentation were evaluated by Dr. A and the RN documenting against this real scenario with the anxious state of the patient, unexpected topics raised by the patient, difficulties in communication, and incomplete translations of meaning between clinical and colloquial speech.

The shift from individual physician to patient care teams entails a shift in design orientation from a long-standing focus on medical reasoning (particularly the diagnostic expertise of physicians) to systems design that integrates medical, clinical, and operational practices (the interactive expertise of both clinical and non-clinical staff comprising the organizational

community). A team-based design perspective recognizes that patient care always involves teamwork over time--that it is never only a phenomenon of individual cognition. Extensions of design beyond single encounters and single care teams are important for constructing meaningful continuity of information between interactions, interventions, and encounters that comprise episodes and events and for creating a picture of a continuum of care, a patient's history over time also called a longitudinal patient record. These were among the difficult design problems engaged by the Software Company, envisioned but not yet materialized in the earliest versions of the EHR prototype.

The *module point of view* supported by the video taped encounters is a cornerstone along the way to building broader and deeper understandings of the integrated organizational teamwork required before, during, after and in between diverse types of encounters at diverse points of care. Organizational teamwork is not represented by the video taped encounters other than by references to interactions with staff in other departments in the Family Medicine Clinic and Medical Center. Furthermore, there are additional complexities of coordination, communication, and collaboration with patients and families. Patient-care provider relationships are changing given desired reforms and changing models such as the active patient and consumer models. The difficulties of realizing the fuller participative inclusion of

patients as collaborative actors (as members of the team) is sometimes referred to ironically as the problem of "the disappearing patient" in patient-centered clinical systems design (e.g., Forsythe: 1996).

E. Summary discussion

In this chapter, I counterposed two times: the baseline (near past) and an imagined future (an indeterminate future). The middle ground is occupied by prototyping design and use, working through the design to address practice problems. By presenting three primary care exemplars, I aimed to illuminate practice dilemmas and clinical work practices in the present and suggest how these were problematized as design problems. In many ways, the imagined future is easier to describe and to interpret than is the middle territory, the prototyping experiences with use of the early versions of the electronic health record. By definition, the interim versions of the EHR prototype cannot represent the whole vision; at best the prototype evokes the future vision metonymically by materializing pieces of it. The incomplete utopian project suffuses not only the imagined future but also the interpretation of experiences with the EHR prototype in use (the near present) by EHR Prototype Project leaders. For me, the incomplete utopian project of the EHR Prototype Project is a refracting lens for understanding the vision, the imagined future scenarios, and certain struggles in early design and use of

the EHR prototype. Certain of the problems that are taken up in electronic health record design point to deepening contradictions in the activity system of patient care in the HMO. The HMO's historical utopian project contains ideological elements that conflict with new capabilities afforded by the electronic health record. As the heterogeneity of the incomplete utopian project of the EHR Prototype Project suggests, there are alternative possibilities for the reorganization of patient care and work organization, new forms of patient information, and new tools to support patient-care provider interactions.

"It needs to think the way we think." To wish that the electronic health record can do so suggests that it is imagined as an extension of the self; a thinking tool that can extend one's thoughts and collaborate in one's "cognitive blending." An unobtrusive assistant in the intimacy of exam room interactions that remain in the (negotiated) control and at the discretion of caregiver and patient. If the electronic health record cannot fulfill these wishes, will it then be experienced as a tool with its separateness, its own (system) rules and logic? The imagination of a computer system that can "think the way we think," "think across the boundaries," and "support the flow of patient-care provider interactions" contrasts sharply with early experiences with office computers expressed by clerical workers as being "chained to the computer" (Zuboff: 1988; Hoos: 1961). Imagining technology as an extension

of the self presents different images from being "lashed" to the organizational regime.[112] Yet my vantage point and that of the EHR's clinician inventors is located in the EHR prototyping period, one of problematization, exchange of design ideas, and co-development between the Software Company designers and the participating clinicians and information technology staff of the HMO. Much will change as system-wide implementation proceeds in combination with organizational agendas. The system will be customized to embody organizational rules: the HMO's protocols, re-engineered changes in work flow, and re-divisions of labor already contested by one of the nursing unions.

If technology is imagined as an extension of the individual self, it also represents extensions for organizations. In organizational contexts, technology is never singularly a tool of an individual but inherently a tool for collaboration, in this case within and between patient care teams and networks in coordination with the staff responsible for the entirety of behind-the-scenes and front-line organizational work required. In the transformation from paper-based to distributed on-line patient records, clinical information systems introduce a continuous electronic audit that will provide new degrees of visibility of data for a multitude of patient care and administrative purposes. This will extend the panopticon effect (Bentham: 1969 (1789-1812);

[112] "Like those early craftspeople, the exclusive knowledge of the workers in a continuous-process operation lashes them to their managers with bonds of reciprocity" (Zuboff: 1988, p. 55).

Zuboff: 1988) already experienced by the HMO's physicians as “the necessity to ‘practice in a goldfish bowl’ and [to] be subjected to constant peer and director review" (Hendricks: 1993).

I sketched imagined future scenarios partly of necessity because the new system is not yet realized. How are dilemmas manifest and how are they taken up or sublated in design and imagination? How is the invention of the electronic health record suffused by utopian desires that have long historical trajectories? Appreciating these histories opens up additional understandings of how the system is envisioned. I hope that I have shed light on the interplay of the vision of the EHR Prototype Project and the larger historical utopian projects that interanimate the vision. I also hope that the imagined future scenarios shed light on the problems that are taken up in the prototyping and the "long chain" (following Latour) required to move along the path of the incomplete utopian project of electronic health record invention in order to arrive at an imagined future. The history of desires--the genesis of problems to be solved--complicates what we see in the imagined future scenario, not a unified endpoint but a story of different logics, each with respective demands, and deepening contradictions in the activity of patient care.

In the three case examples discussed in this chapter, we begin to see variations in care provider styles and clinical work practices and variations

related to clinical cases. The logic of patient care and clinical work is not only one of recognizable patterns but of particularity, exacting interactions, multiple problems, complexities, and each patient's lifeworld, clinical context and path. It is in relation to this logic that the formal logic of EHR systems design, controlled medical terminologies (CMTs) that comprise the structured content design strategy, and formalisms such as disease management and decision support algorithms develop. Certain of the EHR design problems that surfaced in the discussion of outpatient work practices prefigure organizational agendas related to changing divisions of labor, particularly among nursing staff.

CHAPTER V. CONCLUSIONS

Will enough
Never please thee?
I will seize thee,
Hold thee fast,
And they nimble wood so tough,
With my sharp axe split at last.

See, once more he hastens back!
Now, oh Cobold, thou shalt catch it!
Crashing on him falls my hatchet.
Bravely done, indeed!
See, he's cleft in twain!
Now from care I'm freed,
And can breathe again.

Woe, oh woe!
Both the parts,
Quick as darts,
Stand on end,
Servants of my dreaded foe!
Oh, ye gods, protection send!

And they run! and wetter still
Grow the steps and grows the hall.
Lord and master, hear me call!
Ever seems the flood to fill,
Ah, he's coming I see,
Great is my dismay!
Spirits raised by me
Vainly would I lay!

"To the side
Of the room
Hasten, broom,
As of old!
Spirits I have ne'er untied
Save to act as they are told."

Goethe, 1797

On December 31, 1999, the Software Company closed its doors. An electronic health record system for the HMO is now to be developed by one of the world's largest software companies. I am told that the ambitions of the system that will be implemented organization-wide are considerably diminished from the highly ambitious system-in-the-making envisioned by those who collaborated in the EHR Prototype Project. Although the Software Company ended, the electronic health record application lives on in that its design concepts, especially its clinical content knowledge base, were taken up by a major clinical information system software company, and, at the time of writing, the application was still being used in clinical practice by care providers who participated in EHR prototyping. Most importantly, the EHR Prototype Project generated articulations of informational and functional requirements for electronic health records that have lasting significance for clinical information systems development and clinical information infrastructure building yet to be achieved.

I have been asked many times whether this is a story of a success or a failure, but that is not how I see or understand the EHR Prototype Project in which I participated. To me, this is a story, not of a failure or success but of the elaboration of a particular vision of electronic health record invention, "a beautiful logic," and the difficulties that confront the logic of the system's design in clinical use given the logics of patient care interactions and clinical

work practices. For whom is this electronic health record design "a beautiful logic?" The vision of the EHR system-in-the-making is "beautiful" in complicated and contradictory ways--in its hopefulness for the invention of clinically meaningful tools that will help care providers to visualize overviews of patients' health and care, on one hand, and, on the other hand, in its close association with a managed care package of concepts and techniques emerging from the United States. From my experiences in the EHR Prototype Project, I gained an understanding of the incomplete utopian project of electronic health record invention, moving forward through time, for which a "failure" is not necessarily a fatal obstacle and "success" is a moment of practical instantiation along the way towards a future horizon. Efforts to realize envisioned electronic health record systems will be worked out in practice as patient care and clinical information systems continue changing; electronic health record invention will always be incomplete, heterogeneous, and argumentative.

In this dissertation, I contribute in three areas: (1) to theorizing regarding technological change and the imaginative power of innovation-in-the-making; (2) to insights into difficulties and dilemmas encountered by designers and practitioners in the interplay between "the beautiful logic" of design and the logics of everyday work practices and interactions (in this case,

clinical logics, clinical work practices and teamwork, and patient care interactions); and (3) to understanding the relationships between the current periods of innovation in clinical information systems and on-going change in the largely privatized United States health care delivery system and its extensions into public contexts and into other countries. I discuss these three areas in turn: theory, health informatics, and changes in patient care. I briefly critique my theoretical framework and research approach. In doing so, I return to core questions posed and point in addition to future directions and questions generated.

A. Theorizing innovation, technology and work practices

The concept of an incomplete utopian project began as a grounded concept motivated by my struggle to understand the story of electronic health record prototyping as it unfolded. What explains the *imaginative power* of innovation-in-the-making and the persistence of concepts in the face of difficulties in practical realization? The incomplete utopian project of electronic health record invention draws from several utopias with long historical roots: the search for a perfect language, the desire to eradicate mistakes, managerial desires for intricate and far-reaching control over decision-making and standardization of practices, the quest to rationalize and scientize medicine including the movement for evidence-based medicine,

and, more recently, the idea that everything can be electronically connected and traceable through ("intelligent") software whose automata can intelligently "read between the lines." There are hard edges to the incomplete utopian project of electronic health record invention, notably when it is translated into the emerging managed care package.

In relation to activity theory, I integrate Ilyenkov's (1977a) discussion of the ideal and Wartofsky's (1979) discussion of the relative autonomy of ideas in science and the arts with conceptualization of technological change and work practices considered in sociohistorical context. One of my motivations is to more fully consider the importance of resources of imagination in the work of innovation. An incomplete utopian project is a concept with which to think about how what we regard as material and as ideal are always imagined together; incomplete utopian projects are not posed as idealist rather than material. Another motivation in constructing the intermediate concept of an incomplete utopian project is to take a step towards responsibly correlating detailed analysis of qualitative case examples from field research and socio-economic and socio-political concerns. An incomplete utopian project is an intermediate concept in that it is simultaneously a grounded concept, actively informed by ethnographic research and experience in fieldwork, and a generalizable concept, characterizing other experiences in innovation although by no means

universally so. Thinking of an incomplete utopian project—or, more accurately, of multiple utopian projects—is another way to conceptualize sociohistorical context, how it animates meanings in the present and envisioning “possible worlds [that] become actual, differentially" (Wartofsky: 1979).

The incomplete utopian project of electronic health record invention is a substantive and conceptual construct for thinking about how the imagined future and the imagined design logic shape the imagination of work practices in the present, and how the imagined design logic is already informed by imagination of medical knowledge representation, clinical work practices, and organizational regimes. For example, problematization of patient care and how it is to be changed are profoundly shaped by concepts developing in evidence-based medicine and medical informatics; at the same time, design logics in medical informatics are vitally informed by developments in evidence-based medicine, clinical epidemiology, and business modeling applied to patient care. Rather than perceiving design and use as divided spheres, we see that design and use are neither so separate nor are they two poles that need a bridge built between them. We see instead that, from the start of the EHR Prototype Project, design and use were already intermixed, imagined together, yet distinct in the demands each makes on each other in the form of demands on human actors, practitioners in design

and clinical practice joined together in the work of innovation. Significantly shared problematization of practice and design is clearly evident in the five year period of electronic health record prototyping. However, the co-construction of design and use is not unique to prototyping phases of computer systems development but rather characterizes generally how design and use are imagined together and reciprocally modify each other.

I began by telling a story of two logics—the logic of the electronic health record's design and the logic of patient care interactions and clinical work practices--yet in that telling, the logics reveal themselves as much more heterogeneous, a constellation of multiple logics arrayed across the initial semblance of two logics. Throughout the discussion, my interest is in the interplay and tensions between the logics at the heart of clinical informatics and patient care. In similar ways, by depicting three dimensions of the incomplete utopian project of electronic health record invention, my interest is in their inter-animation and the cross-traffic between them. In creating a sketch of the clinical, technical, and managerial dimensions of electronic health record invention, it is apparent that they, too, are much more heterogeneous and that their utopian contents are tension-laden. Each of the dimensions initially schematized comprises diverse and disparate logics, beginning with a multiplicity of clinical logics. The initial three heterogeneous, argumentative dimensions—clinical, technical, managerial--

are hybrid constructions both analytically and in lived experience. My discussions in Chapter III: Incomplete Utopian Projects and Chapter IV: Changing Patient Care can be read as an anatomy of utopias and the tensions that suffuse them, tensions that utopias seek to contain yet inevitably embody, at their best as resources for creativity and transformative innovation. What happens when contradictions are not negotiated in practice—when dilemmas, tensions, contradictions are not brought to the surface for mediation?

Exploring innovation-in-the-making calls into question how we conceive of reality and imagined but as-yet-unrealized invention. How do we regard the material power of ideas, moral values, and communal imaginaries as lived practices? The tensions between imagination of new worlds and practices in the present are at once fraught and taken for granted, expressed in language but not heard as exceptional. We simultaneously hold contradictory thoughts in the argumentative structure of common sense, in the work of creating narratives that lend our lives and actions intelligibility. In doing so, we often reach towards an imagined future from one or more romanticized pasts in the on-going struggle to make the present both intelligible and changeable. To pursue these questions, relationships and interanimation between actions and utopian and dystopian imagination need to be contextualized historically and contemporaneously, and resources of

imagination need to be more fully conceptualized than I have accomplished here. More can also be done to understand collective imaginaries and their dynamism, and to recognize individuals' creativity and the creativity of diverse groups.

When do utopian projects open up boundaries and when do they represent extensions and consolidations of power? In recent years, social scientists and philosophers engaged in science studies have undertaken efforts to overcome dualisms, whether the forms dualisms take are philosophically Cartesian, Hegelian, or Marxist or persistent popular and intellectually canonized dualisms that counterpose humans and non-humans, social construction (the practices of scientific discovery) and the real world (the world out there awaiting discovery), or the cultures of literature (narrative) and science (fact). Feminist and other critical theorists of science and technology emphasize the situated and partial nature of knowledge(s), hence their commitments to a multiplicity of theories, the irreducibility of heterogeneity, and emphasis on anomalies (and monstrosity) as generative clues to new knowledge and understandings. Critical science and technology studies represent important alternative theoretical resources that invite fuller consideration of the resources of imagination that actors bring to daily life and to utopian projects.

How does the concept of incomplete utopian projects contribute to theorizing about technology and work practices? Social policy questions are often posed in terms of interests: Whose technology? Whose progress? How are relations of power built into the design of new technologies and how are they designed into the use of new tools? Technological "imperatives" are the form that the voice of technological determinism most often takes. How are such technological imperatives produced? Further integration of these concerns about power will extend what an activity theoretical framework offers by suggesting ways to contextualize technological change in an activity system or an organization within the socio-economic and political landscape in which activities and organizations are located and the networks of actors in which they participate, while preserving a social constructivist rather than deterministic perspective.

B. Health informatics

Throughout the discussion of electronic patient record invention, I have referred to clinical informatics, medical informatics, clinical information systems design, and clinical information infrastructure building. In closing, I introduce *health informatics* as a broader conception of the arenas in which systems design, organizational change, and changes in health care delivery systems occur. The area broadly known as health informatics brings together

computer science, information sciences, organizational and managerial aspects of information systems, distribution and uses of information by public as well as professional communities, relationships between health care and regional and community development, and concept, knowledge and language representation particularly regarding structured content codification and classification of terminologies and documentation for analyzability—applying all of these to health care.

Given the potential of health informatics and new information and communication technologies to contribute to improving patient care, what makes it so difficult to design tools for patient care interactions and clinical work practices? The case study occurs in a "best case scenario" in terms of plentiful human and technological resources; however, the "beautiful logic" of the system proved difficult to realize. This effort in electronic health record invention was fortunate in having significant leadership by clinicians in the Software Company and in the project in the HMO; many of the system's developers have clinical backgrounds as physicians, nurses, clinical social workers, pharmacists. Furthermore, that the HMO also represents a best case in that it is an integrated health care organization underscores the difficulties of designing clinical tools that can afford shared longitudinal pictures of a patient's health and care, for continuity of care amongst multiple care providers and across diverse locations, encounters, episodes, and modes of

care. Designing clinical information tools to visualize patient trajectories of complex and multiple problem patients, starting from primary care and preventive care perspectives, remains highly challenging.

Why is it so difficult to design tools for patient care interactions and clinical work practices? This case study of iterative prototyping of an ambitious electronic health record system suggests several kinds of difficulties. First, in the activity of patient care, we go quickly back to the human body, to the variability of clinical cases and the uniqueness of individual patients' lives. A patient's body, his or her will, and the patterning of his or her life history and circumstances during the time he or she lives with one or more problems—all of these set profound limits to rationalization of medicine and clinical work. As Strauss and his colleagues write: "The entrance of the patient is what makes medical work *fundamentally* nonrationalizable" (Strauss et al.: 1997 (1985), p. 154, original emphasis). If we regard diseases and illnesses as actors (or actants) in a clinical episode and in the body and life of a patient, additional limits to rationalization of medicine and clinical work are apparent. Diseases and illnesses, while broadly patterned and knowable, can be extraordinarily heterogeneous, unpredictable, and mutable. The moral, ethical, and social basis of patient care should also impose limits to forms of commodification and rationalization. Patient care is a moral and ethical activity whose interactions

are governed by covenants of care between care providers and the people in their care. The patient's well-being is the logic of patient care, ethically and in work organization, when the activity of patient care is itself in a healthy state.

The complexity of medical and clinical expertise is a well-known source of difficulty in designing pragmatically viable clinical information systems. The unexpected complexity of outpatient clinical work is among the important discoveries of the work of the EHR Prototype Project. It is far more difficult to design comprehensive clinical information systems for primary care than for more narrowly bounded and relatively well-defined specialty domains. One goal of the electronic health record design intentions reported here is to create the underlying clinical databases that should comprise the basis for specialized decision analytic tools including clinical practice guidelines and protocols, as well as generic clinical alerts and reminders. Electronic health record prototyping uncovered unexpected complexities in outpatient nursing skills and practices, for example, represented, in the practical and design dilemmas entailed in outpatient orders and unexpected possibilities for medical risk in ambulatory care settings discussed in Chapter IV: Changing Patient Care. Telephone triage by registered nurses in Cardiology and Internal Medicine represents a complex and dilemmatic nursing activity for which new clinical information tools have the potential to provide much needed help. It is difficult to design for telephone triage given

its location at a nexus of patient, medical, clinical, documentation, operational, organizational, and business priorities and the needs for interpersonal, electronic, and paper-based communicative actions—taken together, these present competing criteria in a given moment.

A further source of difficulties confronting the work of design is that there are many more actors than technical designers and clinician practitioners. A host of organizational and institutional actors, associated networks and a multitude of change agendas are directly and indirectly engaged in the design, development, and deployment of electronic patient records, clinical information systems, and clinical information infrastructure building. All of these are situated in a dynamic sociohistorical context constituted from deeply motivated historical trajectories and, simultaneously constituted from and constituting competing imagined futures. To take one set of difficulties among many, user interface design, what problems, challenges, and dilemmas are posed for designing interfaces for clinical information systems? How are interface design strategies for electronic patient records shaped by the sociohistorical context of clinical, technical, managerial and regulatory agendas that are changing patient care? Among the problematics engaged by the electronic health record design generally and the structured content design strategy specifically are: (1) changing representations and notational structures and idealizations of medical

concepts; (2) cognitive processes that involve synthesizing medical knowledge and holistic knowledge of patient care and clinical histories, as these are essential to clinical expertise and collaboration; (3) pragmatic and organizational constraints, including time pressures and contingencies and work organization; and (4) current design limits--problems, challenges, dilemmas--to supporting teamwork and group communication needs.

I return now to difficulties related to commitments to different logics. The design logic clearly stands out as a powerful actor but we also see the power of multiple and diverse logics as actors. In Chapter IV: Changing Patient Care, I concretely illustrate some of the ways that clinical logics and the logics of everyday work practices and interactions can bring a powerful formal logic to its knees.

I believe that the logics engaged in electronic health record invention are incommensurable but translatable. There are certain obduracies that divide "the beautiful logic of design," clinical logics, and the logics of everyday practices and interactions in clinical work. Understandings can be reached through mutual respect and acknowledgement of partial perspectives and what they bring to bear critically on improving patient care quality and access. I find an inspiring starting point in Verran's (1998) proposal for working together disparate imaginaries that evoke and constitute different logics, different rationalities, and different metaphors as these live in

embodied practices. A communal imaginary perpetually grows and changes, enriched by many voices and competing metaphors embraced in a culture of argument.

Finally, I return to the power and problems of utopianism implicated in electronic health record invention. Heroic utopian projects have tremendous imaginative power yet they risk imposing impracticable burdens on both design and practices, and on both designers and practitioners. How can we constitute non-utopian, non-heroic design practices? What might alternative critical design practices for electronic health record and clinical information systems invention be like? Can we construct more modest, incremental design strategies that are imaginatively powerful at the same time?

C. Changes in patient care

Why do the incomplete utopian projects of electronic patient record invention, medical informatics, and evidence-based medicine have such momentum now? The current wave of innovation in electronic patient records and clinical information systems coincides with recognition that medical records systems are in disarray and that the fragmentation of patient records reflects and exacerbates the fragmentation of patient care services and contributes to problems in quality of care (Institute of Medicine: 1999).

Patient care is becoming increasingly complex in ways that pose challenges for coordination and continuity of care that are critically important for quality of care. At the same time, problems of unequal access to health care services and quality care have worsened as a growing percentage of the United States population lacks health care coverage. In what ways may such new tools and systems improve patient care quality and access? How is patient care changing for clinicians and other care providers, for health care organizations, and for patients and communities?

Advances in health informatics and the development of new clinical information tools and infrastructures offer unprecedented possibilities for improving patient care. Of particular importance are new information tools that promote proactive modes of care and extensions of preventive care, development of tools that visualize shared longitudinal overviews of the health and care of patients and populations of patients, "intelligent" tools designed to provide decision support to front-line clinicians, integration of on-line interactive templates for protocols and clinical practice guidelines, development of standardized medical and clinical vocabularies for analyzability of multi-disciplinary clinical documentation, and information tools to facilitate timely access to rapidly changing medical knowledge from sources on the Internet and World Wide Web. Yet, in the context of the largely privatized and increasingly for-profit United States health care system,

new clinical information technologies are deeply implicated in an emerging managed care package of concepts and techniques, certain of which are well-grounded in clinical principles (for example, clinical strategic goal-setting, clinical epidemiology data collection, movement towards realization of social medicine goals) while others are market-driven or based in industrial efficiency models of the organization of clinical work.

In the EHR Prototype Project, as in other electronic patient record initiatives, electronic health record prototyping involves not only strategizing how to work within and around today's practicalities but also how patient care practices are being redesigned or re-engineered as patient care business processes. Certain contradictions deepened in clinicians' experiences with use of the electronic health record during the prototyping period. I argue that, by analyzing the experiences of the prototyping period and imagined future scenarios of electronic health record use through the lens of the incomplete utopian project of electronic health record invention, we discern the deepening of these contradictions, not as temporary problems of *electronic health record prototyping* but as the deepening of systemic contradictions in the *patient care activity system as it is undergoing change.* Because new clinical information technologies disrupt and change current work organization, they introduce additional pressures (whether or not they also streamline operations), creating time conflicts and making structural dilemmas more

visible. In the HMO, it was understood that use of the electronic health record during the prototyping period as it was constituted as a period of research and development interfered with efficiency and productivity as traditionally defined by the corporation. A degree of disruption to physicians' productivity was anticipated to allow for learning to use the early versions of the EHR prototype. I believe, however, that the emergent disruptions provoked by the introduction of electronic health records and other computer-based patient records have much deeper roots and that they represent structural dilemmas understood as historically developed contradictions in work organization and the organization of patient care delivery.

The HMO discussed here is considered to be the original model for health maintenance organizations, a model since distorted by the rise of for-profit managed care and corporate medicine since the 1980s. As a non-profit trust, co-managed by the Physician Partnership, with a significantly unionized workforce and patient populations, the HMO has a distinct social history that is important to understanding the heterogeneous clinical, technical, and managerial motivations that animate this particular electronic health record systems design. At the same time, the HMO has, throughout its history, contributed powerfully to the development of concepts and techniques of corporate medicine (Starr: 1982) as practiced in the United States. The HMO is

exceptional in its commitments to social medicine, preventive and proactive care, yet deeply immersed in the U.S. health care system.

For-profit managed care in the United States is, rightfully, criticized as threatening the ethical and moral foundations of patient care, the very "covenants of care" between care givers and patients. Yet the *managed care package* of concepts and techniques is gaining influence in public sector contexts and in other countries. The Wall Street Journal (Gentry: 1999) reports that: "Latin America has become a managed-care laboratory, with ... an estimated 60 million enrollees" and, as one example, health care coverage by managed care plans "is growing 20% a year in the Philippines." Criteria for computer-based patient record development promulgated by the United States State Department and Department of Defense represent additional means of global influence in shaping clinical information systems and infrastructures that are aligned with concepts and techniques developed in the context of the United States health care system.

How can the managed care package of concepts and techniques be "deconstructed"? How can clinicians, managers, policy and decision makers evaluate and act upon--take, adapt, customize, appropriate—desirable elements of a technological package of concepts and techniques such as electronic health record systems created for patient care delivery in the United States managed care market without taking on a whole tightly bundled

package? How can certain principles and concepts that are clinically grounded be taken up as part of incremental approaches based on different assumptions and realities regarding resource-intensity, infrastructure, cultural historical differences in concepts of illness, care and healing, and varying traditions and ways of working?

The current period of change and innovation in information technologies is crucial for shaping clinical information technologies on medical and clinical, social and ethical bases. Agendas for change in health care delivery systems shape not only informational and functional requirements for the design of computer-based systems but also the purposes for which patient data and information generated about the performance of clinical work may be used. Strategic choices by organizations and institutions regarding deployment of computer-based patient records and clinical information systems are integrally linked with changes in occupational structures, work organization, skills and competencies, and needs for training and education. In addition to patient care quality and access, social concerns over control over clinical decision-making, patient-care provider relationships, issues of work organization, and the privacy of confidential patient data are paramount.

D. Critique of theoretical framework and research approach

I have taken a narrow path through the many research materials and analytic questions of this dissertation, constraining my interpretation within an activity theoretical framework with selected additional influences in order to extend and expand the analysis. By "narrow" I do not mean to imply that activity theory represents in any way a narrow path, but rather to acknowledge paths not taken. Activity theory was the primary theoretical perspective for the field research, particularly for framing the video documentation of clinical work practices and teamwork, and for the interpretation of the field research through the construction of the incomplete utopian project of electronic health record invention as an intermediate concept. Certainly, activity theory could have been combined explicitly with actor network theory, critical feminist theory, or theories employed in science and technology studies and information studies. Although I chose not to carry out a combined approach for this work, I plan to combine theoretical approaches in future analyses. I have referred to some possibilities for fruitful combinations of theoretical perspectives above.

What are the limits of my research approach and methods in addressing the questions posed? There are many limits to this work. The EHR Prototype Project of the HMO and the Software Company is, of course, not a closed system but rather situated in a larger context that I describe only

partially. The social construction of a new clinical information system needs to be more fully contextualized in relation to long-standing problems of health care in the United States than I am able to accomplish here. As a starting point, I have illustrated, through the specific instances presented, how larger socio-economic concerns show up in daily patient care interactions and in imagining and discussing electronic health record design. Further development of the relevant histories of clinical, technical, and managerial utopian projects, structural change and social transformation of medicine and health care delivery, and innovations in artifacts such as medical records and patient charts will lend more depth to the discussion begun here. As the case study is limited to a singular and particular instance of EHR/CPR invention by one health care company and one software company, the analysis will be strengthened by comparative research. I focused on understanding the logic of the strong structured content design strategy central to this particular electronic health record development effort. Further discussion of alternative design strategies for electronic health record and clinical information systems development will provide important contrasts and perspectives, for example considering contrasts and common ground between natural language processing and structured content design approaches. Alternative approaches to electronic health record and clinical information systems development are motivated by differing philosophies about what the

relations between systems development, work practices, and change should be.

This study of electronic health record design and use is unusual in that I was able to observe the clinical work practices and teamwork of the patient care teams during the year before-the-fact and through the first three versions of the electronic health record prototype in clinical use. The iterative prototyping period enables one to see intensive problematization of clinical practices, organizational intentions, and design strategies. Collaboratively working these together, the EHR Prototype Project participants articulated informational and functional requirements for electronic health records that will last for a long time. In this regard, we see beyond the prototyping period within the HMO and the Software Company, to the larger collective imagination of what electronic health records should become as they are invented.

In different ways, the research and analysis is also limited by its location in the period of prototyping of an electronic health record system-in-the-making (1993-1998), rather than in a period of clinical information system use after significant implementation within an organization. At the time that my dissertation research ended, the EHR application was in use by the two patient care teams in Family Medicine and Cardiology and Internal Medicine participating in prototyping the EHR in clinical use. In the fall of 1998, the

fourth version of the EHR application was implemented in a second Internal Medicine department in a second Medical Center in the HMO. But the electronic health record application discussed here was never implemented into widespread organizational use (as was intended). The prototyping period affords different insights than an analysis of a system already in use or implementation of an already existing system. Whereas I generalize from the case study analytically, I try not to engage in predictions. Throughout the work, I stay as close as possible to what I saw and what I came to know directly, tangibly, and concretely. In this, I do my best to follow the principles of grounded theory to be accountable to research materials and data. That I do so may disappoint expectations among some readers regarding certain issues of obvious importance that one could well expect to find in a case study of electronic health record invention. For example, what does this case study suggest about disciplining practices (clinical work practices) and disciplining a practice (the practice of physicians, the practice of nurses)? In relation to these concerns that I share, I have tried to point to the mechanisms and directions that I see unfolding in the future based on incipient moves and intentions as I understand them in the contexts of work practices and of sociohistorical and socioeconomic forces and their dynamics. Certainly, disciplinary intentions are evident but not yet realized—nor is it clear to what degrees they can be realized. Again, my interest is not in prediction but

rather understanding the actors and dynamics in play, where they come from and where they are going or trying to go.

My greatest regret is that I was not able to delve into nursing informatics, a critically important and dynamic area of great interest to me personally and to both specialized and general constituencies concerned with electronic health record development. The central importance of nursing informatics is underscored by the movement towards recognition of the multi-disciplinary nature of care and its fuller representation in multi-disciplinary patient profiles and documentation. Critical issues related to the inclusion of nursing diagnoses in multi-disciplinary problem lists were in discussion within the clinical informatics teams of the HMO and the Software Company. Although these were discussed, they were barely evident in the clinical work practices and clinical documentation of the two patient care teams engaged in EHR prototyping whose clinical use of the EHR prototype is the central activity that I analyze. This is due in part to the fact that EHR prototyping began in outpatient care and in primary care (family medicine) where the roles of nurses are considerably circumscribed according to the clinical practice setting compared with the central roles of nurses in hospital-based care and in emergency medicine.[113] What I saw instead were fundamental

[113] The contrast in roles is often described as a difference between more "dependent nursing" practices in outpatient care and more "independent nursing" practiced in hospital.

difficulties for design and use of electronic health record systems in outpatient care to which such complexities will be added as such systems integrate patient data across the spectrum of ambulatory and inpatient care.

The Clinical Informatics efforts required exacting work by physicians, nurses, and other clinical practitioners in the HMO, the Software Company, and additional institutions in consortia devoted to the development of standardized clinical and medical terminologies. However, my primary access was in the clinical settings of the HMO, not with the Clinical Informatics teams. For the units of analysis I chose for this study, development of standardized clinical and medical terminologies remained a neighboring activity system that is critically important to overall electronic health record design efforts. These are important areas for future research and analysis.

"Dependence" and "independence" refer to degrees of interdependence and autonomy in varying relationships between nurses and physicians. A nurse's degrees of dependence on doctor's orders or relative autonomy include whether a nurse can initiate nurse's orders (nursing orders). Within the two outpatient settings for EHR prototyping, Cardiology and Internal Medicine provided a window onto more independent nursing practices including occasional initiation of nursing orders. For example, a registered nurse conducting telephone triage could order a social work consultation as a nursing order, without a physician's order. Several types of Cardiology patient encounters were conducted by registered nurses without the direct presence of a cardiologist, for example patient encounters in the pacemaker and cardiac rehabilitation clinics. Yet these nursing practices did not yet pose in practice the kinds of issues for EHR/CPR design and use for multi-disciplinary patient profiles that one would expect to encounter in hospital-based care where nurses act as front-line clinicians with continuity of clinical observations of patients over hospital shifts (often with a one-to-one or one-to-two ratio in critical care).

Although I have discussed utopian projects throughout this work, I have given only scant attention to dystopian concerns. In the managed care environment in the United States, the degree of mistrust among patients towards large health care organizations has, perhaps, reached a nadir. For patients, a dominant dystopian spectre is expressed in recurring questions: Who is really making decisions about care? Are clinical decisions being made on a cost-benefit basis rather than on a medical basis? Am I being denied the best possible care that I need and deserve? Will I or my loved ones be injured or die as a result of decisions that are wrong for me / him / her / us? Concerns over clinical decision making are also the central concern for physicians in the era of managed care and corporate medicine. Physicians are reacting strongly to for-profit managed care intrusions on clinical decision making while, at the same time, nurses are responding to threats to quality of patient care. Yet physicians' and nurses' reactions do not appear to be directed toward computer-based patient records nor toward clinical information systems *per se*, even though these provide new means to extend the reach of managed care regimes and the potential to "steer" physicians' decisions and practices ascribed to clinical practice guidelines and protocols.

I conclude my discussion by returning to the utopian project shared by the inventors of this electronic health record system—what I think of as

"the signature of the clinicians"--that the use of the electro nic health record will improve patients' health, well-being and quality of life by providing new means for practicing proactive and collaborative care. To consider the social consequences of a new technology such as the electronic health record, we need to consider carefully how and in what contexts clinical information systems may improve patient care. How do uses of new technological artifacts affect interactions among members of patient care teams and networks with patients and with each other? Given the potential of clinical informatics and new information and communication technologies to contribute to improving patient care, what makes it so difficult to design tools for patient care interactions and clinical work practices? What criteria and change agendas are being built into the design of new clinical information tools and information infrastructures? In what ways are the design and use of new clinical information technologies implicated in the same problems of the health care systems that they intend to address? What are the prospects for new forms of collaborative between patients and care providers and amongst care providers? I hope that I have been able to provide resources for thinking concretely about these questions. As at the end of Goethe's poem, The Sorcerer's Apprentice, order is durable but new magic, new tools, new knowledge are already released into the world, its order in transformation, destabilized, changing.

APPENDIX A: REFLECTIONS ON METHODS

In writing this dissertation, my struggle has been to tell the story in front of me–to keep myself positioned *in* the story. By this, I mean that I try not to abstract the issues, concepts, and problems I encountered, but rather to write from my own embodied experience, my path through the Electronic Health Record Prototype Project as it was illuminated by the twists and turns that shaped that experience as well as by analytic questions and concepts. The dilemmas and tensions I discuss were neither abstract nor someone else's; they were my own moral, ideological, and practical dilemmas experienced deeply within.

I struggled also with the necessary condition of writing an account from mid-story, before grasping with the help of mentors and friends that we always tell a story from mid-story. Staying in the field for five years is unusual and it was unintended. Because I wanted to understand reciprocal modification through a particular kind of design cycle (as I imagined it), I stubbornly waited for a long time. At the same time, I was actively engaged in and genuinely fascinated by electronic health record prototyping. Howard Becker writes of the importance of being aware of the underlying imagery

with which one approaches phenomena of study and how one's imagery is necessarily tested, modified, and changed through one's participation in "'a rich dialogue' of data and evidence" (Becker: 1998, p. 66). I have described how, as the years went by, the questions confronting me changed. The question of the imaginative power of technological invention began as a somewhat private rumination; the incomplete utopian project of electronic health record prototyping was a concept that was "good to think with" (Darnton: 1985 following Lévi-Strauss), a concept that gradually took shape as I learned more about the historical roots of the HMO, motivations, and movements in medical informatics.

As I am reporting from an extended ethnographic case study, I will begin these reflections on methods by giving a sense of my relationship with ethnography. To me, ethnographic research means striving to understand the world through the eyes of one or more communities and to critically reflect on dialogues and tensions between communities. In recent years, anthropologists have moved into new contexts, and, at the same time, researchers from disciplines other than anthropology are employing ethnographic methods, particularly in the computer software industry and in organizational development and "re-engineering" efforts. Ethnographic methods, if not ethnography, are being integrated--often uneasily--into computer systems design, development, and implementation. Although

ethnography is apparently being taken up quite readily in design and industry settings, the meanings, intentions, and purposes of ethnographic research are often diffused to refer to qualitative field research of any kind (see critical discussion by Forsythe: 1999). Whether such projects are grounded in principles of participatory design or modes of extractive knowledge acquisition will powerfully shape the ethics of the project and researchers' relationships with research participants whose cognitive and work practices, forms of distributed expertise, communication and collaboration, and ways of organizing their work and lives are the phenomena of study.

In an address to the American Anthropology Association in 1998 honoring Diana Forsythe, Lucy Suchman suggests that "[f]eeling simultaneously marginal and complicitous with practices of power is the special form of vulnerability … for the contemporary ethnographer" working within institutions of science, technology, and work. To Suchman, this characterizes contemporary anthropological practice in general, not only ethnographies carried out in science and technology institutions. Moral dilemmas (ideological dilemmas) are neither new nor unique to the movement of ethnographic research into corporate and other organizational settings; rather, moral dilemmas are deeply implicated in the history of anthropological practices. "…[Anthropology] as a whole was created in a

nexus of relations of power that included colonial administrators in whose service the ethnographer was employed, and by whom she or he was empowered with respect to the ethnographic subject" (Suchman: 1998, 1999). Ethnographic practice should be understood as "a practice of the heart," as "located, embodied, and interested forms of witnessing." In business and institutional settings, ethnographers "not only witness but are increasingly subject to the heartbreaking machinations of business as usual within contemporary corporate America."

> Diana [Forsythe] points out that, having struggled to make a space for an ethnographic practice in the worlds of science, technology, medicine and work, we now find ourselves troubled by the appropriation of ethnography-as-method within those same arenas. Ethnographic methods seem to promise new and more authentic access to the various others--patients, users, consumers, workers--who are the objects of technoscientific, entrepreneurial and managerial activity (Suchman: 1998, 1999).

A few autobiographical notes are *apropos* regarding my sensibilities towards work practices research and my stance toward ethnographic research. My own history shapes my perspective, and I am aware that many other researchers working in such settings do not necessarily share the concerns that I have. I have an abiding interest in work and technology from my professional life before embarking on my doctoral studies. I served as research director for 9to5, the National Association of Working Women (1979-1984) and as a research staff member for the Department of Professional

Employees (DPE) of the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) (1984-1986). For seven years, I explored social consequences of technological change for professional, technical, office and clerical workers, combining experiences reported by members of 9to5 and members of the twenty-six unions comprising the DPE / AFL-CIO with analysis of the published literature and available labor force statistics and related data. My passion then and now is to understand people's work and how it is changing, particularly in the service sectors of the economy. What do people actually do and why? How do people work, in what working conditions and relations, and with what kinds of technological and other tools and artifacts? What kinds of transformations are occurring, in what circumstances and contexts, and for what reasons? What kinds of participation in change are possible? How might work, technologies, services and the relations between them be different?

A. Concepts and terms

A note of introduction is in order regarding language. Throughout the dissertation, I shift between colloquial and theoretical or conceptual uses of certain terms. This is especially so when I discuss the hybrid construct of incomplete utopian projects in Chapters III and IV. Generally, rather than seeking to strictly avoid colloquial uses of certain words—contradiction,

problem, ideal--in order to adhere solely to theoretical uses, I try instead to guide the reader by introducing specialized uses of terms while also employing more everyday meanings of certain terms—for example, contradictory, contradiction; problem, problematization–when it makes more sense to do so than to keep sharp separations between theoretical and colloquial language. I intermix these terms (reasonably, I hope) recognizing the inevitable entanglements of words in multiple meanings and the awkwardness, if not impossibility, of adhering to "pure" specialized languages. The notable exception to the general principle just stated is my consistent adherence to the activity theoretical meaning of *object* as *object of activity* which I reprise below. In addition to the cross-traffic between colloquial and theoretical uses of terms, there are keywords in the discourses of clinical informatics—for example, protocol and template--that are especially multi-faceted and nuanced, always in motion and unsettled in their meanings between discourses, communities, and situations. Another reason for my choice to intermix theoretical and colloquial uses of common words to some degree is that I understand words with hybrid meanings as representing traffic across colloquial, conceptual, and theoretical discourses; through their interplay, new words and ways of thinking are generated, put into circulation, and changed. In these choices about language, my goal is to leave readers

less encumbered, where possible, while maintaining sufficient distinctions for clarity's sake. I can only hope that I have succeeded in some measure.

Objects of activity. In activity theory, *object* has particular theoretical meanings that are difficult to translate into English. The object or objects of activity in an activity system (lifeworld) are irreducibly material and ideal, and shared. I chose *teleological objects* and *motives* as working translations in order to avoid confusion with *goals* or *objectives* from which *objects* in *practical object-oriented activity* should be distinguished. "Goals are primarily conscious, relatively short-lived and finite aims of individual actions. *The object is an enduring constantly reproduced purpose of a collective activity system that motivates and defines the horizon of possible goals and actions* (Engeström: 1995)" (Engeström, Y.: 1999a, p. 170, emphasis added). Y. Engeström (1999a) gives the example of a hospital, clinical and organizational work, and the lives of patients to illustrate the analytic meaning of objects of activity. "[T]he object of a hospital may be characterized as the trajectory from symptoms to treatment outcomes in the context of the patient's life activity. *The object is projective and transitory, truly a moving horizon. But it is also specific and concrete, crystallized, embodied and re-problematized in every single patient and illness entering the hospital, time and time again"* (Engeström, Y.: 1999a, p. 170, emphasis added).

Units of analysis. Kari Kuutti regards determination of a *unit of analysis* as a fundamental research question: "One should be able to delineate the

object of research and to draw a boundary between the object and the background, and one should be able to find an entity to which all the threads of research can be conveniently connected" (Kuutti: 1991, p. 249). Activity theory, developmental work research, and the larger sociohistorical school have intellectual roots in a dialectical materialist perspective that emphasizes transformation and change, development and learning over time, and contradictions that compel change and expansive cycles. "Work and the means for it are continuously reconstructed, and thus the unit should be suitable for studying transformation and development" (Kuutti: 1991, p. 253). In activity theory, a unit of analysis requires "an intermediate concept--a minimal meaningful context for individual actions … an activity. *Because the context is included in the unit of analysis, the object of our research is always essentially collective*, even if our main interest lies in individual actions" (Kuutti: 1991, p. 254, emphasis added). Activity can be conceived as an intermediate construct in that activities are between structures and individuals. An activity system always involves communities of practice, within larger communities and networks of activity systems (e.g., Korpela et al.: 1998). Contexts of activities may be conceived as organizational context, sociohistorical or cultural historical context, situated contexts—or all of these as they interact and co-construct instances of activities through which subjects (actors) and objects of

activity (motives) are mutually transformed from one instantiation to the next through time.

In the EHR Prototype Project, the working concept of explicitly defining units of analysis proved very helpful. Every research study required a high degree of agreement among diverse participants regarding the rationales for the research and methods, modes of analysis, and forms of reporting. On the other hand, there are limits to explicitness in advance regarding expectations in that research is inherently a discovery process that must be open to the unexpected, in principle.

Intermediate concepts (*intermediate constructs*) are intermediate in that they are between concepts (theoretical principles, conceptual lenses) and data. An intermediate construct is not given at the beginning of research but rather is built from what researchers see on the ground in the field—how concepts "live" in the field, and how they are situated in multiple contexts. Intermediate concepts are means for reciprocally making sense of field research and making sense of concepts in relation to both empirical research and theory-building. As examples, Y. Engeström (1999a) discusses three sets of "data-sensitive intermediate theoretical tools": (1*) disturbance, innovations*, and *contradiction*; (2) multi-voicedness of discourse manifest in *social language*, *voice*, and *speech genre* (following Bakhtin: 1976, 1981; Engeström, R.: 1995; Wertsch: 1991); and (3) intermediate concepts for understanding qualitative

transitions in interactions such as *coordination*, *cooperation*, and *co-construction*—when members of a community engage in "reflective communication and an effort to transform their own activity as a community" (Engeström, Y.: 1999a, p. 179, following Fichtner: 1984; Raeithel: 1983; Wehner et al.: 1996; also Engeström et al.: 1997). With units of analysis, intermediate concept construction contributes to the basis for generalization from particularized qualitative case examples.

To understand an activity system, a starting question is where and how we may see joint activities that will open up insights into communication, coordination, collaboration, and co-construction amongst members of communities of practice. "Where" and how do actors and perspectives come together? How is the work held together—by what forms of mediation, intermediaries, coordination, conventions, norms, rules, and so on?

Problems and problematization. I use the term *problem* generically and colloquially to refer to problems that patient care providers face in practice, problems for clinical information systems designers and information technology staff, organizational problems, and problems in patient care in general and in the United States. (In clinical practice, *problem* has clinical meanings as a medical problem, diagnosis or assessment, as should be clear from the context of discussion.) By *problematization*, I refer to the analytic

processes through which problems are conceptualized (re-conceptualized, re-imagined) as *research problems* or, in the context of systems design, as *design problems*. As for dilemmas, problems often become known from practitioners' expressions about their work, how they would like it to change, and how they imagine that a new tool such as an electronic health record might help them in clinical practice. Problematization is required to analyze the dynamics of problems, dilemmas, and contradictions in order to conceptualize proposals for construction of new artifacts and ways of working.

I think of problematization as an on-going reflective process, similar to John Dewey's conceptualization of *inquiry*. Dewey described inquiry as "a progressive determination of a problem." "Inquiry, in settling the disturbed relation of organism-environment … institutes new environing conditions that occasion new problems. What the organism learns during this process produces new powers that make new demands upon the environment" (Dewey quoted by Koschmann et al.: 1998, p. 37).

Dilemmas, double binds, systemic disturbances, breakdowns. In presenting my theoretical framework (Chapter II), I defined dilemmas, following the discussion of ideological dilemmas by Billig and his colleagues (Billig et al.: 1988), to expand an activity theoretical framework in order to lay the basis for the discussion of the dilemmatic character of patient care in Chapters III and

IV. I now turn to discussion of *dilemmas* in relation to *double binds*, *systemic disturbances*, and *breakdowns*.

My analytic emphasis on dilemmas is consistent with the language in which I discussed systemic dilemmas and structural dilemmas in my work in the Electronic Health Record Prototype Project. To reiterate the OED definition of dilemma upon which Billig and his colleagues build, "a dilemma involves 'a choice between two (or, loosely, several) alternatives which are or appear equally unfavourable.'"[114] Although I distinguish types of dilemmas--as practical, as systemic or structural, or as ideological--in discussing exemplary instances, in lived experience each dilemma confronts us as irreducibly practical and ideological, always tension-laden with choices between conflicting actions that are irreducibly value-laden. In work settings, dilemmas may be identified from their expression in language (in discourse analysis, see, e.g., Billig: 1987 and Billig et al.: 1988), explicitly identified by practitioners in response to researchers' queries (e.g., Timpka and Arborelius: 1990a, 1990b, 1991; Timpka and Nyce: 1992), identified through analysis of discoordination and other forms of trouble in action, or through combinations of the aforementioned methods.

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[114] Cited by Billig et al.: 1988, p. 8.

Because dilemmas point to systemic tensions in activity systems that confront individuals in their everyday activities, they are especially important, not only for the analysis of everyday troubles, but also as clues toward the analysis of contradictions. Dilemmas seen from an activity theoretical perspective share kinship with *double binds* (Bateson: 1987 (1972); Engeström, Y.: 1987, especially Chapter 3). Gregory Bateson, describing a learning experiment with a porpoise, concludes by pointing to "two aspects of the genesis of a transcontextual syndrome" that may link confrontations with trouble—disturbance, dilemmas--with innovation. "First, that severe pain and maladjustment can be induced by putting a mammal in the wrong regarding its rules for making sense of an important relationship with another mammal. And second, that if this pathology can be warded off or resisted, the total experience may promote *creativity*" (Bateson: 1987 (1972), p. 278, original emphasis). In cycles of expansive transition in developmental work research, double binds represent "secondary contradictions" for analysis, problematization, and transformative proposals (Engeström: 1987).

Breakdowns. A breakdown is a relatively rare, explicitly marked, dramatic type of systemic disturbance. Koschmann, Kuutti, and Hickman (1998) discuss "the role of breakdown or failure as a means of revealing the nature of the world around us" in the works of Leont'ev, Dewey, and Heidegger. These three theorists of human action and learning provide

"descriptions of breakdowns that offer models in which the disruption of ongoing, nonreflective activity results in a shift to a more deliberate form of practice" (Koschmann et al.: 1998, p. 32). Koschmann et al. distinguish their conceptual and theoretical meanings of *breakdown* from diverse everyday meanings: "... we use [breakdown] in a special sense to refer to a disruption in the normal functioning of things forcing the individual to adopt a more reflective or deliberative stance toward ongoing activity" (Koschmann et al.: 1998, p. 26). "Breakdown ... is more than a simple disruption of ongoing activity—it is a vital precursor to productive inquiry and subsequent learning" (Koschmann et al.: 1998, p. 40).

A. N. Leont'ev did not use the term *breakdown*, and there is no corresponding term in activity theory. But Leont'ev pointed to the mechanism and circumstances for breakdowns resulting in its conceptual sense when, in the concept of activity and internal dynamics of activities ("mutual transfer" between objects, motives, goals, activities, actions, and operations), conditions are absent and operations are "unfolded," when operations are transformed into sequences of actions. The context for Leont'ev's emphasis on routinized operations--"technization," "fossilized activity"--and "discernment of intermediate goals" lies in the emphasis, in articulating the concept of activity, on practical activity as sensuous, social, practical object-oriented activity, and the organization of labor in complex

activities extended in activity systems and networks of activity systems. Leont'ev's emphasis on "mediated action as a unit of analysis" lays the basis for extending breakdowns to communicative action (following Wertsch: 1985).

We can see some relationships between these discussions of breakdowns and learning, the significance attributed to dilemmas and to double binds, and the relationships between disturbances, anomalies, and innovations in activity theory with complementary theoretical frameworks such as science and technology studies and critical feminist theory. Koschmann et al. suggest that the theoretical work on breakdowns by Leont'ev, Dewey, and Heidegger shares two "unifying themes": (1) "… an implicit rejection of dualistic ontologies based on distinctions of mind and body, of subjective and objective worlds" in that breakdown is / is in *situation*; and (2) emphasis on the primacy of conscious human action, of "intentionality: that is to say, breakdown always occurs in the context of directed activity" (Koschmann et al.: 1998, pp. 33-34). In activity theory, "directed activity" is expressed as the "object-directed" nature of activity (Koschmann et al.: 1998, p. 34, footnote 10). Dewey's conceptualization of habit formation and his concept of inquiry highlight the social and future orientations of human activities. Discussing the significance of breakdowns in Dewey's thought, Koschmann et al. write: "… [H]abit formation is 'pulled from beyond' to reflectively constructed ends-in-view. For Dewey, life,

especially life that involves complex organizational factors, is a continuing process of breakdowns and reconstruction of habits" (Koschmann et al.: 1998, p. 32).

Contradictions. My uses of *contradiction* and *contradictory* represent the most frequent alternations and interchanges between the particular meanings of contradiction in activity theory and everyday meanings of contradictory. When I refer to "the heterogeneous, argumentative, and contradictory" structure of incomplete utopian projects, *contradictory* has more general meanings although these should still be read against the background of the activity theoretical meanings of *contradiction.* Here, I will begin with colloquial definitions from the OED and then proceed to a discussion of the theoretical significance of contradictions in dialectical materialist analysis and activity theory. Among the definitions of *contradiction* in the OED, those that are germane are: "a state of opposition in things compared; variance; logical inconsistency" and "a person or thing made up of contradictory qualities." One of the many definitions of *contradictory* reads: "Mutually opposed or inconsistent; inconsistent in itself." While these everyday meanings suggest states of co-existing oppositions and internal tensions, none of them evokes the dialectical meaning that contradiction has in activity theory.

In developmental work research, trouble and opportunities for innovation are understood as related, both motivated by the dynamics of

contradictions. Attention is especially directed to *systemic disturbances* and to the *emergence of new artifacts and practices* including *mundane innovation*. A mundane innovation may "make [a] contradiction more visible and articulated, as well as open a horizon of possibilities beyond the contradiction." Following dialectical historical materialist principles, activity theory posits "the idea of contradictions as the driving force of change and development in human organizations" (Engeström, Y.: 1999a, p. 181). Y. Engeström writes:

> … the analysis of disturbances and innovations leads to the conceptualization of contradictions within and between activity systems. While power and domination are at work in contradictions, it is important to distinguish contradictions from a general assertion of asymmetric power relations. *A contradiction is a historically-accumulated dynamic tension between opposing forces in an activity system* (Ilyenkov: 1977). It constantly generates disturbances which open up opportunities and call for novel solutions that can lead to transformations in the system (Engeström: 1987, 1995) (Engeström: 1999a, p. 178, emphasis added).

Contradictions must be analyzed and discovered, they are not "given" to a researcher by practitioners or otherwise.

> The objects of our perception (including statements) are themselves socio-historically formed and produced. *The practice under our eyes is already theoretical and cannot 'speak for itself.'* It cannot be directly or spontaneously grasped. It has to be *reconstructed theoretically,* using consciously conceptual *instruments* that correspond to the nature of the means and methods with which the objects of reality were originally produced (Engeström: 1986, p. 55, first emphasis added).

Generalizability. Activity theory makes strong claims regarding generalizability from qualitative case studies. This is in part related to explicit delineation and conceptualization of units of analysis, and to intermediate concept construction. My own experience, as reported in this dissertation, attests to the generative power of the methodology. Developmental work research is an action research approach, committed to identifying opportunities for development and transformation and devising interventions for change in relations of collaboration and reciprocity with practitioners in local communities of practice. "In such a dialogical and longitudinal relationship, the researcher is interested in the practical, material generalization of novel solutions and developmental breakthroughs" (Engeström, Y.: 1999a, p. 182). Y. Engeström therefore proposes an alternative way to look at generalization as "practice-based hybridization" in work and organizations, in other words to look at innovations that result from cycles of research as processes of generalization.

General and *generalizability* may then take on alternative meanings and qualities in this context.

> The general or universal is something quite real and material. It is not just an abstraction, based on the observation of external similarities. … *It is realized in the form of a tendency, manifesting itself in the behaviour of a complex ensemble of individual phenomena, through the negation and breach of the universal in each of its*

> *separate manifestations* (Engeström, Y.: 1986, p. 66, emphasis added).

B. Ethnographic approach

My ethnographic approach included volunteering in two clinical settings, carrying out a pre-study of a local computer-based patient record conversion (prior to the EHR Prototype Project), identifying intermediate settings within and between activity systems (EHR Prototype Site Medical Center Steering Committee meetings, hospital rounds by primary care physicians), use of shadowing to understand clinical work practices and dynamic creation and use of patient information through the eyes of diverse clinical practitioners, creation of graphic representations, and significant use of audio and video documentation and analysis throughout the field research. In addition, I had regular informal contact with people in the Family Medicine Clinic during the period when I lived in the community of the EHR Prototype Site Medical Center and worked in an office at the Clinic. Informal "learning by walking around" was critically important to my early ethnographic research and relationships.

Table A.1 presents a summary chronology of the progression of my field research from the pre-study and volunteering experiences to project research studies (highlighting cycles of video documentation), indicating

clinical environments, EHR prototype versions, and noting significant changes in the HMO's clinical information systems efforts. All studies for the

Table A.1: Ethnographic Approach: Chronology						
Participated in ethnographic study of DSS for complex protocol eligibility and care for people living with HIV and AIDS.	Volunteer in Oncology Unit. Pre-Study of local CPR conversion in a primary care clinic of the HMO.	Volunteer in Emergency Room at Prototype Site Medical Center.				
Proposed doctoral research to Software Company and to the HMO.	July 1: EHR Prototype Project formally begins. Fall: Began baseline (pre-EHR) field study in Family Medicine Clinic.	Winter: Video documentation of baseline (pre-EHR) patient visits in Family Medicine Clinic. Fall: Version 1 of the EHR Prototype in clinical use in Family Medicine.	Baseline (pre-EHR) field studies in Cardiology & Internal Medicine & CAPD. Video recording Family Medicine patient visits with EHR use. Evaluation of first year of use of Version 1 of the EHR prototype. Initiated graphic representations. Seminar series for Software Co. (1995-1996).	Version 2 of EHR prototype in clinical use in Family Medicine. Baseline (pre-EHR) field studies in Cardiology & Internal Medicine (to update from 1995 studies) and Rheumatology. Video documentation of message-handling and telephone triage. Video documentation of EHR use: MDs' reasons for using structured content or free text. Seminar series for Software Company.	Version 3 of EHR prototype in clinical use in Family Medicine and Cardiology & Internal Medicine. Baseline (pre-EHR) field study, Cardiodiagnostics. EHR Evaluation Framework proposal developed with clinician leaders. Templates evaluation interviews with HMO and Software Company principals.	Video documentation and video analysis for user Interface quality assurance testing for Version 4 of the EHR prototype.
1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
	July: Joined EHR Prototype Project as research associate with outside institute	October: Employed by HMO as Co-Investigator for EHR Prototype	→ New Clinical Information Systems group formed in the Physician	→ Convergence of National Clinical Information Systems (NCIS) efforts and infrastructure; national	→ End of EHR Prototype Research. Restructuring of NCIS and all IT efforts; control shifts	Second restructuring of NCIS and IT departments.

	consulting with HMO.→	Research. →	Partnership in the HMO Region.	HMO mandates consolidation of regions.	to the Health Plan.	

EHR Prototype Project were carried out by various combinations of myself and members of the extended research and development team in collaboration with colleagues from standing teams, project leaders and clinical liaisons, and clinical practitioners.

Learning by doing. I gained working exposure to qualitative research methods and activity theoretical perspectives through my participation in the Research Group on Expertise as Collaborative Activity, led by Yrjö Engeström and Michael Cole of the Laboratory of Comparative Human Cognition (LCHC) and Department of Communication, University of California at San Diego. The research group provided a base of intellectual support for my early field research. I participated in the research group over a three year period (1990-1993) and learned greatly from our discussions of each others' research design, delineation of units of analysis, intermediate concept construction, conversation analysis and other forms of close data analysis from transcripts, artifacts, and video documentation, generalizability and limits of concepts across contrasting domains (legal, educational, medical, among others), and the work of conceptualizing from field data and theorizing findings and their implications. I gained a working knowledge of interaction analysis during the summer of 1992 when I was a summer doctoral intern at the Institute for Research and Learning (IRL) in Palo Alto. In the weekly Interaction Analysis Laboratory, led by Brigitte Jordan and Charlotte

Linde, IRL research staff, interns, field researchers, and visitors viewed, reviewed, and analyzed video documentation from studies in progress in diverse workplace and educational settings. From these sessions and from my participation in an IRL research team conducting an ethnographic study of a medical informatics design project, I learned from hands-on experience about interaction analysis, strategies for note-taking in field research, conventions for transcription of audio recordings and video content logs, and documentation of fieldnotes in group ethnographic fieldwork. In LCHC, I briefly supervised students doing field research in The Fifth Dimension as well as participating in field research studies with members of the Research Group on Expertise as Collaborative Activity. These experiences in diverse group ethnographic projects, several that span different geographic sites, have helped me throughout the years since.

The research methodology and methods that I employed--activity theory (developmental work research), qualitative case studies, ethnographic research, and video interactional analysis--differ in principle and in practice from certain other research traditions associated with positivism. Activity theory and developmental work research are among qualitative research approaches that entail participatory approaches to organizational and technological change, committed in principle to more reciprocal and mutually reflective relationships between researchers and practitioners whose activities

are studied (between "observers" and "observed"). Newer methodologies such as these are especially suitable for research on innovation in real world settings (see, e.g., Jordan: 1992), rather than laboratory research and research following experimental models.

Developmental work research, as a form of action research, moves through research cycles. A research cycle begins with phenomenological or ethnographic understandings of an activity system and community of practice. A developmental work research cycle can be schematized as moving through: (1) phenomenology of the activity system and delineation of one or more units of analysis; (2) analysis of activity including empirical analyses of situated activities and historical analyses of objects of activity and of theorizing regarding activities; (3) formation of resources for reflection and / or new artifacts (springboards, models, prototypes, a microcosm); (4) interventions such as the introduction of new artifacts to change the activity; and (5) reflection, evaluation, and reporting (toward the next cycle) (see Engeström, Y.: 1987, Figure 5.3).

In my initial research proposal to the HMO, I proposed to study the current patient records system (who uses it for what, when and where); to observe various clinical staff; to follow representative cases of patients' progress; and to follow systems (flows of patient data from the perspectives of systems). From these, I would identify patterns of interactions and

communication, routine work practices, gaps and breakdowns that disrupt the flow of patient care and related work, and local innovations devised to overcome gaps and breakdowns. In relation to all of these, I was interested in common artifacts involved in work practices, particularly patient records undergoing transformations. As I put it in a broad schematic outline, I proposed to:

- follow different *clinical staff* as they carry out daily and weekly activities and as they coordinate their activities in teams and networks;
- follow *patients* as they move through the clinical settings, identifying types of visits and problems encountered;
- follow *patient records* in paper form and then in electronic form (and mixed media) as shared artifacts undergoing transformation; and
- follow existing *clinical information systems* in current use and as they undergo change (what activities and staff are supported through use of the computer system, what activities rely on paper-based records and means of communication outside the scope of computer support).

From such rounds of observations of interactions between and amongst staff and patients, work practices and processes, and uses of artifactual resources, cumulative understandings of the activity systems of particular patient care teams in particular clinical settings can be mapped. In Figure IV.3: Systemic Gap Between Patient Path, Chart Path, Clinical

Activities, these schematized types of observations are represented as *clinical activity paths, patient paths, patient chart paths,* and *patient data and systems paths.* They are also represented in the delineation of clinical staff roles and responsibilities, patient care encounter types, local and centralized patient record-keeping and chart-keeping, and multi-media systems used to generate, record, and track patient data, shown in Figure IV.4: Internal Medicine Cardiology / Rheumatology and Figure IV.1: A Module Point of View for EHR Design. A graphic overview is an abstracted picture in time, not a map for how things should be or how to design but a shared representational resource for design and for reflections about how an activity system is being and may be transformed by changing uses of clinical information technologies and / or changes in the organization of work.

The research schema of looking at clinical activity paths, patient paths, patient chart paths, and patient data and systems paths describes general types of observational foci and one kind of cumulative mapping of knowledge from the field research. Initial observations were carried out by "walk throughs" in the clinical settings and by "shadowing" members of the patient care teams participating in electronic health record prototyping. In walk throughs, a researcher may begin by mapping physical workspaces, access to on-line systems, printers and communication media, and sites for interaction and coordination. Shadowing provides windows onto interactions

and practices including dynamic uses and creation of artifactual resources (patient data, records, charts, information systems, diverse media), patterns of communication, coordination, and collaboration (instances that occur in-person and instances that are distributed temporally and spatially), and routine and unusual situations and routine troubles in activities (dilemmas, systemic disturbances). The distinctions between foci--as actions and properties of clinical staff, patients, charts and records, data and systems—within such heterogeneous ensembles should be understood not as an attempt to separate out components or elements but rather as a practical matter of disciplined research practice (to attend to all of these as much as possible) and analysis (to discern and appreciate relationships, resources, and interactions required to accomplish the work at hand). Shadowing generates questions and provides orientations towards ethnographic and phenomenological understandings. Analysis obviously requires further investigation beyond any observational period, for example, to understand the motivations for actions and the intricate workings of chart, records, data and systems paths. I made extensive use of video documentation of patient care encounters and clinical documentation during the baseline period prior to the introduction of the first version of the electronic health record prototype, with cycles of video documentation during periods of training and clinical use of the first three versions of the prototype.

B.1. Naturally occurring activity

Activity theory generally and developmental work research particularly share with theories of situated action a stress on observing and understanding *naturally occurring activities* and *situated practices.* We need a "relational and processual theory of these activities, understood as forms of societal practice" (Engeström: 1986, p. 52). From such practice-based perspectives, theorists point to loss of analytic qualities and capabilities if one does not look at practices, activities, interactions, and relationships *in action* but relies only on practitioners' descriptions, commentaries, and reports about practices, activities, interactions, and relationships. "… [K]nowledge exists only in the form of material and mental actions. If these actions and their wider contexts—activities—are not studied, it remains unclear and unknown, just what actions constitute the 'conceptions' obtained from the subjects in different situations and what is the overall importance of the given 'conceptions' in the subject's activity" (Engeström: 1986, pp. 51-52).

In research practice, I found the principle of observing naturally occurring activities to be a critically important approach, distinguishing field research methods informed by activity theory from other research conventions and paradigms. However, there are difficulties and tensions in carrying out observations of naturally occurring activities in work settings such as health care. I will discuss two types of limits and constraints here: first, constraints

in patient care settings that present additional complexities for carrying out such an approach; and, second, difficulties of analyzing what we see when observing naturally occurring activity. By problematizing what it takes to analyze what we see, I reflect critically on the principle of observing "naturally occurring" activity.

Patient care settings Patient care is not a world in which one can easily stand by (or hang around), other than through specially worked out agreements in agreed upon circumstances. While this can probably be said of any work research setting, access to health care environments is especially sensitive for compelling reasons regarding rights to confidentiality and privacy of patients and their significant others in addition to the protections of research participants' rights for organizational staff and patients alike. Furthermore, the HMO is a particular kind of health care institution, a patient care *practice setting* organized within and through a managed care regime—a *production environment* as I was frequently reminded by colleagues in the EHR Prototype Project. Unlike medical research centers such as Stanford University, University of California, or Johns Hopkins, the HMO is not constituted as a site for research *per se* (although a number of clinical research studies are carried out there); thus the environment differs in important ways from the academic medical research centers that are the research sites for a number of studies of medical practices (e.g., Berg: 1997a, 1997b; Bosk: 1979).

In academic medical research settings, all patients are to be apprised that they become research participants (in a broad sense) upon entry, whereas this has not been the norm in a non-research clinical practice setting. The relationships between the HMO, its care providers, and patients also differ. A symbolic difference regarding the presence of researchers perhaps signifies such a difference. The HMO clinic administrators wanted the EHR Prototype Project researchers to be visible to patients, distinct from clinical staff; therefore, unlike many ethnographic researchers in clinical settings, it was never an option to wear a white coat to blend in among clinical staff. The additional requirements of clinical research and specialized educational training for research are factored into the temporal order (temporal matrix) of an organization (Barley cited by Strauss et al.: 1997 (1985)) and structures shaping the organization of work, elaborated in different ways than the ways in which work organization and time are structured in an HMO. The HMO's distinct organizational culture also plays an important role in such structuration. Whereas managed care practices—what I call the emerging *managed care package*—have moved into public health sectors such as the military theatre, the pace of clinical work may move at a tangibly slower pace than in the outpatient settings in which I carried out my field research in the HMO.[115]

[115] For example, I was struck by the difference in pace during field site visits to the United States Navy Medical Center in San Diego, California.

Furthermore, my field research is not hospital based (although I sought to gain an introductory understanding of hospital settings and relationships between outpatient and inpatient care). Outpatient care settings differ from hospitals; until recently, ambulatory care settings were less frequently studied than hospital-based care, resulting in general under-recognition of the complexities of outpatient clinical work.

Analyzing what we see. Writing of photography, Susan Sontag points out that meaning is not *in* a photograph but in relations and interactions of viewer(s), situations and acts of viewing, and photographic images (Sontag: 1973). I want to frame my discussion of the principle of observing naturally occurring activity and the uses and complexities of audio and video documentation methods and analysis in relation to Sontag's point. I have in mind two senses in which "meaning is not in the photograph"[116]: first, in relation to how we see and analyze naturally occurring activity; and, second, in relation to how we see and how we analyze video documentation.

How do we understand what we observe that people are doing? We cannot understand people's activities from external observation alone, without reciprocal relationships between researchers and practitioners. This research approach is reliant on active participation of practitioners whether

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[116] My paraphrase.

before, during, or *post hoc* in order to understand and problematize practices and activities more fully. Direct participation of clinical practitioners is required in design processes, in addition to participation through clinical use of successive versions of prototypes; in the EHR Prototype Project, direct participation in design discussions was generally organized on a representative basis (for coverage of professions, disciplines, and domains). One consequence of observing naturally occurring activity is that reflection by practitioners then needs to be organized as explicit and separate as in reflective interviews conducted *post hoc*.

I encountered two related problems given constraints in how time was structured in the EHR Prototype Project. The first was that reflective interviews were not possible; proposals to conduct reflective interviews were not approved for reasons regarding clinical practitioners' time, as I have pointed out. This meant that I could not fully pursue the developmental work research principle that "the practitioners themselves are asked to look at, comment on and make sense of the researcher's initial data and provisional analysis" (Engeström, Y.: 1999a, p. 182). Instead, I had to adapt activity theoretical principles and methods as best I could, given practical constraints and circumstances.

The second type of problem I encountered had to do with difficulties adhering to the principle of observing naturally occurring activity. In field research from an activity theoretical perspective, questions of which activities to observe are decided upon in relation to units of analysis based on preliminary and iterative ethnographic and phenomenological understandings of activity systems. In the first rounds of video documentation of patient visits that I crafted, interactions between patients and members of the clinical team and clinical teamwork to accomplish patient care (instances, encounters), highlighting the dynamics of how records are created and used amongst members of clinical teams, were treated as the central activities, mediated by an array of semiotic-material artifacts (resources) including representations of patient care interactions in clinical documentation and processes for how information is communicated between and amongst patients, care providers, and other organizational staff. Subsequently, we conducted video documentation focused on capturing clinical documentation at the user interface in physicians' offices (and, more rarely, during exam room consultations), with physicians verbalizing reasons for choosing to use free text rather than the structured content capabilities of the EHR prototype to document patient encounters. Clinical documentation at the computer interface is, of course, a naturally occurring activity and a well-founded research strategy to understand difficulties with the EHR's

structured content design strategy in practice. However, if the object of activity is to improve patient care by creating an electronic health record system that will contribute to improvements in patient care, better understandings of difficulties in clinical documentation at the point of the user interface will be gained by continued inclusion in video documentation of the central activity of the patient care interactions (in exam rooms, at nursing stations) that need to be represented in clinical documentation, rather than reducing video recording to on-screen clinical documentation *per se* as the activity observed. More importantly, techniques such as *in situ* verbalization change the activity; we are no longer seeing naturally occurring activity, and care must be taken to make this clear in carrying out analysis and in communicating research findings. Reflective interviews and forms of interaction analysis can be used to meet similar research purposes, and, I believe, more robustly so. As I have said above, in the EHR Prototype Project, organizational concerns regarding clinical practitioners' dictated against reflective methods such as these.

B.2. Volunteering

My two experiences volunteering in clinical settings early in my field research, although not part of my research in any formal sense, were important for my acculturation into the community of clinical practitioners. In deciding to become a volunteer, I was inspired by Brigitte Jordan's

ethnographic approach (Jordan: 1978), by the concept of "legitimate peripheral participation" put forward by Jean Lave and Etienne Wenger regarding situated learning (Lave and Wenger: 1993 (1991)),[117] and by pre-med students for whom I was a teaching assistant in communication courses at the University of California at San Diego. I would recommend volunteering to anyone from a non-clinical background entering into the health care domain.

Volunteering in a clinical setting puts one in a peripheral position in relation to clinical activities but nonetheless in a position of caregiving, as a participant in caregiving and as an observer of acts of caregiving that are often implicit in patient care activity performed as a whole and therefore often invisible. One sees the admixture of expert and utterly mundane actions, the integration of medical work with sensitive interpersonal relations and the necessary choreography of many types of work that must coincide including but not limited to housekeeping tasks, attention to emotions, diagnostic testing, and care planning. Forms of administrative work and articulation work of all kinds--planning, prioritizing, evaluation, and management of time and schedules, human resources, material supplies, equipment, record-

[117] My interpretation of Lave and Wenger's concept of legitimate peripheral participation in relation to my approach, albeit naïve as I now understand it, nonetheless served as a sustaining source of inspiration.

keeping—are integral to clinical work.[118] One also sees how time pressures are ever present, how time acts as a powerful "silent actor." Seeing what Gordon (1997) calls “the tapestry of care” from the perspective of a peripheral participant observer affords insights into the visibility and invisibility of tasks and interactions, particularly the visibility and invisibility of emotions in patient care. I reflected on these experiences as a way to reflect on patients' experiences, to think about the imagination of the patient that is so important to the “nursing model” or “holistic model” of patient care. Volunteering helped to keep me honest to patient perspectives given that, in my field research, my attention was strongly organized towards clinical staff and organizational perspectives.

The two settings in which I volunteered--a hospital ward for cancer and AIDS care, and an emergency room—are evaluated differently. My volunteer role in the oncology ward was given more weight while the patient advocate volunteer role in the emergency room was regarded more slightly. Yet I see continuity between the two experiences. I found it extraordinary when doctors and administrators from non-clinical backgrounds sometimes described patient advocate volunteering in the emergency room as "public

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[118] I am thankful to Toomas Timpka for pointing this out to me. This simple statement clarified my thinking while I was trying to make sense of distinctions drawn between “direct” and “indirect” patient care activities, “real nursing” versus time devoted to planning and documentation, and so on

relations." Many of the small things I did touch on the emotional work of caregiving, interacting with patients and illness, being around fears, uncertainties, and dangers. One Friday night, an emergentologist told me that he had come to realize that it was good to have the volunteers there because "you can handle some of these things we want to do but we just can't get to them." Physicians, nurses, and other care providers need to be in many places with many patients attending to many concerns and actions at once; they work through a perpetual series of dilemmas between acts of caregiving in interactions with patients and the peripheral monitoring and tasks required by the relentless movement of diverse cases. The moments when one is able to attend to a patient's emotions in and of themselves are crucial to caregiving—they signify our images of caregiving--but they are rare and often fleeting in many clinical settings. The emotional work of caregiving is much more embodied in demeanor and tone of voice, in a way of being with patients that often does not or cannot take the form of a special conversation, a special touch, or a special act. The emergentologist was pointing to the ways that a volunteer is free to carry out small acts of caregiving when a physician or nurse "just can't get to them." The more closely a volunteer becomes attuned to the choreography of the clinical team and the work as a whole, the more one is able to do for patients and clinical staff alike.

From time to time, in the oncology ward and in the emergency department, I kept company with someone, listening to his or her life stories; I sat quietly with various patients in states of distress or shock in the emergency room; I arranged for family members or significant others to have as quiet and private a space as possible to meditate or to pray for a loved one's recovery; I silently held hands with a man in the intensive care unit who knew he would soon die. On the other hand, many of the things I did as a volunteer in the oncology ward and the emergency room were absolutely mundane. If the shift in the emergency room was slow, I took care of as many routine tasks as I could in order to be helpful to the staff. My "rounds" were to check the supply of linens and pillows in each room, to warm up blankets, to round up wheelchairs, and to endlessly sort through the emergency department's clinical progress notes. Patient records needed to be sorted for routing to the off-campus Family Medicine Clinic (to patients' personal physicians and the Clinic's chartroom), and for routing to the Internal Medicine Department for patients seen in the Emergency Department who needed to have a personal physician assigned. On the oncology ward, I created "death kits" (sets of records that must be documented when a patient dies), cleared dishes from patients' rooms after meals, rounded up wheelchairs, photocopied hospital records in triplicate when someone was transferred to a skilled nursing facility or hospice, filled in the graphical

representation of vital signs, ran (literally) to and from the hospital's pharmacies, and accompanied a discharged patient (in wheelchair), family member, or significant other to the parking lot. Other routine tasks I performed had the same intent, to make it easier for the clinical staff to focus on their highest priority demands, and, hopefully, to free small margins of time that one can devote to the emotional qualities of care interactions in and among medical, coordinative, and technical responsibilities.

B.3. Pre-study

Kari Thoresen, a geologist by training who has worked in informatics for more than twenty years, explains that when a geologist examines new terrain: "You must look at the ground with your eyes open, to see the unexpected. But you need to know what's expected in order to see the unexpected, to have a sense of familiarity about structure in order to perceive anomalies. To have trained eyes as well as eyes that are open, trained ways of seeing."[119]

I believe that, most likely, I would not have had the opportunity to participate in and conduct my doctoral research in the EHR Prototype Project if I had not had the opportunity to conduct a pre-study of a local computer-based patient record conversion in the winter and spring of 1993, in another

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[119] My paraphrase from Thoresen's doctoral defense, April 1999, Oslo.

primary care clinic of the HMO. The initial familiarity with the organizational culture and work organization of the HMO proved invaluable. In the preliminary cartography of dilemmas I perceived (described in Chapter I), I identified issues that carried through the succeeding years. In terms of methods, it was crucial for use of audio and video documentation in the EHR Prototype Project research that I had the chance to explore and test the usefulness of these methods in the pre-study, especially for video documentation of patient visits.

In the pre-study, I explored methods for understanding the activities of physicians, nurses, appointment clerks, clinic assistants, physician assistants, and information technology services staff, for following patient charts and understanding on-line clinical documentation, for following patients (accompanying patients through office visits), and for testing processes to carry out informed consent in the fast pace of an outpatient clinic. Interviews with staff were conducted on a strictly voluntary basis, over lunch, during break time, or immediately after work in contrast to the EHR Prototype Project in which research participation was always on paid time, governed by organizational considerations and labor-management agreements about staff time. To understand patient care interactions and clinical teamwork in patient visits in the pre-study, I determined that video documentation was warranted only after a gradual progression through

different methods. For example, I stood in on exam room consultations with and without taking notes. Doing so was a useful experience but, if I did not take notes, reconstructing interactions from memory was not precise enough, whereas note-taking in an exam room is often distracting to the patient, if not to the care provider, and displaces a researcher's peripheral observations. I also tried audio recording exam room interactions (without taking notes). Yet, as often as not, it was awkward to have a third presence in the exam room in addition to the care provider and patient. It is somewhat ironic, given heightened concerns about privacy and confidentiality usually evoked by video recording, that video documentation is less obtrusive than even quietly standing in, because the experience of one-on-one intimacy and privacy between a patient and care provider during the exam room consultation is preserved.

I followed a similar progression with methods to understand the work of physicians and physician assistants in their offices and nursing staff at the nursing stations. I first documented observations in offices by taking notes and audio recording. Subsequently, I tried video recording in physician and physician assistant offices only, in other words without simultaneous video recording of consultations in exam rooms, and I then tried video recording in exam rooms only, without simultaneous video recording of chart reviews and clinical documentation in offices. I then decided to conduct

simultaneous video documentation in physicians' and physician assistants' offices and exam rooms with audio recording at the nursing station, while I accompanied the patient during intake at the nursing station and at the end of the encounter for actions upon physician orders and patient education at the nursing station (in other words I tried to accompany a patient throughout the encounter other than in the exam room). These experiences made it possible for me to propose the approach to the video documentation of patient visits in the EHR Prototype Project field research (described in Chapters I and IV).

B.4. Intermediate settings

Selection of intermediate settings within and between activity systems is a deliberate choice;[120] in this case, the intermediate settings are within the same organization. Such settings provide insights into areas where types of problems in the project surface and recur; those that are malleable, those that are not; problems that were raised (e.g., productivity issues) whereas other problems were not (e.g., verbal orders); and gaps and dilemmas at varying organizational levels. I identified several intermediate settings in my field research, among them the EHR Prototype Site Medical Center Steering Committee meetings and hospital rounds conducted by the primary care physicians from the Family Medicine Clinic.

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[120] I am thankful to Michael Cole for explaining the importance of identifying intermediate settings.

The EHR Prototype Site Medical Center Steering Committee meetings represented an intermediate setting between the EHR Prototype Project staff from the Physician Partnership and Information Technology department at the HMO Regional headquarters offices, administrators at the Medical Center and Family Medicine Clinic, and clinical liaisons representing the patient care teams participating in electronic health record prototyping. Steering committee meetings were held every other week; I audio taped most sessions for three years (1993-1996). Audio recording these standing meetings provides a basis from which to trace and document the history of important junctures, dilemmas, and decisions regarding representations of medical knowledge and organizational practices. Among recurring topics were: productivity issues; delays in software delivery and problems in software quality assurance; numerous technical issues related to building interfaces, changes in technical platform (e.g., a change from Next to NT) and to client server based systems, availability of qualified technical support staff, and the technical status of the application; issues related to the clinical content knowledge base and controlled medical terminologies; difficulties for clinical users with forward compatibility (upward compatibility) from one version of the EHR prototype to the next and from one iteration of the clinical content knowledge base to the next (especially consequential for interactive templates

that embed structured content terms); issues and strategies involved in learning the application and designing training and education to support the system; problems understanding the specialized language of the application (on occasion, administrators asked: "What are they [the physicians in the EHR Prototype Project] talking about?"); intellectual property rights issues between the HMO and the Software Company (particularly regarding templates and development of clinical content and clinical objects); the difficulty of conveying the HMO's primary care orientation to the Software Company personnel; and the integration of organizational goals and EHR prototyping.

Hospital rounds represent an intermediate setting for understanding relationships, differences, and interactions between outpatient and inpatient care and care settings. While care is perceived (more or less) continuously by a patient (as an integrally embodied experience), hospital-based care has distinct divisions of labor with more specialized clinical services and more elaborated patient records systems than are typically found in ambulatory settings. Nurses have more central roles in hospital care, exercising more "independent nursing." The HMO maintains separate chartrooms for outpatient and hospital patient records; one of the goals for an electronic health record system is to support continuity of care by integrating clinical information across diverse sites and modes of care. I was particularly

concerned with relationships between hospital-based and outpatient clinical documentation as representations of communication, coordination, and collaboration across primary, secondary, and tertiary care settings (how to support continua of care). How are outpatient and hospital records consistent and how do they differ? How do primary care physicians manage responsibilities and clinical documentation when patients are in hospital and when they are discharged? How is patient information communicated and integrated back and forth between the off-campus Family Medicine Clinic and the hospital on the Medical Center campus?

When I accompanied a physician during hospital rounds, I augmented my note-taking with 35 mm slides to document his or her review of multiple inpatient charts, on-line patient data (e.g., laboratory data), x-rays and other diagnostic images, his or her handwritten and dictated clinical progress notes, admission and discharge summaries, orders and care plans, and creation and use of other records. The series of slides for certain instances of hospital-based patient records use and documentation resembled photo essays. From these, one sees extensions of difficulties for clinical practitioners confronted with the fragmentation of patient information and the uncertainties of irreconcilable information, and extensions of representations in patient records in more detailed paper-based forms, more finely grained clinical information, and more specialized elaboration of complex clinical orders. I

also saw opportunities for design for the mobility of clinical information between points of care (as well as within a care setting), for example in physicians' uses of a handwritten list annotated throughout hospital rounds and carried in one's coat pocket and hand-held computer "wizards" used to keep (abbreviated) problem lists and "pre-discharge" notes, to keep track of the status of patients, and to jot down "to do" items for oneself and one's colleagues. Accompanying physicians on hospital rounds afforded chances to see in-person *in situ* collaboration between primary care physicians conducting rounds and specialists, attending physicians, and nurses on duty. Gaining even this limited familiarity with hospital-based care, through the intermediate context of accompanying the primary care physicians on hospital rounds, helped me to understand what I was hearing in interactions and seeing in clinical documentation in the primary care and outpatient specialty care settings for electronic health record prototyping. Altogether, these helped me to understand the larger institutional and social networks of collaborative relationships in which the Family Medicine and Cardiology / Internal Medicine patient care teams participate.

C. Working in parallel: project work, dissertation work

As I have explained, I was a participant in the EHR Prototype Project, responsible for a research team, and accountable for the comprehensibility of

the field research for project purposes. I was a participant observer implicated in and subject to the field. For me, this meant "working in parallel"; the research had to meet the pragmatic requirements of the EHR Prototype Project while enabling me to meet the theoretical requirements of a doctoral project. Although there was sufficient coincidence of methods and foci to craft my doctoral work, these two sets of requirements were not the same; they had different purposes and entailed different demands on my time and ways of thinking. In this section, I discuss techniques I employed to adapt research methods and principles for the multi-disciplinary fieldwork in electronic health record prototyping. In describing these, I refer to tensions and constraints related to project responsibilities, settings and time, and I comment on limits to my research approach.

I begin with a few introductory remarks regarding tensions between field research cycles, software development cycles, and business reporting cycles. Such tensions are not unique to this project but indicate general difficulties for conducting ethnographic research and related approaches in business contexts. Because the EHR prototype research was inherently exploratory and unpredictable, perpetual tensions needed to be managed between research as a process of discovery and interpretative analysis, time windows for communication of findings and recommendations for iterative software design cycles, and expectations for "just-in-time" business reporting.

The “master plan” approach adopted from the multinational accounting firms advising the HMO’s clinical information systems development projects set tight time cycles that were dissonant with the realities not only of viable field research and analysis but of software design and development as well. The master plan approach combined with the HMO’s organizational regime in shaping accountabilities and constraints for the field research. All research and development activities of the EHR Prototype Project and other clinical information systems projects required release time from patient care for clinical practitioners and painstaking scheduling around clinicians’ patient care responsibilities. To give a sense of the impact from the HMO’s accounting perspective, if hard costs (external outlays of funds, for example for the Software Company or another software development partner) were estimated at twenty-five million dollars, then total costs were estimated at one hundred million dollars once indirect costs (time lost from patient care and other on-going responsibilities) were included. There were also constraints to access, resources, and time due to divisions of labor in the EHR Prototype Project, particularly boundaries between the responsibilities of the Information Technology and Physician Partnership staffs, and between project teams. Finally, the HMO has no tradition of qualitative research; I worked within a temporary opening during the prototype research that closed over time.

C.1. Types of studies and reporting

The EHR Prototype Research Team was responsible for baseline (pre-EHR) and evaluation studies in the clinical settings of the patient care teams participating in electronic patient record prototyping. We produced a series of reports on baseline studies in the primary care and specialty care settings for prototyping (Family Medicine, Cardiology and Internal Medicine, Cardiodiagnostics, Continuous Ambulatory Peritoneal Dialysis (CAPD), Rheumatology) and evaluations of clinical use of successive versions of the EHR prototype (1993-1998). In each of these, we presented textual and graphical overviews and summaries of clinical work practices and teamwork, patient care encounters and interactions, and clinical documentation and use of patient data from diverse information systems and media. The reports are action oriented: informational and functional requirements, recommendations for planning, and action items regarding organizational change and medical-legal policies and procedures are highlighted throughout each report. In addition to the reports, video documentation was conducted for baseline clinical work practices (patient visits, message-handling, telephone triage) and clinical documentation with EHR use (1994-1998), from which video exemplars were produced as project resources.

In between the publication of summary reports and creation of video resources, I was responsible for in-progress reporting—on a weekly, bi-

weekly, monthly, and / or as-needed basis--to a number of standing EHR Prototype Project teams responsible for prototype design and development, education and training, implementation and transition planning, and clinical informatics and templates-building, and project leadership bodies for cross-cutting strategic and policy questions and potential medical-legal issues. I was also asked to lead and / or carry out special assignments that required qualitative conceptualization and analytic research: an analysis of the "verbal orders" issues that surfaced in the Family Medicine Clinic (1994); conceptualization of a framework for evaluation of the EHR prototype in collaboration with clinician project leaders (1995-1996); development of the seminar series for Software Company staff (1995-1996); a mid-project evaluation of EHR templates design and use by HMO and Software Company principals (1997); video documentation of use of templates and on-line references from the World Wide Web during exam room consultations (1998); and video documentation and detailed video analysis of user interface usability evaluation of the fourth and final version of the EHR prototype in a joint team with members of the Software Company's product design team (1998). As for all of the EHR Prototype Project research, these were carried out collaboratively with members of the extended research and development teams, project leaders and clinical liaisons, and clinical practitioners.

C.2. Techniques adapting research methods and principles

How do you follow a common object through time when the common object is itself (always) a moving target? How do you conduct ethnographic fieldwork within a multi-disciplinary team that is a larger group than the team carrying out ethnographic research? How do you conduct detailed analysis of ethnographic materials in an intensely time-driven strategic business project? Techniques adapting research methods for multi-disciplinary group field research and project work with tight turnaround times were both necessary and useful. These include: identification and creation of video exemplars; use of a shared fieldnote template for group ethnographic work and in-progress reporting; development of graphic representations as tools for field work, for mapping knowledge from the field, and to create shared pictures to bridge contexts of use and design; and creation of portfolios for video documentation and other types of field documentation. Table A.2 provides a general description of these.

Memberships and participation in HMO project teams varied and were variable over time, and project teams had overlapping memberships. With this in mind, I indicate types of membership in the extended research and development teams in the EHR Prototype Project. At different times, the core research team comprised myself, one or more research assistants (from film / video editing, bilingual education, and history backgrounds), and two doctoral students conducting field research (from organizational psychology

and anthropology backgrounds), representatives from the Physician Partnership clinical systems development department and from the Information Technology department (with information technology or clinical backgrounds or both), representatives from the Organization Development

Table A.2: Techniques for Adapting Methods for Multi-disciplinary Field Research and Reporting	
Fieldnote template • Used primarily by research team	• Support for rapid in-progress reporting and to facilitate communication • Flexible and iterative; easily adaptable for research foci in specific studies • Thinking across multiple perspectives • Support for training in field research methods
Graphic representations (other than video) *Graphic representations, including photo images from 35 mm slides* • Used in series of EHR Prototype Project research reports • Creation and uses shared with extended research and development teams and clinical practitioners • Used in seminars for Software Company	• Mapping activities and activity systems: mapping diverse perspectives on shared objects of activity • Building cumulative pictures; mapping team knowledge from fieldwork about: clinical staff activities; patient encounter types and patient paths; patient charts, records and data; information systems and media • Visualizations for understanding gaps and dilemmas; for verification, feedback, reflection
Video documentation (audiovisual documentation) *Patient visits (pre-EHR baseline and with EHR use); clinical message-handling and telephone triage; analysis of user interface for structured content use* • Used by extended research and development teams and project steering committees • Used in seminars for Software Company	• Documentation of collaborative activities and units of analysis • Documentation of naturally occurring activities; interviewing *in situ*, combined with verbalization for specific research purposes • Identification and creation of video exemplars as resources for design and reflection
Portfolios *With patient visits and instances of clinical activity and documentation. Video documentation does not stand on its own.* • Used to develop video exemplars and to map information into graphic representations and reports.	• Artifacts, documents, screen prints

and Operational Analysis departments (with management engineering and organizational consulting backgrounds). The physician clinical liaison from the EHR Prototype Site Medical Center participated as an active advisor; I consulted throughout with the physician project sponsor and administrative project manager with whom I served as co-investigator.

Below, I describe the uses of a shared fieldnote template and graphic representations, and rapid identification of video exemplars from video documentation (see Table A.2). I begin with the fieldnote template. The fieldnote template was designed to support semi-structured fieldnotes documentation for group fieldwork in this context and rapid and frequent in-progress reporting. The fieldnote template was used throughout the field research, and modified as the research proceeded and from study to study. For me, fieldnotes documentation is also an important means for reflecting on and iteratively adapting methods. Using a common semi-structured template for fieldnotes provided the basis for systematic identification and discussion of patterns in clinical work practices and EHR use, and implications for in-progress reporting regarding multiple project purposes. The fieldnote template also facilitated rapid communication amongst research team members (fieldnotes were posted via e-mail within the research team), and training in fieldwork for research assistants.

In the fieldnote template, core areas for gaining understandings include: *work practices* including both formal and informal rules and structures; routine activities, complex, difficult and / or time-consuming activities; *interactions* between clinical staff and patients, between care providers, clinical and non-clinical staff, and between clinical staff and Software Company and Information Technology staff; *relationships* and *divisions of labor* including formal lines of authority, variations in scope, and informal relationships such as social networks; *communication, coordination, and collaboration*, formal and informal patterns within a patient care team, module or unit, and between a module / unit and the medical center at large; *learning and training*, formal and informal, on the job, peer learning, and learning and training involving HMO and Software Company staff from the EHR Prototype Project and Information Technology department; *tools and resources for problem-solving* including all types of artifacts, resources, and media; and emergent new patterns and work practices; *gaps in medical information*, incompleteness of charts, and problems in availability of information; *disruptions* or *breakdowns* in communication, work practices, and teamwork, including "close saves," conflicts, problems. *Possible implications* were noted for communication purposes within the team and in-progress reporting purposes. The areas to consider for possible implications from field observations give a sense of the range of issues and topics for which the field research might generate insights and reporting: patient care;

learning issues, education and training strategy and curriculum; prototype design and development; types of patient charts and medical records in use at the time; messaging practices; orders / results practices; dynamic use and creation of on-line and paper-based patient profiles, patient summaries, health maintenance records; organizational and medical-legal policies and procedures; regulatory requirements; reference materials (on-line and paper-based); minimum data sets; roles, rotating responsibilities, escalation procedures, proxy coverage; transition planning (from paper-based records to electronic records and otherwise); qualitative benefits of EHR use; linkages between primary care, specialty care, inpatient / outpatient ancillary services; facilities and equipment, including ergonomic issues; opportunities to streamline operations to gain potential efficiencies; and regional implementation planning. The fieldnote template was modified continuously throughout the EHR Prototype Project, and tailored to the foci for each research study and software development cycle. For example, for a study of structured content and free text in clinical use of the second version of the EHR prototype, the physicians participating in prototyping were asked to verbalize reasons for using free text rather than structured content for clinical documentation. Detailed foci were added to the fieldnote template including: structured content, free text, templates, clinical content (present, missing), use of browsers and problems in practice related to the user interface, usability,

navigability, time, convenience, expression, and other reasons for free text use.

A series of graphic representations were created by the research team (1995-1997). We had as goals to represent multiple perspectives and to create shared pictures as bridges for understanding clinical and operational environments and practices and needs for design and development of the electronic health record system. The graphics were used in research reports from the field studies and in the series of seminars for the Software Company in 1995 and 1996. Two of the series of graphic representations are included in Chapter IV: Changing Patient Care (Figures IV.1 and IV.4). The graphic representations highlight processes, interactions, activities, actors and resources: patients, clinical staff, records, images, charts, diverse media, systems, recurring and typical situations (types of patient encounters, procedures such as diagnostic tests, patient-staff interactions, interactions between clinical staff and between non-clinical organizational staff, clinical staff and patients). In their emphasis on processes, interactions, and relationships between actors and resources, the graphic representations resonated with object-oriented programming in contrast to structured analysis. In-progress versions of the graphic representations were used in field research and preliminary analysis to annotate ("map") knowledge about the patient care setting: the physical space, activities, roles, and

responsibilities, types of patient records and clinical documentation, and information systems media and use, encounter types, and other information relevant for electronic health record prototyping. In the seminar series conducted for Software Company staff, the graphic representations were used to facilitate shared understandings of the clinical and operational settings for use of the electronic health record among members of Software Company teams responsible for product design, software engineering, clinical informatics, and client services.

When I proposed the creation of the graphic representations in late 1994, I had several motivations and sources of inspiration. There is no common language in multi-disciplinary systems design teams such as those in the EHR Prototype Project. Graphical languages emerge of necessity; design cultures tend to be visually oriented. Graphic representations are useful for mapping, analysis, and visualization of changes and possible changes. I was inspired by work using graphic representation and audio-visual materials as resources for design presented at the 1994 Participatory Design Conference (Trigg et al.: 1994, see also Wall and Mosher: 1994), and by conversations with other field researchers and system designers, particularly Toomas Timpka and Cecelia Sjöberg at Linkôping University, and members of the Work Practices and Technology group at Xerox Palo Alto Research Center.

The creation of the graphic representations was motivated by additional needs and concerns within the EHR Prototype Project and field research. Their development was in part a response to difficulties in using video documentation due to problems with the inevitability of individual identification in video recordings, especially in the tight-knit peer community of clinical practitioners in the HMO. In this community, it was hard to get away from interpretations of individuals *as* individuals (what is known about an individual's quirks and reputation, style and preferences in work practices). This made it difficult at times to see individual troubles (represented in video documentation) as situational troubles (practice dilemmas, systemic gaps). Graphic representations proved useful in visualizing the generic nature of practice dilemmas, in combination with discussion of video exemplars. In Chapter IV, Figure IV.3 representing the systemic gap discussed in exemplar #1 is such an example.

C.3. Audio-visual documentation and video exemplars

Jordan (1992) discusses why video documentation is valuable for creating resources for design, reflection, and analysis. I paraphrase Jordan's discussion in the following summary points: (1) video recording creates permanent primary records as resources that can be shared between researchers and practitioners whose activities are recorded, facilitating reflective review by both researchers and practitioners; (2) repeated viewing

can reveal antecedents, patterns that emerge over time, and phenomena which were at first invisible to participants; (3) audiovisual records help to counteract biases of fieldnotes and other methods which rely on reconstruction of events by researchers; (4) by approximating direct observation, video provides a shared resource to overcome gaps between what people "say" they do and what they "do"; and (5) video can be used to "map" collaborative but temporally and spatially distributed activities among members of teams.

In addition to audio recording of talk at work as part of video documentation, formal interviews and selected project meetings were audio recorded. Interview transcripts were used primarily by members of the research team, as many interviews were conducted on a confidential basis. Information from interviews was used in analyses in reports and mapped to graphic representations. I used transcripts from audio recordings of project meetings in the analysis of particular case studies and project issues. For my doctoral project, audio recordings of the bi-weekly EHR Prototype Site Medical Center Steering Committee project meetings served as a basis for longitudinal understandings of recurring issues, problems, and questions over time.

Rapid identification and creation of *video exemplars* provide an example of working in parallel, balancing commitments to EHR Prototype

Project work and my doctoral work. Exemplars are case examples that are exemplary instances of activities (units of analysis) that are also exemplary as springboards for reflective discussion. The generalizability of such qualitative case examples as these video exemplars is grounded in the conceptualization and delineation of meaningful and generative units of analysis. For example, four exemplars were prioritized among the thirty-six baseline patient visits video recorded in the Family Medicine Clinic (three are discussed in Chapter IV). Important problems of interest for electronic health record prototyping are manifest in these patient visits (units of analysis) as instances of clinical teamwork and clinical work practices required for patient care (objects of activity) in a primary care setting.

As a practical matter, the video exemplars approach makes it possible to go relatively quickly from video documentation to joint development of criteria to preliminary identification of exemplary case examples for review by a multi-disciplinary team responsible to diverse constituencies. For any cycle of video documentation, criteria for video exemplars were developed with members of the extended research and development team; the criteria were oriented to diverse EHR Prototype Project purposes (requirements for design, implementation planning, education and training strategies, and so on). I reviewed all video documentation from which I quickly identified a number of instances as candidates for exemplars based on the criteria. Quick

mock-ups of candidate exemplars were then reviewed and discussed by team members. The instances selected as exemplary were developed as resources for design and reflection on clinical work practices. Video presentation of these required different kinds of editing according to the interests and attentional tolerance of members of different project teams. I first created a research version of each exemplar in which actions occurred in real time (at least relatively so), with gaps and silences preserved, and usually including actions that immediately preceded and followed the beginning and end of the sequence of actions in the exemplar.

Sontag's point that "meaning is not in the photograph" applies in various ways to the complexities of audio and video documentation methods and analysis. What do we see in video documentation? What do we need to do and to know to make sense of video documentation? Video documentation, even more than photography, can all too easily carry with it the illusion that it captures real and natural actions that are self-evident and complete unto themselves. Video exemplars have a "natural" appearance because *in situ* activities are presented, but they do not represent a natural view. No individual researcher can see the range of actions distributed in time and space amongst collaborating members of patient care teams.[121] Yet a

[121] Furthermore, a wide angle view of the dynamic use and creation of patient records by nursing staff was video taped from a camera positioned approximately twelve feet above the nursing station.

video exemplar is a mini-documentary of a patient visit, representing the actions of team members in a sequence of time following the chart, then patient, then care providers, then records and chart through the encounter, with concurrent actions represented simultaneously through picture-in-picture insets.

Finding meanings in video documentation requires more than the video itself. Making sense from instances of video documentation requires additional documentary resources and discussions with practitioners. To analyze video documentation requires assembling relevant artifacts—into *portfolios*, for example--including other forms of documentation as a step in preparation for interaction analysis, reflective discussions, and elicitation of multi-perspectival meanings of exemplars to diverse practitioners.[122] Portfolios for the video exemplars in the EHR Prototype Project might include: care provider schedules, patient records created and used, handwritten notes and marginalia, drawings, relevant protocols, standard forms, screen prints from computers, and still photographs of physical work spaces, desks, and offices. Understanding video documentation of a patient visit may require reviewing a patient's chart for important summary records

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[122] The creation of portfolios is inspired by work-oriented design in which artifacts from workplaces are critically important for analyzing work practices for design (see, e.g., Ehn: 1988; Blomberg et al : 1996).

(a health maintenance record, problem lists, medication lists), messages and progress notes that represent antecedents to the encounter, interactions that are part of the same clinical episode (what may be called an event in hospital), and / or the context of the encounter within diagnosis and treatment for a problem over time.[123] These artifacts and documents are crucial as visual and textual cues in the development of detailed audio transcripts and action logs for video taped patient visits, as well as for interaction analysis and other reflective discussions.

The construction of video exemplars is not given but involves a series of choices. To identify and create video exemplars requires images and understandings anticipating what one looks for concretely and how one conceptualizes focal points for analysis. For example, how should the beginning and ending of a patient visit be defined given analytic purposes related to electronic health record prototyping? For the beginning of a patient visit, I took the appearance of a patient's chart at the nursing station as the starting point rather than the arrival of a patient and / or family at the nursing station for intake and vital signs. For the ending, my interest was not when the patient and / or family members left but rather when all members of the

[123] The search for such information can also sensitize a researcher to the difficulties and gaps practitioners encounter in searching for salient patient information, even though there are of course many differences in information-finding abilities between the experiences of a non-clinical researcher and an expert clinical practitioner.

patient care team completed all forms of documentation for the encounter. For example, exemplar #1 does not end until the registered nurse completes the immunization documentation after the Clinic was closed for the day.

Video documentation of EHR use for clinical documentation at the user interface provides another example of how meaning is not self-evident—how "meaning is not *in* the photograph"--in relation to video documentation combined with verbalization by practitioners. Analyzing the user interface exemplars entailed additional work, beyond the portfolio materials described above. For the user interface exemplars, I walked through the clinical progress notes that were documented with the EHR at the time of the respective patient encounters with a physician clinician liaison who has expert knowledge of the EHR clinical content knowledge base and who is deeply involved with the development of clinical objects based on controlled medical and clinical terminologies. Retrospectively recreating the documented notes was a way to "walk in the shoes" of the clinical users of the EHR prototype. Doing so made the questions asked of the physicians much more concrete by providing another kind of information about what the physicians meant when they verbalized their reasons for choices to write free text rather than using structured content terms for documentation in the real time of clinical practice. What does it mean that a clinical term is hard to find or cumbersome to get to? What are the problems of quality of expression

and / or loss of narrative qualities missing related to the use of structured terms? Systematically walking through the clinical documentation in the exemplars provided another way to verify whether a structured term existed in the clinical content knowledge base and where it was in the user interface, in addition to practitioners' accounts of experiences at the time of documentation in clinical practice.

Video exemplars differ from idealized, peopleless scenarios. Forsythe pointed out important differences between "typical" scenarios of patient-physician interaction offered by a neurologist and interactions between patients and neurologists transcribed from audio-recorded consultations.[124] In similar ways, patient presentations of problems differ generally and importantly from "logically" anticipated sequences and expression in the communication of clinically salient information (see Chapter IV). Because video documentation offers partial pictures of activity and interaction *in situ* that are not sanitized or purified as idealized scenarios are, video exemplars display routine troubles from the real world of clinical work. Given inevitable gaps between policies and practices in clinical work as in all types of work, the use of video documentation is charged with sensitivities, discomforts, and tensions.

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[124] Personal communication, 1992.

Regarding video analysis, I began the research with the intermediate concepts of communication, coordination, cooperation, and collaboration in teamwork as foci for analysis, and continued with these as they were fruitful for the EHR Prototype Project. I have discussed additional foci for electronic health record prototyping above. In the pre-study, I schematized problematics for analysis of structured content for clinical documentation as: (1) representations, notational structures, and idealizations of medical concepts; (2) cognitive processes that involve synthesizing medical knowledge and holistic knowledge of patient care and clinical histories; (3) pragmatic and organizational constraints; and (4) current design limits to supporting clinical teamwork and work practices. These were useful as background points of reference in analyzing use of structured content at the user interface; they were not, however, in the foreground of analysis for the EHR Prototype Project but rather for my analysis for this doctoral project. For both the EHR Prototype Project and my doctoral project, analysis of "trouble"—dilemmas, systemic disturbances, gaps, routine troubles, and other difficulties in practice—was methodologically central in analysis of video documentation and other research materials. When I conceived the incomplete utopian project of electronic health record invention as an intermediate concept, I carried through close analyses of the video exemplars

informed by this organizing concept for the analysis presented in this dissertation.

The sheer labor intensity, time, and skills required for working with video materials posed tensions and challenges for the use of video documentation in the field research. The labor intensity of video documentation and interaction analysis were barely tolerable within such a time-pressured project with its particular assumptions about viable turn-around times for research, analysis, and reporting, individuals' time constraints and thresholds for reviewing or viewing detailed field research materials, and organizational time constraints for releasing physicians, nurses, and information technology staff from patient care and other core responsibilities to participate in research-related activities.

C.4. Resources for design

I close my discussion of techniques adapting methods to working in parallel with two comments on the usefulness of qualitative research methods for systems design and development, implementation strategies, and organizational planning. The specialized qualitative methods which I employed—especially video ethnography, interaction analysis, and close analysis of material-semiotic artifactual resources including talk and resources of imagination—were valuable in this co-development project; otherwise they would never have happened. In the end, however, my sense is

that resources from video documentation can be most helpful for design, in contexts constituted as spaces for design. I believe these methods and the materials they generate as resources for design, particularly video exemplars, have much to offer software designers and developers. For example, video exemplars of electronic health record use at the user interface *in clinical practice* offered potential values for Software Company designers and product developers for whom detailed video documentation can be reviewed from the multiple vantage points towards design of collaborating but distinct teams with specialized yet intricately interrelated responsibilities and perspectives.

In addition to video exemplars, I see graphic representations as promising, useful, and necessary. The graphic representations initiated in the EHR Prototype Project proved hard to create; by this, I mean that we did not get very far in constructing graphical representations compared to our ambitions to overlay multiple perspectives in ways that could be distinguished, combined, and communicated flexibly to see each others' different vantage points on the same setting, practices, or scenario. As a matter of explicit principle, the graphic representations were multi-perspectival, in other words we were not trying to resolve different perspectives into a single unified view. The genres of graphic representations created for the EHR Prototype Project are more local and more physically grounded than the genres of formalized "high-level" graphics programs that

are commercially available for systems development. Project-specific graphic representations can be both local and general, created as deliberately "open texts." The EHR Prototype Project graphic representations were short-lived; they were difficult to maintain in the face of "high-level" representational tools such as Oracle Designer 2000 that are not primarily concerned with localized practices, and also difficult to maintain in light of the HMO's strong history of infrastructural commitments to structured analysis rather than object-orientation with which the EHR Prototype Project graphic representations share more conceptual affinities.

In the final sections of this discussion of methods, I turn to reflections on ethnographic dilemmas related to design projects, and to the methodological principle of "looking for trouble" in activity theoretical research.

D. Ethnographic dilemmas

I began by pointing to ways that moral dilemmas are constituitive of ethnographic and anthropological research practices. I turn now to reflections on dilemmas I experienced in carrying out field research for electronic health record prototyping, to *ethnographic dilemmas* in relation to practice dilemmas and ideological dilemmas. I return briefly to my introductory framing of

dilemmas that confront ethnographic researchers in work settings, especially in corporate settings in the United States, to discuss the tensions of ethnography in organizations and in the service of corporate change projects and strategic initiatives.

Critical discourse regarding "making work visible" (Suchman: 1995) provides a useful starting point for thinking carefully about ethnographic dilemmas. Making design intentions visible and rendering future scenarios of practice with the use of new systems visible, meaningful, and thereby open for discussion are integral aspects of the work of design. When work is analyzed, visibility and invisibility coexist in dynamic relationships shaped by the ways that work is structured, articulated, and accounted for or deleted (Star and Strauss: 1999; Star: 1991). Making work visible entails making dilemmas visible, both practice dilemmas and what we may call ethnographic dilemmas--dilemmas that confront researchers in the course of fieldwork. I was once asked: "Isn't an ethnographic point of view antithetical to re-engineering and technological change initiatives?" Grudin and Grinter (1995) express the tensions between ethnography and design in what they call "the ethnographer's dilemma":

> This is the ethnographers' dilemma. The better they do their job, the more fine-grained in detail their understanding of the nature of the work as it is currently organized, the more likely they are to see how disruptive a new technology will be. A distant designer may see the workgroup on one peak and dimly through the haze see a higher peak nearby, and imagine a

> straight path from the one up to the other, but an ethnographer sees the valleys in between, the difficulties in making the trip, the uncertainty of success, the possibility that the higher peak will not be as comfortable a place to work after all (or was an illusion) (Grudin and Grinter: 1995, p. 56).

What agendas motivate decisions to employ ethnographers and with which actors are we then allied and aligned? How do various actors and agendas shape the purposes to which ethnographic research and new degrees of visibility of work will be put? How do these relationships, balances of power, and contexts change over time, and change through the interventions of research and design?

Ethnographic research in systems design projects affords openings to talk about aspects of work that are not usually discussed and may not be easy to talk about under normal everyday circumstances. For ethnographic researchers, there is often a sense of heroic mission to addressing the problems of invisible work; we walk then "on the side of the angels." The desire to walk with the angels is a powerful motivation, yet in our work we live with and through the dilemmas of change projects. Design projects are, always, projects about change. Making work visible in design projects is accomplished in change projects motivated by particular agendas that are animated by sociohistorical as well as organizational contexts and actors. Making work visible in design projects contributes to transformations of interactions, processes, divisions of labor, and translations and inscriptions of

these relations into computer-based information systems and infrastructures. Because visibility involves objectification, it can be put to use for purposes that have double-edged qualities that may prove problematic. For example, the deployment of new information and communication technologies concurrently introduces or extends capabilities for surveillance. The continuous electronic audit trail produced by electronic health records systems exemplifies the unprecedented reach and extended traceability of on-line records of communication and transactions. Because design projects are always about change, there is no "side of the angels" but rather one lives with ethnographic dilemmas; there is no position of pure, unequivocal "good" by which to judge one's own and others' actions. The dilemmas of doing ethnographic work in computer design projects do not require a dramatic turn of events; they are there from the first day.

That design is always about change leads to my last reflection on the ways that meaning is never *given* by observations of naturally occurring activity any more than meaning can be found *in* a photographic image: activities observed, documented, and analyzed in the present are problematized and interpreted through lenses of design oriented towards imagined futures.

Between policy and practice. Patient care is a world of policies and practices, with inevitable gaps, tensions, and breaches in between how one

should practice (policies, ideals) and the constraints and contingencies (in time, resources, available knowledge, multiple roles and responsibilities) that shape how clinical practitioners carry out patient care (practices, pragmatic realities). In patient care environments, the tensions between policies and practices are immediately apparent. You need only to spend a few hours in any primary care clinic or hospital ward (unit) to appreciate how and why this is so. Tensions between policies and everyday practices generate practice, ideological, and ethnographic dilemmas.

In Chapter IV: Changing Patient Care, I discussed a pediatric immunization encounter in detail to illustrate a practice dilemma (exemplar #1). It is worth noting that it was a gap, not more—an absence of a tool or absence of resources adequate to the tasks at hand--that opened this window onto a systemic dilemma. There is a systemic gap between the patient path, the chart path, and clinical activity paths, and there are gaps in information, communication, and coordination amongst members of the team and the mother and the child (the patient). To bridge this gap in the fast pace of real-time outpatient appointments, clinical staff throughout the Family Medicine Clinic employed a long-standing work-around involving physicians' and physician assistants' routine use of the patient's appointment registration and billing form (an ephemeral, non-medical form) to communicate orders to the nursing staff while an encounter is in progress. The work-around was so

taken for granted as an absolutely mundane everyday practice that it was un-noteworthy and un-noticed--invisible--until subjected to scrutiny for the purposes of the EHR Prototype Project. An electronic health record introduces not only new tools to follow existing policies and principles (to carry out physician orders, to follow the immunization protocol which presented difficulties for each of the three care providers trying to get the child "back on track" by completing the immunization series), but also extensions of policy and new types of formalization regarding standards of care and means for monitoring standards of practice through use of new tools with unprecedented reach. One question, then, for research practice is: What kinds of work does it take to frame trouble as opportunity, in other words to conceptualize troubles as resources for constructing alternatives?

Living with dilemmas. Ethnographic dilemmas arise from multiplicities of interests, relationships, and communities of practice, and transformative changes that confront researchers with choices to act among conflicting interests and contradictory motives that are beyond the control of single individuals. A dilemma embodies a double bind or moral conflict in light of the impossibility of a singularly good choice. To keep dilemmas visible, an ethnographic researcher of work practices needs the support of more than one community, beyond the communities of practice in which we are immersed every day, to be in touch with communities of practice whose shared values

include seeking to imagine the world through a diversity of perspectives. What meanings does the research have for different members of a community of practice? Where is research in workplace settings in corporations and in organizations located in the larger pictures of science, technologies, industries, labor and management? In addition to our own careful, conscious crafting of our roles, how are the roles of ethnographers and work research organizationally and sociohistorically constructed? With which agendas is our work aligned whether deliberately or inadvertently? For what purposes is ethnographic research useful, and how may the research be used over time? When proven generalizable through their service to company-led or organization-directed change projects, what, then, do theoretical analyses of work and technological innovation contribute beyond such market-defined agendas and organizational imperatives? For ethnographic researchers, keeping visible before us images and sensibilities about where we are in the picture is part of a practice of striving to see not only our relationships to the nexus of organizational actors and interests but also where we are in sociohistorical context.

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