

Information in Healthcare:
An Ethnographic Analysis of a Hospital Ward

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Information)
in The University of Michigan
2010

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Dedication

To

My grandmother Yuzhen Zhang.

Acknowledgements

I am very lucky to have had Mark Ackerman as my adviser and dissertation committee chair. He has provided instrumental advice from the very beginning of this study. Throughout the progress of my hospital observations, his regular meetings benefited me greatly. He often challenged and helped shape my thinking. When I was too excited about practical findings from the field, he would pull me back then push me forward, asking me to think hard about: “what is the theoretical contribution.” He considered every detail and helped draw the big picture for this study. The sharp analysis in his own work also provided a great source of inspiration whenever I was stuck in my data analysis.

I am also very fortunate to have had Michael Cohen, Lee Green, and Kai Zheng serve on my committee. Each provided tremendous support for this research. Michael Cohen has been a great mentor since the beginning of my studies in the doctoral program. He always encouraged me whenever I got stuck, and knew just what guidance would provide the needed support and intellectual stimulation. As a physician himself, Lee Green has been always insightful and has provided valuable feedback to aid my understanding of the medical field. Kai Zheng introduced me into the medical field and helped with all possible research resources. In addition, he was often the first to listen to my latest findings from the field and we exchanged research ideas extensively.

I owe this work to the nurses, doctors, clerks, and clinical administrators who allowed me into their daily lives. They provided enduring support, allowing me to shadow their work without restriction and tolerating my outsider's endless and perhaps naïve questions, particularly during the beginning of this study. I spent numerous days and nights with them throughout the past two years. They gradually accepted me as part of their world, including me in baby showers, potlucks, and dinner parties. Without their huge support and different perspectives, this work would not have been possible to present with so many details.

I would like to thank Margaret Hedstrom and Beth Yakel for their mentorship during my first two years in the doctoral program. They gave me training and insights into the field of archives management that greatly influenced my interest in exploring the issues of information documentation from a long-term perspective. They led me to the door of academic research.

My fellow students' support has been a continuous fuel during my long journey in finishing the doctoral program. Particularly, BlearyTheory in School of Information, including Emilee Radar, Eric Cook, Jina Huh, Rick Walsh, Libby Hemphill, Yong-mi Kim, Jude Yew, Beth St. Jean, and many others, was a student self-organized support group that gave me opportunities to share ideas, brainstorm, and receive feedback. My research group members, Jun Zhang, Jina Huh, Kevin Nam, Jiang Yang, Ben Congleton, Ayse Buyuktur, and Tao Dong, who are all advised by Mark Ackerman, have been great mental support and given me the feeling of a family. My officemate Brian Hilligoss, whose research is also situated in the hospital with a focus on clinical handoffs, has been a great discussant during my data analysis during the writing stage. Xiao (Tracy) Liu has

been a consistent companion during quiet evenings when I worked in my office until late at night; a casual hallway talk always brought joyful moments. William Cron, a graduate alumnus from the School of Information, took on the great challenge of helping edit my dissertation manuscript at a difficult time under pressure.

This work was supported by a Barbour Scholarship from the Rackham Graduate School, by the School of Information, and by NSF (0325347). This support allowed me to spend time extensively in the field without other financial concerns.

All my friends suffered or enjoyed my research talk in everyday interactions. They all know my study through casual get-togethers, parties, and phone conversations. Nancy Bartlett, Michael Chan, and Dwight Davis provided tremendous help improving my English and volunteered on numerous occasions to edit my writings. My best friend Mei Du, back in Beijing, knows all the stories of my doctoral program journey through our frequent international long-distance phone calls. She often eased my frustration and cheered me up. Lingling Zhang was a great roommate and friend who perhaps suffered the most from my complaints and also shared the most from my happiness. My long-term friends John Holland, Randy Wallach, and Bill Wallach have been always great pillars of mental support since my first day in the doctoral program.

Most importantly, my family has been a big supporter as a whole. My father, Xuesheng Zhou, inspired me to pursue this degree through his continuously diligent academic work even after retirement. My mother, Junying Li, two brothers Xiaolong Zhou and Xiaohu Zhou, and two sister-in-laws Hua Wang and Mei Wang are always there whenever I need them and they have had great faith in my academic success. I am in deep debt to my son Yutong Chen and my husband Jianping Chen during my entire

journey through the doctoral program. I wish that I could have spent more time with them. I hope my pursuing a higher degree in the U.S. even after my years of university teaching back in China is an inspiration to my son, who in fact already expressed this feeling in one of his birthday gifts to me.

Table of Contents

Dedication	ii
Acknowledgements.....	iii
List of Figures	xii
Abstract	xiii
Chapter 1 Introduction	1
1.1. Motivation.....	1
1.2. Information Work in Healthcare Organizations	2
1.3. Research Questions	4
1.4. Overview of the Dissertation	6
Chapter 2 Medical Information and Boundary Objects.....	9
2.1. Introduction.....	9
2.2. Medical Information	9
2.2.1. Medical Records	10
2.2.2. Temporary, Short-term Information	14
2.2.3. Computerization of Medical Information	17
2.3. Boundary Objects.....	21
2.4. Other Related Studies	29
2.4.1. CSCW Studies on Workspace	29
2.4.2. Organization as Negotiated Orders	31
2.5. Gaps and Understudied Issues	34
2.6. Summary.....	35
Chapter 3 Research Strategy and Design.....	37
3.1. Introduction.....	37

3.2.	Research Site Selection.....	38
3.3.	Data Collection	39
3.3.1.	Observational activities.....	39
3.3.2.	Review working documents and patient records	45
3.3.3.	Semi-structured Interviews	46
3.4.	Data Analysis	48
3.5.	Summary	51
Chapter 4	Organizational Background of Research Site	52
4.1.	Introduction.....	52
4.2.	University of Michigan Health System.....	52
4.3.	General Medicine Service Team – Medicine Howard.....	55
4.4.	Nursing Unit.....	57
4.5.	Patient Profiles	59
4.6.	Summary	60
Chapter 5	Working Documents in Nursing Work	61
5.1.	Introduction.....	61
5.2.	Nurses’ Work	62
5.2.1.	Informational Objects	63
5.2.2.	Shift-change meeting	67
5.2.3.	Preparing medication	71
5.2.4.	Reconciling medication orders	72
5.2.5.	Documentation.....	74
5.2.6.	Interacting with others	77
5.3.	Working Documents as Assembled Information Objects.....	79
5.3.1.	Nursing Kardex.....	79

5.3.2.	Shift Report Sheet (SRS)	81
5.4.	CPOE Adoption	84
5.4.1.	CPOE Impact on Local Knowledge.....	84
5.4.2.	Location, Workflow, and Group Practice	89
5.4.3.	Politics of Information and Social Arrangement of Work.....	92
5.5.	Summary	95
Chapter 6	Information Assembling and Boundary Objects	96
6.1.	Introduction.....	96
6.2.	Information Assembling at the Individual Level	96
6.3.	Information Assembling as Knowing	99
6.3.1.	Information Assembling	99
6.3.2.	Assembling as Knowing	109
6.3.3.	Implications.....	114
6.4.	CPOE as an Information Assemblage.....	117
6.4.1.	Complexity of Medical Orders	118
6.4.2.	Orders and eMAR as Boundary Objects.....	123
6.4.3.	CPOE as an Information Assemblage.....	129
6.5.	Summary	138
Chapter 7	Doctors' Information Work.....	140
7.1.	Introduction.....	140
7.2.	Doctors' Work	141
7.2.1.	Receiving Patients.....	142
7.2.2.	Acquiring Information	144
7.2.3.	Diagnostic Interview	145
7.2.4.	Morning Rounds	147

7.2.5.	Interacting with Others	150
7.2.6.	Documentation	156
7.3.	Psychosocial Information: What and When to Document?	159
7.3.1.	Psychosocial information, but only in ‘talk’	159
7.3.2.	Psychosocial information in the record, but when?	162
7.3.3.	Detailing psychosocial information in the record	166
7.4.	Medicalized Viewpoint and Legal Requirement	169
7.5.	Politics of Information in Records, What and How?	173
7.5.1.	What to Leave out	173
7.5.2.	Beliefs vs. Facts	177
7.6.	Process-oriented vs. Patient-oriented Representation	180
7.7.	eCare as an Information Assemblage	182
7.7.1.	Nuance and Relevancy	184
7.7.2.	Episodes vs. Trajectory	188
7.7.3.	eCare as an Information Assemblage	194
7.8.	Summary	196
Chapter 8	Recommendations and Design Implications	198
8.1.	Introduction	198
8.2.	Recommendations to UMHS	199
8.2.1.	Organizational Recommendations	199
8.2.2.	System Integration	202
8.3.	Support Local Knowledge Use and Informality	206
8.4.	Support Long-term Information Reuse	208
8.5.	Summary	210
Chapter 9	Conclusions and Future Work	212

9.1.	Introduction.....	212
9.2.	Study Contributions	213
9.2.1.	Contributions to Medical informatics	213
9.2.2.	Contributions to Information Science.....	217
9.2.3.	Implications to System Design	226
9.3.	Limitations	227
9.4.	Future Work	228
9.4.1.	Study of Workaround Issues	228
9.4.2.	Study of Chronic Pain Information Use in Medical systems.....	229
9.4.3.	Study of Healthcare Information Use from Patients' Perspective	230
9.5.	Concluding Remarks.....	231
	Reference	232

List of Figures

Figure 1 An overview of electronic system in UMHS	54
Figure 2 (top) Floor map of the unit; (bottom) Staff Center and Nurse Conference Room	62
Figure 3 Ecology of information objects	64
Figure 4 An example of AS before the adoption of the CPOE.....	68
Figure 5 Trays contain doctors' new orders for nurses.....	73
Figure 6 Thank - you notes board.....	77
Figure 7 Nursing Kardex (two sided)	80
Figure 8 An example of the SRS before the adoption of the CPOE.....	82
Figure 9 An example of nurses' personal work sheet	97
Figure 10 Individual information assembling process before and after the CPOE adoption.....	101
Figure 11 Documents interface of eCare	142
Figure 12 A resident's rounding sheet.....	150
Figure 13 An overview of problem summary list (PSL)	204

Abstract

This dissertation uses psychosocial information as a lens to examine doctors' and nurses' information use and documentation practice. It draws on a 17-month ethnographic study, in-depth analysis of medical records, and semi-structured interviews to investigate clinicians' documentation behaviors.

This investigation produced several findings. First, adopting a Computerized Prescriber Order Entry (CPOE) system can cause loss of written psychosocial information as nurses reluctantly make certain data permanent. Second, CPOE adoption may create information gaps in nurses' knowledge about patients. Third, while use of a CPOE system can successfully reduce medication errors, it removes discretion, nuance, temporality, and human interpretation from paper order practice to rigidly fit machine requirements. This can redistribute power and responsibility. Fourth, although doctors document psychosocial information in an electronic health records (EHR) system, they record it selectively and a medicalized viewpoint governs this selection process. As a result, missing patient representations affect work activities and patient care.

This study has broad implications for medical informatics. It cautions against casual computerization. Many well-intentioned efforts to computerize paper records assume the transition only changes media, but this study shows how social agreement and institutional arrangement around documenting patient psychosocial information can be shattered by this transition. It also suggests that efforts should be made to respect local

knowledge and practice in the computerization of medical information. The findings also suggest a need for a dual conceptualization of EHR as both a representation of medical work (process-oriented) and patients (patient-centered, as to consider information reuse from a long-term perspective).

This study also seeks to extend theories of boundary objects. It reveals that the nature of a boundary object can change when that object and the practice surrounding its use are both automated. It proposes to conceptualize process-oriented systems, such as CPOE or EHR, as information assemblages, which embed multiple information objects, heterogeneous practices, work processes, and coordination mechanisms. Furthermore, the analysis of this study uses a stack of conceptual framings: boundary object, extended boundary object, assembled object, collection, and assemblage, and argues these framings together serve to understand computerized records in a medical setting far better than can any single concept.

Chapter 1

Introduction

1.1. Motivation

I have a special interest in understanding issues in long-term information use, partially because of my first two years of training and research in the University of Michigan doctoral program in archival records management. My later research considers people's information behavior from a Computer-Supported Cooperative Work (CSCW) perspective, which focuses among other areas on the examination of issues arising from work activities carried out by groups of people in organizations. Given my training and research interests, I decided initially for my doctoral thesis to go to an organizational setting to study people's use of information and how they document long-term information. Along with my academic coursework, my unrealized childhood dream to become a medical doctor motivated me to go to a healthcare organization to investigate the gaps and issues in clinicians' use of medical information.

With the advances in information technology (IT) in healthcare settings, there have been numerous studies examining the deployment of electronic systems in hospitals. However, health informatics as a research field has had a prominent focus on outcome-based evaluations, while it has by and large neglected the socio-technical aspects of

integrating IT systems with clinicians' daily practice. Despite the general consensus that IT has great potential for improving the safety, quality, and efficiency of healthcare (Dick et al., 1991), many health IT implementation projects have failed to achieve desired outcomes due to poorly designed systems, a complex organizational setting, and a lack of understanding of real-world clinical practice (e.g. Kazley and Ozcan, 2008; Han et al., 2005; Sicotte et al., 1998). My concern about the inadequate understanding in the creation and reuse of healthcare information by clinicians in everyday practice oriented my initial research ideas for this thesis, as did the question of how an information system's adoption may affect clinicians' practice. The promise of CSCW's emerging research areas along with the evidence of inadequate analysis of medical information use in the current literature together set the general parameters of my research interest.

1.2. Information Work in Healthcare Organizations

Delivery of healthcare is usually conducted in a highly cooperative fashion. Doctors alone cannot provide the entire spectrum of care services. They must work closely with many other healthcare professionals including nurses, pharmacists, radiologists, pathologists, clerks/receptionists, medical assistants, and administrators. In addition, healthcare information needs to be frequently handed over to other groups of people because of the nature of medical work, such as when primary care physicians hand over their patients to hospital doctors, doctors in emergency department admit patients and pass them to other services in hospital, inpatient doctors pass their patients to the next team due to monthly rotations in the hospital, nursing shift-change, and so forth. This highly collaborative nature of work provides a rich environment for researchers to study the issues of information sharing and information reuse.

In clinical environments, healthcare information is highly decentralized across a variety of physical media and electronic applications. It may be collected and stored in tangible media (such as on paper forms, whiteboards, order trays) or in digital systems. While to achieve a paperless clinical environment is one of the major objectives of introducing electronic systems such as Electronic Health Records (EHR) and Computerized Provider Order Entry (CPOE) systems, clinicians still need to employ numerous existing artifacts to communicate and coordinate among groups (Østerlund, 2002; Chen, 2010). In addition, they are often creative in inventing new artifacts or workarounds whenever digital systems fall short (Halbesleben and Rathert, 2008). This interesting phenomenon deserves close attention and in-depth investigation. For instance, one may examine whether the unintended consequences are purely caused by system design flaws, or whether they are attributable to the very nature of clinical work in which tangible artifacts indeed carry meaning beyond just the formal information content alone.

A healthcare organization is comprised of highly hierarchical social groups, so the same information may mean differently to different groups because each group has its own norms of practice. While each group can adequately perform its designated tasks, it cannot achieve the collective goal of providing high quality healthcare to patients without cooperation with all other groups. The complexity of relationships among groups in a healthcare organization may affect the success of a new technology adoption, or the maximum efficiency of the new system (Kaplan, 2001).

Furthermore, even in the same health organization, departments (e.g. pharmacy, procedures, emergency) can have their own information systems, and these systems are often incompatible. This results in repetitive data entry, data inconsistency, potential

errors, and information sharing issues. This phenomenon seems to be true across many health organizations (Kelty, 1997).

These characteristics, i.e. the highly collaborative nature of work, the rich and varied media of information objects, and the complexity of the relationships among social groups in the hospital settings, and the issues of IT implementation, provided me with a rich environment in which to investigate social and technical issues in the process of medical information use. More specifically, I am interested in the issues involved in clinicians' information documentation practice – how they document information to support ongoing process and at the same time prepare that information for a long-term reuse.

1.3. Research Questions

In an extensive review of existing EHR literature, Greenhalgh and colleagues (2009) state that there is not much research conducted to date at the level of fine-grained detail of collaborative clinical work. For instance, we do not know much about what “working knowledge” is and how it is produced in different settings. They further call for more studies on “hidden work” or invisible work (Bowker and Star, 1999; Star and Struss, 1999) notably in nursing, whose work is close to patients. Indeed, much research in medical informatics has been focusing on the construction of information systems themselves rather than what they mean for the patient care activities.

The purpose of my research is to start to fill the gaps identified above, i.e. exploring and understanding, at a micro-level, both social and technical issues in the process of generation, use, and documentation of medical information in inpatient care settings. Furthermore, I also will investigate how this practice may be affected by the

adoption of a new information system. Specifically, I have a list of questions related to understanding medical information use, which includes:

- What information (e.g. disease, illness experience, family and social history, psychosocial issues) is represented in long-term medical records? And how do clinicians access, use, supplement, and document this information?
- What information is considered short-term and only captured temporarily? Why? How is it used?
- How do long-term information and short-term information interplay in the medical practice and knowledge production?
- How may the adoption of an information technology change the nature of information?

On a more general theoretical level, I want to examine how boundary objects (Star and Griesemer, 1989) are shared and used in healthcare settings and whether there is any new extension of boundary objects in this organizational setting that contributes to our general understanding of information objects. Particularly, the issues I am interested in exploration include what it means when psychosocial information is embedded in a boundary object, what it means when the understanding of one boundary object is built over others, how boundary objects are situated in a large scale information systems such as an EHR or CPOE that includes various types of information objects, heterogeneous and interrelated practices, automated work processes, complex coordination mechanisms, and special functions designated for different groups.

Because of the rich social context of healthcare systems (Mishler, 1981), there is diverse information generated and reused to support clinical operations in everyday

practice. Through an in-depth investigation of the research questions listed above, this study contributes to a better understanding of medical information use, discovers potential issues resulting from the adoption of new information technology systems, and further extends our theoretical understanding of boundary objects.

I employed three research methods in this study. First, I conducted extensive ethnographic field observations. Through a detailed observation of clinicians' work, I am able to understand how clinicians use certain medical information, how new information is generated in various activities, and how this information is (or not) subsequently documented in the records system. Second, based on this understanding gained from these observations, I examined in-depth a selection of clinical working documents and patient records. This permits me to identify any missing representations by comparing my field observations of the work with the tangible documentation. Third, I conducted semi-structured interviews with key informants from my field site, including primary care physicians, medical records management staff, and hospital administration to gain a broader understanding of medical information management from a long-term perspective. These interviews were designed to help me gain a greater understanding of the issues from the perspective of those who were being observed and start a broader investigation of medical information use in a larger healthcare context.

1.4. Overview of the Dissertation

The remainder of this dissertation proceeds as follows.

Chapter 2 Medical Information and Boundary Objects – This chapter provides an extensive literature review on the research related to patient's formal (permanent) records and clinicians' informal and temporary working documents. It also includes the literature

focusing on shared information objects in organizational settings, which explores the attributes of these objects.

Chapter 3 Research Strategy and Design -- This chapter describes the strategy of research site selection, data collection design, data coding techniques, and data analysis perspective.

Chapter 4 Organization Background of Research Site – This chapter describes the organizational background of my research site. I include an overview of the University of Michigan Health System, the organizational structure of the doctor team and nursing unit I studied, and the patient profiles.

Chapter 5 Working Documents in Nursing Work – This chapter introduces nurses' work in general. Then, it focuses on the analysis of locally-created two group working documents, illustrating how they play distinctive roles in nurses' information needs and how they were replaced by the CPOE. The findings from this investigation contribute to a better understanding of local knowledge use in nursing work and suggest that the design of information systems should consider how to support informality.

Chapter 6 Information Assembling and Boundary Objects – This chapter describes what nurses' information assembling process is like at the individual level and analyzes how workflow changes after the CPOE adoption have affected nurses' patient knowledge. Since the CPOE adoption has changed the medical order practice and work arrangements and automated work processes in many ways, I use boundary object as a theoretical construct to analyze some of the distinctive attributes of medical orders as shared information objects. I also suggest conceptualizing the CPOE as an information assemblage, which provides a common information space for different communities of

practice, which embeds not only boundary objects but also heterogeneous and interrelated practices around medical orders, automated work processes, coordination mechanisms, and the special functions for designated groups.

Chapter 7 Doctors' Information Work – This chapter focuses on doctors' documentation practice. I use psychosocial information as a lens to examine medical work. I illustrate how doctors acquire information from different channels to understand a new patient case, how they cope with a complex case that involves substantial psychosocial issues in addition to medical conditions, and how they document (or leave out) such issues in patient records. Since patient records are generated by each individual group but shared by different communities of practice, I use boundary object theory to analyze some of the distinctive attributes of these medical records to extend our theoretical understanding of shared information objects in medical settings. I further suggest conceptualizing eCare (, which stores collections of patient records, practices, and navigation schemes,) as an assemblage to better understand information reuse from a long-term perspective.

Chapter 8 Recommendations and Design Implications – This chapter provides several organizational recommendations and draws out implications to improve system design.

Chapter 9 Conclusions and Future Work – This chapter summarizes major contributions of this study for medical informatics, information science, and system design. I also point out the limitations of this study, and lay out my plans for future work.

Chapter 2

Medical Information and Boundary Objects

2.1. Introduction

In this section, I review studies that address the functions and use of formal records (i.e. long-term information) and temporary, short-term information (often existing in working documents and other tangible artifacts) in medical work. I will also review the studies that have explored the issues with shared information objects in other organizational settings. This is an attempt to identify gaps in the body of existing literature in understanding information use and further elaborates the research questions I am interested in investigating in this dissertation.

2.2. Medical Information

Medical information exists in various media and formats. Some is captured in permanent system as patient records, whereas other may be jotted down by clinicians on working documents or other tangible artifacts for a temporary use. In this section, I discuss the studies that focus on medical information use and documentation in both situations. I further discuss the impact of computerization of information on medical work.

2.2.1. Medical Records

A considerable body of research addresses the functions of medical records in healthcare practices. Berg (1997) serves as a useful starting point and suggests ‘formal tools’ to explain the function of medical records in clinical work. He states, “Formal tools (i.e., those tools that operate on circumscribed input using rules and that contain a model of the workplace in which they are supposed to function) are attributed central roles in organizing work within many modern workplaces” (p. 403). According to this working definition, medical records are a formal tool or system that has predefined rules (e.g. what should be in the systems, and in what formats). These rules also embed abstract models that describe the workplace and activities.

However, one may ask the question -- how well do medical records, the production of these models and rules carried out in workplace, represent human practice in clinical settings? In everyday life, a map is a representation of the terrain, and different maps serve different purposes; there are always gaps between the terrain (represented) and the map (representation). Likewise, medical records, as a representation of medical practice, also have gaps about the medical world they represent. Further, one representation can yield more gaps if designed for another purpose. For instance, Moss et al. (2007) uncovers that only 25% of the narrative nursing documentation is reflected in their structured documentation; furthermore, they point out nursing documentation only reflects a very limited part of the entire nursing care practice regardless of the representation methods (i.e. structured or descriptive). In reality, nursing care information is often jotted down on handy working documents. It may be a sentence, or several key words, but it does not have to fit in a predetermined categorization scheme. In

fact, Bowker and Star (1999) show the complexity of nursing work, as they state, “...How can one capture humor as a deliberate nursing intervention? Does sarcasm, irony, or laughter count as a nursing intervention? ...No one would dispute its importance, but it is by its nature a situated and subjective action.” (p. 247) This suggests that any categorization scheme may lose a substantial amount of the nuance of real nursing work.

Although it is important to acknowledge the inherent gap between representation and the real world, perhaps very critically, researchers should also want to explore which information should be documented or represented and for what purpose.

Medical records, as a formal representation of clinical work, aim to support current ongoing patient care activities and also serve as an information source when a patient comes back, i.e. long-term use across care episodes. This is in addition to legal and financial accountability. The documentation is part of clinical practice, which often takes one third of a clinician’s time in general practice (Oxentenko et al., 2010) and involves the efforts of all groups of clinicians. However, many years after Garfinkel’s (1967) well-cited research on “bad medical records”, medical practice is still struggling to create good documentation processes. Simply put, it is still unclear to clinicians “when to record what information” in order to create maximum efficiency for a long-term reuse. Because of the historical focus on facilitating acute care, medical practice presents itself predominantly as episodic in nature (Proudfoot et al., 2007), which is reflected in its documentation. This has produced many difficulties when healthcare information needs to be reused, especially in chronic disease treatment.

For instance, chronic conditions such as diabetes, cardiovascular diseases, asthma, and depression contribute to 47% of the global burden of disease¹. Because of the limitation of short consultations and little emphasis on patients' role as a partner in the care process, clinical and social information (e.g. patient's experience of their chronic disease) is often poorly recorded or simply missing (Goudswaard, 2003; Gray et al., 2000). According to Khanna (2005), patient information such as demographic data, medical history, treatments, test results, and family history is often unavailable. As many patients suffer multiple chronic diseases, or they need to see multiple physicians for the same health situation, the absence of necessary data for subsequent visits significantly affects the quality of care.

There have been efforts to improve documentation practice. For instance, Hempel (1990) used the guidelines of National Diabetes Advisory Board to assess the quality of documentation in a community hospital-based ambulatory care center, and further designed a flow sheet based on guidelines as an intervention to capture essential data from early diagnosis. This flow sheet also included weekly teaching clinic content. It was placed in the medical records of patients and both nurses and physicians input different content. As a result, the quantity of documentation was significantly increased as well as the number of referrals for prevention care.

In managing multiple chronic diseases, a patient often needs to see more than one doctor. Branger et al. (1999) reported an inter-physician electronic communication network that tackles the problems of fragmentation and discontinuity of medical records. Through the communication network, physicians are able to exchange consultation

¹ World Health Organizations: WHO Non Communicable Disease Program. <http://www.who.int/nmh/en>

² In this dissertation, I define a working document as a temporary one that will be discarded eventually. It is

outcomes, reduce repetitive data entry, and provide more complete information about the care that patients are receiving.

The studies reviewed above demonstrate that there is an urgent need to understand how to construct good medical information systems for long-term reuse. There has long been a complaint that “medical records no longer serve a useful clinical role because they have evolved to primarily serve regulator, medico-legal and billing needs,” and clinicians have started to develop their own informal solutions (Nemeth et al 2006, p. 586). In addition, there are also debates on whether medical records should be conceptualized as process-centered (i.e., organized around a medical facility’s work processes) or as patient-centered (i.e., organized around the patient’s disease descriptors and health conditions) (Greenhalgh et al., 2009; Østerlund, 2002). If a system only focuses on a process-centered model, it will be difficult for doctors to obtain a clear and complete view about a patient and her illness trajectory (Strauss et al., 1997). Even though the information about this patient is captured in the system, it may not be organized in a way that doctors can easily access, and instead is scattered in a large volume of process-oriented records.

All issues discussed in this section beg a clear answer to a fundamental question -- how can medical information systems be constructed to support not only current activities but also long-term reuse. The problems discovered in the field have inspired researchers to explore the issues and challenges of constructing medical information systems that serve a variety of needs.

2.2.2. Temporary, Short-term Information

There is a huge amount of temporary, short-term information used at any time in medical settings. For instance, when a doctor or nurse is talking to or taking care of a patient, he or she may use a piece of paper to scribble data on and later may (or may not) enter these data into the patient's record. This piece of paper is not a final product in the records system, and most likely it will be thrown away right after the episode. However, this type of handy tools provides convenient means to accomplish the current task.

Researchers have long been studying the impact of tangible artifacts used in different organizational settings to support collaborative work (e.g. Boguslaw and Porter, 1962; Xiao et al., 2001). A healthcare institution is a physically rich environment. Clinicians use many artifacts, such as paper, whiteboard, color stickers, magnets, and so on, to record and share information in real-time. Xiao et al. (2001) studied the cognitive properties of a whiteboard in an intensive care unit. They illustrated how a whiteboard, as part of an external representation (Hutchins, 1995; Zhang and Norman, 1994), “remembers” the schedule and cases, “displays” constraints and options to the user, and “stimulates” possible scheduling solutions. They also explained how the small items on the whiteboard (e.g. magnetic strips and tags) were used to facilitate changing the representation of task activities and work schedules to match the frequent alteration of work statuses.

Temporary and short-term information is also used heavily for coordination among groups of clinicians. As clinical work usually involves time-sensitive cooperative work, coordination is achieved by use of temporary information. Bardram (2000) analyzes three types of coordination in a surgical unit: 1) communicative, via telephones,

papers, paper notes; 2) instrumental, via awareness about the activities of others, special signs on the wallboard; 3) scripted, via the pre-determined schedule distributed among groups. This finding also applies to general inpatient units and outpatient clinics. In fact, convenient color coding devices are also used for coordination between physicians and nurses. For instance, physicians may use a specific color attached to a patient chart folder to notify nurses/clerk that new medication is issued that needs emergent care (red) or regular care (yellow); nurses use color pointers attached to a door frame of each exam room (in outpatient clinics) to notify a doctor that her patient is ready to be seen; each doctor has a distinct color so she can locate the right room and the right patient.

Temporary, short-term information also exists in sketch paper (e.g. nurses' personal work sheets and doctors' rounding sheets) that all clinicians carry around in their pockets. Nurses refer to their personal sheet as their 'brain'. They use these sheets to scribble data in real time, and help remember what has happened and who needs care at what specific times (Hardey et al., 2000; Hyde et al., 2005). In addition, outgoing nurses use various media (audio tapes, paper working documents², verbal communications, whiteboards) to disassemble the information; incoming nurses receive information from various channels and assemble them into their personal sheets, which they carry in their pockets during the entire shift (Tang and Carpendale, 2007).

Temporary and short-term information exists even in formal documents during the process of a trajectory development. Hardstone et al. (2004) report that certain text on formal documents is written with pencil as work-in-progress information; it will be replaced with final and formal information written in pen after group discussion. The

² In this dissertation, I define a working document as a temporary one that will be discarded eventually. It is not part of the patients' records. It only supports working process.

pencil written information allows initial ideas to shape. Some of these ideas will be taken up in the final documents, but others may not. New ideas will also emerge during a group assessment and discussion. The work-in-progress information is found to be critical to achieve final and formal documentation.

Indeed, many paper-based working documents carry temporary, short-term information. Some of this information can be redundant, i.e. the same data appearing on different media such as in a permanent record system. While the redundancy may cause data inconsistency leading to misconceptions and medical errors, the positive side of the redundancy is that it has been found to facilitate coordination, articulation, and collaborative work in medical settings (Tjora, 2004; Cabitza et al., 2005). One of the main goals of many healthcare information technology systems is to remove data redundancy. However, without fully understanding the roles of redundancy in clinical work, simple removal of redundancy may cause work deficiencies, and even degrading the quality of care. Studies have shown that the effort of removing redundancy ironically resulted in the relocation or recreation of the redundancy to another format (Munkvold et al., 2006).

Paper-based working documents are often used to support group work. The information on working documents are usually jointly created by group members and shared among them (Randell et. al, 2008). The life circle of this information is episodic (e.g. within one shift, within a patient's hospital stay). These working documents are eventually thrown away instead of being stored in the formal records system. This impermanence is perhaps one of the reasons that nurses feel comfortable to jot done

psychosocial information about patients on working documents. This information is often important for nursing care.

The studies reviewed in this section address the necessity of the temporary, short-term information use in a physically rich and clinical context. With the advances of IT development, the tendency of ‘formalizing’ work with a technological solution, while neglecting the nature of ‘informality’ of this type of information may create new problems in practices (Munkvold et al., 2006; Hardstone et al., 2004). This is one of the topics that my study will further illustrate and provide detailed analysis.

2.2.3. Computerization of Medical Information

There have been many very well-intended efforts, both in the HCI/CSCW and health informatics research fields, to computerize tangible tools such as paper-based medical records and working documents and whiteboards, so the medical information can be shared among groups of clinicians simultaneously (e.g. Tang and Capendale, 2007; Campion and Denny, 2007; Nemeth et al., 2006; Berkowicz et al., 1999) or to support future research and marketing.

With the widespread adoption of EHR systems, the resulting loss of social context and nuanced use of medical information on paper records has received the attention of researchers. Heath and Luff (1996) examine the use of paper medical records and illustrated how the implicit knowledge extracted from the process is important for later use. For instance, all entries on patient cards were explicit information. Handwritten entries on paper records, however, carried much implicit meaning as well. By just ‘a glance’ at the paper records, doctors are able to recognize the handwriting of their colleagues. They therefore knew ‘who saw which patient for what’. By a quick scanning

of entries across a stack of patient cards (previous diagnoses, a variety of treatments, chronic and acute situations) and assembling the text with regard to an impression of how the current symptom is related to previous diagnoses, doctors could produce trajectories of patients' illnesses. This rich implicit information lying within paper records provides an invaluable resource for doctors making sense of an illness. The implicit meaning of paper-based records was created by each individual doctor, but it was interpreted and used by many other colleagues. On paper-based patient cards, when writing an entry, doctors were sensitive to the inference colleagues could draw. For instance, they might include 'trivial' or information with ambiguity but exclude particular items, knowing that any competent reader (his/her colleagues) would be able to make sense of the entry and retrieve the relevant information. With the introduction of electronic patient records systems, however, doctors were forced to choose from a set of pre-determined diagnosis, which was in fact one of major goals of EHRs, i.e. to remove the 'ambiguity' and formalize the entries so the data could be used for future research and marketing.

There were other issues with EHRs identified by Heath and Luff. For instance, there was a clear separation between diagnostic versus therapeutic files, and acute versus chronic treatments, which in the past was on one single patient card so a quick glance might provide a doctor the full picture. By treating doctors' reading and writing of a record as a single process and comparing their use of paper versus electronic records, Heath and Luff revealed how the paper-based records used in day-to-day consultations, seemingly an individual task, instead relied on a socially collaborative organizational process.

Likewise, there have been a number of studies that examine the computerization of temporary, short-term, or “work-in-progress” medical information (e.g. Hardstone et al., 2004; Xiao et al., 2001), which in the past only existed on tangible artifacts. Indeed, IT allows some part of the temporary, short-term information to be captured directly in electronic systems and thus enable long-term information reuse. The boundary between long-term medical records and short-term informal information in a paper-based environment has become somewhat blurred in a computerized medical setting.

In a paper-based environment, permanent documents are primarily comprised of patient records. The system does not intend to preserve working process documents, such as the various kinds of nurses’ report sheets, Kardex, doctors’ sign-out sheets. With the increasing adoption of information technology in medical settings, convenient preservation of working process documents becomes possible. For instance, traditionally resident sign-out sheets are only used by residents and attending physicians. It is a transitory process that residents use to track patients’ medical situation, report to their attending physicians, or handover to on-call residents. In a computerized environment, the sign-out sheets can be easily documented and made available to many other groups of clinicians. *Campion and Denny (2007)* found that that nurses used them frequently in addition to residents. Although this study did not investigate the reasons why nurses started to use this information that was not available to share in a paper-based environment, it showed how the electronic documentation might have changed and affected the working process and ultimately influenced the quality of patient care.

As mentioned before, whiteboards are commonly used in hospital settings. They not only present information but also facilitate changing the representation to match

alterations of work status with the help of other small items such as magnetic strips and color tags (Xiao et al., 2001). For these traditional whiteboards, the ‘downside’ is that they can only ‘remember’ a very limited and latest version of information. With the advance of information technology, eWhiteboards has been used to solve such problems. Although, research has shown that digital whiteboards function more or less as new and improved display devices, because they can present more information in multiple screens, they, nevertheless lose the ability to enable coordination, collective problem solving, and negotiation among clinicians (e.g. Berkowicz et al., 1999).

In a hybrid environment, people often view verbal communication, handwritten records, and electronic records in a hierarchical order, i.e. “what is communicated or documented has increasingly ‘permanent’ character, becomes more authoritative, accountable, and potentially available to a wider audience” (Hardstone et al., 2004). Many working documents are used to record work-in-process or certain sensitive information that is only meant to be shared within the group. However, the tendency to computerize working documents has changed the nature of the ‘informality’ of temporary, short-term information into a ‘formality’ and permanence, which is perhaps not desired by clinicians in various situations.

At a system design level, HCI/CSCW and health informatics research has focused on the gap between what an EHR can provide and how the medical work is done in reality. Bossen (2006) studied a prototype EHR system constructed according to a Danish national EHR standard. The system was found to only partially support clinical work, which was largely attributable to the model used in the standard design process deviating from how clinical work is actually performed. Similarly, Niazkhani et al. (2009) reported

that the overly simplistic representation models underlying current medication ordering systems led to severe interference with, rather than facilitation of, the actual medical work. Further, Fitzpatrick et al. (2004) showed that in reality, clinicians often tailor, re-present, and augment clinical information according to their roles and preferences, which is not adequately supported in the current EHR design.

The studies reviewed in this section suggest that computerization may hinder the nuanced use of medical information that was originally enabled by the use of tangible artifacts. When electronic systems are introduced to clinical practice, they also change the scope of information sharing, the nature of information (e.g. from informal to formal), and communication pattern and social dynamics across different groups (Ash et al., 2006). New information systems are often expected to assume the functions of the original tangible artifacts while also improving the processes and making the work more efficient. But new types of errors may occur in the coordination process; clinicians may resist using the new system, because such systems misrepresent collective, interactive clinical work as a linear, clear-cut, and predictable workflow (Ash et al., 2004). Indeed, computerization has changed the way medical information is generated. This results in a need for re-interpretation to understand how an electronic medical records system should be applied in the realm of a nuanced empirical medical workplace (Berg, 2001; Reddy et al., 2003; Kaplan, 2001). The impact of technology deployment needs to be understood fully to avoid the unintended or adverse consequence of casual computerization.

2.3. Boundary Objects

Boundary object is a concept first introduced by Star and Griesemer (1989), referring to those objects that serve as an interface between different communities of

practice (Lave and Wenger, 1991) while being viewed or used differently by each of them. There are four types of boundary objects identified in the original study:

- Repositories: objects indexed in some standardized fashion;
- Ideal type: objects that do not have local details but bear attributes from all domains;
- Coincident boundaries: common objects with the same boundaries but different internal contexts;
- Standardized forms: devised as methods of common communication across dispersed work groups.

Boundary objects need to be flexible and adaptable because they serve different viewpoints. They also need to be robust enough to maintain identity across different communities of practice (Bowker and Star, 1999; Wenger, 1999). These different types of boundary objects can be identified in many organizational settings. Since then, numerous studies in HCI/CSCW have used this theoretical component in various situations to address issues surrounding information objects (e.g. Mambrey and Robinson, 1997; Bechky, 1999; Henderson, 1999; Pawlowski et al., 2000; Ackerman and Halverson, 2004; Lee, 2007; Lutters and Ackerman, 2007).

Studies using boundary objects as a theoretical construct present a spectrum of information use in different settings. These studies have expanded our theoretical understanding of the original concept of boundary objects. Boundary objects designed to be shared across different communities of practice often fail, for example when assemblers do not understand engineers' drawings (Bechky, 1999). In this situation,

verbal communication and a tangible definition to the elements of drawings are often needed as a way to provide enough contextual information for shared understanding. Then the question becomes: should this contextual information be provided within the original boundary object or as a separate information object?

When a boundary object is created to satisfy multiple communities, it is “weakly structured in common use” and then it becomes “strongly structured in individual-site use” (Bowker and Star, 1999). Indeed, to meet the needs from multiple communities, the boundary objects often have to be de-contextualized, i.e. not including too much contextual information only necessary for one community. However, the de-contextualization of boundary objects often mean that the reuse of boundary objects needs re-contextualization (Ackerman and Halverson, 2004) and this can be difficult. Sometimes, substantial negotiations are needed because the historical context of boundary objects may not be perceived from the object itself (Lutters and Ackerman, 2007). Indeed, studies have found that the use of boundary objects may need amendment in various settings (Henderson, 1999). For instance, the same engineering drawings are not only used in manufacturing, they may be used in commercial (i.e. marketing and sales), inventory control, and accounting management. This raises a further question: whether this type of the amendments is itself a boundary object?

Information studies in organizational settings have found that the concept of boundary objects is not adequate to describe various information objects in the production of work. For instance, to coordinate work activities across groups, other representations and intermediary objects are also found to be necessary for the process of collaboration. From investigating engineering designing activities, Boujut and Blanco

(2003) point out that intermediary objects, such as sketches and drafts, are powerful tools to describe and understand different levels of knowledge-in-actions, which include “when and with whom communication occurs”, “what information is needed”, and “what is a suitable medium”. These intermediary objects often serve “mediation” and “transformation or translation” between groups, and “representations” of the product or the design process.

Then, is there a problem to use the concept of boundary object as a “catch-all” (Lee, 2007) to analyze and understand shared information objects? In her extensive review of empirical studies that employ boundary object to theorize material artifacts, Lee questions the conceptualization that “all objects that move between communities of practice are boundary objects.” She implies that the information objects that cannot satisfy the information requirements of the other community (e.g. the engineering drawing in Bechky, 1999) or the amendments created through interaction between two communities (i.e. the conscription devices in Henderson, 1999) are not boundary objects. From her own ethnographic study of collaborative activities in the design of a museum exhibition, Lee finds that material artifacts in this setting are better conceptualized as “boundary negotiating objects” because they serve to “establish and destabilize protocols themselves and that artifacts can be used to push boundaries rather than merely sailing across them.”

Lee’s argument may be debatable because one can also argue that needing extra contextual information does not disqualify a shared artifact from being a boundary object. In fact, various studies have shown that the use of extensively shared information objects (i.e. perfect candidates for boundary objects) always need contextual information to re-

contextualize the situation, whether it is verbal communication, meta-negotiations, or further elaboration (Ackerman and Halverson, 2004; Lutters and Ackerman, 2007; Hertzum, 1999).

Regardless, Lee's survey and empirical study is very valuable for researchers in information science to realize that there are various kinds of shared information objects that may not comfortably fit the original definition of boundary object. From another perspective, however, this also means that the concept of boundary object may need to expand to become more nuanced.

Indeed, in analyzing three artifacts created to support the repairing of aircraft technical problems that involve several communities of practice, Lutters and Ackerman (2007) find that the conceptualization of boundary objects cannot sufficiently address the issues of artifacts used across institutional boundaries. They then extend the original concept of boundary object to address three additional concerns. They note that 1) even though all three boundary objects in that study embed well-established standardization, tensions often occur between this standardization (both object and process) and their use in routine work; 2) a boundary object represents a unique event that is created at one point in the sequential time path of an entire situation (i.e. punctuated crystallization), and it is continuously under interpretation and contextualization; and 3) the use of a boundary object is situated in a historical context and the process of use involves implicit negotiations (i.e. meta-negotiations and even streams). This study adds nuance to our understanding of how boundary objects are created (e.g. they may include past information), used in routine work (often with tension occurring), and potentially reused in the future (both anticipated and unanticipated).

Furthermore, Ackerman and Halverson (2004) point out that boundary objects and most of information in organizations used by more than one group has an implicit politics of information. In a detailed analysis of two hotline calls involving to correct entries in payroll record database systems, they uncover that information that serves as memories often has mixed provenance; however the information on final records is authoritative and governed by one party. This situation often creates tensions or conflicts when the information is reused. Likewise, Bowker and Star (1999) also point out that politics of information, such as comparability, visibility, and control, exists in any categorization systems, and categorization scheme is the central concern in constructing boundary objects in organizational work.

In the medical context, a patient can be seen as a boundary object -- she is examined directly by doctors, nurses, and lab/radiology technicians, and served by even more groups of caregivers indirectly. Her medical records, i.e. the surrogate representation of this patient, act as boundary objects that are shared across all groups of caregivers (Berg and Bowker, 1997). Boundary objects as a theoretical construct is understudied in medical settings. For instance, we do not know much about how a boundary object is built upon other objects (i.e. a patient's medical records as a collection), and how much nuance, psychosocial information, and politics that a boundary object can and should embed given that boundary objects are often condensed into standardized forms.

Acknowledging the incompleteness of original conceptualization of boundary objects, research in CSCW has used other analytical frameworks to understand work practices. Assemblage is a theoretical concept that overlaps some attributes of boundary

objects while also focusing on the nature of local practice and knowledge. Watson-Verran and Turnbull (1995) use assemblage referring to “the amalgam of places, bodies, voices, skills, practices, technical devices, theories, social strategies, and collective work that together constitute technoscientific knowledge/practices” (p. 117). This is a perspective that aims to understand work in the context of wider cooperative work arrangements, rather than focusing on only boundary objects and practices around those objects.

From this perspective, Tellioglu and Wagner (1997) illustrated some complex assembling processes in software development, including acquiring specific requirements, modules, pieces of code, and prior versions of the code. This study describes how practice and tools could be developed to support collaboration across institutional and social group boundaries while simultaneously being “respectful of regionalization”. Their research extended this viewpoint to medical information, pointing out that medical information, especially documents, is often arranged in assemblages of artifacts (Tellioglu and Wagner, 2001; Schmidt and Wagner, 2004; Schmidt et al., 2007).

A similar concept but with different terminology and different focus is bundles. Gorman et al. (2000) studied extensive informational objects in a hospital setting, and consider bundles as “organized, highly selective collections of information”. They characterize the bundles in medical settings as always “actively created” by the people who want to solve the problem, so it is “task oriented” and “context specific”, which should be highly “selective” to the most relevant information; they are a “collection” of many information components which can be found elsewhere in the system, so they can be “redundant”; they are “physical” and therefore distinguished from purely mental

representations, and are comprised of “multi-granular” information from words, sentences, or paragraphs to describe the situation. This characterization depicts many informal and temporary working documents used in medical settings, such as doctors’ and nurses’ personal sheets, Kardex, and group working documents.

Bundle as a concept is very useful to understand how various material artifacts are connected together to serve specific tasks. However, it does not embed the meaning of practices within or around the objects. As a comparison, the assemblage in its original definition (Watson-Verran and Turnbull, 1995) has multiple meanings referring to objects, requirements, practices, processes, and strategies as a whole. This is a perspective looking at information objects and practices in a wider context, including work processes, work arrangements, and coordination mechanisms. For example, Schmidt and Wagner (2004) use ‘ordering systems’, which are assemblies of specialized practices and artifacts, to analyze the coordinative practices in architectural design and planning. In the ‘ordering systems’, each of the artifacts is specified and critical in coordinative practice and they are all interrelated to one another.

The studies reviewed in this section show that both boundary objects and assemblage are useful conceptualizations to study information objects and work practice around them. It is perhaps particularly useful to characterize a complex information system and its practice as an assemblage that involves a cluster of not only boundary objects but also specialized information objects for designated groups, heterogeneous and interrelated practices, coordinative mechanisms, and work processes. In later chapters, my analysis will examine a number of information objects and practices around these objects from both the boundary object and assemblage perspectives. I will illustrate how

using boundary objects as a theoretical construct to examine various shared information objects in hospital settings may be limited and how assemblage can be theoretically developed to further our understanding of information practices in organizations.

2.4. Other Related Studies

There are several additional analytical concepts that are important to help understand medical work. These studies have influenced my analysis substantially. In this section, I will briefly discuss these related studies.

2.4.1. CSCW Studies on Workspace

A hallmark of CSCW has been the analysis of workspaces in organizational settings. One common theme is awareness in collaborative work. In a general sense, awareness in a workspace involves knowing “who we are working with, what they are doing, where they are working, when various events happen, and how those events occur.” (Gutwin and Greenberg, 2000, p. 246). Awareness is the type of information that is fundamental to coordinate group activities; therefore, many CSCW researchers have focused their analyses on this issue.

Awareness in a workspace involves various types of input. For instance, Gaver (1991) shows that auditory cues are crucial sources of information and sounds often support general awareness of ongoing events without requiring consciousness from a receiver. Likewise, coworkers also use the awareness from spatial cues to successfully manage interactions and facilitate cooperative activities (Heath and Luff, 1992). The prudent use of space often provides peripheral awareness of what is happening through seeing ‘at a glance’ (Benford et al., 1994).

Auditory and spatial awareness requires coworkers to be in a synchronous and largely collocated environment. When coworkers are constantly mobile, such as doctors and nurses in hospital settings, awareness of where to find a desired person is crucial to coordinate the task. To address this concern, Bardram and Hansen (2004) examine a prototype context-aware computing device, 'AwarePhone,' which aims to promote social awareness – knowledge about where to locate a desired doctor or nurse without interrupting her work activities. 'AwarePhone' is used in a post-it note style as a way to avoid the problem of the Instant Messaging method, which can be disruptive and obtrusive.

Indeed, too much awareness can be very disruptive and obtrusive. In their study of London Underground Line Control Rooms, Heath and Luff (1992) analyze how the physical layout of each facility and its space arrangement provide the traffic controller and divisional information assistant with only the necessary awareness of one another's task, how the work of one person enables the other to subsequently take appropriate actions without interrupting what they are doing, and how they seamlessly move from one task to the other. This study found that while coworkers 'monitor' one another's activities, they also 'display' their own activities and status publicly to others. The complementary aspect of awareness information ('monitoring' and 'displaying') ensures the 'appropriate obtrusiveness' (Schmidt, 2002).

In a later study, Heath et al. (2002) suggest that "awareness is not simply a 'state of mind' or a 'cognitive ability', but rather a feature of practical action which is systematically accomplished within developing course of everyday activities." (p. 318) This perspective takes a somewhat different stance from the view of the "passive" nature

of awareness information (Dourish and Bellotti, 1992; Dourish and Bly, 1992). In a review article, Schmidt (2002) points out that the notion of ‘passive awareness’ may ‘mystify’ what the CSCW research needs to understand: “the practices through which actors align and integrate their distributed but interdependent activities.” (p. 290) He argues that CSCW research on awareness should explore how coworkers “effortlessly pick up” awareness information and subsequently make sense of it (which will be used to guide subsequent actions) and also how ‘appropriate obtrusiveness’ is maintained in the coordination of collaborative work.

Studies on awareness have focused on interactions among coworkers. Awareness arises from the different status of information objects (tangible artifacts and electronic systems) and physical layout of various informational objects. The ecological aspects of human conduct are understudied, as also argued by Heath et al. (2002). For instance, in paper operations, inpatient doctors’ new prescriptions are often placed in patients’ order boxes located at a station center so that nurses would not miss them because they frequently pass by the order box for various activities. Whiteboards are often used to display “status information” (including that of both patients and doctors) as a way to communicate asynchronously among non-collocate personnel in a ward (Bardram, 2000). When medical practice in hospital settings has been increasingly computerized, how to provide awareness information originally arising from tangible artifacts warrants more research.

2.4.2. Organization as Negotiated Orders

In 1963, Strauss and colleagues published a seminal paper, reporting findings from their field observations in two psychiatric hospitals (Strauss et al., 1963). This study

not only provides numerous insights about the reality of life in the ward but also contributes to our theoretical understanding of orders in a hospital setting. The concept of hospital as negotiated orders has been examined in other organizational settings, such as prisons (Thomas, 1984) and in public sector accounting and financial control (Rahaman and Lawrence, 2001).

The departure point of Strauss et al.'s work is to understand "how a measure of order is maintained in the face of inevitable change (derivable from sources both external and internal to the organization)." (p. 148) According to them, researchers tend to focus on understanding the external change; however, the rules, hierarchical status, and other features of organizations are far less stable and are constantly prone to change. While organizational work is still accomplished, it is done based on shared "agreement," established "understanding", binding "contract", and institutional "arrangement", which are all part of negotiations.

In their observations, Strauss et al. find that the rules governing the actions in hospital production are often not clearly spelled out. Some rules may be made and enforced, then they may be forgotten and fall into disuse after a short time. This fact naturally leads to negotiation (among physicians, nurses, nurse aides, and even patients) about how the work should be done. From another perspective, Strauss et al. also notice that when a set of rules is too rigid, it causes "turmoil" and affects the efficiency of the work. As a result,

"almost all these [hospital] rules are much less like commands, and much more like general understandings: not even their punishments are spelled out; and mostly they

can be stretched, negotiated, argued as well as ignored or applied at convenient moments.” (p. 153)

Negotiations occur at all levels, among the same group of professions and between physicians and nurses, nurses and nurse aides, physicians and patients, and so forth. Even though the general goal is “to return patients to the outside world in better shape,” different professionals may perceive and interpret “getting better” in their own ways. For instance, nurse aides, who spend the most time with patients, would interpret it based on a patient’s daily behavior, whereas psychiatrists would look for the signs related to the patient’s personality. Furthermore, physicians with different professional training, such as neurologically- versus psychotherapeutically-trained psychiatrists, may provide very different treatment to the same patients in the ward, which is another condition for negotiations. To add another layer of complexity, each patient is unique, thus the action around the patient should always be customized to suit each individual case. All these conditions predetermine that “only a minimum of rules can be laid down for running a hospital.” (p. 156)

Strauss et al. further argue that “agreements” on how things should be done and how work should be arranged do not occur by chance nor are established by random parties; instead, they are “patterned” (that is, “who contracts with whom, about what, as well as when these agreements are made”). This pattern, the kind of negotiation, renders predictability. For instance, certain physicians may have their “particular philosophies of treatment,” so nurses, nurse aides, and secretaries would know the particular ways to deal with the situation when things become troublesome when they work with these physicians.

Perhaps most importantly, “agreements” are often temporary – “the hospital can be visualized as a place where numerous agreements are continually being terminated or forgotten, but also continually being established, renewed, reviewed, revoked, and revised.” (p. 164) Then, the central issue raised to our researchers is to explore and understand what and how relationships exist between current work arrangements (although temporary) and the relatively more stable organizational structure.

In the climate of increasing computerization of medical information, hospitals are facing rapid change both externally and internally. Strauss et al.’s work provides both practical and theoretical background for understanding how medicine is practiced in the modern world. To the interest of my thesis, i.e. clinicians’ information use and documentation behavior, in later chapters, I will start unpacking and illustrating the process of negotiation and renegotiation - how doctors and nurses come to certain agreements on what should be documented, how they disagree on certain issues and then renegotiate, and how work arrangements are reshaped after the adoption of electronic systems.

2.5. Gaps and Understudied Issues

I am informed by the literature reviewed above to recognize the gaps and understudied research issues in this research area. For instance, HCI/CSCW and health informatics literatures do not adequately address the detailed use of medical information. Studies of medical information use tend to see medical information as a whole without acknowledging the differing forms that medical information may take when used in different clinical activities. For instance, psychosocial information, a patient’s psychological and social issues in her chronic illness experience, is notably important for

doctors to know to make an informed treatment and for nurses to provide emotional care in addition to medical care. Then, how do doctors and nurses learn about such issues and how do they document this information? Do they document it in permanent records systems or on temporary working documents? If they need to document this information, how do they describe the issues in order to be more objective rather than subjective? How differently do doctors and nurses handle this information?

From a theoretical perspective, there are very few studies that have examined information systems as a boundary objects (Ackerman and Havlerson, 2004; Pawlowski et al., 2000). Particularly, when an information system automates information objects (publically shared and local knowledge), work processes and work arrangements may be greatly affected, which may result in shifts in power and responsibilities (Zuboff, 1989).

My dissertation aims to explore these understudied issues (identified above) in a medical setting. In particular, I will use psychosocial information as a lens to examine clinicians' information use and documentation practice. In addition, because I have the opportunity to observe the implementation of a new information system (the CPOE), I will also explore how the overall work arrangements around order practice have been affected, and what this change means for shifts in work responsibility and administrative control.

2.6. Summary

In this chapter, I reviewed studies that focus on medical information use and documentation. I also discussed existing literature that has examined the issues with shared information objects in other organizational settings. From this literature review, I am able to identify gaps or understudied issues in HCI/CSCW and medical informatics.

Finally, I further elaborated my research questions. In the next chapter, I describe the strategy of my research design, data collection, and analysis.

Chapter 3

Research Strategy and Design

3.1. Introduction

The goal of this research is to get an in-depth understanding of information use and documentation in medical practice. Since I want to explore what information clinicians need when they receive a new patient in order to provide medical and emotional care, how they familiarize themselves with a patient, examining what new information is generated through the process of achieving an understanding about a patient, in determining how they eventually document this information or why they choose not to document certain categories of information, this investigation requires me to closely observe clinicians' work on a day-to-day basis, to carefully examine their working documents, and to review permanent patient records – the “informational product” (both informal and temporary, formal and permanent). Consequently, I selected ethnographic observation and in-depth analysis of medical documents as the two main research methods for this study. I also interviewed various clinicians who are not covered in my observation to broaden my understanding of various related issues. In this chapter, I describe the strategy of research site selection, data collection design, data coding techniques, and data analysis perspective.

3.2. Research Site Selection

The University of Michigan Health Systems (UMHS) is a large health organization. It offers many potential research sites relevant to the focus of this study, where I will be able to examine information use and documentation in medical practice. As part of the pre-study, from August to November 2007, I completed eight observations in different potential sites in the UMHS system. These included Cardiovascular ICU (Intensive Care Unit), Cardiac ICU, General Medicine/Gastroenterology-Liver unit, Neurology General Care unit, General Care/Cardiovascular unit, General Care unit, the Birth Center in Children's Hospital, and a family clinic. Among these, seven are inpatient units and one is an outpatient clinic.

From the perspective of exploring the long-term use of information, an ideal research site for my study was a workplace that provides: 1) rich data related to a patient with chronic illness trajectory, 2) a welcoming culture willing to host a student researcher for a lengthy period of time, and 3) the opportunity for the researcher to engage with the clinicians and to conduct informal interviews with them. Using these criteria, I selected an inpatient unit of general medicine. It hosts four internal medicine doctor teams, including two specializing in general medicine service and the other two specializing in gastrointestinal (GI) issues. The nursing team on this floor serves a diverse range of patients. Many patients hospitalized on this unit have a long history of chronic illness accompanied by various psychosocial issues in their daily life. In addition, the floor features a highly collaborative nursing care team, whose work is accomplished in a hybrid informational environment. In addition, among the four doctor teams on this unit,

one attending doctor also granted me the opportunity to shadow his team. All of these aspects fit my profile of an ideal research site.

3.3. Data Collection

This study consists of extensive field observation and in-depth examination of formal and informal medical documents, combined with thirty semi-structured interviews. I introduce each of these data collection methods in detail below, and present an overview of each data collection technique, the data sources, and amount of time spent employing each technique in Table 1 at the end of this section.

3.3.1. Observational activities

Shadowing Nurses

My investigation in the selected field, under approval of the Institutional Review of the University of Michigan Medical School, started on January 14, 2008 and lasted until October, 2009. During the first eight months, I spent time intensively with nurses. I took turns observing all three shifts - the morning shift (7 AM~3 PM), the evening shift (3 AM~11 PM), and the night shift (11 PM~7 AM). My initial observation included nursing activities such as shift-change meetings, generating working documents, preparing the medication, charting the medication administration results, charting the patient assessments on a 24-hour patient flowsheet, writing nursing care plans into eCare, and so on. I wanted to gain an overall understanding of nursing activities.

Shadowing morning shifts can be challenging and overwhelming for a new observer. There are many activities going on at the same time: Many doctor teams simultaneously rotate from one patient room to another and occupy large areas of the

hallways to discuss each patient's case; various special service teams are often called in to help evaluate patients; the phlebotomy team is hanging around to draw blood; a meal service cart often blocks the hallway; and patients' family members are also present to meet with doctors to discuss the diagnosis and treatment during their morning rounds. Comparatively, the night shift is much quieter. Since I had so many questions about workflows and activities in the first couple of months, I tried to come to the hospital during night shifts more often so I would have the luxury to talk with nurses during their slow hours. This strategy facilitated my understanding of overall nursing work and helped familiarize me with nurses at a personal level. The nurses on the night shift actually seemed to enjoy my presence as a break from the usual tediousness of the slower shift. One night, the 'coldest' nurse, who usually avoided eye contact with me and never talked with me during her day shifts, initiated a discussion. She spent almost half an hour explaining how the order reconciliation was done in a very comprehensive and systematic way. At that moment, I felt that I had made an important inroad.

Getting to know nurses in person during the night shifts was indeed a successful strategy. It helped me not only to understand the overall nursing work faster due to having more interactions with them but also to build my confidence to spend time with them even during the relative chaos of the day and afternoon/evening shifts - I did not see myself an "intruder" anymore and the nurses accepted me as a part of their work group. I even received invitations to join their group events such as a Super Bowl potluck and a baby shower.

Along with my research questions becoming increasingly clear, I gradually turned my attention to the use of informal nursing working documents and to the related

activities of generating and managing these working documents, which required me to observe one hour before and one hour after a shift change meeting. At this time, information exchange was very intensive, including various kinds of information disassembled and documented by out-going nurses and assembled by in-going nurses.

On April 28, the hospital adopted a new information system called the CPOE (Computerized Prescribe Order Entry) system. The first three days were scheduled to intensively convert all medical orders in the original paper system into the electronic system. During this important period, I spent eight hours each day in the hospital observing the transition process. Later, I also participated in five feedback meetings related to the new system adoption, organized by the hospital administration for lead nurses from each of the units from the entire hospital. These observational activities contributed to my data collection and gave valuable insight into the nursing perspective.

Shadowing doctors

Beginning with the ninth month, I mainly shadowed doctors. My experience shadowing nurses familiarized me with general medical practice (primarily from the nursing perspective), and more importantly, let me learn the “insider” language to talk with the doctors. Using the same strategy, in the beginning with the doctors, I wanted to gain an overall understanding of their work, so I tried to shadow every aspect of their activities, including receiving a new patient, performing morning rounds, participating in a group discussion, conducting a diagnostic interview, serving an on-call day (i.e. 30 hours straight in the hospital), interacting with other teams and patient family members, and generating admission, progress, and discharge notes. To show my firm commitment to the study, in the very first week with this team, I shadowed their work during one of

their on-call days. This turned out to be the most productive investment in building my relationship with the doctors – they invited me for their round table breakfast the next morning and started to explain what they were doing without me having to ask.

Comparing to shadowing nurses where every activity took place in one local unit, shadowing doctors required a significant amount of physical energy. The patients this team received were spread out over five floors, the fourth through the eighth. During the transition from one patient room/floor to the next, doctors always skipped the elevator and walked very fast to save time. Most of the morning rounds lasted two to three hours, and the discussion about each patient often took place in hallways, right outside a patient's room. Standing through the duration of the morning rounds was normal for them but I had a hard time keeping up with them during the first several days. I bought myself an expensive pair of shoes which was especially designed for doctors and nurses to support standing for long hours, and this made my field work much easier.

After three months observing the doctors, I gradually realized that the task of receiving a new patient and then investigating the case should be my focus. It involves intensive information seeking, assembling, and sense-making. My broad observations gradually switched to a more focused participation – I joined the team on their on-call day (during the day time) when they received new patients, for the morning rounds following the on-call day, and probably one of the following morning rounds if there were some interesting cases to follow.

In the meantime, my consistent involvement in team activities, especially during the morning rounds, solidified my social relationship with them. The attending doctors invited me a few times to join their end-rotation team parties. Then, I had the chance to

experience part of the doctors' social interactions beyond the hospital settings. Surprisingly, they still talked about patients, clinical performance, and lab findings, during their dinner in a fancy restaurant.

Tracking incidents and attending seminars

During my observation of both nurses and doctors, I tracked critical incidents and unusual events, and explored further how and why they happened. This often revealed interesting issues. While every case in the hospital is unique, there are certain cases that are of greater interest to a researcher as she seeks to answer her research questions. For example, one of my initial research questions was whether there exists any information gaps in medical practice, which naturally led me to pay closer attention to the incidents where doctors took an unusual amount of time in their diagnosis. This helped shape my research focus on the use of patients' psychosocial information in diagnosis and treatment, and led me to investigate when and why this information is often absent in the records.

In addition to observations in the inpatient setting, I also attended lectures along with doctors and nurses on the introduction of new information systems, feedback meetings about system adoption, and seminars on treatment and management for patients with chronic pain. This allowed me to understand the issues from a broader perspective.

Taking field notes

My observation of nursing activities was very much localized in the unit. I used an A4 size notebook that allowed me to jot down brief notes and then filled in descriptions in greater detail on site. I made a consistent effort to always take some time away from the observations to add details into my notes a few minutes after the incidents.

This strategy was very helpful during my observational activities with nurses. It also helped a great deal in saving my time later when I wrote up the field notes at home.

However, jotting down notes during my shadowing of doctors was very different, particularly during morning rounds. They talked about the patients while walking from floor to floor, and standing in hallways for two to three hours. I did not have any time to break away from them. On more than one occasion, I had to excuse myself to use the restroom, and later had a difficult time reuniting with them because they were consistently traveling from one floor/room to another. Although the attending doctors and a couple of residents offered their page numbers for me to use for coordination, I never paged them because I considered it an interruption to their work. In this situation, I made several adaptations to my observation strategy – I drank less water during breakfast, I started to use a more portable notebook for jotted notes that might help facilitate recall later, I always recorded the patient room number as a key identifier, and later asked the residents for more details if I did not initially capture as much detail as I wanted. In order to add descriptive information to the more interesting cases while rounding, I sometimes had to stand outside of a patient's room and participate in the doctors' discussions while in fact jotting down notes about the previous patient. In later observations, after my research topic became increasingly clarified, I was able to better predict which patient cases might be more interesting to my study before the morning round started.

In addition to jotting down notes during my shadowing activities, I also took detailed notes at the site during the slow hours, such as meal times, evenings, and late nights. Other than several special occasions when I spent long hours - the CPOE activation days and two on-call days - I usually spent a few hours (from two to five)

observing activities or reviewing onsite records and working documents, and then spent the rest of the day (or the next day if the observation involved a night shift) typing up the notes. As part of this process, I periodically drafted analytical notes as a strategy for highlighting my understanding of the issues and summarizing the work for the period.

3.3.2. Review working documents and patient records

In-depth examination of medical documents represents another major part of my data collection. I collected numerous copies of nurses' working documents and a few doctors' rounding sheets right before they were discarded into garbage containers in the conference rooms. Any working documents tossed in these containers are eventually destroyed by hospital custodians, and this occurs on a fairly regular basis.

Collecting these documents involved some measure of luck - whenever I spotted a doctor or nurse who was going to throw working documents into the garbage, I asked whether I could take the documents for my research. Most of the clinicians were comfortable sharing their handwritten documents with me or giving them to me after they were finished using them, but some preferred to keep the documents as their own records. One nurse told me that she had kept her personal records ever since she started nursing work six years ago. On many occasions, I was a few seconds late after the clinicians threw the working documents into the garbage container, so I had to dig them out and examine whether they would indeed be useful for my later analysis. It was difficult to collect these types of documents because they were temporary - they were thrown away at the moment the patients were discharged or the shift was finished. Unless I stayed in the hospital all the time, it was impossible to collect all of the working documents that clinicians used. To compensate for this lack of a complete record, I always tried to review

working documents on site before they were disposed of and I took notes from that reviews.

After the first two of months with doctors, I gained access to patients' records. These included admission notes, progress notes, ED notes, lab/radiology results, and discharge notes, all of which were stored electronically in eCare. Without these records, it would have been impossible for me to compare the important issues doctors communicated verbally with what they eventually documented in the system. My understanding of doctors' work was greatly facilitated when I gained access to the eCare system in later months. By gaining this access, I could review interesting patient cases before the next day's morning rounds.

I was keenly aware of IRBMED and HIPAA (Health Insurance Portability and Accountability Act) regulations, as my observations exposed me to a great deal of private patient information. Following the rules I learned from IRBMED staff, I always blacked out identifiable information on the working documents immediately after I collected them, and then carefully put them in chronological order for my future data analysis. When I took notes from reviewing documents and records, I was careful to use a unique code and not to copy patients' names into my notebook.

3.3.3. Semi-structured Interviews

To complement my investigation of medical records issues from field observations, I also interviewed various personnel, including the key informants from my observations (doctors from the MH team and nurses at the unit of general medicine where I observed), ED doctors, primary care physicians, and records management staff to explore the issues further. This data contributed to my broader understanding regarding

the overall documentation practice and challenges in the computerization of medical information.

In summary, Table 1 shows an overview of my data collection methods, observed activities, collected/reviewed documents and records, number and category of interviewees, and total time spent on the various research tasks.

Table 1 Data Collection Methods, Data Sources & Descriptions, and Quantity

Data Collection Methods	Data Sources	Quantity
Observation (nurses)	Shift-change meetings, order management, documentation	8 months, > 340 hours, 1 nursing manager, 1 administrative assistant, 1 nursing clinical specialist, 56 registered staff, 19 nurses aids, and 7 clerks
Observation (doctors)	Morning rounds, diagnostic interviews, on-call days, etc.	9 months, > 400 hours, 4 attending physicians, 11 residents, 14 interns (1st year residents), and 2 medical students
Lectures and meetings	CPOE adoption and feedback, chronic pain management	6 meetings about CPOE, 2 lectures on pain management
Working documents collected	Assignment Sheet (AS), Shift Report Sheets (SRS), Kardex, rounding sheets,	90 copies of AS, 98 copies of SRS, 7 copies of Kardex, 20 copies of doctors' rounding

	personal sheets	sheets, 10 nurses' personal sheets
Working documents reviewed on-site	Kardex, Shift Report Sheets	50 copies of Kardex, 360 copies of SRS
Patient records (reviewed electronically)	Admission notes, progress notes, discharge notes	80 patients' records
Interviews (semi-structured)	Doctors, nurses, pharmacists, records management staff	30 in total (9 inpatient doctors, 2 primary care physicians, 2 ED doctors, 2 pharmacists, 10 nurses, 2 nursing management personnel, 3 records management staff)
Interviews (informal, on-going with the observation)	Doctors, nurses, pharmacists, discharge planners	"n/a"

3.4. Data Analysis

I employed the grounded theory (Glaser and Strauss, 1967; Charmaz, 1993; Miles and Huberman, 1994) approach to begin my data analysis. This approach allowed me to identify emerging themes from broad observational activities and to gradually evolve into more focused data collection. Therefore, grounded theory method is not only an approach

for analyzing the data but also a guide for gathering data during the process of data collection.

For instance, in shadowing both doctors and nurses, I started by observing every aspect of their work. My earlier field notes were taken from all of these activities I was involved with. However, I did have a general research question before I went into the field - what is information use like in medical settings, particularly from a long-term reuse perspective? My coding process was realized by periodically drafting analytical notes. These analytical notes were constructed from: 1) extracting important themes from the field notes, 2) coding the collected documents, and 3) adding my understanding of situations and discussions. Several themes gradually emerged, including informal information, psychosocial information (emotional care, patient motives, nursing care, etc.), working documents (such as the Kardex, Assignment Sheet, and Shift Report Sheet) used to support team work, and missing representation in patients' admission notes. Together, field notes, analytical memos, working documents, medical records, and interview data were used to corroborate one another during the data analysis process.

The grounded theory approach allows new issues to emerge into the forefront. For instance, in the early notes of my observations of the doctors, I did not realize that a missing representation in a patient's admission notes from their last episode could cause a serious difficulty for doctors seeking to make an efficient diagnosis. I gradually noticed this because among all of the patient cases in my observation and notes, those who had serious psychosocial experience always took up a greater amount of the doctors' time. This realization led me to a new focus of investigating why psychosocial information is

often missing in the representation of patient records despite its importance for doctors to make a long-term care plan.

While grounded theory is useful to help generate categories and themes, how I analyze and interpret the data is influenced by social/symbolic interactionism (Strauss et al., 1997). Symbolic interactionism, a major sociological perspective, has been increasingly used to study groups and human conduct on a micro-level analysis within HCI/CSCW (Ackerman and Halverson, 2004). Blumer (1969) states three premises that distinguish this perspective from others:

- “Human beings act toward things on the basis of the meanings which these things have for them” (p. 2);
- This perspective sees meaning “as arising in the process of interaction between people” (p. 4), and thus
- Symbolic interactionism sees “meaning as social products, as creations that are formed in and through the defining activities of people as they interact” (p. 5).

Informed by this perspective, my study focuses on: 1) social interactions among small groups (and beyond) in medical settings, and 2) individuals and their interaction with the environment. These interactions are mediated by the use of symbols, modes of signification, ascertaining meaning from one another, and interpretation. For instance, I pay close attention to how doctors and nurses communicate among themselves and how they interact with patients and family members. I also investigate how they use physical space, various magnified signals, subtle symbols from the text, and so on, to interpret the information they receive and make sense from it.

Many qualitative researchers use the grounded theory approach to analyze raw data, collected from interviews and/or participatory observations. However, a researcher needs a strand, a particular worldview, in order to be able to clearly interpret the data and provide her understanding of the situation she studies. To summarize, I use grounded theory approach to guide my data collection and to see through the data I gathered; whereas I interpret that data from a social/symbolic interactionism perspective. They serve to inform different levels of the analysis and jointly contribute to my data collection and analysis.

3.5. Summary

Based on my general research question - how information is used and documented for long-term reuse - I chose a general medicine doctor team and nursing unit for my thesis project, which offered me the greatest potential for collecting rich data and getting support from the leadership of the team and unit. I use qualitative research methods, including ethnographic observation, in-depth analysis of working documents and patient records, and semi-structured interviews to conduct this investigation. Grounded theory approach and social/symbolic interactionism guide my analysis and influence my interpretation of the data collected from various medical activities situated in extremely sophisticated social and technical settings.

In the next chapter, I will describe the study site, which is necessary for understanding my later analysis. The chapter will provide an overview of the hospital, selected doctor team, nursing unit, and patient profiles.

Chapter 4

Organizational Background of Research Site

4.1. Introduction

In this chapter, I will describe the organizational background of my research site, where I spent seventeen months over the past two years. I will first present an overview of the University of Michigan Health System. Then, I will describe the doctor teams and nursing unit that provided tremendous support for this study. In addition, I will also introduce the patient profiles, which may distinguish some of the characteristics of the observed doctors' and nurses' work processes from those in other units (for example, clinicians working in ICU settings).

4.2. University of Michigan Health System

The University of Michigan Health System (UMHS) is comprised of three major categories: 1) hospitals (University Hospitals for adults, C.S. Mott Children's Hospital, and Women's Hospital – a birth center for pregnant women), specialty centers (i.e. Cancer, Cardiovascular, Diabetes, Depression, and Eye), and 38 health centers and clinics throughout the Southeast Michigan area; 2) the University of Michigan Medical School and Faculty Practice Group; and 3) the University of Michigan School of Nursing. The system employs more than 18,000 faculty and staff. According to statistics for 2009, the

hospitals and health centers had 930 licensed beds (865 acute care licenses and 65 psychiatry licenses) and made 43,558 admissions. Its emergency service and urgent care visits numbered 80,510. The UMHS as a whole has been consistently recognized as one of the nation's best hospital systems and is ranked in the top 20 by U.S. News and World Report³. Several specialty care units are ranked even higher. Excellence in medical education, patient care, and research has won this system various awards through the years.

Situated in this large teaching hospital system, nearly all of the 1,600 faculty physicians in the Medical School are associated with the Faculty Group Practice, through which they care for patients at the three U-M hospitals and all U-M health centers and clinics. Many of these faculty physicians attend the residents every year in the hospitals and various health centers. In addition to education and patient care, UMHS sponsored over \$412 million in research expenditures in 2008, including research on patient safety, biomedical informatics, translational clinical studies, and other fundamental research in medicine.

It is worth noting that while the overall EHR (Electronic Health Records) adoption rate remains low in the U.S. (Jha et al., 2006), computerization of the UMHS is high. See Figure 1 for an overview of the several major electronic applications utilized in the UMHS and how they are connected to each other. Care providers in UMHS use computers to generate various kinds of notes (such as patient records), prescribe medical orders, record administration of medications, store lab/radiology results, and so on. There is only a small portion of the medical work that remains paper-based, and the level of automation varies from one unit to the next.

³ <http://www.med.umich.edu/1busi/bests.htm>, March, 16, 2010

UMHS – Electronic Medical Systems Overview

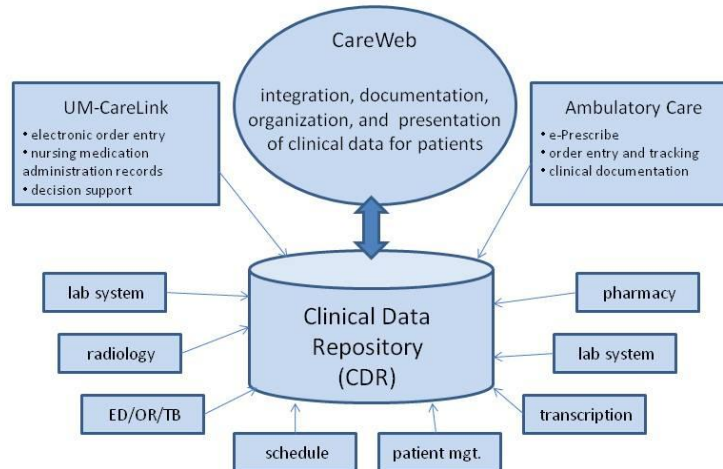


Figure 1 An overview of electronic system in UMHS

eCare is a web-interface to the Clinical Data Repository (CDR), which stores patients' medical records. CDR pulls together data from several discrete systems, including real-time lab/radiology results, prescriptions, the Emergency Department (ED), patients' scheduling and registration data, and so on, and makes all the data available to UMHS care providers through eCare. Clinical data drawn from the CDR cannot be modified through eCare; however, care providers can generate notes in eCare, such as doctors' admission/progress/discharge notes, primary care physicians' patient visit notes, nurses' care plan (SOAP notes), social workers' notes, and so on. In addition, patients' immunization records and medication lists can also be added to CDR through eCare. To expedite the care delivery and billing process, eCare also allows attending physicians and hospital workers to digitally sign the relevant documents. With the increasing security

protection available in recent years, care providers can use the eCare and the CPOE off campus (at home) through VPN protection via the Internet.

As a particular interest of this study, I will introduce the functions of eCare and the CPOE and discuss how they are used by care providers in detail in later chapters. In the rest of this chapter, I will introduce the doctor team and nursing unit at my research site and describe patient profiles as a way of presenting the environment and potential issues that doctors and nurses deal with every day.

4.3. General Medicine Service Team – Medicine Howard

General Medicine is a division in the department of Internal Medicine, one of the largest clinical departments in the hospital system. In addition to General Medicine, there are eleven other divisions in this department, including Allergy and Immunology, Cardiovascular Medicine, Endocrinology and Metabolism, Gastroenterology, Geriatric Medicine, Hematology and Oncology, Infectious Diseases, Molecular Medicine and Genetics, Nephrology, Pulmonary and Critical Care, and Rheumatology. While specializing in one or a few of these divisions, doctors in this department often share their patients' profiles, particularly because many patients suffer chronic illness and they often have complex psychosocial issues around disease management in their daily life.

In the division of General Medicine, doctors practice general and preventive medicine for adults of all ages, as well as management of medical conditions including arthritis, asthma, diabetes, hypertension and heart disease, immunizations, health counseling, and sports physicals. Medicine Howard (MH) is one of the four General

Medicine teams, which share the same functions and a similar team structure⁴. Four attending doctors from the division of General Medicine take turns attending MH residents.

The team usually consists of one attending doctor, one (or occasionally two) second-year residents, and two first-year residents who are often called interns. Periodically, the team hosts a medical school student (third or fourth year) for training purposes⁵. As in many other teaching hospitals, team members rotate monthly. To ensure the continuity of patient care, the attending doctor and the residents rotate on the first day of the month, whereas interns rotate on the 23rd of each month.

While the team takes primary responsibility (diagnosis and treatment) for the patients who are admitted to their service, it is supported by other clinical personnel for their routine daily work. For instance, the team works closely with the practice management team, which helps plan patients' discharges, including reviewing health insurance and ensuring the appropriate living situation for acute condition recovery and chronic illness management. Special service teams are often called upon for medical consultation. In Chapter Seven, I will report on MH's medical operations in more detail.

⁴ During the process of selecting the teams to observe, my committee member Dr. Kai Zheng sent emails individually to the attending doctors of all four teams. Two attending doctors responded with interest. I took turns shadowing these two teams during the first month. Later, I decided to focus on MH team because the other team sometime has no intern residents and thus the attending doctor does not have to coach very much. For the purpose of understanding medical practice, I wanted to participate in a team that employs a great deal of discussion so I would have more opportunities to learn.

⁵ There are four roles in the team. I will use the four terms written in *italic* to refer them in the rest of manuscript.

4.4. Nursing Unit

Organizationally, each nursing unit belongs to one of the seven medical nursing services in the UMHS. The nursing unit I studied is under the division of the Internal Medicine & Cardiovascular Center, which includes 20 nursing units/teams in total. Geographically, each nursing unit/team occupies one section of a floor, with two hallways surrounding one nursing station at the center location. While most nursing units have a specific focus, such as pulmonary, cardiology, and gastroenterology, several nursing units belonging to Internal Medicine division take all kinds of acutely and chronically ill patients, which is the reason that the MH doctor team travels across several floors to see their patients. The nursing unit I observed is a General Medicine nursing unit, with a slight focus on gastroenterology. This unit has:

- one nursing manager, who is the lead administrator of the unit and does not staff (i.e. practice nursing care for patients);
- one administrative assistant, who mainly deals with nurses' scheduling issues, and assists the manager with whatever she needs, and who also does not staff;
- one nursing specialist, who comes to the unit early every morning to participate in the shift-change meeting, and makes sure that the nursing care plan for each patient is appropriately drafted and carried out, and who does not care for patients directly;
- 56 registered staff nurses, who take care of patients on a regular-shift basis;
- 19 nurses aids, who also take care of patients on a regular-shift basis, assisting nurses to get patients' vital signs and provide them with baths and other nursing care;

- 7 clerks, who help process medical orders, coordinate family visitors, and perform a general help-desk function.

Among the 56 staff nurses, one senior nurse takes the role of clinical supervisor (long-term), maintaining the authority to make decisions on all nursing care issues. Two other senior nurses act as education coordinators. Nurses often need to adopt new technologies, follow new guidelines and protocols, and learn new information about drugs and treatments, so the education coordinators take on significant responsibilities to keep the entire unit updated and to ensure everyone's continued self-learning.

In addition, nurses voluntarily serve on the Clinical Practice Committee (CPC) and the Workload Review Committee (WRC) within the unit. The CPC usually decides what the best clinical practice should be locally. For instance, evidence-based practice states that insulin should be given during the day-shift morning time, but this unit has been doing it during night shifts. It is CPC's responsibility to decide what the best solution is. The WRC, on the other hand, is in charge of how specific clinical practice is carried out and how much workload is dedicated to each task. One of the main goals of the WRC is to ensure that nurses on three different shifts should receive roughly equal workloads for the same amount of time.

All these roles are professional and/or organizational. In addition, there are some roles that are temporary, such as shift-based charge nurse and team leader, event-based CPOE adoption team lead, and CPOE "super users" during the preparation of the adoption. I will describe nursing work in greater detail in the next chapter.

4.5. Patient Profiles

As alluded to above, the patients admitted to General Medicine service teams and nursing units have diverse profiles. Many patients admitted to this service have chronic episodes of illness throughout their adult life, and come to the hospital when they experience a flare-up or other acute situation. While some patients do have medical conditions like arthritis, asthma, diabetes, hypertension and heart disease, or gastroenterological problems, this unit also often takes patients who attempted suicide through drug overdose. Even though these patients may need to be sent to a psychiatric unit eventually, they have to rule out any possible pressing medical situation in an internal medicine unit, so both MH team and the nurses have to deal with patients who have psychological issues. Furthermore, there have recently been an increasing number of patients who demonstrate various kinds of pain issues not directly related to their original chronic illness. Many of these issues are caused by, or contribute to, serious psychosocial problems they bear in life. This trend requires doctors to acquire a complete view of a patient's history in order to make informed treatment decisions and requires nurses to understand patients' motives or provide emotional care.

Indeed, chronic illness can significantly affect a patient personally and socially over time (Charmaz, 1993). This situation complicates nursing care because some patients present questionable behaviors when they are hospitalized. While nurses are proud of their ability to anticipate patients' emotional needs, they are indeed aware of psychosocial issues that are magnified through the short period of hospitalization, such as faking certain symptoms in order to get desired medication. As a result, both doctors and nurses in General Medicine service often share information among themselves verbally

about those patients who are likely to fake their symptoms. This is similar to Strauss and colleagues's observation that moral judgments are very frequent and severe in emergency rooms (1997).

4.6. Summary

In this chapter, I outlined the organizational background of the research site, the different professional and organizational roles of the doctor team and nursing unit which I studied, and the diversity of patient profiles. It is worth noting that even though I focus on only one doctor team and one nursing unit in my observational study, they share the same workflow and practice with other similar services, particularly in the department of Internal Medicine. Furthermore, because they also share the same patient populations, many of whom have chronic medical conditions and complicated psychosocial issues in their everyday life, the issues revealed in this study are relatively representative. The rotation mechanism of residents in the teaching hospital also contributes to the similarity of work practices across different services.

In the next chapter, I begin by introducing the work of the nurses. There is no particular reason why this report of nurses' work should go before that of doctors. However, my understanding of medical practices began with my observation of nursing. Therefore, I will write about nurses first as a way to present how I built my understanding starting with a time-based sequential investigation from the field.

Chapter 5

Working Documents in Nursing Work

5.1. Introduction

As mentioned, my observations of medical practice involved both doctors and nurses. There are several internal medicine service teams of doctors, and each team admits patients who may be hospitalized in several nursing units. Each nursing unit, on the other hand, also takes patients who are admitted by doctors from several internal medicine service teams. In this situation, there is no one-to-one relationship between a team of doctors and a group of nurses, as is the situation in an ICU, where doctors and nurses are organized in the same team (Reddy et al., 2002). Therefore, I situated myself in one nursing unit for eight consecutive months, and then switched to shadow a team of doctors. I periodically returned to the internal medicine nursing unit after I started writing up the research results. These periodic return visits allowed me to clarify some residual issues from previous observations, to verify my interpretation and analysis, and also to learn about any new changes in practice.

In this chapter, I will focus on nursing practice. I first describe nurses' work in general, including the physical environment in which the work is situated in and the major activities in which nurses engaged in during each shift. My analysis will focus on

several working documents, examining how these assembled information objects play a unique role in assisting nurses' information needs. I conducted this investigation before, during, and after the CPOE adoption, which allowed me a unique opportunity to find out whether and how the adoption of new technology have an impact on nursing work.

5.2. Nurses' Work

The unit has 32 beds, with 16 beds along each of two hallways. See Figure 2 below. Most of nursing care takes place in patients' rooms. In the nursing conference room, nurses attend shift-change meetings and take breaks, having a meal or snacks. There are four computers, an overhead TV, two file cabinets (which store the templates for various working documents), and a mailbox for each nurse, clerk, and nursing aide. There are also several information boards on the walls used for education, seminar announcements, thank-you notes, social events, and so forth.

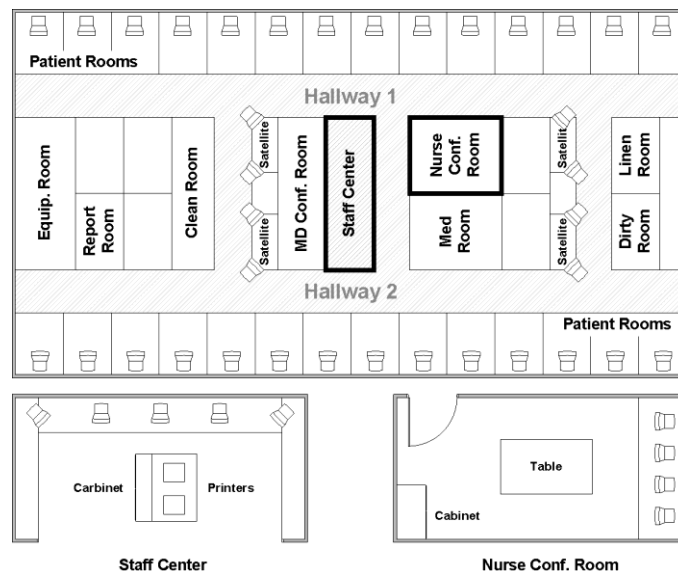


Figure 2 (top) Floor map of the unit; (bottom) Staff Center and Nurse Conference Room

Nurses often spend time near the station center, the geographic center of the unit. Two clerks, who are responsible for two teams/hallways, occupy either side of the station facing the hallways in order to help coordinate visitors and clinicians. “Traffic jams” often happen in the path between the staff station, and the nursing conference room and the medication room, which connects two hallways, because nurses (and doctors) need to use the copy or fax machine located at the center of the station.

One of the characteristics of this unit is that it has several internal medicine teams of doctors working together in the same territory, so the unit nurses need to communicate with doctors from different teams. The patients admitted in this unit experience various types of acute or chronic problems, such as arthritis, asthma, hypertension and heart disease, sports ailments, alcoholism, ulcerative colitis, and chronic abdominal pain. Other cases include patients waiting for liver transplants or undergoing cancer treatment.

In this section, for nurses’ work, I will first list the various informational objects (with a brief introduction of each) that nurses use on a daily basis. This is necessary to discuss first because all activities I describe involve the use of these objects. It would be beneficial to list them all in one place as a reference. Then I will introduce several major activities that nurses accomplish during their shift to provide an overview of nursing work. However, I place more emphasis on analyzing certain activities which are of particular relevance.

5.2.1. Informational Objects

There is an extensive ecology of information objects that nurses must use every day. See Figures 3 for only a partial representation of this ecology. These information objects include formal records (information permanently stored in the records system)

and informal and short-term artifacts (information temporarily assembled on tangible artifacts, such as a piece of paper, a durable card, or whiteboard).

The information objects which constitute the permanent system include:

- eCare, an electronic patient record system developed in-house, which stores doctors' admission, progress, and discharge notes, nurses' SOAP notes, social workers' notes, special consultation notes, physical therapy notes, and so forth. eCare is a web-interface to the clinical data repository, which stores various patients' medical data gathered from multiple electronic systems, including real-time lab/radiology results, ED diary/log entries, prescription history, and so forth.

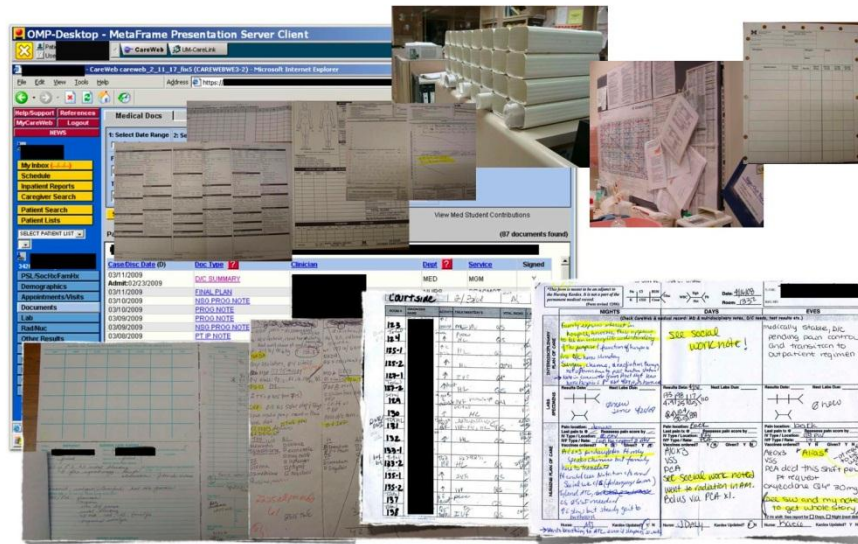


Figure 3 Ecology of information objects

- SOAP notes in eCare, a formal nursing note recording a patient's description about themselves (Subjective), the nurse's observation (Objective), the nurse's Assessment, and the nursing care Plan. In normal situations, only one shift nurse needs to write a SOAP note every two days (among six shifts).

- (Paper-based) 24 Hour Patient Flowsheet, which requires nurses to record: a) a patient's vital signs; b) food/liquid intake/output, c) information about stool test, glucose, fall risk assessment, chemstrip (a blood test to determine blood sugar level), and urinalysis; d) wound care; e) cognitive/perceptual, activity/exercise, eliminations on abdominal symptoms, enteric tubes, drainages, stool/urine color, nutrition/metabolic, psychosocial, sleep/rest; f) patient care activities; g) equipment used; h) IV therapy; and i) patient education.
- (Paper-based) Medication Administration Records (MAR), which require nurses to record the results of how each medication is administered, on-time or delayed, whether the patient accepts or refuses, and how well the patient tolerates medication. MAR records are printed out by the pharmacy at midnight to indicate all active medications. Throughout the day, when a new order is prescribed, nurses transcribe the order into MAR. MAR was later replaced by the CPOE adoption.
- (Paper-based) Orders prescribed by doctors. Before the CPOE adoption, nurses needed to transcribe a medication order into MAR and a procedural order into the Kardex (see description below). Furthermore, night-shift nurses needed to do order reconciliation, comparing what doctors wrote and what the pharmacy transcribed on a printout. After the CPOE, doctors are no longer writing paper orders except in a situation that the CPOE breaks down.
- Lab/Radiology Requisition forms, often processed by clerks but needed by nurses to know what lab/radiology tests were ordered to help patients save the specimen or prepare the patient for procedures.

- Patient Records folder, a hard-covered big blue binder, which collects various administrative forms during a patient's hospitalization (e.g. consent form, personal belonging forms, admission form), paper orders (prior to the CPOE), and eventually will hold the 24-Hour Patient Flowsheet after a patient is discharged.
- The CPOE, allowing authorized prescribers to write medical orders and deliver the orders electronically to pharmacies, labs, procedure departments, and nurses.

To facilitate the work, nurses create various temporary information objects. These working documents often rearrange the information components from the formal records, and present the information as necessary to support the work of the nurses. In addition, these information objects may carry nursing care information generated by the nurses themselves. These artifacts include:

- Audiotape, used by an outgoing charge nurse to record patients' information that needs to be passed along to incoming nurses.
- Assignment Sheet (hereafter referred to as an AS), including brief information about all 16 patients (in one hallway) for which a team is responsible. Nurses use it to coordinate and assist each other.
- Kardex, a durable card which summarizes a patient's illness and some of her critical ongoing procedural and IV treatment orders. This only existed prior to the CPOE adoption.
- Shift Report Sheet (hereafter referred to as an SRS), used to record a summary of doctors' notes, newest lab results, and nursing care information about a patient. This working document was terminated shortly after the CPOE adoption.

- Personal Sheet (hereafter referred to as a PS), used by a nurse to assemble her patients' information (e.g. basic medical condition and ongoing treatment), which serves as a memory aid and handy artifact throughout her entire shift, and is used to track her patients' ongoing care activities.
- Whiteboard, displaying all patients and the services they are receiving, their status (for example, upcoming or discharging), and their doctor's name and pager number.

5.2.2. Shift-change meeting

Nurses start their work with the shift change meeting. The incoming nurses usually arrive 15 minutes to half an hour before the shift change meeting takes place. There are always two teams working on two hallways. The charge nurse is responsible for overall clinical care activities on both hallways. She is also in charge of one team responsible for patient assignment. The team leader is in charge of another team.

The shift change meeting takes place separately in the Nursing Conference Room and Report Room. It always starts in a timely manner, at 7 AM, 3 PM, and 11 PM respectively for day, evening, and night shifts. The incoming charge nurse/team leader plays the audiotape reports prepared by the outgoing shift charge nurse/team leader. The oral report contains ongoing issues (medical and sometimes psychosocial) about all 16 patients on one hallway. The incoming nurses sit around the table, taking notes on the assignment sheet (AS), a shift-based working document including brief medical information about 16 patients at each hallway, such as a patient's room number, "diagnosis/patient's name", activity level (e.g. whether the patient could get up under their own power or required assistance), "treatments/IVs" (what type of IV treatment the

patient is receiving), “vital sign” (how frequently the patient’s vital signs need to be checked), “I&O” (explaining what specific diet the patient was on and whether their urine need to be collected and measured), “CS/WT” (whether the blood sugar and weight need to be checked and how often), “specimens” (whether the patient was schedule to have any lab tests that required nurses to collect specimens), and “report” (any medical issues that were considered worthwhile to report) (See Figure 4).

Although mainly created by the charge nurse, sometimes nurses also voluntarily update information on the AS. The root AS is a pencil copy sheet, which allow the charge

ROOM #	DIAGNOSIS NAME	ACTIVITY	TREATMENTS/IV'S	VITAL SIGNS	I & O	CS/WT	SPECIMENS	REPORT
123		↑	ML HL	GS			shot	Asst Fall/Seize prec
124		↑	PRN HL	GS				Plan baseline 1/10 vital bands
125-1		↑	HL	GS				Plan prec
125-2		↑	HL	GS				Asst prec
127-1		↑	IVF	GS				Asst prec
127-2		↑	HL	GS				Asst prec
129		↑	IVF	GS				Asst prec
130		↑	HL	GS				Asst prec
131		↑	HL	GS				Asst prec
132		↑	HL	GS				Asst prec
133-1		↑	HL	GS				Asst prec
133-2		↑	HL	GS				Asst prec
135-1		↑	IVF	GS				Asst prec
135-2		↑	IVF	GS				Asst prec
137		↑	HL	GS				Asst prec
138		↑	IVF	GS				Asst prec

Figure 4 An example of AS before the adoption of the CPOE

nurse to easily erase the old information and update it with news at the end of their shift. Then the outgoing nurse’s aide help make copies for the incoming nurses. For example, one patient entry on the AS reads:

“Room 138, Johnson⁶, lupus, BRP, IVF-D5/.45 bs, QS, Renal/S+, daily, S/P-cytosan, urine, Q20, S/P, chest tube ends at 5/26, SCDS, chemo prec.”

[-- from field notes, May 24, 2008]

By reading this line, a competent nurse would understand that the patient in room 138 is diagnosed with lupus; that he should only be getting out of bed for “bathroom privileges” but that otherwise he should be on bed rest; that he has IV fluid of 0.45%NaCl /Dextrose 5%⁷ at bedside; that his vital signs need to be checked every eight hours (one shift); that he is on a renal diet; that his chemstick and weight need to be checked daily; that he is at status post Cytoxan⁸; that the nurse need to collect urine every two hours⁹; that his chest tube should end on May 26; and that he has sequential compression devices¹⁰ and is “on chemo” precautions.

While brief, this entry tells a nurse a great deal of information about the medical issues involved with this patient. This, however, may not be enough to provide nurses with the entire picture about the patient. Accordingly, the audiotape addresses this shortage. For example, for the same patient, the tape report says:

“Mr. Johnson, with alert and orientation times 3, IV fluids D5/.45, going up to 125 (ml) an hour, does have some pain issues, the doctors were paged on that, they changed the frequency to every two hours, and they gave him a lot, like 2 milligrams; they also asked about ... hmmm... the Laxatives he might ask forlaxative makes him feel full, they don’t want to give him many laxatives. ... he’s gonna get some chemo tomorrow; they don’t want to dehydrate him. He is on chemo precautions. He will be given another dose tomorrow.”

[-- from field notes, May 24, 2008]

⁶ All names used in this paper, including that of the electronic system, are pseudonyms.

⁷ Dextrose (a carbohydrate caloric agent) and NaCl (sodium chloride) are administered IV, used as a source of calories, sodium chloride, and water for hydration.

⁸ Cytoxan is an anti-cancer chemotherapy drug.

⁹ Some chemotherapy drugs require the patients to empty the bladder every two hours so they do not “burn” their bladder.

¹⁰ A device designed to limit the development of Deep Vein Thrombosis (DVT) and Peripheral Edema in immobile patients.

This audio information is based on each nurse's oral report individually about all her patients given to the charge nurse, usually near the end of the shift, after which the charge nurse records the information on the tape. While listening to the tape, nurses make notes on the AS for each patient. At this time, a nurse does not know which patient she may receive, and thus need to pay attention to all 16 patients. By reading information on the AS and listening to the tape report, incoming nurses would know how busy they would be for their shift as a team.

This is a well-known heavy workload unit in the hospital. Each nurse receives three to five patients for her shift and sometimes one patient might have over twenty different kinds of medication in two hours. However, nurses are not allowed to carry patients' medications in their pocket while engaging in other activities or taking a break. They are also not allowed to prepare medications for two patients at the same time. During the rush hours (i.e., a period when many medications needed to be passed out), nurses often have to travel back and forth between patients' rooms and the medication room at a fast pace in order not to delay the medication administration. In this situation, if one nurse is caught up by one total care patient (a patient needing frequent one-on-one attention), the other nurses on the team often take care of her remaining patients. The AS provides a very convenient reference in real-time – a nurse could easily take it out from her pocket as a quick source of information before she goes to see a patient who is not covered as part of her duty.

After the tape report, usually less than ten minutes, the charge nurse takes five to ten minutes working on the assignment based on the workload of each patient. Day shift nurses are usually assigned three patients, but night shift nurses normally have five or

even six patients. In either case, each nurse is almost always assigned at least one total care patient.

The entire shift change meeting takes about 20 minutes and ends with an announcement of the assignments from the charge nurse. Next, each nurse starts to assemble information from various channels in order to prepare her personal sheet before going to see her patients. In the meantime, outgoing nurses take the chance to talk with the incoming nurses face-to-face on issues that have occurred very recently and are not covered by the audio report.

5.2.3. Preparing medication

Administering medication on time and recording the results is one of the most important nursing activities. In fact, many other nursing activities are arranged around order administration. Nurses prepare the medication in the local medication room. Before the CPOE system, nurses were required to carry MARs (Medication Administration Records) with them when they entered the medication room. MAR consists of a folder that held all of a patient's medication sheets since their hospitalization, with the most recent sheet on the top. In this small room, nurses read the medication order before and after they take the medicine out of the patient medication box on the shelf or Omnicell machine (used for storing controlled substances) for a specific patient. This double-check is to make sure that the medicine in a patient's box (prepared by the hospital pharmacists and shipped by pharmacy staff regularly) is the one for this patient, and also that the MAR has the right records for this patient.

The local medication room is very small. Three people in the room at the same time make it very crowded. However, during the rush hours (7:30 AM - 9 AM) when a

lot of medication orders need to be administered, there are often over seven nurses in the room preparing medication for their patients. They walk quickly back and forth between patients' rooms and the medication room.

After the CPOE adoption, the workflow of preparing medication changed. MAR was replaced by the electronic order system. Nurses no longer have a tangible artifact, like the MAR folder, to check the medication before they pull out the medicine from the medication box for their patients. They are required to get on the computers in the medication room before they can take the medicine out of any patient's box. However, there are only four computers in this small room, and two out of these four are located in an inconvenient place for nurses to double-check and match the order information in the CPOE with the pills in the patients' medication boxes.

When doctors provide an order involving a new medicine, nurses often need to get online or read drug reference books before they go to see the patients and feed them, so they can explain the medicine to the patients if asked. Nurses see themselves as the 'last defense' for medication errors. They always try to make sure that they know what they are giving to patients and why. After the administration of the medication, nurses need to chart the results about whether the patients took or refused the medication on the paper MAR (before the adoption of the CPOE) or CPOE system.

5.2.4. Reconciling medication orders

Before the adoption of the CPOE system, doctors wrote orders on paper and then used the color code on patients' records folders to notify clerks as to whether they were stat orders (which required action within 20 minutes) or regular orders (requiring action within one hour). It was a clerk's job to process these paper-based orders. She faxed one

copy of the medication order to the hospital pharmacy, put one copy in the patient order tray on the counter, and saved one copy in a patient's permanent records folder. The patient order tray was located at the center of the nursing station, so nurses would immediately know the new orders at a glance whenever they passed by (See Figure 5).



Figure 5 Trays contain doctors' new orders for nurses

For non-medication orders, such as lab and radiology requests, the clerk filled out special forms and put the request forms into a tray mounted on the wall of the nursing station, waiting for the procedure departments to retrieve them. They also might phone the procedure departments for any emergency tests.

Every night at midnight, the pharmacy printed out each patient's order sheet(s) for the next day and sent them to the unit. It was the night shift nurses' responsibility to perform the reconciliation. Specifically, they read carefully each originally handwritten order on paper and compared it with the relevant pharmacy printout. During the reconciliation, nurses often needed to call the pharmacy or the doctors who wrote the

orders to clarify ambiguity, either from poor handwriting or other misunderstandings. The reconciliation was one of the major activities for night shift nurses. Nurses working on day and evening shifts relied on the accuracy and thoroughness of the night shift nurses' reconciliations and gave full trust to their work.

Reconciling medication orders became all nurses' responsibility after the adoption of the CPOE system. While there is no need for handwriting interpretation, the nurse who receives the new order is responsible for making sure the order is prescribed correctly regarding medication, dosage, timing, and so forth. In most cases, doctors select (instead of write) orders from a predetermined order set, which largely prevents dosage errors during writing. Doctors still need to write some orders that are not included in the predetermined order sets, but the verification is left to the pharmacy.

5.2.5. Documentation

Nurses spend lots of time recording information on various kinds of documents. These documents include formal and permanent representation in the medical records system based on administrative and/or legal requirements, either paper-based or in an electronic system, such as the paper-based 24-Hour Patient Flowsheet, paper MAR (later e-MAR in CPOE), and SOAP notes in eCare. Nurses also generate information on several informal working documents that are not permanently stored in the records system. These informal working documents are often locally created and used to facilitate information sharing and teamwork within the unit, including the Kardex, Assignment Sheet, and Shift Report Sheet.

Other than the documentation of MAR (or e-MAR later in the CPOE system), which requires nurses to immediately document the medication administration results,

there is no specific workflow or timing requirement for nurses with regards to other documentation. Each nurse may arrange their work priorities differently – some prefer to get the documentation done as soon as possible, others may leave it until their shift is close to finished so that they document all serious issues happening during their shift.

The following vignette describes nursing documentation activity from one perspective:

It is 8:30 AM. Mary should have left since she worked for the night shift, which ended at 7 AM. However, it seems she is still buried in some documentation (24-Hour Flowsheet, Kardex, etc.). A moment ago, she looked pretty stressed out, yelling out to others, “Don’t look at me!” Now, she seems to calm down a bit, and then explains to me, “I was working on the shift change document that should have been done an hour ago. I was late.” While she did not miss or delay any patient care activities, she did not get a chance to do the necessary documentation during the shift, so she had to work late, making sure every part was recorded correctly. Now, she looks very happy, saying “Yeah! Time to go home.”

[-- from a day shift field note, January 14, 2008]

Indeed, some nurses have to work overtime to finish the documentation requirement, since other nursing care activities usually have time constraints and should not be delayed. Most of the night shift nurses can manage to finish work by 7 AM. Once the incoming day shift nurses receive enough information during the shift-change meeting, the night shift nurses are ready to go home. In order to finish work on time, nurses gradually learn how to do the documentation in between the nursing care activities; as one nurse put it, “I do as I go, because if you don’t do it, you get really behind.”

However, even with a good plan and being fully aware of timing for documentation, things may dramatically change and nurses have to spend extra time for the documentation. For instance, a new nurse spent over half an hour after the shift finished composing a SOAP note in eCare to officially notify the doctor teams and other caregivers, documenting an unexpected heart attack in one of her patients. This was in

addition to the phone report immediately after the incident. In normal situations, only one shift nurse needs to document a patient's SOAP note every two days (among six shifts). However, when the situation has a critical change, the nurse needs to write the SOAP note right away even though it is not scheduled. Subsequently, this nurse had to update all other documents, which made her work for one and a half hours of overtime. [January 24, 2008, afternoon/evening shift]

It is worth noting that there is a strong teamwork culture in this unit. If one nurse is seen having a hard time finishing her work on time, other nurses in the team often offer help when they are assigned to work with this nurse. The following vignette reflects this:

Linda rushed into the conference room at 10:50 PM for a night shift. She was not late, but somehow she felt she was behind schedule. Right after she sat down, she started complaining about the problem she had with another nurse. Nancy often stayed to work overtime because she could not finish what she was supposed to during the shift. Instead of talking with her team members who were all willing to help, Nancy remained quiet and would not talk with anyone. Linda commented, "..... the lack of communication on a professional level left us (the other team members) in the dark." Linda mentioned to other nurses that she even talked about this problem with Karen, the clinical supervisor of this nursing unit.

[-- from night shift field notes, January 17, 2008]

In order to maintain a good spirit of teamwork, the unit nursing leadership also created a local recognition program. Each nurse who receives help from others always writes thank-you notes with specific mentions of the assistance and then posts them on the public information board in the conference room (See Figure 6). A lottery at the end of each month awards one nurse, whose name is chosen from the thank-you notes, with a \$10 gift card. This reinforces team collaboration and built it into the organizational culture.

5.2.6. Interacting with others

Nurses often need to communicate with doctors, patients, patient family members, social workers, and nursing home staff. Before the CPOE system, they often needed to



Figure 6 Thank - you notes board

call doctors to clarify handwritten orders. After the CPOE adoption, nurses still needed to call doctors fairly often to ask them to clean up the replicated orders.

Additionally, nurses still customarily approach doctors when their patients do not ‘behave well’, for instance, when they refuse certain medications, leave the floor while taking pain medications, or refuse to follow other orders (such as eating and drinking under an NPO - nothing per mouth order). When patients have serious psychosocial or behavioral issues, nurses usually inform doctors immediately. Below is a vignette that reflects this concern:

A nurse waited outside of the patient Mrs. Davis’s room. When the doctor service team arrived, she immediately reported, “I just want you guys to know -- Mrs. Davis kept on saying she got a terrible headache, but behind me, she was chatting on her cell phone with friends all the time, no pain, no moaning, just like a normal person.” Acknowledging the importance of this information, the attending doctor assured the nurse, “we will take care of this.”

[--from the field notes on July 22, 2008]

It is the nature of nursing work that nurses spend more time than doctors with patients. They often notice abnormal situations, like when patients do strange things to harm themselves (such as the patients who suffer Münchausen syndrome¹¹), or when patients exaggerate in front of doctors for the purpose of securing medications. Before morning rounds, some nurses wait to report these issues to doctors before they enter patients' rooms, so the doctors can address the issues with the patients. Usually, doctors need to make a decision as to whether a patient needs a sitter¹² to prevent unwanted behaviors from happening. This is often initially based on nurses' reports of patient behavior. On several occasions when patients were problematic, doctors asked nurses to write formal nursing notes (like a SOAP note in eCare) about the specific issues in detail, but it was my observation that nurses still preferred to report verbally instead of keeping the sensitive information in any written format, as the case shown above, which was not recorded in the SOAP note.

In addition to doctors, nurses often interact with patients' family members. While there may not be an issue for many patients, some patients may have problematic family/social dynamics that nurses have to deal with. For instance, one senior nurse still remembered a case that happened years ago. It was a coincidence that a young woman

¹¹ Münchausen syndrome is a term used to describe a psychiatric disorder. It is also known as hospital addiction syndrome. The affected patients often exaggerate and create symptoms of illnesses, or even harm themselves in order to extend the hospital stay, demanding more investigation, treatment, attention, sympathy, and comfort from medical personnel. Some patients who suffer Münchausen syndrome are very knowledgeable about medical practice. They may create medical symptoms resulting in a lengthy medical investigation, so they can stay in the hospitals. For more details, see Fisher, J. A. (2006). Playing Patient, Playing Doctor: Munchausen Syndrome, Clinical S/M, and Ruptures of Medical Power: *Journal of Medical Humanities* Vol. 27(3) Sep 2006, 135-149.

¹² A sitter is assigned to a patient who is hard to manage, or is a threat to her/himself, the staff, or to others nearby. A sitter's job is to keep nurses apprised of any changes in patient behavior.

patient's divorced parents came to visit her at the same time. Because the marriage ended badly, the visit resulted in a serious violent fight in the hospital and the patient was emotionally affected by this incident. The nurse referred to this incident as a lesson for her later nursing career and she used it to teach younger nurses that they needed to think in advance about how to avoid potential conflicts.

Next, I turn my focus to several information objects that nurses use to support their work. This discussion is highlighted by the change of CPOE adoption and how the new system implementation has impacted nurses' information needs, and what this change mean to knowledge production, information reuse, and patient care.

5.3. Working Documents as Assembled Information Objects

Before the CPOE system activation on April 28, 2008, nurses used two group working documents, the nursing Kardex and the Shift Report Sheet (SRS), to share information within the team and pass nursing information across shifts, in addition to audiotape and the Assignment Sheet (AS) prepared by the outgoing charge nurse, as I already introduced in last section. These working documents contain informal, short-term information that is important to the nurses' work as a team. Below I will introduce them in greater detail.

5.3.1. Nursing Kardex

A Kardex is often used in nursing practice, particularly in a paper-based environment (See Figure 7 for an overview of the nursing Kardex). In the unit I observed, it was an A4 sized card, enabling frequent revision with eraser and pencil. It provides a quick overview of basic patient care information, including name, age, marital status,

religion, allergies, diagnoses, brief orders information (procedure, diet, IV treatment, tests), DNR/DNI status¹³, consultations, permitted activities, functional limitations, and emergency contact numbers. Some items might be left blank but the necessary information is always recorded.

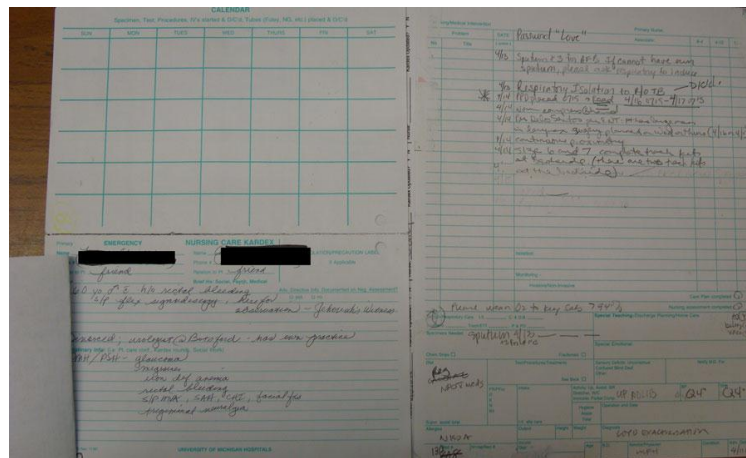


Figure 7 Nursing Kardex (two sided)

Nurses updated on-going orders on a Kardex with pencil, so they can immediately erase information when an order is finished or discontinued. When a patient has a code change, e.g. from DNR/DNI to full code, or sets up a password to protect her medical information from being revealed to unnecessary people, this changing information will be highlighted with underlining or simply just by enlarging the font as a way to catch people's attention. In this way, the Kardex always contains the most current medical care information. When a patient is admitted, the admitting nurse would create a

¹³ DNR stands for Do Not Resuscitate and DNI for Do Not Intubate. It is a specific physician order, which means in the event of cardiac no CPR or electric shock will be performed to re-start a patient's heart and in the respiratory arrest no breathing tube will be placed in the patient's throat. The order can be given separately. In the situation of full code, i.e. without DNR/DNI order, clinicians are legally required to perform CPR or other possible actions to save a patient's life.

Kardex for the patient, filling in basic information assembled from the eCare system and from interaction with the patient. It is jointly modified and updated by nurses in subsequent shifts during a patient's entire hospitalization. When the patient is discharged, the Kardex is discarded in the trash container and eventually destroyed.

5.3.2. Shift Report Sheet (SRS)

To complement the information on a nursing Kardex, which mainly consists of the medical issues about a patient, one local unit nurse invented the SRS (Shift Report Sheet) in an effort to provide a media to share more nursing care information. See Figure 8 for the structure of this document.

It is essentially a 3x3 table. Three rows are headed with "Interdisciplinary plan of care," "Lab specimens," and "Nursing plan of care." The three columns are for night, day, and evening shifts. In the box "Interdisciplinary plan of care," the nurse of the current shift may write a summary of the doctor's admission notes if a patient is a new admit, or progress notes if the patient had been staying in the unit already. This summary includes the present illness, past medical history, past surgical history, home medication, allergies, social history, and family history, providing the nurses on the next shift(s) a quick understanding of who this patient is and why s/he is here by just a glance at this box. This box is left blank if a patient had no significant progress or deterioration since admitted. In order to make this summary, nurses needed to get on eCare to read doctors' notes. As mentioned, patients' lab and procedure results are also stored in eCare.

The image shows a handwritten SRS form with three columns: NIGHTS, DAYS, and EVES. The form is filled with handwritten notes and medical data. Annotations in yellow boxes point to specific sections: 'Doctor's note summary' points to the top right section; 'Most recent lab results' points to the middle right section; 'Nursing plan of care' points to the bottom right section; and 'Night shift', 'Day shift', and 'Eve. shift' point to their respective columns.

Figure 8 An example of the SRS before the adoption of the CPOE

Information in the “Nursing plan of care” on the SRS is handwritten by each shift nurse. Here is an example:

- A03
- VSS
- Fall Precautions; Non compliant
- Hot packs applied to back & btwn ankles
- PCA dose ↑ from 0.2 mg to 0.3mg
- Recheck pain & assoc info Q1H
- Very needy pt

[-- from the SRS, evening shift on April 13, 2008]

This annotation explained that the patient was alert; she had been asked about orientation on three dimensions (knows who she is, where she is, and what the current date and time are); her vital signs were stable; she was on fall precautions, but she was not compliant; there were hot packs applied to her back and between her ankles; her PCA [Patient-Controlled Analgesia] dose increased from 0.2 to 0.3mg; there was a need to

check the patient's pain related issues every one hour; and the patient was very needy. As we read here, information in this box conveys information about medical conditions and also about the social and emotional issues for this patient.

Side notes about psychosocial issues, emotional needs, and warnings about patients are one important category of information on the SRS. Examples include "pt [patient] moaning," "needy for pain meds. [medication]," "tearful, brother at St. Paul's [another hospital in town]," and "see social worker and my note to get whole story." This type of information not only conveys extra workload-related information but also suggests to an incoming nurse how to approach her patients. In some cases, nurses often put casual information, such as "daughter very friendly/needy," "calm today," "likes to talk a lot," "likes orange sorbet," and "pt is a MD – urologist," as a way to provide a richer picture of the patient's situation.

For the SRS, each outgoing nurse spends a little time, usually near the end of the shift, to note both medical and social issues and emotional needs about a patient. The overall benefit is that the next incoming nurse would gain an efficient and thorough familiarity about her patients by reading the accumulation of nurses' notes from several previous shifts, and thereby a longer view of a patient's entire hospitalization. Even though the SRS may contain what is considered socially sensitive information or judgmental words, nurses feel comfortable writing them down because they believe it is good to let the incoming nurses know about these things. The SRS is only kept during the patient's hospitalization, and only shared among the unit nurses. Since it is eventually tossed out, nurses have fewer social concerns about what to say (or not say) on this sheet.

5.4. CPOE Adoption

Nursing work is arranged around the administration of medical orders prescribed by doctors (Wagner, 1993). A CPOE system allows doctors to write electronic medical orders and deliver them directly to pharmacies, labs, procedure departments, and nursing. In addition to the electronic order management, the CPOE system in the study site was designed as an attempt to replace all paper-based nursing working documents through a function titled “Clinical Summary.” On this page, nurses are able to find information about a patient’s health issues, significant events, and allergies – information that Kardex originally carried. Furthermore, the “Comments” area on this page allows nurses to note any concern from a nursing perspective, such as what the SRS assumed in its Nursing Plan of Care box, which included a rich array of personal information about the patient.

In this section, I describe how the adoption of CPOE affected the group working documents and analyze what this change means to local knowledge and information reuse.

5.4.1. CPOE Impact on Local Knowledge

During the preparation of the system adoption, the unit CPOE adoption lead team, including the clinical nursing supervisor, the nursing specialist, one education coordinator, and two senior nurses, discussed the future of the AS and the SRS. The lead team quickly reached an agreement to keep both of the documents.

The clinical nursing supervisor stated that she did not want to “change too much at one time.” This seemed to fit the unit leadership’s basic concerns about continuity and consistency of the work practice. However, they were also aware that paper-based

documents, no matter what they were, would eventually be phased out. Indeed, they were told by the hospital's top management that all paper-based documents were discouraged.

The lead team had no doubts about keeping the AS because neither the CPOE nor eCare had the functionality of providing a quick, portable overview of information on 16 patients at a time. As discussed in an earlier section, the main purpose of the AS was to give nurses a quick source of information in their pockets when they needed to assist other nurses. Without the AS, the shift change meeting would have to change to another model – from a group shift change meeting to a one-on-one handoff, which would take a much longer time to finish in a unit where each nurse took over four patients, and these four patients might be assigned to four different nurses in the next shift. One senior nurse made the point very clearly: “We are doing the teamwork, and we still want to.”

There were several rounds of discussion by this lead team about whether to keep the SRS. Although the “Comments” area in the CPOE system was designed for sharing nursing information, the lead team of adoption was concerned about the transfer into the new system of the subjective and judgmental language used by the nurses in the paper SRS. In addition, the clinical nursing supervisor did not want to change the workflow, which included documenting patients' social issues and emotional needs on the SRS near the end of the shift. Eventually, the lead team reached an agreement to keep the SRS, just to see how it would go.

Since the very day (April 28, 2008) that the CPOE system went live, the conference room table has been clear. Previously, the Kardex folded with the SRS were placed on the table. The function of the Kardex was completely replaced by the CPOE

Clinical Summary and Orders page. Although the SRS was supposed to stay, it was moved into the hallways and kept with the patient's 24 Hours Patient Flowsheet.

Gradually, the SRS was abandoned. The collected samples of the SRS after the introduction of CPOE showed that many pages were left blank. On May 16, eighteen days after the CPOE adoption, the Workload Review Committee (WRC) of the unit met for over three hours to discuss the workload after the adoption of the CPOE. The WRC members decided to provide more extensive audiotape reports to compensate for the loss of the information originally documented on the SRS. The committee concluded with the decision to discontinue the use of the SRS.

As a result, the SRS was terminated after six years of serving as a teamwork and information sharing document. It was interesting to note that no person who served in the CPOE adoption lead team and recommended keeping the SRS served subsequently on the WRC. When asked for comment individually, the CPOE lead team expressed surprise at the SRS being gone so soon. Asked what might be the reason for this situation, they gave different answers:

- "I just don't know why it's gone."
- "People think it is a bit repetitive and they have to do extra work for no good reason."
- "We [the CPOE lead team] talked about the possibility to discontinue the SS, but we did not know how the work would be changed after the [CPOE], so we decided to keep it. It came a lot sooner than we expected. Plus, prior to [the SRS], people still could do the work. They passed over the information from oral reports."
- "Perhaps the (physical) location. I am surprised why [the manager of the unit] let it go."

[- from field notes, May 20th and 23rd]

It is worth noting that both the creation and the termination of the SRS were attempts to reduce the workload. Before the CPOE, the nurses did not have to spend much time in front of computers, except when they had to enter nursing notes or prepare discharge documentation for the patients in the eCare system. In this situation, the SRS, an assembled information artifact which extracted a great deal of medical information (doctors' notes and lab results) from the eCare system by outgoing nurses, allowed incoming nurses to immediately know about the patient without having to log into eCare. After the CPOE, the function of Kardex was replaced by the computer system, so nurses needed to access the computer right after the patient assignment to get an overview of the patients' critical ongoing orders and related information. In addition, there was a "super link" on the left corner of the CPOE that leads to eCare, so nurses could read doctors' notes and get lab results about their patients if they wanted. From this perspective, there was no need to require outgoing nurses to still handwrite this kind of information on the SRS. The termination of the SRS saved outgoing nurses time, so it was a positive outcome for many nurses in that respect.

The majority of nurses cheered the termination of the SRS, arguing that the eCare system adequately carried most of the information the SRS used to contain. This was mostly true since the information in two boxes out of three on the SRS could be located in eCare. However, what about the information in the "Nursing Plan of Care" box on the SRS, which carried nursing care information not only about medical concerns but also about emotional support and nuanced psychosocial information in the box?

The nursing leadership anticipated the full use of the "Comments" field in the CPOE system as a way to pass along nursing care information. However, the comments

field remained largely empty. Surveys of CPOE records conducted at the end of the sixth, eighth, and sixteenth weeks after the CPOE adoption showed no information entered into the comments area for between 13 and 16 of 32 patients each time. The rest of the patients had 1 to 7 entries, but roughly 10 patients contained only one entry: family contact information or antibiotics precaution.

During the preparation of the CPOE adoption, nurses were warned by the management of the unit not to put any “judgmental” words (e.g., “needy” to describe a patient) into the system because the information in the comments area was shared throughout the entire hospital. As a result, various psychosocial contextual information originally contained on the SRS was largely lost in the digital format. Nurses have since been trying to have more oral communication, but the oral channel is only good from one shift to the next, not across multiple shifts. An outgoing nurse tended to report what had happened during her shift instead of the cumulative information that the original SRS carried.

While taking care not to enter any potentially sensitive information in the CPOE system, some nurses did not even enter medical nursing care information. The clinical nursing supervisor once encountered a patient with a cast on her right leg, which certainly needed special care. However, this medical care need was not noted anywhere, which left the incoming nurse, the supervisor herself, with an unwanted surprise. “That’s not acceptable,” she reported. To deal with this problem, the WRC sent an email to all nurses:

Midnight shift update clinical summary, and all nurses - be sure to look at nursing (e) Kardex under order tab and also clinical summary for pertinent patient information.

However, after two years of the CPOE adoption, the constant encouragement (from administration) to use the “Comments” area in the Clinical Summary to share nursing care information does not seem to have had much influence. This information space is still largely underused.

Now, after hearing about the CPOE, one may have these questions: since the nursing care information (including psychosocial information, largely local knowledge) is important for the work of the medical staff, why did the SRS cease to be used since the CPOE adoption lead team had decided to keep it? Was the SRS redundant? If nurses themselves stopped using the SRS, they should have contributed nursing care information in the CPOE just as they did on the SRS as a way to share information. However, they do not - why? There are several interrelated reasons to explain this unexpected and unintended outcome, and each is discussed in detail below.

5.4.2. Location, Workflow, and Group Practice

To understand why the SRS was discontinued so quickly and to determine whether the SRS was redundant after the CPOE, one needs to think about where the SRS was originally located, how it fit into the workflow, and how it was created and used among the unit nurses.

First, does the physical location matter? Before the CPOE adoption, all 16 patients’ SRS folded with Kardex were stored together in a big binder placed on the table in the conference room, where everyone could view and use them. Because the functions of the Kardex were completely replaced by the CPOE, the leadership decided not to keep the big binder on the table. Instead, the 16 patients’ SRS were separated and moved to the hallways to be kept with each individual patient’s 24 Hours Flowsheet. However, the

conference room is the place where nurses start to assemble information to prepare their personal sheets from a variety of sources (e.g. tape report, working documents, and face-to-face interaction), so there is an expectation that information will be obtained in this location. In the hallway, information exchange does take place; however, it is only sporadic and informal.

Second, does the new workflow matter? Before the CPOE, nurses would always first get an overview about a patient from the Kardex, including most of what nurses need to know in order to provide medical care, such as a patient's basic information and ongoing procedural and IV treatment orders. The Kardex was replaced by the Clinical Summary page and Orders page in the CPOE. This requires nurses to log onto the computers immediately after the patient assignment. While there are computers in the hallway corners, nurses prefer to use the computers in the conference room; they often discuss issues with each other and outgoing nurses can expect to find incoming nurses there if needed. Thus, the new location for the SRS made it difficult to use during nurses' initial information assembling process and did not fit the new workflow.

Third, it was a socially established group practice to come to the conference room to note nursing care information and keep the SRS in this common information space (Schmidt and Bannon, 1992). When the SRS was moved into hallway, scattered, and kept at each patient's bedside, this group practice was changed into an individual task – no one knew whether a nurse had contributed her knowledge to others, unless someone went to that patient's bedside to find it.

The inconvenient location, the new workflow, and the change from group practice into individual work may partially explain why the SRS was largely left blank starting

from the first day of the CPOE adoption, and then terminated so quickly even though the decision was made by the leadership to keep it. But does that mean that the SRS was indeed redundant after the CPOE?

The CPOE provides a convenient link directly to eCare. With a couple of clicks, nurses could read doctors' admission notes and lab results when needed. These two categories of information used to be assembled (by nurses via handwriting) on the SRS. From this perspective, the CPOE system simplified nurses' documentary practice. This was in addition to the better order management that the CPOE promised. Since nurses' work is largely organized by administering medication orders provided by doctors (Wagner, 1993), the CPOE system worked well enough for nurses to get medical data about a patient, particularly in that it aggregates all orders in one place, and provides easy access to eCare. In this situation, the SRS, a manually assembled working document, was considered redundant because two out of three categories of the information has been directly linked by the CPOE. There is no good reason to manually assemble this information into a piece of paper when one can easily access it online. So, a majority of the nurses were happy about the termination of the SRS.

However, the nursing care information originally carried on the SRS does not come automatically. It needs nurses to contribute and share with one another. The design of CPOE has taken this into consideration, and the Comments page is meant for this purpose. However, why do nurses not take advantage of this new common information space and maximize its use?

5.4.3. Politics of Information and Social Arrangement of Work

Publishing nursing care information (, which involves psychosocial issues) in an electronic system has been a major concern since the preparation for the adoption. The new common information space for nursing care information, i.e. the “Comments” area in the CPOE was implemented as being visible throughout the institution. This potentially makes nurses’ invisible work visible (Bowker and Star, 1999; Star and Strauss, 1999), and publishing entries in the CPOE could make nurses a target for social control and surveillance (Wagner, 1993). Indeed, nurses thought that psychosocial information, as “subjective” information, should be shared only within the unit - it is local knowledge that tells the unit nurses about the situation of their patients.

In addition to being visible, entries in the “Comments” field of the CPOE system were permanent. Nurses learned from one another that information entered into the computer system would be permanent; even though you could delete the text on the screen, that text would still stay in the log data. The SRS, on the other hand, was a temporary document, and was thrown away every few days. Hospital systems are often systems of accountability (Bardram, 1997), and this CPOE was no exception. Systems of accountability are concerned with auditing capabilities and clear lines of responsibility.

The permanence of the CPOE record, and the visibility it engendered, brought concerns. Entering socially sensitive, emotional, or judgmental information about patients was held to be problematic by management at all levels. This reinforced the “politics of knowledge” often found in nursing care (Bowker and Star, 1999; Wagner, 1993). Even though nurses are concerned about care and have career anchors in care, their work is often considered problematic or secondary by doctors. As a result, the “subjective”

information, the local knowledge formerly contained on the SRS largely vanished in its textual format. It was shared only through oral channels, i.e. face-to-face or via tape report.

It should be noted that the disappearance of the psychosocial information did not happen immediately. In fact, the unit's nurses made many different attempts to find written locations for the psychosocial information. The AS has the wrong size, with only one line for each patient. Some nurses tried entering psychosocial information into the CPOE, but for the reasons discussed above, only certain kinds of psychosocial data, that which was considered suitably decontextualized and close enough to "medical fact," were placed in the CPOE. Since no location prevailed, each also had the standard melt-down problem from CSCW: When no one looks at the location, the motivation for using the location also decreases, fewer people use the location, and use cycles down. No suitable location has been found to date, two years after the adoption.

However, all of the discussion above about the concerns over disclosing subjective information does not really explain why the nurses also omitted even general nursing care information in the CPOE, such as the missing report that "the patient has a cast on the leg," which used to be carried by the SRS.

Writing nursing care information on the SRS near the end of the shift was an institutionalized arrangement, which had been in place for six years. Even though it was not required by the hospital administration, there was a social agreement among the unit nurses of how the work should be done. This information was originally assembled with the summary of doctors' note and newest lab results. Nurses collected collecting

information from elsewhere (mainly in eCare) and also noted nursing care information that is local and unique.

When the CPOE system was introduced, this assembled information object disintegrated, as two categories of information were superseded by CPOE functionality (the super link to eCare). But more importantly, the institutionalized arrangements that made SRS use possible also fell apart. At the beginning of the study, the politics of information were essentially hidden, in that institutionalized arrangements had been negotiated (implicitly or explicitly) among the nursing staff. Every nurse would note on the SRS what they observed about the patients during their shifts. The politics of this arrangement became critical, however, when the CPOE record became visible to a larger public (and therefore a boundary object and public knowledge, Bowker and Star, 1999). The previous agreement to detail the psychosocial information but to keep it private and informal on the SRS disintegrated. The public nature of the CPOE record made the generation and within-group sharing of local knowledge problematic.

As mentioned above, there were some debates about the very nature of nursing care including psychosocial context information. Some nurses insisted that the AS should only include “medical” and medical “workload related” information on the AS, but others thought it was okay to put a short note about a patient’s being “needy.” The discussion also centered on whether “subjective” data could be placed in patient records or only “medical facts.” After the CPOE introduction, the politics of knowledge metastasized – discussions were no longer just about the CPOE system, but about the value and nature of the data itself, such that they have been trying to set up a template (in the CPOE system), making it clear “what data” should be in the system. Some nurses

even proposed bringing the paper SRS back with a modification to remove the requirement of doctors' notes and the newest lab results, only keeping the nursing care information. Regardless, the unit leadership and nurses have not been able to find a better solution than lengthening the tape report.

Either this new template or the modified SRS requires a new "negotiated order," Strauss's term for a new consensus about meanings (Strauss et al., 1963). In this case, it is a consensus about proper data and work - what could be public, what should be local knowledge, what media would be appropriate to carry the data, and how it would fit into the new workflow. Without the consensus of a new negotiated order, there can be no new form to resume the previous practice of including psychosocial information.

To conclude, the adoption of the CPOE demonstrates how the computerization of medical information can turn local knowledge into more readily available and public information objects. In the process, however, this automated common information space, which is designed to foster information sharing, in fact de-motivates nurses' information contribution and actually hampers information sharing.

5.5. Summary

In this chapter, I analyzed nurses' work, with a focus on group practice, the role of local knowledge in nursing care, how the group working documents were created to rearrange the information components to fit the nurses' information needs.

In the next chapter, I will focus on nurses' information assembling at the individual level and how the workflow and process change (due to the adoption of the CPOE) has an impact on their knowledge about the patients. Then, I will extend my analysis to the medical order practice broadly.

Chapter 6

Information Assembling and Boundary Objects

6.1. Introduction

In the last chapter, I examined nurses' use of two group working documents, focusing on how they each contributed to the group information sharing and how this practice was affected by adoption of the CPOE. In this chapter, I turn my attention to each individual nurse's information assembling process during the construction of their personal working sheet. My analysis focuses on how the change of workflow and media of the information objects (from paper to electronic) may have an impact on a nurse's overall level of knowledge about a patient. Then, I will discuss what the computerization of medical information means to nursing work of medical order practice in a broader context.

6.2. Information Assembling at the Individual Level

In addition to various documents that are collaboratively created to facilitate information sharing as I described in Chapter 5, nurses also assemble information from many sources to create a personal working sheet (PS) as a memory aid during their

shift¹⁴. They carry the PS in their pocket at all times, not only using it to remember what they need to do but also to jot down important issues that should be passed along to the nurses on the next shift. When they report to the outgoing charge nurse, who prepares the audiotape recording, they use the PS to remind them of all of the issues that arose during the shift. Therefore, while assembling information at the beginning of the shift and jotting down notes throughout the shift is by no means a requirement for nurses' documentation, they write down information to create a memory aid as an essential part of their work.

In practice, this personal sheet can be very different depending on how nurses structure it. While some nurses prefer to use a structured template, a majority of the nurses I observed use a piece of blank paper and follow their own preferred format,

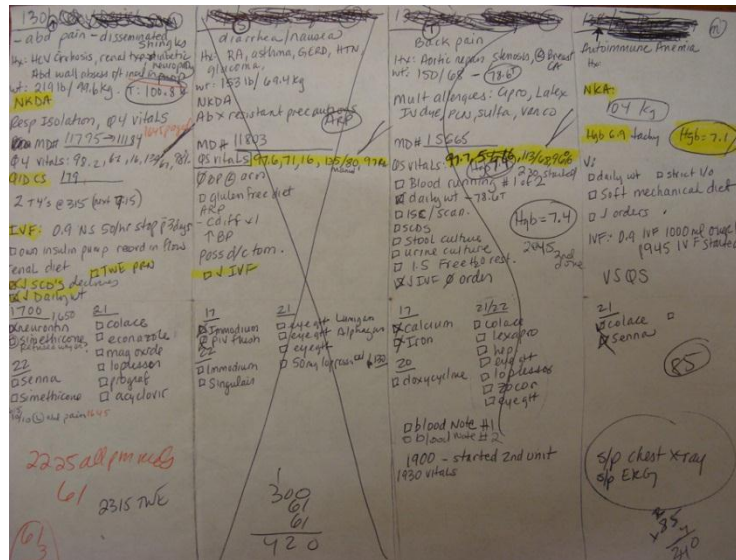


Figure 9 An example of nurses' personal work sheet

¹⁴ In this section and Section 6.3., I use the verb “assemble” or its ongoing tense “assembling” to describe nurses’ information gathering process when they construct their personal work sheets. This is to be consistent with the use from earlier literature (such as Tang and Carpendale, 2007) in referring to the same process. Note that the use of “assemblage” in earlier chapters, and its extensive use in Section 6.4. and Chapters 7 and 8, have distinctive meanings .

which they may have learned during nursing school. See Figure 9 for one example of a nursing personal sheet prior to the CPOE adoption.

Prior to the CPOE adoption, the construction of a PS started right after the charge nurse/team leader assigned patients to each nurse. As shown in the figure above, the general information on a personal sheet included a patient's room number, name, diet, diagnosis, medical history, vital signs, I&O, whether the patient has IV and specimen, the doctor's pager number, a list of what to do and when to do it, and so on. Throughout the shift, nurses might add more information and also circle, highlight, or underline certain items that may be important to note and report to the next shift nurse.

The information components on a PS were assembled from various information channels, such as the AS, nursing Kardex, SRS, whiteboard, 24 Hours Patient Flowsheet and MAR. In addition to these channels, face-to-face interaction with outgoing nurses was also an important information channel for an incoming nurse to understand the situation, particularly when it involved substantial psychosocial issues.

It is worth pointing out that these information objects were stored in different locations. (See Figure X for the information flow and physical location of each artifact.) The first stage of the information assembling took place in the conference room, which included the tape, AS, nursing Kardex, and SRS. Then nurses traveled to the nursing station to retrieve doctors' information from the whiteboard, and finally, they walked to the bedside in the hallway¹⁵ to locate the 24 Hours Patient Flowsheet and MAR.

In either situation, both before and after the CPOE adoption, nurses carried their PS and AS in their pockets throughout the entire shift, the former for her own patients

¹⁵ Bedside in this situation refers to a fold-down shelf that holds a patient's 24 Hours Flowsheet and the MAR (Medication Administration Records). It is mounted on the wall in hallways instead of at a patient's actual bedside; however, clinicians often use "bedside" to refer to this document location.

and the latter for assisting other nurses when necessary. Nurses relied heavily on the PS, and they sometimes referred to their PS as their “brain.”

Most of the nurses throw the personal sheet away after they finish their shift. There are indeed some nurses who saved and filed all their personal sheets since the beginning of their nursing career. One nurse mentioned that she liked to occasionally go back to browse them, and also mentioned that she kept them in case a legal issue arose for which the old personal sheets could help her better remember details of a particular situation, but she did say she never had to use her old personal sheets for this purpose.

6.3. Information Assembling as Knowing

With the disappearance of two group working documents, the individual nurses’ information assembling process needed to change to fit the new system. To illustrate the new practice, I use one representative case throughout the following sub-sections to illustrate how one unit nurse, Joan, assembled information about her patient Ms. Watson at the beginning of her morning shift. Figure 10 below shows the graphical order of information objects Joan accessed in this process. Then, I will discuss whether this new practice has any impact on nurses’ knowledge about their patients, and the implications of this for patient care. My interpretation is interwoven with the description of the case.

6.3.1. Information Assembling

Receiving New Patients

It was 7 AM on Saturday. Joan sat before a computer, holding a copy of an AS and a PS template. Three other nurses sat around the table while the incoming charge nurse started playing the audiotape prepared by the outgoing charge nurse.

The original entry for the patient Watson on the AS was very simple, “Watson, (room) 433, chronic cough, ↑, HL, QS, ADA, QID, sputum¹⁶.”

While short and simple, the AS entry for Ms. Watson told Joan that this patient’s current diagnosis was a chronic cough, that she could get up to walk without assistance, that she had a Heparin Lock (for an IV treatment), that her vital signs should be checked every shift, that she was on a diabetic diet and that her blood sugar should be checked four times a day, and that sputum should be collected. The AS described the patient’s current diagnosis and had a very minimal description of the ongoing medical situation. As one of the nurses said, only “basic stuff, anything that pertains to each shift” goes on the AS. As such, with only an AS entry, Joan might have gotten the impression that patient Watson was perhaps not a heavy workload patient and that it was a pretty easy case. However, when she listened to the portion of the audiotape for Watson, Joan heard,

“Ms. Watson. This patient is A (Alert) O (Orientation) times three, and the vital signs are stable. She is under chronic cough. Her issue is that she can be really dramatic at times. And she will request more pain medication. MDs were at the bedside several times. They have warned us that they will not be ordering any more pain medications for her. She does receive Toradol every six hours IV, and that is helping a little bit with her pain. The patient, she claimed she had seizures but the MDs think this is made up. They think she also has some borderline psych issues so she even has her own bed. She actually was o.k. for us on night shift and didn’t have any episodes but has a warning she can’t do that.”

Joan was a bit surprised in hearing this, and made a note on the entry for Ms. Watson on her AS, “dramatic @Xs, Ø more narcotics, per pt sz hx – MD deny? Psych.”

¹⁶ A sputum sample refers to the mucus coughed up from the lower airways. It is usually used for microbiological investigations of respiratory infections.

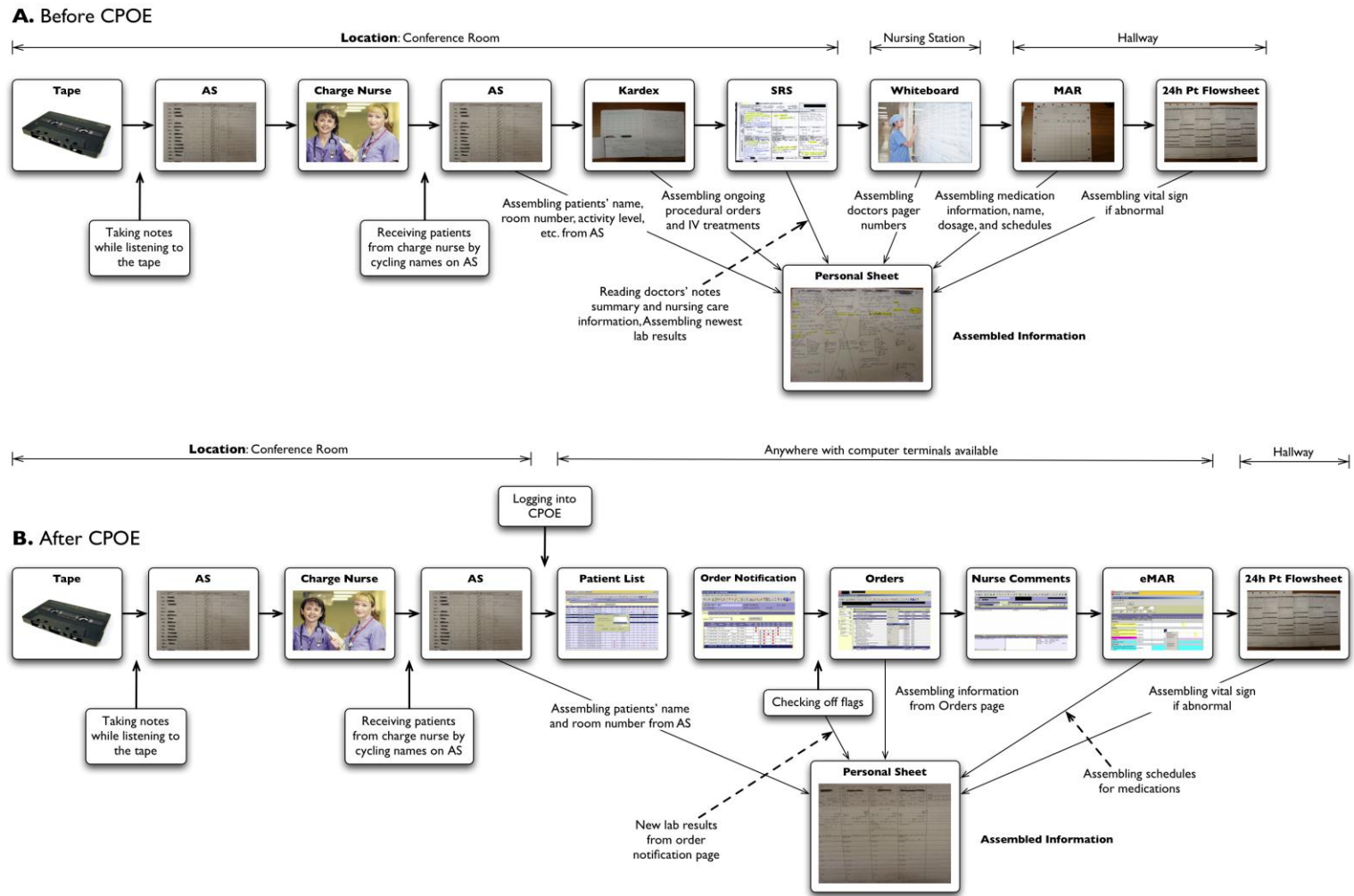


Figure 10 Individual information assembling process before and after the CPOE adoption

Indeed, the AS entry alone was not able to convey a full description about Ms. Watson. As one can read from the tape transcript, the charge nurse conveyed a richer picture, which was largely based on the outgoing night shift nurse's oral report. It was particularly important for an incoming nurse to understand that Ms. Watson might have some potential behavioral issues and conflicts with the doctors because the doctors did not believe what Ms. Watson reported about her "seizure" experience. It warned the nurse that the patient should not get more pain medication.

Nurses were often proud of themselves in advocating for patients; however, they have to follow doctors' orders. Ms. Watson's situation implied a difference in understanding between the doctors and the patient about her illness, which would put any nurse who took care of Ms. Watson in an awkward situation. During the playing of the tape, Joan had not yet received the patient assignment. While she was not sure she would receive Ms. Watson, she still noted several key pieces of information on her AS as a reminder that psychosocial issues might be a major concern for this patient even though the medical issues might not be critical.

After the CPOE implementation, for various reasons as described in last section, nurses have become hesitant to enter nursing care information (particularly psychosocial information) in the "Comments" area on the CPOE Clinical Summary page, as was intended by the system design. Instead, nurses have tried to make the tape report longer, to include the sensitive, psychosocial, or problematic issues such as those in Ms. Watson's case. However, this oral channel is effective only from one shift to the next, not across multiple shifts. An outgoing nurse tended to report what had happened during the

immediately previous shift instead of the cumulative information that the original SRS carried.

The case continues:

After the entire tape report, the charge nurse spent about 7 minutes to make the assignment. Joan received four patients, including Ms. Watson. Then, she immediately started to construct her PS. She quickly copied all of her four patients' room numbers and names from the AS onto her personal sheet, and carefully noted the diagnosis, activity level, diet, and vital sign check frequency. Then she logged into the CPOE.

It is worth pointing out that Joan in fact did not copy her short note on the AS about Ms. Watson's psychosocial issues into her PS. Indeed, as detailed below, the PS served as a to-do list for Joan, as it did for other nurses we observed. It is also worth noting that the psychosocial information learned from the audiotape contributed enormously to a better understanding of the patient and of the situation, such as the conflict between the doctors and patient in Ms. Watson's case.

Next, I describe how Joan used information from the CPOE to continue her PS construction.

Working with CPOE

After logging into CPOE, Joan located Ms. Watson. She first went to her "Orders" page. Under the very top category, "Admit/Discharge/Transfer", Joan was able to find various information she needed to know, such as allergy, diet, weight, diagnosis, code status, service code and doctor's pager, and so forth, so she copied them all into her PS. Joan could not find the patient height information, so she marked "HT" over the weight data on her PS as a way to remind herself that she needed to find out about the patient's height and entered it into the system.

At the time of this case, Joan and other nurses had become very happy with the automatic assembling done by the CPOE. On the top of the "Orders" page, she could find almost all the medical data she needed to fill in her PS. These data were originally carried

in multiple information objects (on the Kardex and AS in the conference room, or on the whiteboard at the nursing station) in the prior paper-based environment.

After this basic medical data assembling, Joan wanted to know more about overall orders as well as nursing care information:

Joan skimmed other orders and then clicked the Clinical Summary page, hoping to find some nursing care information about Ms. Watson. However, she only found one entry - "allergy precaution". Then she quickly jumped onto the "eMAR" page, which showed the scheduled medication and was also used to record medication administration results. She circled 9:00, 12:00, 13:00, and 14:00 on her PS as a way to remind herself that she needed to administer medications for Ms. Watson at these specific times.

This constitutes a significant shift in Joan's work. Previously, with paper-based orders, Joan always wrote down the medication names and dosages and then circled the time on her PS as a way to remind herself of the tasks she needed to do. The PS was also used as a mechanism to double-check her work before giving the medication to the patient. Officially, nurses were not supposed to copy medication orders onto their PS, because they might copy something incorrectly and create dangerous medical errors. Instead, nurses were encouraged to bring their MAR folder (which contained the official paper printout of ongoing medication orders from the hospital pharmacy) with them into a patient's room as a reference to double-check.

However, nurses did not want to bring the MAR folder into a patient's room since it was often very bulky (with a hardcover protection and an accumulation of all medication orders since the patient's hospitalization); since the MAR might contain bacteria harmful to the patient, because it was usually placed on a fold-down shelf in the hallway; and since moving the folder in and out of a patient's room could spread dangerous bacteria. Because of these concerns, even though it was not encouraged by

official policy, Joan, together with many other nurses, always first reviewed the MAR and then copied medications onto her personal report sheet.

With the CPOE in place and after computers were installed in all patients' rooms, the medication room (which stored patients' medications), hallways, the conference room, and the nursing station center, nurses could access medical order information in real-time almost anywhere. So, there was no longer a need for Joan to copy this information onto her PS. In fact, she only reviewed the eMAR, and circled the times as a reminder. The color-coding of eMAR highlighted medications in their various statuses, which provided Joan an easy way to figure out what medications were ongoing, what was being used as-needed, what was delayed, and so forth.

It should be noted that it took Joan quite a few months to reach her comfort zone, where she no longer continued to copy medication information (names and dosage) over onto her PS. She had been doing this for many years of her nursing career as a way of knowing what medications each patient was prescribed. Her traditional practice was, however, gradually replaced by the ease of real-time access at almost any location on the nursing ward.

Face-to-face Interaction

As mentioned, sometimes the outgoing nurse spoke directly to the incoming nurse:

While Joan was preparing her PS in front of a computer, the outgoing nurse, Beth, who took care of Ms. Watson for the night shift came into the conference room. She talked with Joan about some further issues with Ms. Watson. Apparently, at 6 AM this morning, Ms. Watson woke up with her hands shaking, asking for pain medication for her cough and pain. Beth told Joan that the doctors had made it clear that they did not want to be paged; however, Ms. Watson demanded to have Dilaudid (a strong, addictive and abusable pain medication). While listening, Joan

nodded. She quickly finished the information assembling on the PS for her all patients and started her first visit to Ms. Watson.

Face-to-face interaction is always very powerful in communication. In this case, however, since Joan had already learned the problematic situation about Ms. Watson during the tape report, Beth's story did not surprise Joan. Still, this information provided Joan with a further understanding of Ms. Watson's most recent situation and how her shift might play out with this patient. She knew that she might run into a very problematic situation. Apparently the doctors did not want to be paged while the patient insisted on wanting stronger pain medication, and Joan had to satisfy both sides. As in the previous section, Joan did not record this information in her PS. Rather, this information gave her a better understanding of the situation rather than serving as a to-do task, as were many of the other items on her PS.

Indeed, as we examined Joan's PS after she finished her shift, most of the items she wrote or circled at the beginning of her shift had been crossed off. For her, constructing a PS was now the equivalent of creating a to-do list for each of her patients. Throughout the shift, she crossed off tasks as she finished them, one by one. In her own words, "I am a 'cross it off the list' kind of person."

What Is Missing

Throughout the information assembling process for Ms. Watson, Joan accessed several different information channels, including the AS, audiotape, CPOE, and the outgoing nurse. Joan did not read the patient's medical history stored in doctors' admission notes in the eCare system. In fact, she did not do this for her three other patients before she went to visit them. Previously, she would have read doctors' notes as summarized by previous nurses and carried via the SRS. As observed in this case, by the

time she finished her PS preparation, it was already past 7:50 AM. According to Joan, she always wanted to see her patients at least ten minutes before 8AM. She was under time pressure to review all four patients' information and assembled that information into her PS.

Prior to the CPOE adoption, nurses did not necessarily have the time to log on to eCare to read doctors' notes after a shift-change meeting. However, they could get a brief description from the previous nurses' summary of doctors' notes, which was included in the SRS. More often, nurses liked to copy doctors' notes into a Word document, remove the unnecessary details, shrink the font, and then print out a page to be pasted onto the SRS or Kardex. In this way, incoming nurses could get a full idea about the patient illness in a larger context. Along with cumulative nursing care information, also documented on the SRS, nurses could get a nice picture about who the patient was and why the patient was in the unit. In my observations after the CPOE adoption, I saw only a couple of senior nurses routinely trying to read the eCare notes during the information assembling for the PS, even though doing so significantly delayed visits to their patients. Among them, one commented, "I know I am slow, but what's the point if you do it [getting on eCare to read patient's overall medical history] later?" The other said,

"Just because I like to go in there, instead of being blank, not knowing a thing about the person. I got the heads up what this person is going through ... So when I see them, I can talk something other than illness that I can relate to, 'Oh, you are a sea captain!' ... Something unusual. That, they are very happy to share ... So, patients feel better, knowing I know something."

This raises the question: what is the minimum information that a nurse needs to know in order to provide patient care? Was the information on the SRS indeed necessary? When pushed to answer this question, nurses agreed that as long as they knew the ongoing orders about a patient they could start their work; for other things (patients'

illness trajectory, emotional needs, personality), they felt they could always catch up later during the shift. This is consistent with what I observed: some nurses' initial PS may only have limited information, such as name, diagnosis, room number, and scheduled time for medication orders.

In a formal interview, Joan was asked to compare how well she was able to assemble information before and after the CPOE adoption to serve the need to understand patients. She sighed,

“I feel that there is more personal stuff that is passed along through Kardex and (SRS).”

I asked what “personal stuff” meant and Joan replied:

“About the patients. In many ways, it’s a great loss. We don’t have those little things (i.e. Kardex and SRS) any more. On the whole, [CPOE] saves tons of the time, because I am not going [to have] to try to figure out doctors’ scribbles [of orders]: I often had to [hold] doctors handwritten orders upside down in order to figure out what they wrote. It wastes time and it leaves room for errors. Now it’s faster and it’s safer.”

Joan’s comments were confirmed by quite a few nurses. While appreciating the positive outcome of the new technology, they were indeed aware that the nursing care information, particularly psychosocial information and in-depth knowledge of the patient originally documented on the SRS, had partially disappeared.

What is Gone

With the adoption of CPOE, some of the group assembling processes were automated by the new system. For instance, nurses no longer need to write summaries of doctors’ notes or copy new lab results onto their SRS. There is a super link that connects eCare with the CPOE, and nurses do not have to write ongoing critical IV information or procedure orders on a Kardex anymore because the Orders page in the CPOE displays all

orders through various filter functions. This reduction of the documentation burden was celebrated by the nurses. In fact, the only group practice that remained after CPOE was to jointly document nursing care information in the Comments area on the Clinical Summary page, the part of the common information space (Schmidt and Bannon, 1992; Bannon and Bødker, 1997) designed for nurses to facilitate information sharing. However, as I discussed in Chapter Five, nurses have not utilized that area well. The important group documentation practice for local knowledge sharing has largely switched to an individually-oriented oral report to the charge nurse and then from the charge nurse to the incoming nurses.

6.3.2. Assembling as Knowing

The prior description illustrates the dual processes of constructing a PS before and after the CPOE adoption. It provided an interesting case of how computerization of medical information not only changes the way nurses assemble information but also the nature of local knowledge practice. What does this change mean? How might this change affect what a nurse knows about her patients?

The biggest difference for the PS is that majority of the nurses no longer write down medication names and dosages; instead, they only circle the scheduled time for medications. This is an intended outcome of the CPOE adoption. As mentioned, both the technology affordance of a real-time access to review orders in the CPOE and hospital policy have ensured and enforced this improved practice.

However, the difference in medication information on the PS may not reflect the full change from before to after the CPOE adoption. The purpose of information assembling had been not only to produce a PS, but also to contribute to a nurse's

knowing about her patients, even though this knowledge may not have been written onto her PS. To understand this difference, we must take a close look at the information objects used and the sequential order in which nurses assembled information within both processes.

Prior to the CPOE, nurses used a number of local information objects to help them assemble information into their PS, such as audiotape, AS, Kardex, SRS, and whiteboard. They were local not only because they were locally created but also because they contained substantial local knowledge that was meant to be shared only within the unit. The accumulated information contributed by each nurse, particularly on the SRS, conveyed a very rich picture about a patient and a shared understanding of the patient's illness experience. It contained "personal stuff," allowing nurses to know their patients as a person rather than just information about their illness. In addition, it also embedded group wisdom, such as an observation that a seemingly cranky patient could be easily cheered up with humor, a comment that a nurse could note on the SRS, so the other nurses would be able to use the hint to cheer the patient up. The SRS also let other nurses know, and share responsibility, about patients, such as warning one another about a patient hiding medicine potentially for illegal or inappropriate use.

In addition to the local knowledge, this assembled information object also included substantial publicly available information. It included a summary of doctors' notes and the newest lab results in eCare, which provided nurses with an up-to-date picture of the patient and also a larger context of why the patient was hospitalized and how the current illness or other related medical condition had been managed in the past - a full trajectory of information about a patient. Likewise, the Kardex gathered all ongoing

procedure orders and IV treatments at the nursing station. Nurses re-arranged these components on a piece of paper, making it handy in the conference room, so they could access it while sitting around the table during the shift-change meeting. The easy accessibility of the components, their close fit with the routines of nursing work, and the time savings they afforded explain why these working documents were able to assist nurses' information needs prior to the CPOE. Different representations of the same information, carried by different records and media (Ackerman and Halverson, 2004) supported the nursing work, which explains why nurses created these information objects in the first place.

The CPOE successfully automated the publicly available information and gathered the information originally in various documents and records into one place. As I have shown, nurses mainly use the CPOE to construct their PS now (copying only the room number and the patient's name from the AS and sometimes abnormal vital signs from the 24 Hour Patient Flowsheet).

However, the nurses feel that "personal stuff" about patients is missing in this new process, which creates a hole in their knowledge about a patient. The attempt in the design of the CPOE to provide a common information space for the unit nurses to share nursing care information was underutilized, because it essentially ignored the nature of local knowledge and made that local knowledge public to everyone in the hospital. The resulting visibility and the politics of this information in the new system held nurses back from contributing their knowledge about patients to others. Of course, they could still share some of this information through the oral report or sometimes face-to-face interaction; however, the oral channel is less systematic and cannot present a trajectory of

information as would an accumulated written record. Again, having information and including it in the record are different; it makes a huge difference for knowledge collection and information reuse (Ackerman and Halverson, 2004).

In addition to the gap of knowing detailed nursing care information about a patient, another miss in the post-CPOE process is the lack of a mechanism for viewing a patient in a larger context from reading doctors' notes before nurses go to visit their patients. As described, the CPOE indeed provides a super link for nurses to access eCare and then, with just a couple of clicks, to read doctors' notes, so the nurses could know about their patients in their larger care context (as opposed to having only the current diagnosed illness). However, as I observed, other than a couple of nurses who routinely access eCare to review doctors' notes during the construction of their PS, the majority of the nurses do not take advantage of this feature. They may get on eCare to find out more about patients later, but that is usually over half-way through or close to the end of the shift, shortly before they stop taking care of a patient. As described earlier, the patient assignments are made based on the rule of even workload distribution rather than by who might have had earlier experience with the patient. A nurse could be assigned to take care of the same patient from the day before if she made a note, but that was not guaranteed. In fact, nurses often do not get the same patients the next day. Therefore, learning about her patients later in a shift does not contribute to the work ahead or to others' awareness of potential issues. So, why is this mid-shift information review happening?

Let me review the sequential order of accessing information objects, which will provide an answer. Previously, right after receiving the patient assignment, nurses who sat around the table could access the Kardex and SRS within an arm's distance, since

these two information objects were stored on the table. The nurses pulled them out, briefly copied ongoing procedural and IV treatments (if presented) onto their PS, and flipped through a stack of SRS's, which provided them with both rich nursing care information and the doctors' notes about the patients giving a larger context. Assembling the significant medication orders took place after the nurses left the conference room and traveled to each patient's MAR folder located in the hallway, which stored a patient's medication information.

After the CPOE, right after they receive their patient assignments, nurses immediately get on the CPOE to review the Orders pages and eMAR schedules. The first category (Admit/Transfer/Discharge) of the Orders in fact provides nurses most of the medical information about the patients: diagnosis, diet, vital sign/blood sugar check frequency, admitting doctor's pager and service code, and so on. The nurses quickly copy all this information onto their PS, review non-medication related orders (procedural and lab orders), and then quickly jump into the eMAR page, which tracks how the medication orders are to be administered and whether they are on time. As described above, when the nurses are under time pressure, which seems to always be the case, they skip the chance to read doctors' notes stored in another system (eCare) before they visit patients.

Indeed, nursing work is arranged around order administration. Administering medication (including IV treatments) on time is perhaps the first priority for them to focus on. The CPOE reinforces this practice by recording the results of medication administration with a hard time stamp in the eMAR. It is unclear whether this is a reasonable way to measure a nurse's work, but many nurses do not want to have too many delayed order administrations in their performance records. These delays are

automatically captured in the CPOE system. Previously in the paper order system, a five-minute delay in medication administration would not be so significant to nurses; however, it would mean much more in such an automated system. As our investigation shows, nurses said that as long as they knew the orders prescribed by the doctors they could start their work, and so they began.

In this situation, knowing a patient better becomes a marginalized concern. With the CPOE, it becomes each individual nurse's preference whether she wants to get to know patients to a greater extent than just seeing their illness diagnosis and ongoing orders when she goes to see her patients. Previously, in the paper-based environment, it was a group practice that everyone would read the SRS around the table in the conference room to get a sense of the patients' trajectories. It is true that my investigation alone does not offer sufficient evidence to claim that there is any clinical outcome difference under the new patient care with its reduced level of contextual knowledge about patients. However, given that patients in a medicine unit can have over twenty to thirty medications in two hours, among which some are prescribed for co-morbid chronic conditions, one may assume that knowing patients within their fuller and larger context would enable nurses to understand more fully why certain medications are prescribed for this patient in the first place. Knowing the patient by getting a more complete picture may help nurses catch potential medication errors, provide more pleasant care, and prepare for emergency situations that might occur during the current hospitalization.

6.3.3. Implications

Medical informatics research has focused on studying how to construct an information system to make information sharing more efficient, especially at a larger

scope. The careful examination of how nurses' use group and individual working documents shows a complex relationship between local knowledge and publicly available information sharing. It also shows a complex relationship between how medical work is socially distributed and how medical information is socially constructed from a nursing perspective.

Informal information (such as that transferred orally), information captured in records (permanent or temporary), and information on different media has different meanings to the users due to the inherent politics of information, physicality, mobility, and easy accessibility. When information is captured in an informal, temporary, local, and tangible means, it affords convenience and mobility (such as the PS, AS and Kardex) and allows a certain level of autonomy, respecting the nature of nursing work (such as with the SRS and audiotape). Furthermore, nursing care information can often be very subjective in its interpretation (Bowker and Star, 1999). A nurse may make a note that says "possible sundowner" on a group-only shared document noting an observation of a patient's behavior change after sunset. That would not be formally diagnosed by doctors, but it might be important for understanding a patient in a potentially difficult situation. The local knowledge contributes greatly to a better understanding of the patient, enabling nurses to provide emotional care in addition to medical care.

Computerization of medical work can bring what was informal and impermanent into permanence and formality with the promise of accountability, safety, and facilitating information sharing in real-time on a larger scale. What I have learned from this study is that certain information, once becoming part of the permanent record and shared within a larger scope, could largely vanish. Its original written form was a systematic group

practice and shared social arrangement, and this could also vanish. In this case, the automated common information space ironically hinders information sharing, which previously afforded contribution by everyone in the paper-based operation. Further, other nursing care information sharing (not psychosocial related) is also affected by the change as I described in last chapter.

Indeed, nurses are very aware of the loss of rich nursing care information. They reported that they were “still struggling” about how to increase use of the Comments page in the CPOE for sharing nursing care information. From this practical perspective, how to bring back that “personal stuff” about patients in nursing care in a more systematic way and via a collaboratively-oriented practice is a key concern.

This lesson raises a technical question about how to treat the local knowledge practice in the design of computerization of medical information. In addition to the politics of local knowledge embedded in these information objects, the heterogeneous nature of local practices makes it very hard to computerize local working documents in a uniform format to meet the potentially different needs of each different nursing unit (for example, an internal medicine unit for adults, as opposed to a pediatric unit). Indeed, local working documents are the informal representation of local practice.

Computerization tends to formalize and make practice uniform, which is necessary in certain situations, such as enforcing a standard order prescription practice for doctors; however, it should not also ignore specific and unique nursing practices in different units. The critical issue in this regard should be to acknowledge the informal nature of some information.

The analysis of individual nurses' information assembling also points out that while nurses need to get enough information before taking any action for patient care, the information which contributes to a better knowledge about that patient may not be easy to present. Therefore, how to provide nurses with an overview of a patient's medical history, including some narrative description about the patient and a fuller description of the current illness within the patient's larger medical and care contexts within a CPOE, should be considered in any design activities. This would be greatly appreciated by patients because the people who provide care for them would know them much better.

6.4. CPOE as an Information Assemblage

Working with the CPOE to assemble information is just the start of each shift. Since nursing work is largely arranged around order administration (Wagner, 1993) and the CPOE is central to this activity, in this section, I extend my discussion to the impact of the CPOE on medical order practice. To do this, I first contrast order practice before and after computerization in a broader context. I then discuss how two major information objects, Orders and eMAR in the CPOE, are used as boundary objects by different communities of practice to provide diagnostic tests, procedures, and treatment to patients; next, I further analyze how the CPOE as an information system acts not only as a boundary object, which assumes the functions of medical order management, but also an information assemblage of automated processes, coordination mechanisms, practices, and special information objects/functions designated for different communities.

6.4.1. Complexity of Medical Orders

Most of the medical orders are prescribed by doctors. Medication orders need to be verified by pharmacists and then administered by nurses. Procedural orders are executed by lab/radiology and other procedural departments or nurses. Dietary and other referral orders go to the meal service and referral arrangement unit. These different clinical groups use the orders in different ways, but orders serve as a central information object that connects all caregivers with a unified organizational goal – to provide treatments to patients and improve their medical conditions.

Before computerization, once a paper order was prescribed and placed, it was quickly interpreted and transcribed into other media, such as the pharmacy system, lab system, nursing Kardex, and paper MAR. The original orders were preserved in the patient's permanent records as documentation for future reference. Clinicians acted on transcribed orders, rather than doctors' original orders. The multiple handoffs resulted in errors and incompleteness (for example, missing orders on the Kardex cards were not uncommon).

To reduce errors produced in this process, computerization of medical orders allowed doctors to write electronic orders so other clinicians could take actions based on the original orders. In fact, an earlier version of the CPOE only had the function to allow doctors to write electronically and then print out electronic orders. Nurses or other parties did not have much input into the system. Nurses still had to use paper orders (on printouts) and to record administration results on paper documents. This simple version of the CPOE might have had less impact on overall workflow and work arrangement because the system was only involved with doctors' input. The modern CPOE, however,

as shown in this study, has extended this function to not only computerizing information objects but also work processes to a substantial degree. It also brings all caregivers into one system that essentially has changed the nature of medical orders to make all parties work within the same information space. This has caused changes to work arrangements in medical order practice as discussed below.

Medical orders in the paper environment vary a lot in terms of how they are generated. It is not as simple as just an order from doctors to other parties to execute. Nurses may also get approval to prescribe certain orders when it is necessary to accomplish the work more efficiently. For example, when a nurse saw a patient had blood in her/his stool, if she wanted to test it she would immediately fill out the lab requisition form and send a stool sample to the lab. As a general medicine unit that often gets more VRE¹⁷ patients who potentially should be on Antibiotic Resistance Precaution, the hospital infection control has approved for this unit that when a patient comes in with a history of VRE, nurses can fill out a lab requisition form and send a new culture to the lab to have the patient retested for VRE. Within the CPOE, however, the system blocks nurses from writing lab orders. It is designed in a way that may fit the majority of units in a general situation, but it does not fit well with the practice of a specific unit that requires nurses to be more proactive for infection control. As a result, nurses call doctors to order the lab test, which slows down the work.

Medical orders also have a lot of temporal nuances (Reddy and Dourish, 2002; Egger and Wagner, 1993). The different temporality of orders results from the nature of

¹⁷ Vancomycin-Resistant Enterococcus, a bacteria originally developed in people who were exposed to the antibiotic. VRE is normally not dangerous for healthy people. However, because it cannot be controlled with antibiotics, it may cause life-threatening infections in people with compromised immune systems, such as very young babies, elders, and people who are very ill.

how different orders are executed. For instance, a patient may need to wear a special boot for foot inflexion. The medical order needs to make it clear how often the boot is supposed to be on and off (e.g. “wearing it for six hours”). In the CPOE, however, as soon as the nurse picks up the boot in the procedure unit, the order will be marked as finished in the system and then disappear from the active order page. When the nurse comes back to the unit, she will not find the order any more. Then, she has to ask the doctor again. Even if the doctor tells the nurse how to use the boot, the next shift nurse will not be able to know the same information because there is no order for the boot in the CPOE. The system design for this type of orders only takes into consideration equipment management from the perspective of the procedural unit rather than the nursing perspective, but nurses are the ones who will ultimately execute the orders.

Furthermore, medical orders in a paper system can be narrative, and the interpretation of such orders can be very easy and straightforward for a human being. However, there is no easy way for an electronic order system to ‘interpret’ doctors’ intentions, so the system has to break down a simple order into several segments. For instance, in paper world, for an existing heparin order, the doctor may write another order, which says, “Don’t give this patient his doses of heparin tonight and tomorrow morning, and then restart it tomorrow afternoon.” This is a fairly common order that doctors often prescribe if a patient has a scheduled procedure the next day. In the CPOE, it will take two different orders along with free-text comments to finish the task. First, the doctor needs to “discontinue” the heparin medication and add on a stop date before the dose the doctor wants held. (Note: the date is structured in the system, but the time is missing.) If the doctor cares about the specific time of the day or which dose, they have

to add a free-text message in the designed comment box. Then, the doctor needs to write a new order with the heparin medication for the future and then again add a free-text message in the comment box if they want the starting time or dose to be specific, which is common in this type of situation¹⁸.

This solution encourages doctors to act like a machine, which they often describe as “stupid.” Generating this type of mechanical order not only increases doctors’ work but also creates extra cognitive workload for nurses when they receive the new orders. It essentially breaks down a fluid human sense-making process into several fragmented information-receiving stages and then requires putting them back together to understand what the doctors really mean. This is at least part of the reason that nurses say that they are now receiving “more prompts” (to remind them of the new orders coming or existing orders overdue) and feel “pushed” by the computer after the arrival of the CPOE.

Also, human interpretation is often needed when multiple orders are prescribed for the same medication with a different dosage or administration method. Again, this is not an issue for doctors and nurses because they have a shared understanding that the new order overrides the old one for the same medication. For instance, the doctor wants to increase the dosage for the medication prescribed the day before, or change a dietary order from regular to clear liquid or NPO (nothing per mouth). The CPOE is not able to tell the subtle difference between the orders. When an order is still active (based on the time range), it needs a nurse to execute it even though it is a duplicate order that is

¹⁸ The most extreme case is for Coumadin orders, which is a blood thinning medication that patients often take different doses of on different days. The most intuitive order writing should be something like, “Monday, Wednesday, Friday, please give X doses; Tuesday, Thursday, Saturday, give Y doses”. However, no physicians know how to translate this order into what a CPOE order requires, so they all just send a text to the pharmacy to let them write the order. Then, the difficulty of interpreting the machine order for Coumadin is left to the nurses.

already updated by the new order. This became a major issue during the first few months of the CPOE adoption. Nurses often had to deal with hundreds of accumulated duplicate orders.¹⁹ However, the only way to solve the problem was to call doctors to discontinue the previous orders, because nurses have no power to modify or discontinue what doctors write. When the duplicate orders accumulated and became overdue, the system presented bright red solid bars in eMAR, which made nurses feel that they were not doing their work correctly, which was of course not true. Then, nurses went back to ‘bug’ doctors over and over to discontinue the duplicated orders.

The loss of nuance, discretion, and human interpretation of medical orders has made doctors more responsible for prescribing the right order and discontinuing or cleaning up the orders that have been updated or never fulfilled. In fact, to maintain the integrity of the order system, the extra workload is distributed to all parties. Nurses or lab technicians have to identify those duplicated or unfulfilled orders, which can be many; then they call doctors to clean them up if the doctors forget to do so. As well, some work arrangements have also changed in this case: the power loss from nurses to place certain lab orders also increased doctors’ workloads to deal with the task that was originally carried out by nurses.

The discussions above illustrate that while the legibility of electronic order operation has successfully solved the problems that resulted from interpreting doctors’ handwriting, the rigidity of the CPOE orders (not allowing discretion, nuance, and interpretation) has changed work arrangements around certain orders. This rigidity has also made clinicians do extra work, which is often counter-intuitive to humans.

¹⁹ One nurse representative shouted out during the hospital feedback meeting, “The duplicated orders are killing us!” The hospital nursing administration encouraged the nurses to ‘educate’ doctors not to write a new order before discontinuing the old ones.

Furthermore, one group's power loss (nurses cannot prescribe lab tests any more) can mean another group's increased responsibility (Zuboff, 1989), which slows down the work and may jeopardize patient safety (in the form of a delayed lab test). Some of these issues will be further analyzed below in the context of how medical orders serve as boundary objects and how tensions occur between formal and informal use of boundary objects.

6.4.2. Orders and eMAR as Boundary Objects

Medical orders are clearly boundary objects that different communities of practice use differently (Star and Griesemer, 1989; Berg and Bowker, 1997; Wenger, 1999). Medical order practice is automated in the CPOE with 'Orders' and 'eMAR,' which are two information objects and perform two central functions of order practice: prescribing orders and tracking medication administration. When an order is prescribed for a patient in the CPOE, it is assembled by the system into that patient's Orders page. This Orders page is essentially a collection of a patient's diagnostic procedure and treatment during her hospital stay; eMAR is used to track and record medication administration in the process of treatment for this patient.

In this section, my analysis will focus on how Orders and eMAR as boundary objects are used by different communities of practice, how the processes are embedded and developed with the status and responsibility change when Orders and eMAR cross boundaries (Mambrey and Robinson, 1997), and how tensions and negotiation may occur between their formal and informal use of boundary objects (Lutters and Ackerman, 2007).

When a doctor prescribes a medication or IV treatment order in the system, the new order entry will show on the Orders page, and then pharmacists need to verify it before they notify nurses and send medication (e.g. pills and IV bags) into the nursing unit where the patient is hospitalized. Once the order is verified, it changes its status from pending to active, which produces a new entry on eMAR accordingly. Then the task and responsibility switches to nurses. Nurses need to prepare the medication based on the entry listed on eMAR, administer the medication at scheduled times, and record the results on eMAR right after the patient has taken (or refused) the medication. While the medication orders constitute a large category on the Orders page, nurses in fact do not look at them that much. Just like Joan (the case in Section 6.3.1.), nurses skip them when they prepare their personal work sheet. According to them, if the medication has not been verified by the pharmacy, they cannot do anything with it; after the verification, the medication will show up in eMAR, so they go to eMAR (rather than Orders) to find out what they should do. In this way, the order status change, (before the verification and after) indicates the responsibility change from pharmacists to nurses.

Indeed, eMAR not only defines nurses' responsibilities, it also serves as a window to doctors and pharmacists to show the ongoing status of a medication when the order is taking place, that is, how the medication is administered (on time or delayed) and how well the patient tolerates the medication (accept or refuse, and the reason). It is the nurses' responsibility to document this information in eMAR to serve not only doctors and pharmacists' information needs but also to serve as legal evidence of what the hospital has done to the patient. When an order is finished, the responsibility of providing

treatment to patients switches back to doctors, who may prescribe new medical orders based on how well the patients responded to the previous medications.

When doctors prescribe a lab/radiology or other procedural order such as dialysis, the procedural departments receive the task and arrange their work based on the schedule indicated by the order.²⁰ At the same time, nurses also have the responsibility for collecting culture samples or preparing patients to be ready for the procedure. Once the sample or the patient arrives, the responsibility switches to procedural departments, where they need to get the test or procedure done and send the results back to the CPOE system (or to eCare if it is a radiological test) so doctors and nurses can act accordingly.

For a dietary order, it is often clerks' responsibility to contact the meal preparation unit. The nurse is also responsible to see that her patient gets the right food because the dietary change often indicates that a new treatment or procedural test is coming. In addition, there are many orders that may only involve nurses or nurse aides, such as a dressing change, vital signs check, patients' physical activities, notifying doctors when certain things happen, and so forth. Both nurses and nurse aides will document the results of what they did with these orders in a patient's 24 Hours Flowsheet.

This whole complex scenario of order practice (due to a large variety of orders) shows how different communities use Orders and eMAR when an order or the result of finished order crosses a boundary: its status changes, and the obligation and responsibility also transitions from one community to the other(s). How the task is

²⁰ If the test is related to collecting a blood sample or performing an EKG (a test that checks for problems with the electrical activity of heart), the corresponding procedural units will send their technicians to the nursing unit to collect the sample or conduct the test. In this unit, the nurses do not draw blood. The phlebotomy team comes to the unit to draw blood samples. In addition, patients do not have to travel to other departments to get the EKG test.

accomplished in one community determines what another community can and will do next.

As boundary objects, Orders and eMAR have standard structures and should satisfy the information requirements of different communities (Star and Griesemer, 1989). In reality, however, this is not always the case. As shown, sometimes an order is written in the comment box rather than following the structured format. During the first several months of the new system adoption, doctors used the comment box extensively for various orders. The message in comment box is unstructured free-text, which is designed only for further instruction such as how a medication should be administered. The unintended use of comment box made the pharmacists do extra work to transcribe doctors' orders into standard formats; or sometimes the orders written in comment box got missed because they showed up in other categories of orders rather than in medication orders. This situation demonstrates the tension between formal and informal use of boundary objects (Lutters and Ackerman, 2007).

The use of boundary objects often needs more contextual information through either amended information or negotiation among different communities (Henderson, 1999; Lutters and Ackerman, 2007). After the comment box function was taken away by the administration (because of its extensive misuse by doctors), doctors have to write a separate order entry to provide contextual information for the previous order, thereby amending the initial order. For example, certain medications can be administered either per mouth or per rectal (PO/PR). For patients who are neutropenic, getting any medications rectally can be dangerous. Doctors need to have another medical order with "no rectal medications" to nurses who may administer the medication rectally when a

patient is nauseous. This amended order becomes contextual information for how to use the previous order entry.

Likewise, as shown, negotiations about how to construct complicated medication orders occur between pharmacists and doctors. After the comment box was taken away, doctors agreed to follow the structured format for prescribing a majority of the medical orders; however, they still leave the most complicated ones to pharmacists – they just send pharmacists a narrative message about the order rather than prescribing the order through the formalized Orders function. While not a standardized practice, it has become routine for all doctors to bother pharmacists when they have to prescribe Coumadin, a blood thinning medication that patients often take different doses of on different days, which is considered one of the most complicated orders to prescribe through the CPOE. As well, negotiation often occurs when nurses refuse to tolerate too many duplicated, confusing orders, and call doctors to clean up the previous orders before prescribing new ones.

These attributes of Orders and eMAR (contextual and amendment information, negotiation, and tensions between standardized and routinized use), are also identified by earlier studies (Ackerman and Halverson, 2004; Henderson, 1999; Lutters and Ackerman, 2007). The uniqueness of Orders and eMAR, however, is that they are a collection of each individual order entry and the records of medication administration during a patient's hospital stay. Within this episode, Orders and eMAR as boundary objects are continuously inscribed for new orders; they are constantly interpreted by different communities when they receive new orders; they are developed along a patient's trajectory during which different communities take actions on these orders; and they are

updated when they record new results of the actions (Mambrey and Robinson, 1997). Only when a patient is discharged are Orders and eMAR crystallized (Lutters and Ackerman, 2007). Then, they will be exported to a clinical data system as part of the patient's permanent records.

The use and creation of Orders and eMAR present the trajectory perspective of these two boundary objects. According to Strauss et al. (1997), an illness trajectory refers “not only to the physiological unfolding of a patient's disease but to the total organization of work done over the course of treatment plus the impact on those involved with that work and its organization” (p. 8). Orders and eMAR are both information objects used to record what medical work has been done to the patient (also including information about who did that work, at what time, and how) and the process that make the order prescription and medication administration take place, that is, object in process and process in object (Ackerman and Halverson, 2004). Within an episode, doctors often have to look for previous orders before prescribing new ones. Nurses also often have to retime the medication on eMAR based on what time the patient has received the last dose to avoid overdosing patients, particularly when they are transferred from one unit to the other. This reflects the trajectory information use within boundary objects along the continuous process of development of the boundary objects. When the patient comes back, she will have new Orders and eMAR in the CPOE for the new episode. In the new episode, however, doctors may still use the medication information from previous Orders through eCare to make an informed decision for new treatment. From this perspective, medication information on Orders is still in process after its crystallization (Lutters and Ackerman, 2007). In fact, what medications a patient has had before or has been on are

considered part of the information that doctors always want to know when they receive a new patient.

6.4.3. CPOE as an Information Assemblage

As shown, Orders and eMAR are boundary objects for order prescription and medication administration. They are situated in the CPOE. As a shared information system that supports different communities of practice to work in the same space, the CPOE not only computerizes information objects but also automates various work processes and supports coordination. It even embeds some local practice (although this can be problematic).

Most earlier studies use boundary object as a theoretical construct to study individual material artifacts, as pointed out by Lee (2007). Very few studies that have examined information systems from the perspective of boundary objects, as did Ackerman and Halverson (2004) and Pawlowski et al. (2000). In the last section, I examined the use of the CPOE as boundary object through the analysis of Orders and eMAR. In this section, I conceptualize the CPOE as an information assemblage to examine how the system automates various *work processes*, *coordination mechanisms*, and *special functions* for designated groups.

First, to automate the process of prescribing an order and to improve doctors' order prescription practices, the system preloaded standard order sets that provide best practice based on evidence-based medicine. An order set is a group of medical orders that is recommended to doctors to consider when treating patients with a certain disease. For example, it is notable that ten doctors may prescribe ten different treatments for the same lung disease, each treatment consisting of several medical orders. Among these different

treatments, some may lack a consideration of potential complications. Predetermined order sets are created by the experienced doctors in specific areas from the hospital to help improve the quality of order prescription. The doctors who serve on the CPOE committee come from different representative departments in the hospital, such that the order sets can be frequently updated based on new or specialized needs from different departments.

With these preloaded order sets in the CPOE, doctors in practice do not have to consult their medication manual book all the time, or write or type in orders word by word. Instead, they can choose from these predetermined order sets and then modify certain parameters to fit each individual patient's case. In addition, because the CPOE is a web-based application, doctors can access the system remotely and prescribe orders from virtually anywhere. Compare this to the previous paper order situation where doctors needed to physically come to the nursing station to write orders – clearly, the CPOE and the predetermined order sets automate this ordering process and provide significant convenience for doctors.

The CPOE also automates the process of receiving an order. This requires nurses or lab/radiology technicians to frequently log into the CPOE to check for new orders. When nurses are busy on other care activities and not able to get onto a computer, clerks often page nurses to remind them of new incoming orders. Compared to the physical order tray (Figure 5, located at the center of nursing station), which could be used as a means to receive new orders by just a glance, logging into the CPOE to find out whether there is a new order takes some extra effort.

Second, in the CPOE, different groups interact and coordinate through the status change of Orders and eMAR. The status change of the objects (such as from doctors to pharmacists to nurses) is realized by the information flow through various signals, which are used to coordinate the work (Schmidt and Wagner, 2004). For example, after a pharmacist verifies the medication, a ‘verified’ icon appears in front of the medication; then nurses receive an alert on the front page of their patient’s list indicating that the new order needs to be acknowledged. If the nurse does not acknowledge on time, the clerk will page the nurse. After nurses collect culture samples for testing, they notify lab departments by adding a sign “sample on the way.” When a new lab report comes back, there is a flag that requires nurses to acknowledge their awareness. Furthermore, there is a color code scheme for medication status on eMAR: “blue” for orders pending upon conditions, “yellow” for ongoing orders, “red” for overdue orders, which makes the overall medication very clear to anyone with just a glance. The different communities interact with one another and coordinate the work by changing the status signs and marks of the Orders and eMAR.

Compared to the paper world, where coordination is often realized by the state change of artifacts from one group to the others (Schmidt and Wagner, 2004), cooperative activities in the CPOE are largely achieved through various coordinating symbols as presented above.

However, the coordination mechanisms embedded in the CPOE is not sufficient. For example, a medication verified by the pharmacy on the Orders page does not mean that the nurses can get it for a patient. When the medicine delivery is delayed, nurses make phone calls to the pharmacy. Additionally, a bright red bar marked on a medication

in eMAR does not necessarily mean the medication is overdue. It may also mean it is a duplicate order that doctors need to discontinue, or it could be an active order for which the outgoing nurse had not had a chance to chart the result even though the medication was administered already. This is why incoming nurses never just jump in to administer overdue medications, which may overdose the patients; they always need to ask the outgoing nurses and make it clear whether it is indeed overdue or if there is another reason. As a result, the work activities in different communities of practice revolving around order management cannot be coordinated solely through the mechanisms within the CPOE. Clinicians make many phone calls throughout the day and night to further clarify the issues that the system cannot handle.

Third, in addition to the automated order practice and coordination scheme, to support nursing work, the CPOE also automated the nursing information assembling process, as I described in Section 6.3. To briefly summarize here, nurses' knowledge about their patients and their medical treatment are largely built in the Orders page, where the first order (the Admission Order provided by the doctor who admits the patient) includes all basic information about the patient (diagnosis, activity level, vital sign check frequency, DNI/DNR status, etc.). Some of the information is carried through from the last episode, such as demographic information, other health issues (if documented in previous episodes), and allergy precautions. Together with eMAR (for medication information) and the Clinical Summary (for nursing care information), nurses may get bottom line information to start the shift by working with the CPOE. If they need to get a more complete understanding about their patients, they still should switch to

eCare to read doctors' notes. From this perspective, the CPOE has automated nurses' information assembling process.

Furthermore, the CPOE has the functionality to allow charge nurses to monitor how medications are administered unit-wide. The system offers several specific design functions to aggregate nurses' performance data, particularly regarding how they handle controlled substances. These functions help the charge nurse, supervisor, and manager generate various documents that can be used for management control.

Among all of these automated objects and processes in the CPOE discussed above, computerizing nursing care information is perhaps the most controversial effort. As I have shown in Chapter Five, two years after the adoption, the Clinical Summary page is still underused. Nurses do not get enough nursing care information through this automated information channel. Instead, they rely on audiotape reports and face-to-face interaction, which can only provide fragmented rather than trajectory information about a patient. This is a problem of computerizing local practice in a common information space (Schmidt and Bannon, 1992), or the politics of information within a boundary object (the CPOE). This case reifies the permanent tensions between formal and public practices versus local practices and interests (Bowker and Star, 1999).

To summarize, I have tried to unpack the CPOE system to examine Orders and eMAR as boundary objects for order management. I also analyzed the CPOE as an assemblage of several automated work processes around order practice, coordination activities, and several special functions designated for different groups. The lessons I have learned from this study are twofold, emerging from medical informatics and information science perspectives.

First, in designing order prescribing practice, the CPOE changes the nature of medical orders (to some degree) from the original paper environment. It removes discretion, nuance, and human interpretation in the paper operation to fit the rigid configuration of the computation system. Orders as a whole have a standardized practice. However, each individual order *within* the collection of orders can be varied by who the prescriber of that order is (doctors or nurses), the temporal nuance, and the degree of human interpretation involved. The loss of this nuance from original order practice does not only mean extra work for each party, it results in a switching of responsibility and a redistribution of power (Zuboff, 1989). There is trade-off in allowing the nuances or following standardized requirements. However, if it is related to improving patient safety and work efficiency, the system should address these issues.

The CPOE has automated various work processes in addition to computerizing paper orders and medication administration records. It inevitably affects nursing to a substantial degree because nurses' work is largely arranged by order administration (Wagner, 1993). After the CPOE adoption, nurses spend significant time with the system, periodically checking about the new orders, acknowledging the new orders, preparing medication with the eMAR medication list, double-checking eMAR before administering medicine to the patients, and charting the results on eMAR. Perhaps with good intentions, the Comments area is designed for nurses to use as a group notebook for the patient. However, this has unintentionally put nursing work in the spotlight. Much nursing care information involves psychosocial information about a patient, which is often considered local knowledge shared only among nurses. The Comments area is designed to make this information available to all other communities of practice (including management) who

use the CPOE for various purposes. Bringing the local knowledge and politics of information into a boundary object has made the CPOE problematic in this context (Bowker and Star, 1999; Wagner, 1993).

These issues discovered from my analysis of medical order practice through a theoretical viewpoint of boundary objects and conceptualization of the CPOE as an assemblage have broad implications for medical informatics. For example, it raises questions about how to computerize boundary objects so that they can still maintain the nuance embedded in their original form. What is the trade-off between the nuanced and standardized forms? How can tensions between local knowledge, local interests, and local practices and global practice be addressed in a single information system? Also, what do the rearrangement of work and the redistribution of power and responsibility really mean for medical professionals facing computerization of medical information?

Second, CSCW has pointed out that as a research field we should not restrict ourselves to just studying the cases of “group” work where performing a task is assumed to take place in a relatively closed and fixed environment (Schmidt and Bannon, 1992). What I have shown here in the case of medical order practice is that the groups in an organization have to work cooperatively in a much wider arrangement (Schmidt and Wagner, 2004). However, how to analyze these interrelated practices within a single information system is a challenge. My analysis of the order practice in an electronic operation has shown that boundary objects as a theoretical construct has limitations for conceptualizing the CPOE, because the system consists of boundary objects but also automated work processes, coordination mechanisms, special functions for designated groups, and local practices. Other researchers also note the same limitations. For

example, in examining the coordinative practice of architectural design and planning, Schmidt and Wagner (2004) use ‘ordering systems’ to refer an assembly of “interrelated artifacts, classification schemes, notations, nomenclatures, standard formats, validation procedures, schedules, routing schemes, etc.” (p. 402). Ordering systems in that study refers to a cluster of practices and artifacts, each of which is critical to specific coordinative issues.

In my study, I have attempted to conceptualize the CPOE as an assemblage to overcome the limitation of boundary objects in understanding an information system as a whole. This assemblage has the function of boundary objects due to order practice fulfilled by Orders and eMAR. This order practice is embedded in a much broader work arrangement which pulls together many groups of clinicians to work in the same information space. The system helps them assemble the information they need that is critical to their work (order sets for doctors, patients’ diagnostic and medical order information for nurses, drug interaction information for all clinicians, and performance data for management). The cooperative activities are coordinated through the system via various symbols during the status change of an active order when crossing a boundary.

This assemblage also presents a trajectory perspective of medical work, that is, the “total organization of work done over the course of treatment” to a patient (Strauss et al., 1997, p. 8). The information in this assemblage reflects what work has done to a patient, how it was done, what time, and by whom. When the patient is discharged, the information is exported to another system as part of the patient’s permanent records. From this perspective, the assemblage shows a strong episodic nature. Nonetheless, the

use of information still presents a historical and contextual perspective when an order is prescribed, interpreted, and administered within a trajectory.

To conclude my medical order study, the analysis of Orders and eMAR suggests that a boundary object may change its nature when it is carried out by different media. In a paper-based environment, orders as a whole have a standardized fashion, but each individual order has its own nuanced temporality. They also allow discretion and involve human interpretation. When all order entries are made to meet the rigidity of the electronic system, orders as a whole may lose the nuance that ultimately changes the original work arrangements and results in power redistribution and responsibility shift. As well, eMAR as a computerized version of an original paper boundary object has changed how it is used - doctors do not have easy accessibility to read this information right before they enter into a patient room during morning rounds.

Furthermore, this study offers a detailed analysis of heterogeneous and interrelated practices about order management – how the use of boundary objects are negotiated between the standardized requirement and routinized use, how various specialized information is automated to support different groups, how tensions occur between global practices and local practices, and how cooperative activities are coordinated through the mechanisms designed within the system (yet not sufficiently). From an in-depth medical field exploration, this study suggests broadly to information science that an information system may serve as an assemblage which hosts heterogeneous information objects, interrelated work practices, coordination schemes, and special functions designated for different groups. This is a novel conceptualization that I suggest to examine an information object that is built to be centered on boundary

objects however embeds automated work processes engaged by different communities of practice and various special functions for designated groups. This study does not try to theorize an information system, such as the CPOE. By pointing out the limitation of boundary objects as a theoretical construct to understand the CPOE and interpret my data, this study is an attempt at a detailed analysis of how medical orders are practiced and shaped by complex interconnected groups within one electronic system.

6.5. Summary

In this chapter, I started with an analysis of how nurses assemble information to start a shift. In the process, I identified some information gaps resulting from the new workflow after the adoption of the CPOE. I discussed what it meant to a nurse's knowledge of her patients in a broader context. Then, I extended my analysis to use the theoretical framework of boundary objects to analyze the medical order practice, which involves different communities of practice. I proposed that we should extend our theoretical understanding of a boundary object when it involves heterogeneous information objects and interrelated practices and work processes, which is essentially the ecology of boundary objects.

Having identified various issues and knowledge/information gaps resulting from the CPOE adoption, by no means do I oppose the computerization of medical information. This investigation has shown that while computerization facilitated medical data assembling process and improved order handling practice, it also resulted in some information gaps in understanding patients in their larger care context and potential long-term knowledge collection by each individual clinician. It also shows how computerization of medical information can turn local knowledge into more readily

available public information objects. In the process, however, this automated common information space (Schmidt and Bannon, 1992; Bannon and Bødker, 1997), which is designed to foster information sharing, in fact discourages nurses' information contribution and unintentionally hampers information sharing. Furthermore, computerization often changes work arrangements to a greater or lesser degree for different communities of practice. These findings add to our understanding about how boundary objects act in the real world.

In the next chapter, I will switch to doctors' work, examining the functions of medical records in their practice.

Chapter 7

Doctors' Information Work

7.1. Introduction

Building on the understanding I gained from eight months observing nursing work, I switched gears to observe doctors' work. During the first two months of observation, I took turns observing two general medicine residency services and two general medicine hospitalists (who go to see patients on their own to take care of patients) in order to gain an overall understanding of the medical work of general medicine services. In total, I observed six senior doctors (including four attending doctors and two hospitalists), eleven senior residents, and fourteen first-year residents, often called interns. For most of the time, I observed one general medicine residency service team, Medicine Howard (MH). My description of the doctors' work draws largely from my observation of this service team.

In this chapter, I will first introduce doctors' work in general, with a focus on their main activities, such as receiving a patient, performing a diagnostic interview, carrying out the morning rounds, communicating with patients' family members and other caregivers, and constructing admission notes. These descriptions provide necessary background information for my analysis of doctors' documentation practice in the next

two sections. I situate my discussion in the analysis of medical records and representation. I will explore what information a doctor needs before they go to see a new patient and conduct a diagnostic interview, how they acquire that information, whether there is any information gap in this process, how they construct an admission note, and how the politics of information affects this process. Because doctors' notes are formal representations, which will be used for various purposes (billing, legal, and reuse when a patient returns), the key concerns of my doctors' study is to explore how episodic medical information should be captured and prepared for long-term reuse.

7.2. Doctors' Work

In order to examine medical work and the appropriateness (accuracy and comprehensiveness) of representations of this work, I find the concept of trajectory, a term that Strauss and colleagues (1997) first coined, useful in my analysis. According to Strauss et al., a 'clinical course' differs from an 'illness trajectory.' The clinical course describes what has happened since the patient's admission, such as reasons for the admission, medically meaningful symptoms, and diagnostic results and treatment plans; whereas an illness trajectory refers "not only to the physiological unfolding of a patient's disease but to the total organization of work done over the course of treatment plus the impact on those involved with that work and its organization" (p. 8). The difference between a specific clinical course and an illness trajectory, as I will show in my analysis in this chapter, is useful in understanding doctors' information practices and the role of medical records in supporting (or hindering) such practices.

Doctors' information work is embedded in managing, shaping, and experiencing a trajectory; regardless of whether it is spoken or contained in the records. Strauss et al.

assessment based on the patient's past medical records in the system (if the patient has been admitted before), the ED doctors' notes, along with diary log entries about this patient since s/he showed up at the ED. This is to get a broader picture of the patient's situation and to determine whether this patient should be admitted to the MH service.

Sometimes, the resident has to push back if they think that the patient should go to another service, even though the ED doctors have already admitted the patient to the service. For instance, one patient showed up at the ED with abnormal pain, vaginal bleeding, and some other significant gastrointestinal symptoms. The ED doctor believed that the major issue for this patient was gastrointestinal (GI). The resident quickly reviewed the patients' previous records and called the ED doctor back, saying that she believed that the GI problem is perhaps one of the symptoms but that the major issue for this patient is gynecological. Later, the patient was sent to the gynecology department and was diagnosed with cancer of the uterus.

Unlike other service teams, such as the neurology service team with whom the ED doctors need to discuss first *then* assign the patient, as a general medicine service team, the MH often has to take whomever the ED doctors assigns to them. In this situation, the MH often gets patients that other services declined, such as those who indeed have a chronic situation but were not admitted for general chronic pain issues. This predetermines that the MH is likely to run into problematic issues because chronic pain management (diagnose, medication, patients' behavior) has been particularly challenging, as I will describe in later sections.

If a patient is appropriate for MH service, the resident will assign the patient to one of the interns. Eventually, two interns will receive an equal workload based on the

complexity of eight new patients and previously admitted patient cases. The organizational role in a MH service team is such that the resident supervises the interns, but ultimately the interns are responsible for generating medical records (admission notes, progress notes, treatment plan, order prescription, discharge document, and so on) that are later approved by the attending doctor. The resident often helps the interns keep their tasks on schedule, such as placing the orders as soon as the treatment plan is made.

7.2.2. Acquiring Information

Information seeking and assembling takes place simultaneously during the process when MH admits new patients, conducts diagnostic interviews, and evaluates a patient during morning rounds. The most intensive information seeking and assembling occurs right after admitting a patient.

As mentioned earlier, after the resident receives a new patient, they immediately make a quick assessment based on the ED note or diary entries in eCare in order to decide whether this patient is appropriate for MH service. Next, the resident may briefly talk with the ED doctor and then assign this patient to one of the interns. When a patient is referred to the hospital by her primary care physician, the resident often tries to read the primary care physician's note in the eCare system.

Doctors rarely go to see a patient for a diagnostic interview without careful preparation. They need to have a relatively convincing idea of what is going on (e.g. several possible causes) with this patient. In some cases, a patient comes to the hospital for a chronic illness flare-up that has been treated before in this hospital. If the lab results, vital signs, and other measures are consistent with what has been observed before, the anticipated trajectory can be very routine and predictable. For other patients, however,

the resident and interns may not be able to make sense of the case based on the patient's symptoms and performance and their possible causes. In such cases, the doctors use additional information sources. The following case demonstrates this:

A patient was transferred from another hospital as an emergency case. He has past medical history with post kidney transplant and hypertension. Recently he took a vacation to Honduras for a scuba diving trip. After he flew back, he developed nausea with vomiting. In another hospital, his situation improved, but he was found to be hypoxic (i.e. low oxygen in his blood). Based on a concern for him as a kidney transplant patient, the patient was transferred to this hospital for further evaluation.

The intern reviewed the ED diary notes, laboratory test results, and the medical records sent from the outside hospital in order to prepare for meeting with the patient. She could not understand why the patient had developed decreased oxygen saturation with all vital signs and other descriptors appearing fine. She first searched Google and found 'hypoxic' was listed as a possible symptom after scuba diving. She discussed this with the supervising resident and interns from other services. While possible, the trip had been completed several days ago, so the intern then searched an online clinical information database. After gaining an understanding of 'hypoxic' causes, she started to examine this patient's previous records one by one in eCare. Eventually, the intern discovered the patient had experienced a similar condition two years ago, but later recovered without further medical intervention. After this effort, the intern became very confident and conducted the diagnostic interview. This case highlights the intense informational activities that occur during the preparation for a diagnostic interview.

7.2.3. Diagnostic Interview

The diagnostic interview takes place after an intern receives a patient. This involves significant biographical investigation, which may result in an emotional reaction

from the patient (Strauss et al., 1997)²¹. To prepare for a diagnostic interview, the interns often need to read past medical records stored in eCare. According to MH past experience, at least 80% of the patients have at least some kind of records in the system. If a patient has never visited this hospital before, the only information they can review is from the ED diary entries or ED doctor's note about the patient's present symptoms of this episode and some initial investigation.

A diagnostic interview provides the doctor an opportunity to investigate more issues in person from talking with the patient face-to-face along with a physical assessment. From the doctors' point of view, this is the start of a routine trajectory for the patient's hospital stay. There are fourteen standard categories of questions (related to a human body system) to ask a patient. The interview usually goes in a matter-of-fact style, Q&A fashion, and fast (simply "yes" or "no"). However, because doctors want to investigate information not only about symptoms (what's going on now) but also past medical experience, family and social history, and lifestyle (the entire context of the illness experience), a diagnostic interview often leads to a very emotional reaction. Below is a vignette to illustrate this:

It was an on-call day. MH intern Kevin received a patient Ms. Williams who was in her mid-40s. Ms. Williams suffered severe headaches over the last five days. Most recently, she developed shortness of breath and a swollen leg and foot, so she presented at the ED today. The patient has a complicated history of chronic illnesses, such as deep vein thrombosis (DVTs), squamous cell carcinoma²² (SCC) of her mouth and throat. In addition, she did not have good insurance and she wanted to switch her hospital from her native state to this neighboring state in a large teaching hospital for better care. Kevin

²¹ According to Strauss (p137), biographical work is "a rather special type of work, primarily intended to achieve only medical purpose per se, but which sometime has a more intense psychological component bearing on those purposes."

²² Squamous cell carcinoma (SCC) is a form of cancer of the carcinoma type that may occur in many different organs, such as mouth, lips, throat, and internal organs. Carcinoma is a medical term that refers to an invasive malignant tumor.

carefully went through each of the standard categories of the information that he needed to ask. When the conversation turned to family history, Ms. Williams became very sad, and told Kevin that her mother's side had five cancers, including her mother and sister; her father's side also had one case. When Kevin asked whether Ms. Williams had any miscarriages, she burst into tears. Kevin repeated, "I am sorry, I am sorry..." several times and passed her tissues. After a couple of minutes, Kevin explained that he had to ask this pregnancy history because of concerns over blood clots. Later, Ms. Williams asked Kevin to help arrange the surgical treatment for her SCC. Kevin made a highlight on his note. The interview lasted 28 minutes.

[From field notes on July 22, 2008, Emergency Room].

A diagnostic interview often takes place in the ED when a patient is assigned to a service team but not yet ready to be transferred to the floor. It is a fairly open space with other patients around separated by a soft material hanging from the ceiling to divide the space²³. To one patient, diagnostic interviews will be conducted by several doctors at different times - an ED doctor, an intern, a resident who supervises the intern, and also sometimes the attending doctor from the MH service. It is very notable that a patient may tell different people different stories, or will provide more or less information to different interviewers. Some doctors have a fairly easy time making patients comfortable enough to talk more, while others may find it hard to get a patient to open up. In this situation, the team members often share stories, largely about a patient's psychosocial experience during morning rounds right before they go into a patient's room.

7.2.4. Morning Rounds

Normally, doctors start their work with morning rounds. Depending on each team's work style and how many patients are in their service, the starting time may vary from 7AM ~ 8AM. For the MH service, I shadowed three different attending doctors with

²³ I was very surprised to see this arrangement for the first time. This may raise some privacy concerns for patients. Patients should have a comfortable and private space to talk with their doctors.

their different teams. The attending doctor's work style often decides how a team runs morning rounds. For instance, one attending doctor likes to start the morning round at 7AM every day; whereas the other two attending doctors may start the morning rounds earlier on post on-call day (when there are more patients to cover) but later on the three other days.

The post on-call day morning round is very intensive. The team needs to fully discuss each individual case of all eight newly-admitted patients in order to come up with a more precise diagnosis and provide a treatment plan. This is in addition to the workload of taking care of the remaining patients. The morning round on this day usually starts at 7 AM, so the on-call residents can finish up work by noon and go back home to sleep. The first-year residents usually generate admission notes after midnight and before 5 AM, so the attending doctor can have enough time to read and provide comments or raise more questions in the morning on post on-call day when they meet.

On the post on-call morning before rounds, residents and interns usually have already individually visited the newly-admitted patient at least once. Before the team enters into a patient's room, they always fully discuss the patient's situation; the attending doctor often asks the interns to present the case, and provide their understanding of the patient's situation, then the resident or attending doctor contributes what they have learned from talking with the patient separately. This is an interesting sense-making process. Sometimes the same patient tells different doctors slightly different stories, and always some doctors get more stories than others. The discussion in the hallway before entering a patient's room is a process to which everyone contributes their stories about the patient and also their understanding about the case.

Morning rounds on the three other days in a four-day cycle can be less intensive because all patients' treatment plans have been made. Still, residents need to come to the hospital early to visit their patients before the team meeting, so that they can report their patients' progress to the group. In any case, morning rounds are the central activity for teaching and learning. The attending physician often raises various questions that relate to patients' symptoms, challenging the residents to think more carefully about all possible explanations. In addition, the attending doctors often bring in more recent research findings on certain treatments (i.e. pros and cons) to broaden and deepen residents' knowledge. When they are ready to see the patient as a team, they usually have already had a shared understanding of what's going on, and a shared agreement about the treatment plan.

Meeting with a patient includes the physical assessment, talking with the patient or patient's family members about all medical issues (explaining what's going on), answering the patient's questions, negotiating with patients about their special requests, and all other related issues which often include health insurance, home environment, family support, and so on.

During entire rounds, residents periodically take notes on their rounding sheets, mostly related to the treatment plan, such as what prescription they will order. Just as there were various types of personal sheets that nurses created, residents' rounding sheets are also highly personalized. Some residents use the version automatically generated by eCare, which includes a patient's brief medical information (name, registration number, medication) and several empty boxes that residents use to jot down notes during morning rounds. Other residents may have their own versions of the rounding sheets, which they

learned from the medical school they came from. By the end of rounds, each resident will have already generated a to-do list on the rounding sheets for their patient (see Figure 12 for one sample of the rounding sheets I collected). After rounds, the resident often spends time with each individual intern, discussing the patient’s situation again and reviewing the treatment plan for each of the patients. Then, throughout the day, the interns will carry out the plan - generating notes, prescribing orders, and reaching out to family members.

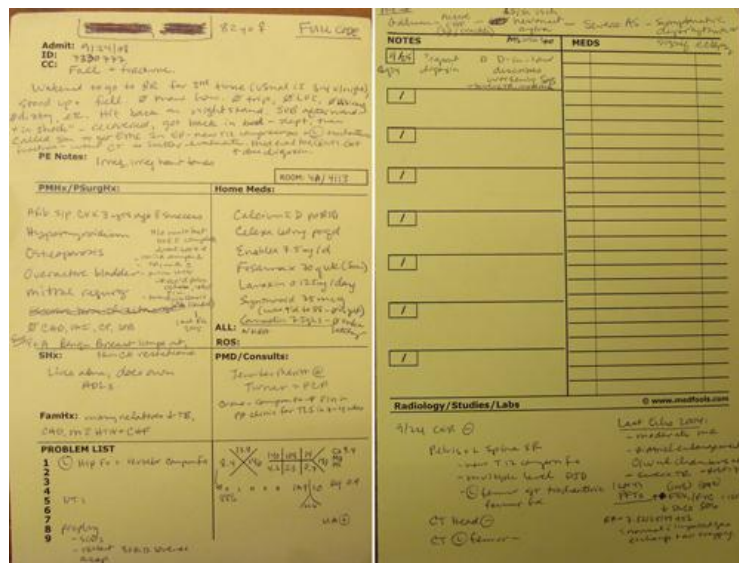


Figure 12 A resident's rounding sheet

7.2.5. Interacting with Others

Interacting with special service teams

The MH team provides general medicine service. As such, they often need to consult special teams when patients have more critical or specialized issues. The special services that are often called up by the MH include surgery, psychiatry, neurology,

oncology, radiology, and the GI special consulting team. Sometimes, the special services are called based on patients' concerns about their chronic illness situation. Tensions often occur in this situation. Some special teams just do not want to solve the chronic situation in an inpatient environment, such as scheduling a surgery for a condition that is not immediately life-threatening. The following vignette illustrates this point:

Mrs. Smith is an elderly woman who is concerned because her digestion system has been bleeding for several months, and she has tried to schedule a surgery as soon as possible. Recently she experienced a flare-up. After she was admitted to MH, her situation is stable, i.e. no bleeding. Then, she asked the MH doctors to talk with the surgical consult team to help schedule the surgery. She really worries that she would have terrible bleeding again after she is discharged to home. However, the surgery team reviewed Mrs. Smith's case, and did not want to get involved immediately. They wanted the MH service to order one more CT, and then they would make the assessment to see when the patient should have the surgery.

[Aug. 28, 2008, field notes]

This seems to be a constant conflict. As a general medicine service, MH is responsible not only for a patient's acute flare-up but also for long-term illness management when they make a treatment plan, which is of course beneficial to patients. However, the surgical team usually does not want to promise an immediate operation. In this case, the patient is concerned that if she doesn't get the surgery done soon, she will start bleeding again. The only thing that the MH team can do is to change her diet as a temporary solution.

This case illustrates one of the well-known conflicts at the hospital between cost-related interest in moving patients along quickly (treating only acute illnesses) versus patients' interests in improving their chronic conditions while in inpatient care, where it is easier to get all sorts of doctors on board. These tensions often occur during the

interaction between the special consulting teams and the MH doctors who are in charge of the patients.

In addition, the MH team also works closely with the practice management team, which includes discharge planners and social workers. They help make various care plans, both for inpatient care and long-term illness management after patients are discharged from the hospital. For instance, because of the body size of some patients, they cannot get a CAT scan or an MRI in the hospital; the practice management nurses make arrangements in an outside facility to get tests done instead of skipping the tests scheduled. The practice management team takes the major role for helping to arrange home care service, long-term follow-up, insurance, and community service or social program for mental health as a long-term plan of care.

The attending doctors meet with the discharge planners on post on-call day. They discuss new patients' care plans and discharge plans *immediately after* the patients are admitted, even though some patients may stay for a while. According to them, this is to “proactively plan instead of reactively plan,” with the result of decreasing the length of patients' stays in the hospital significantly. By doing this, the doctors give the practice management team an adequate amount of time to plan for the discharge. During the discussion, they focus on what the patient's treatment is going to be in the inpatient setting and in the discharge situation, including whether they need to go to an infusion center, whether they need infusions at home, what type of therapies (physical and psychological) or rehabilitation they need, and their insurance coverage.

For psychosocially problematic cases, practice management staff, particularly social workers, are heavily involved, as the practice management team lead stated:

“...the patients don't always tell their doctor what's going on in their social life or what's in their social situations... we go and ask more probing questions and they know that we are the access to getting help in the home, they kind of open up to us and they tell us more.”

In these situations, the social workers not only provide mental health counseling services in the hospital, they often reach out to arrange social programs, such as chronic pain management programs, smoking cessation, alcohol rehab, and other community service programs to provide help. While the notes they generate and document in eCare do not serve for billing purposes, the information is there for care coordination, and doctors often appreciate this work greatly.

It should be noted that it is the attending doctors who routinely interact with the practice management team. It used to be the residents or interns who assumed this responsibility. However, the junior doctors were often occupied by many other issues and struggled to get things done by the last minute because they were still in the process of training. By getting the attending doctors on board, it not only has made the attending doctors more responsible for the discharge and thus long-term care but also improved communication within the doctors' teams. More importantly, it has reduced the length of patients' stays owing to better communication across different care groups.

Interacting with family members

Doctors often spend time talking with patients' family members, either during the morning rounds or during the day through phone calls. The information contributed by family members about a patient's illness experience can be very valuable. Some patients' families carefully document detailed information about a patient's illness trajectory, such as taking pictures of the infected skin during its beginning stages, documenting the specific time when the patient began to feel ill in a PDA or paper notebook, and

recording all medication with a comprehensive list, including brand names, dosages, how it is taken, how long the patient has been on each medication, and how the patient reacts to certain medications. This provides doctors more contextual information, which is valuable for them to understand a patient's condition in a broader context. Additionally, doctors often talk about sensitive issues with patients' family members, including changing the treatment plan from aggressive to comfort care, and the patient's DNR/DNI (Do Not Resuscitate / Do Not Intubate) status.

While perhaps a bit amusing and unusual, the case below provides another example of how interacting with patients' family members may have unexpected valuable outcomes:

Mr. Davis has been suffering skin infections in a large area on his leg and the situation has not improved much. During the morning round, Mr. Davis told the doctor that his wife would like to have a phone conversation. After five minutes, Mrs. Davis was reached. She told the doctor that several years ago, she herself also suffered the same skin problem and did not get well for a long time; however, after taking several medications which were prescribed for other medical issues, her skin problem was completely gone. The doctor wrote down the name of the prescriptions the wife took several years ago, cholesterol-lowering medications. At the moment, the doctor did not really think that the cholesterol-lowering medications would help solve the lichen planus that Mr. Davis was having. Later in the evening of that day, the doctor searched PubMed²⁴ for the newest research findings of the statins treatment, which indicates that statins may cause some changes in the immune system that help to prevent lichen planus and several other dermatological diseases.

In this case, the doctor learned new research findings and medical knowledge indirectly from interacting with patients' family members. It resulted in more efficient patient care and new knowledge collection for the doctors.

²⁴ PubMed is an online service that comprises more than 19 million citations for biomedical literature from MEDLINE, life science journals, and online books.

Interacting with PCP and other health organizations

When a patient comes to the hospital for their first visit, doctors often need to request the patient's past medical records from his/her previous healthcare organizations. These outside records, i.e. the patient's past medical history, are supposed to be read through carefully by the admitting team, who then summarize the patient's medical history and write it into the patient's admission note. In reality, however, it is unclear whether they do so systematically.

When a patient's situation is very complicated, doctors may contact the patient's primary care physician (PCP) for more information. Some PCPs have known a patient for many years, and have a relationship with the patient. Getting to know a patient from a historical perspective from another professional who has been treating that patient for a long time can be very helpful. The PCP has more of a holistic understanding of the patient, which is often not reflected in the records. Sometimes the MH and the patient's PCP may also jointly make a long-term plan for treatment.

As well, when the MH doctors make drastic medical changes for the patient they contact the patient's PCP. For example, one patient was admitted by MH service with a new diagnosis of an irregular heart rate and arterial fibrillation so she needed to be put onto a blood thinner. This situation merited careful monitoring and it required her PCP to be aware of the medication change that potentially caused the patient to bleed. The MH resident contacted the patient's PCP immediately.

In general, the MH service communicates with patients' PCPs through phone or e-mail. These written communications are often not documented in eCare. If the PCPs are

also in the hospital system, they can access the new patient information in eCare. Phone calls or e-mails are just a way to notify them of the change.

7.2.6. Documentation

One research study revealed that the majority of the internal medicine residents (67.9% of 15889 responses) spend in excess of 4 hours daily on inpatient documentation and only slightly more than a third of the same population spent the same amount of the time in direct patient care (Oxentenko et al., 2010)²⁵. This is also true for MH service, where the interns generate most of the formal medical records (e.g. admission notes, progress notes, and discharge notes). These documents need to be approved and signed by the attending doctors and are permanently stored in eCare, offering both legal and financial accountability.

Among the various notes, the admission note contains the most comprehensive information about a patient and is the first document that the service team provides. An admission note includes pre-defined categories of information such as a patient's chief complaint, a detailed history of present illness, past medical and surgery history, allergies, medications, family and social history, the results from the physical exam and review of body systems, vital signs and other lab/radiology data, the assessment, and the care plan. It is used throughout the entire patient's hospitalization not only by the team itself but also by nurses and other clinicians as both a source of baseline information and a guide for care. In fact, when a patient returns to the hospital, doctors also go to the

²⁵ This study also argues that the documentation activities may be valuable for residents in the training process, because it provides benefits for them from self-reflection on their own notes, notes from peers, and feedback from attending doctors or program directors.

admission note from their most recent episode to learn what has previously happened to the patient.

Among various categories of information in an admission note, several are matter-of-fact and straightforward, but others are more subjective and sometimes require careful wording. (See the cases in later sections of this chapter.) For instance, ‘family history’ usually records whether family members have a similar or related disease; ‘social history’ should include any information about the patient’s living situation, occupation, or any other aspects of the patient’s life that may be clinically significant to the patient’s problem. ‘Social history’ is supposed to contain information such as where and with whom the patient lives, employment, social support, activities, habits, insurance coverage, feelings of anxiety or depression, visits to psychiatry or social workers, and ability to care for oneself (if elderly). All of this information will tell a doctor how a patient manages her illness in a social context. However, according to one attending doctor, in practice, the ‘social history’ information has deteriorated to include only habits such as smoking, drinking, and illegal drug use.

In the ‘history of present illness’ section, doctors write in free-text how a patient presents at the hospital, various symptoms, and other phenomena they observed or stories they investigated via a diagnostic interview with the patient and discussions with their family members. At the end of an admission note, the ‘assessment and plan’ should document a doctor’s rational thinking, that is, their interpretation of the patient’s case and why this patient should receive a particular treatment. A good admission note should address the issues clearly and provide a convincing rationale for the treatment plan. However, critical thinking or supporting evidence is often missing, leaving later doctors

to wonder why the patient received an intervention during the previous episode.

Psychosocial issues (if documented) often appear in the ‘history of present illness’ and the ‘assessment and plan’ sections.

MH interns spend most of their time during an on-call night writing their new patients’ admission notes. They need to finish by 5 AM ensuring that the attending doctor has enough time to read the notes before morning rounds. In the meantime, the attending doctors often have arrived at their hospital office by 5 AM, reviewing the notes generated by the interns, reading patients’ past medical records for background, and thinking about the potential treatment plan for each patient. The attending doctors are often able to discover important issues that the interns’ notes have not addressed, which will be discussed during morning rounds.

Based on the admission note, the progress note is generated each day during the patient’s hospitalization. The MH attending doctors advise the interns to write a short, concrete progress note, focusing on just new outcomes instead of copying and pasting the content from previous notes.

Then, when a patient is ready to be discharged, the intern who is in charge of this patient needs to write a substantial document, including a comprehensive clinical course description of what has happened during the entire hospitalization (starting from the admission), the patient’s current situation, medication provided, future medication list, various issues that need to be resolved, follow-up visit plans, educational materials, and so on. Many residents feel that writing discharge documents is a rote routine, far less intellectually stimulating than other documentation activity, however they are able to carry out the activity efficiently by using copy (from other notes and the medication list)

and paste functionality. They hope that electronic applications such as eCare will eventually be able to generate a template with much pre-determined data automatically populated.

7.3. Psychosocial Information: What and When to Document?

A great deal of information is generated during the process of developing a trajectory. What information do doctors document? How do they write a patient's information, especially psychosocial, into the medical records? As psychosocial information is often considered to be subjective and is often vaguely defined or perceived differently by different care providers, the handling of such information magnifies the gap between the work, the patient, and the representation (i.e. medical record).

In this section, I use psychosocial information as a lens to examine doctors' documentation practices. I describe three cases that illustrate how doctors cope with patients' psychosocial issues; how they interpret, use, and document psychosocial information; and how a breakdown in the representation can potentially affect clinician performance, quality of care, and costs.

7.3.1. Psychosocial information, but only in 'talk'

Consider the example below:

Case 1: A 36-year-old female patient with a history of hypertension and anxiety disorder presented at the ED complaining of chest pain. She was assigned to MH and was waiting for a bed. Upon arriving at the ED, Kristine, the MH resident, heard an ED nurse say that this patient showed up at the ED every few days. Often, the patient received an IV infusion (with a controlled substance) and then was discharged. On several occasions she was hospitalized for further evaluation, so she could get more pain medications. The lab/radiological data did not reveal anything clinically significant. When Kristine communicated this case to her attending physician, the attending became outraged and immediately led the entire team to the ED. The attending speculated that the patient was manipulating her

symptoms to gain access to a controlled substance. The attending confronted the ED attending. Eventually, the patient was discharged from the ED as requested by the MH service.

This was a problematic care trajectory that ended with the attending doctor's interaction with the ED doctor. However, the record did not document the conflicting understandings of the attending and the ED doctor nor any of the patient's problematic behavior. It may happen that when this patient arrives at the hospital again, they may be admitted to a different service or even to the same service when the attending, residents, and interns are different (due to periodical rotations). For this case, even though the psychosocial issue emerged as a main concern, it still did not seem legitimate enough to be documented in the record. As one MH resident stated, "You never know for sure." Indeed, compared with other symptoms that can be verified by lab results or technology devices, pain is very hard to justify, as another MH resident said:

"Pain is totally subjective. I can't even say for sure that this person who's coming in once a week for pain meds is not in pain. He very well might be. He's obviously exhibiting some pain-seeking behavior that shouldn't be encouraged. But I can't say he's not in pain ever."

The subjective interpretation about whether the patient is in pain and how severe the pain is has made the documentation difficult, particularly for new residents. One of the MH attending doctors, who is a pain specialist, can be very "aggressive" as he defined himself. He often advises his residents to document situations and highlight issues at the top of the problem summary list in documentation area, so no one will miss them.

Furthermore, from this case, one can see an example of the conflicts between ED doctors and MH team. For almost any other service, the ED doctors have to discuss with the service first before assigning the patients to them. When these services think that the

patients' presented symptoms do not warrant what their services specialize in, they say no to the ED doctors. As a general medicine team, however, MH does not have this privilege. The ED doctors have the ability to just assign the patients to them without their approval. As a result, MH team, along with three other general medicine teams, receives more problematic cases than other services.

If the above patient is so obviously seeking drugs, according to MH's understanding, and the patient's pain issue should be addressed by pain management programs outside of the hospital, why did the ED doctors still admit her for 'further diagnose and treatment' and consequently create the tension between ED doctors and floor doctors? Below is an ED resident's understanding about this situation:

“...it's really hard to send someone home with chest pain because you take that chance of saying, 'Oh, this is just your pain. Send them home.' And it was really a heart attack, that is a huge problem. So, I find that a lot of the chest pain patients every so often get admitted upstairs, and it's probably chronic pain, but depending on who the (ED) attending is and who the resident is, they may or may not get admitted.”

Indeed, according to the numbers for 2009, for 80,510 emergency visits, only about 43,558 were admitted. Among the non-admits, many were pain medication-seeking patients, who were filtered out by the ED doctors. ED doctors are also very much aware of the issue; however, they also admit many patients that, according to general medicine doctors, should not be admitted. Among these 'unnecessary' admits, some of them were indeed the patients whose chief complaint was chest pain; whereas others were perhaps a miss or someone who the ED doctors just had no time to review the records for, or the past records did not make it clear what was going on with the patient, which is not uncommon. In fact, for those suspicious patients complaining of chest pain, one ED doctor has always tried to call the floor doctors upstairs, and say,

“‘This patient probably has nothing, but there’s a small chance that it’s something real and we’re not willing to take that chance. So, this is going to be a bad patient for you and I apologize.’ That’s how I do it because I don’t like to sell someone as being.”

According to this ED doctor, this is her way to ease the tension between the ED and general medicine and encourage the general medicine doctors’ understanding. Patients demonstrating pain symptoms are prevalent in this hospital. Yet, eCare does not provide a systematic means for the medical teams to formally capture this information as part of a patient’s record or, perhaps better, in informal documentation (as noted in Hardstone et al., 2004) since some doctors have difficulties with official documentation, as discussed above, so that this information can be recorded and shared across care episodes among all doctors who happen to receive this patient. This points to missing technical capabilities for supporting this type of long-term information reuse. Whether or not to record this sensitive information and how to record it is largely left up to each individual doctor. Many other psychosocial issues critical to understanding a patient’s needs and motives are also shared only verbally without being documented. This leaves the next care team (including ED doctors) in an information vacuum and requires the repetition of time-consuming investigations into complicated patient conditions.

More importantly, when the patients’ pain problems are not addressed early enough and the system keeps on ‘rewarding’ them with admission and controlled substances, they may develop a greater dependence on these drugs and come back more often.

7.3.2. Psychosocial information in the record, but when?

Under certain circumstances, psychosocial information may be documented in the formal representation. The psychosocial information is largely passed along orally in the

beginning of a patient's illness. Perhaps it will be eventually captured in eCare, but this may not occur for a long time. In the following case, the doctors did not document the issues in earlier visits explicitly until the patient resorted to violent behavior, and doctors had "hard evidence" to note in the record.

Case 2 (All quotes are from doctors' notes in eCare.)

A 23-year-old woman with a history of sickle cell disease comes to the hospital ED every few days complaining of chest pain. During the last hospitalization, the patient had "significant issues with behavior." When she was told she could not have IV Benadryl (an abusable substance), "she became quite frustrated and ripped up all of her paperwork. ...She physically threatened numerous staff members and required security presence on more than one occasion." The MH service ordered full tests, then noted, "there was no evidence of acute chest syndrome demonstrated. ...It was not felt that the patient was exhibiting evidence of serious sequelae of sickle cell crisis."

The attending talked with the patient's primary care physician to put her on a chronic pain management program, which might eventually help the patient stop the drug abuse. They jointly made it very clear in the patient's discharge notes, she "should no longer get IV Benadryl and she was abusing this."

Although this case was of a similar nature to Case 2, details were recorded in the eCare system to inform others about this patient's conditions, which, if used properly, could prevent these issues from occurring again.

As an aside, there is no guarantee that such information would be re-examined, since reuse is subject to visibility, incentives, and the power relationships between doctors. In this next episode, the ED doctor missed the information written in the discharge notes in eCare:

After only a few days, the patient showed up at the ED complaining of nausea, vomiting, and severe pain in her legs and back. She again demonstrated questionable behavior, refusing a chest X-ray when she did not receive IV narcotics. Then the ED doctor gave her one dose of IV Benadryl, which violated her on-going pain management program that the attending and her primary care physician set up.

The ED routinely uses another electronic system, Centricity, which records a patient's vital signs and other medically critical information, a similar function as a patient's 24 Hours Flowsheet. It does not have a patient's detailed past medical history and the previous inpatient doctors' notes. If the ED doctors want, however, they can get into eCare to find out a patient's past episodes, but this requires extra effort. In my observation, several clinicians expressed that if they needed to look at two places, it is not very likely they would do it²⁶. Time is the primary factor. When one of the ED residents was asked to explain what might be the cause for the ED doctors missing the key information such as presented in Case 2, she said:

“I can have it for a couple of reasons. It depends on where they write it in (eCare). How easy it is for us to see it...If it's somewhere written in their notes, if they have a million notes, I don't know which one has that information.”

In some situations, ED doctors tried to get on eCare to read a patient history if they had some suspicions and time allowed. When the patient insisted on certain pain medication, they sometimes even tried to get into a completely separate system, titled Michigan Automated Prescription System (MAPS), to see whether the patient is “hopping from ER to ER,” which would give them a sense about whether the patient is indeed drug-seeking. MAPS is a state-owned system recording a patient's controlled substance prescription history across various physicians in different health institutions.

However, it is a huge effort for ED doctors to use MAPS even though it is potentially very helpful to discover problems sooner. They often only get one or two minutes to react to a patient's case; yet, it takes them about four or five minutes to enter a

²⁶ I described a similar situation in the nursing study in Section 6.3., where nurses do not go to eCare when they work with CPOE, even though navigating there involves just a link and couple of clicks.

patient's birthday and other necessary information into the MAPS system and then wait for the search results to come back.

In their highly time sensitive working environment, one ED resident admits that *many* times that they have given the patients certain medications and then found out that they should not have, as noted by the floor doctors *somewhere* in the previous documentation. That information is just very hard to dig out in the vast ocean of past medical records.

In fact, the system design of eCare has taken into account the concern of highlighting certain important information. It has a tab titled Problem Summary List (PSL), under which a doctor who discharges a patient may want to summarize the major issues about this patient. However, this list is often populated by the chief and secondary medical diagnosis, rather than psychosocial issues about the patient. Some doctors, most often the attending doctors, put warnings about the patients' drug seeking behaviors on this list. Again, the list itself can be very long because the same chief and secondary medical diagnosis are documented over and over across multiple episodes, and psychosocial information, even when noted, can be lost.

In addition to some technical issues of information visibility, there are distinct differences in the priorities and work nature between ED doctors and floor doctors (like the MH team). ED doctors' priorities are in treating the immediate symptoms and moving patients to floor units as quickly as possible. Their job is to determine whether a person who shows up at the ED is sick. If the person is sick, they should be admitted. The ED doctors do not go further to explore why they are sick. Floor doctors, on the other hand, not only deal with acute conditions but also need to plan for long-term care. It is not

necessarily in an ED doctor's interest to explore a patient's history of drug abuse, as this could considerably slow down the interaction with that patient. Floor doctors, on the other hand, must do a great deal of unnecessary work because of patients seeking drugs. Accordingly, there is a conflict between floor doctors' desire to have ED doctors carefully read prior records and the ED doctors' incentives to move patients quickly by admitting them or providing medication and then sending them home. As stated earlier, 'rewarding' the patients with unnecessary admits or with controlled substances would cause them to become more dependent on these drugs and they will come back asking for more. Patients' chronic pain cannot be truly addressed through this short-term viewed strategy. It needs organizational and incentive structural change to ensure a real solution and ultimately a higher quality of patient care.

7.3.3. Detailing psychosocial information in the record

As shown in Case 1 and Case 2, psychosocial information can be very slippery to deal with, either not recorded or recorded late in a patient's history. For Case 3, I will illustrate a situation where even though the information about a patient's trajectory development was very sensitive, it was systematically recorded from the beginning of the patient trajectory. Indeed, some trajectories may be dominated by the psychosocial factors to such an extent that without them being included in the patient's record, the necessary work cannot be accomplished.

Case 3 (All quotes are from the records in eCare.)

Day 1: Mrs. Smith, an 81-year-old patient with a history of dementia, anemia, depression, and hypertension, presented at the ED with multiple falls. Two ED doctors noted, the patient "had some ecchymosis [skin discoloration caused by blood] over the right side of her face.... The number of falls the patient has had over the last several days is concerning, especially given her living situation." MH

team resident Nancy and intern John conducted diagnostic interviews separately and examined the patient carefully. They had serious concerns.

Day 2: Nancy and John reported to the attending that they called the home visiting nurse, who reported that the patient's son who lives nearby said "Dad beats mom." After the attending carefully examined the patient, he noted in the admission note, "It is unclear how one discrete fall could cause the variety of bruises on the patient, including the ... edema, arm bruises, and side bruises. This may be consistent with multiple falls over time because for dementia/deconditioning, however abuse should be considered in this case as well..." The records also noted, when asked why he did not call 911, the patient's husband said because "they would see the bruises and automatically put me in handcuffs." The attending pushed for a meeting with the family and to include a social worker.

Day 3-5: Various personnel were called to evaluate Mrs. Smith. Her primary physician was also informed. Diane, a practice management coordinator, phoned Adult Protective Service (APS) and the visiting nurse organization VNO. Diane noted in the records that VNO expressed "their concerns of the safety in the home due to Mr. Smith's sexual advances toward the home visiting nurse." Soon, APS became involved in the case.

Surprisingly, Mrs. Smith, who was believed to be non-conversant, became more verbal, mumbling "they are mad at me" and "everyone is yelling and asking me what I am trying to do." A nursing note recorded "...she needs to return home to 'fix dinner'."

Day 6: MH wrote in a progress note, "significant bruising over her body, concern for elder abuse. Adult protective services has been contacted, are currently investigating her case. Unsafe to go home."

Day 7-12: While all parties worked hard to investigate the problem, the family was trying to have the patient discharged to her home. Nurses noted that the patient had "crying episode overnight for five hours".

Day 13: The meeting of all parties took place. The APS representative "discussed with the family legal actions against them for their noncooperation."

Day 16: Mrs. Smith was discharged to a nursing facility. Family may not take the patient from the nursing facility without discussing their plan first with the APS agency.

The hint of elder abuse, the psychosocial information, was noted in the records from the very first day. Along the development of the trajectory, details of elder abuse and complicated troublesome family dynamics were increasingly discovered and

documented in the records. Compared to other trajectories, in which the explicitness and accountability of the psychosocial issues in the records was limited, psychosocial issues were at the core of this trajectory and this was reflected in the records.

This is a very special trajectory that highlights the complexity of the emotional work in some cases of medical care. Several issues are of note. First, it is stunning how many details related to psychosocial issues that the MH team investigated and documented in the record. Furthermore, the attending pushed very hard on this case to get all parties involved; otherwise, Mrs. Smith might have been just treated as a normal “dementia patient fall” case.

Second, as described in the story, there were many clinical personnel (ED doctors, MH team, nurses, social workers, practice management coordinators, the primary care physician) and several social services (APS, county sheriff, nursing home) involved in this trajectory. Each of them had a specific role in solving medical issues (perhaps simple in this case) and social issues (extremely complicated). The hospital clinicians described their work and their understanding of the case in eCare in real-time. Information sharing was very intensive, as a coordination device for collectively investigating the issue and solving the problem. In this case, the medical work of care was marginal (treating bruises), but the information work (Strauss et al., 1997) was at the very core of the entire trajectory.

Third, the patient and family members, who were fighting among themselves, were non-cooperative with doctors and social services, and complicated the trajectory by not being able to provide, or by attempting to hide information. However, doctors pieced together the information collectively, and they tried to write the consequences of each

step in the records. In this case, as mentioned, the eCare system effectively supported information sharing and coordination among various clinical groups in real-time. Indeed, eCare, regardless of the other significant usability issues, was able to satisfy the needs of the clinical workflow and work representations in this case.

This case showed how the medical team, when they felt it was appropriate, would document the psychosocial information for a patient. Clearly, this case was unusual as it was more of social than medical issue and had to involve social investigation from the outside of the hospital. It highlights, nonetheless, the emphasis on the doctors' sense of 'appropriateness' in determining when to document. They had the speculation that the patient was not a normal fall case right after they conducted the physical assessment, even though the family members who presented at the ED reported so. After they learned from the son who told another story ("Dad beats mom"), they were convinced that elderly abuse was the underlying reason to this case because it matched what they observed. As such, they provided ample details as the trajectory proceeded as part of the 'diagnostic' process.

7.4. Medicalized Viewpoint and Legal Requirement

One intriguing finding from my study is that while doctors were aware of the subjective interpretation of certain symptoms, they detailed psychosocial information (when they thought it appropriate) in eCare with little concern about sharing such sensitive information institution-wide, which stands in contrast to my earlier investigation on nurses' documentation behavior in Chapter 5. Rather, as one doctor stated, "when it needs to be there, it is there." However, there remains the puzzling question of why they do not always document this information, as demonstrated through the different handling

of such information in Case 1 and Case 3. So, under what conditions do clinicians choose (or choose not) to document psychosocial issues in medical records? What are the underlying rationales for such choices?

I believe it comes from medicine education and training. Doctors are trained to look for symptoms first, and then think about the causes (based on their medical knowledge and their experience). This is the sense-making stage and also the medical reasoning process that leads to diagnostic judgments. Finally, they need to come up with a treatment plan. Therefore, symptoms, possible causes, and treatment and care plans are perhaps the most important three categories of information in medical records to represent their work. These categories of information also constitute valuable information for future reuse when a patient is readmitted to the hospital.

If suspected ‘causes’ match ‘symptoms’ well, a trajectory will be considered straightforward, even though achieving it may not always be uneventful. In an internal medicine unit, most patients are admitted because of acute events due to chronic illness, so the ‘cause’ is easily assumed to be medical. In Case 3, the symptoms were bruises, and the cause was a “fall” (according to the family members’ report). However, a single fall was not likely to cause so many bruises on her body (as the attending noted in the records), and if the bruises were caused by multiple falls, how did these falls happen? Because of this questionable “fall”, doctors could *not* provide a convincing diagnosis, so they went further. In this case, the ‘cause’ was in fact not “fall”, rather, it was psychosocial, but the symptoms were medical. This was reflected in the records, where a great deal of psychosocial information was documented as the ‘cause’. In addition, the treatment could not address just medical issues because the cause was indeed

psychosocial. The doctors needed to prevent the abuse from happening again, so they pulled together additional resources to find a suitable treatment plan.

In Case 2 however, the pain drug-seeking patient had a medical issue, sickle cell disease. Although she was admitted to the hospital frequently, the doctors still first looked for symptoms. The symptoms were pain according to the patient; however, what doctors saw was a series of “questionable behaviors,” which were documented in the records because they did not match sickle cell disease (the ‘cause’). The doctors speculated that the patient was faking the symptoms. In this scenario, the ‘symptoms’ became psychosocial, or at least a mix of medical and psychosocial. In reviewing previous records of this patient, the doctors did not put information about drug-seeking behaviors in her records until the most recent episode in which the patient became violent and threatened others. This became the triggering incident that provided evidence for the doctors’ speculation. Lacking definitive evidence, doctors hesitate to document such suspicions of “faked symptoms” in the medical record. This is reflected in Case 1, where the doctors also speculated that the patient was seeking drugs but did not include this in the records. This missing representation of psychosocial information may eventually create severe problems, such as the incident described in Case 2, where the psychosocial issue was finally brought to the medical team’s attention and documented in writing substantially only at the point where it may have been too late for the patient.

This story is not unusual. Over the past several decades, there has been a tendency to view almost all patient-presented complaints and symptoms as curable diseases that can and should be treated within the purview of medical professionals (Gallagher and Ferrante, 2005). This view, however, often leads to an overly narrow, ‘medicalized’ lens

of health and illness that largely ignores psychosocial causes and other contributing social and economic factors. Smoking and obesity, for example, are increasingly viewed by the medical world and society as diagnosable and curable diseases and treated with nicotine substitutes and obesity drugs. This defocuses their behavioral and socioeconomic root causes (Lanze, 2006).

Medicalization is defined as “the expansion of medicine as an institution and the use of a medical lens to view human processes and behavior” (Zola, 1972). It is largely this medicalized view, not the sensitivity of information, that sets the boundaries of what information is to be documented and what is not. It is also this medicalized view that determines the reuse value of information in subsequent care episodes. Medicalization implies clear diagnostic tests and evidence. Oftentimes certain psychosocial information gets lost, as in Case 1, because such information is not *yet* formally defined in medicalized terms and encompassed in the medicalization view. Such information is relegated to the ‘subjective’ interpretation, becoming less than ‘medical fact’.

Case 3 illustrates a rather unique case where the medical team transcended the boundary set by the medicalized view to actively seek help from other parties including social services. In this case, the symptom, “bruise,” was clearly disconnected from the suspected medically relevant cause, “fall,” which obliged the medical team to think outside the box to find non-medical evidence and seek non-medical interventions. This endeavor, however, does not always take place because such a disconnection is not always readily discernible.

In addition to the medicalized viewpoint of documentation, legal concerns and requirements take a significant role in the situation like Case 3. In most cases, legal

requirements can be “loose” – doctors are generally asked to provide enough details in notes so others can figure out what was going on with the patients. In the situation that a dispute occurs or a patient sues the hospital, the attorneys need to know the full details of what was done to the patient, as recorded in the documentation.

However, when an investigation of a patient case has revealed some *hint* about child or elder abuse, the legal concerns require all parties, particularly practice management staff and social workers, to document as much detail as possible in order for the protective service agency to take to court for prosecution and guardianship cases, which is shown in the Case 3. In this situation, practice management staff and social workers see their work as the central coordination of an entire investigation because it is they who interact with outside organizations (APS, VNO). They document what they have done and what they have found out, so other parties act accordingly.

7.5. Politics of Information in Records, What and How?

In the last section, I described the role of psychosocial information in understanding a patient’s situation and how the missing representation in medical records or lack of information visibility may result in problems. I analyzed doctors’ documentation behavior and discussed how medicalized viewpoints played a major role in how they treat psychosocial information. In this section, I describe what information doctors may deliberately leave out in records, and how they distinguish the facts from their belief in the construction of medical records.

7.5.1. What to Leave out

As briefly mentioned in an earlier section, ‘social history’ is one category of information that doctors always need to investigate when they conduct a diagnostic interview. Ideally, this social background information, if documented completely, should convey a story including where and with whom the patient lives, employment history, social support, activities, habits, insurance coverage, feelings of anxiety or depression and the deeper causes, visits to psychiatrists or social workers, and the ability to care for oneself (if elderly). All of this information provides a doctor a bigger picture about how a patient manages their illness. Unfortunately, in reviewing the records, I found that in most cases, ‘social history’ has only three pieces of information: smoking, drinking, and illegal drug use.

It is the case that doctors usually would leave out anything that they do not think supports their belief about what is wrong with the patient illness. For instance, when they ask about a patient’s living situation, patients often enjoy talking about their dogs or cats. According to one MH doctor, he never writes this type of information in the records. However, this does not mean this type of information, which appears irrelevant at first, has no value for better understanding a patient’s situation. Below is a case that one of the MH attending doctors used to educate his residents about how this type of ‘trivial’ information can help discover the causes of problems:

A patient had infiltrated lung disease. In a previous diagnostic interview, he told the doctor that he was a priest and lived in an old church, which was noted in the records. While discussing the cause of the problem, everyone in the team assumed that the patient was not telling the truth and he was really gay and had AIDS. However, the patient was tested and did not have AIDS, then the doctors considered whether it could be a hypersensitivity-related lung disease. Later, one doctor was all of sudden struck by the fact that the patient lived in an *old church*, and maybe there was mold or fungus. Two doctors in the team took the trip to the church and found out - the patient had an attic full of birds and there was guano

all over the place. It was the fungus in the birds' poop that was causing the patient's lung condition.

This case shows an interesting interpretation and use of the information. At first, the two pieces of apparently 'trivial' social information ('priest' and 'old church') were picked up by the doctors to support their incorrect assumption to associate priest with gay and AIDS. When the test turned out to be wrong, the same information, particularly 'old church', brought out an epiphany, leading them to discover the truth. If this information had been left out, doctors might have to take a longer time to figure out why and how the patient got the lung disease in the first place.

Indeed, it is perhaps tricky to determine which piece of information should be documented from the investigation of social history and what to leave out. It is hard to predict whether certain information will be useful in the future (Garfinkel, 1967). Doctors may use *relevancy* as a rule to decide what to document at the moment. However, relevancy is also highly *subjective*, because it is *this* doctor's anticipated downstream use. A piece of information may appear irrelevant to Doctor A but can be picked up and perceived as very relevant by Doctor B. Furthermore, irrelevancy at the very moment (the current illness episode) may have high relevancy for understanding in the future (the next episode). Therefore, there is no clear line to draw between relevancy and irrelevancy from an individual and historical perspective.

Regardless, as a norm among doctors, they usually do not write a patient's "criminal activity" in the records, because they do not want other people to be biased about the patients, particularly when the criminal activity is not directly relevant to the understanding of the disease. Still, there can be exceptions. For instance, one attending doctor expresses that if a patient has been jailed for drug dealing and he is taking

controlled substances during the hospitalization, the information of this particular criminal charge can be very relevant to illness management and should be documented in the records.

In addition, the concerns of patients' privacy also hold doctors back from documenting the story investigated from diagnostic interviews. One MH attending doctor stated:

“Sometimes people have the belief that the patient's privacy is being violated if they put stuff in, you know, like about their sexual history or their sexual orientation and that kind of stuff. And most of the time, I think people would say if it's really not relevant to what's going on with them, then you can leave it out.”

Again, relevancy to the illness understanding at that moment plays a role in determining what to leave out and what to document. While privacy is a major concern in doctors' documentation, one of the attending doctors of MH service, who is a well-known pain specialist, documented in great detail from the diagnostic interview about a patient's social history, particularly when the patient's anxiety and chronic pain issue was severe. He described what he had noted down in the social history of the patients with complicated issues, such as:

“...how they were raised and who raped them when they were children, and what kind of psychotherapy they had, and what level of education they had, and do they see a psychiatrist now, and are they anxious and depressed.....I use those as tools to decide because in my world I can't treat their pain if their psychiatric disease isn't treated properly.”

These details are very sensitive and also extremely private for the patients.

However, as the doctor expressed, this social history is highly relevant to his understanding of the patients' problematic management of chronic pain. Documenting this information in the records will help other doctors understand the situation and

provide appropriate treatment rather than just dealing with patients' problematic behaviors.

Because of individual differences, some doctors are very good at getting patients to open up and getting the full story; but others may only get very limited information. Patients also may tell different people different stories (Goffman, 1959). This difference was very noticeable in my observations - despite the fact that the attending doctors pushed every resident to investigate in-depth, some residents simply were not successful in doing so. In many chronic pain patient cases, the pain is in fact caused by psychosocial problems they experienced in their early life. Over-dependence on a controlled substance in return contributes even more serious psychosocial issues they have to deal with in the future. How to document and share the information from a social background investigation has become very important for making informed treatment decisions for the chronic pain patients.

7.5.2. Beliefs vs. Facts

In my various informal and formal interviews with doctors about how to generate medical records, doctors always say they should stick with the "facts" rather than writing their "beliefs". According to them, factual data is objective, whereas a person's belief is subjective. However, in many situations, doctors may have a great deal of factual data but still lack *the* piece of evidence to make a definitive statement or diagnosis, such as with the patients who may exaggerate or fake their pain symptoms, or the suspected elder abuse in an earlier stage of the investigation. In these situations, while occasionally some doctors are more aggressive about putting down their beliefs in the records, as an attending stated:

“... most of the time, you can do it in a nice way. You can say the patient didn't have a fever, wasn't short of breath, wasn't intractable pain ... and didn't need to be in the hospital, could be treated at home. Pending making a diagnosis.”

It is a passive way to write about the situation instead of an active description. In the situation of Case 3 (elder abuse) described in Section 6.3.3., the attending doctor explained that they would never write, “the family abused grandma and broke her bones”, rather, they would say that the grandma “has these inexplicable injuries where she ends up with multiple broken bones suggesting falls or trauma.”

Doctors admit that they often need to read “between the lines” in order to figure out a complex situation without actually accusing the patient or family members of something. In an earlier study, Heath and Luff (1994) analyzed in detail how sometimes “less” really means “more” - doctors deliberately leave their colleagues some ‘ambiguity’ to convey more nuanced meanings. In the context of my study, doctors do not make this information obvious to an outsider about what is going on with a patient. However, when other doctors read carefully, they will be able to figure out what is going on for this patient. After all, how to appropriately describe the *facts* to support their *beliefs* becomes partially an art of language in addition to being a professional competency (Goodwin, 1994, 1995).

However, this strategy or practice (reading between the lines) may not apply to a situation when the records are read in a time sensitive manner. When a piece of key information is buried in a note that is several pages long, and for which there may be long notes written by various clinicians, anyone may potentially miss it. Imagine the unlikelihood of ED doctors sitting down to go through past medical records line by line and get the nuance and subtlety from inexplicit writing, with a patient screaming beside them asking for pain treatment. What ED doctors really need is a “shout-out” or “pop-up”

message, telling them exactly whether there is any psychosocial issue beyond the medical problems that they should be aware of. In an extreme case, one attending doctor in general medicine put his warning message in all capital letters at the very top of the problem summary list,

“DO NOT EVER PRESCRIBE CONTROLLED SUBSTANCES FOR THIS PATIENT. HE IS A DRUG DEALER AND FORGES PRESCRIPTIONS.”

This active and alarming description ensures that no one will miss it if they read the medical records.

However, when several residents were asked whether they would make the same warning if they were sure that the patient was indeed problematic, they all expressed in some way, “probably not.” Indeed, for the same piece of information, who handles it, what their social or professional status is, and how much experience and confidence they have, may all contribute to a series of outcomes - whether this information will be recorded, how it will be written, how others will interpret it, and whether it will be picked up and result in actual use by others in the future.

One of the residents was asked why he did not document pain-seeking behavior about a patient, even though it was very obvious already to him. He commented that he did not want the patient to be deprived the opportunity to be seen by other doctors in the future; he elaborated that other doctors might have a better way to deal with the patient’s real issues. Again, this doctor anticipated the future situation that might happen to the patient, which determined his action - not putting the information into the records.

It is interesting to note that while doctors may have some hesitation about whether or not to document certain psychosocial information, they always document the situation, either in detail with the original quotes or explicit implication, when a patient is verbally

aggressive. They believe it is important that their fellow doctors in the future see there is a risk for escalating behavior. Furthermore, when an issue happens where the patient comes back accusing the hospital that they were treated unfairly, a factual account documented in the records will always help explain what has happened.

In last section, I analyzed what and when doctors document psychosocial issues about patients. In this section, I extended my discussion to how they write the records when they document (explicitly versus implicitly), how they describe factual data (objective) to support their belief (subjective), and how they determine the relevancy. As my further analysis in Section 7.7 will show, the implicit writing in patient records may result in issues and challenges when that information needs to be reused from a long-term perspective.

7.6. Process-oriented vs. Patient-oriented Representation

The findings from my field observations and in-depth review of the medical records point towards the need for considering the broader context of medical records systems, the formal representation of medical work. Historically, the practice of medicine has been focused on diagnosis and treatment, by and large neglecting the human side of care. This is manifested by the narrowly-focused documentation from a medicalization perspective in general. While the EHR system has the potential to improve practice, the electronic system itself cannot change the medicalized viewpoint in clinicians' documentation. In fact, the situation is quite the opposite - information models underlying current EHR systems are mainly organized around storing and managing symptoms and treatments, because the underlying reason of EHR is for a more efficient billing process (Greenhalgh et al., 2009), and only clear diagnoses and treatments are reimbursed. As a

result, the Certification Commission for Health Information Technology (CCHIT), the accreditation body for commercial EHR products, places an exclusive emphasis in their certification criteria on whether an EHR system has the capability of capturing and managing discrete, process-oriented, and medicalized data, rather than on the meaningfulness of the data in understanding a patient with a cognitively coherent representation in their care activities. This understanding can be even more difficult to achieve when it occurs across multiple episodes.

More importantly, as shown, there exists a gap between the work, the patient, and the representation which may account for the suboptimal outcomes or adverse consequences observed such as repetitive investigations, delayed diagnoses, inappropriate treatments, unnecessary hospitalizations, and increased cost burdens for the hospital. Indeed, the hospital gets less reimbursement from insurance companies if a patient is admitted and subsequently shows drug-seeking behavior without legitimate and clear diagnosis. My investigation shows the need to gain legitimization for psychosocial issues in system construction and to include appropriate representations in the record formats.

This broader implication raises the need to re-conceptualize medical records adaptively as both a representation of medical processes and of the patients. Recognizing the inherent gap between representation and the real world (Berg, 1997), an extensive body of literature in HCI/CSCW and medical informatics has been devoted to studying the issues related to the representations of work and how they should be designed to support on-going work activities (e.g., Suchman, 1987; Schmidt, 1997; Bossen, 2006; Østerlund, 2002). The findings from my field investigation about how clinicians use information points to a new perspective that representation of information may need to be

constructed in adaptive forms when a singular form cannot adequately support a multiplicity of purposes, changing demands across time, and distinct priorities of information consumers. In the medical context, while the information representation that supports medical processes – routines and procedures in day-to-day care – remains critical, what needs to be shared across multiple patient care episodes is not only process-oriented information but also information centered around the patient’s lifelong illness trajectory (Strauss et al., 1997) – their medical conditions and other associated psychological and social experiences (Charmaz, 1993). As shown in this study, the conceptual models underlying current medical records are largely process-centered, do not accommodate this multifaceted need, and hence may adversely affect medical practice and diminish the reuse value of documented patient care information. This micro-level analysis of how doctors use information in their sense-making process represents an attempt to examine whether focusing on one model may lead to missing critical functionalities for the *continuity* of care when a patient returns. It is part of the critically important examination of long-term information reuse and of work representations in both HCI/CSCW and health informatics.

To conclude, in previous sections, I detailed doctors’ documentation behavior, with a focus on the understanding of psychosocial issues in medical work. In the next section, I want to further my analysis to discuss what I learned from the medical field may have a broader implication to information science.

7.7. eCare as an Information Assemblage

When one walks into the ward and takes a look around to see what system clinicians are using, nine out of ten times one will see that the doctors are using eCare

whereas nurses are working with the CPOE. Doctors do use the CPOE; however, their use is brief - right after they prescribe the medical orders, they quickly switch the system to eCare. Nurses spend most of their time on the CPOE because they need to maintain and administer the orders. Their work processes, which involve time sensitive coordination, have been largely automated within the CPOE. Doctors, on the other hand, spend most of their time generating notes in eCare. They need to systematically document all work that has or will have to be done to the patients throughout the patient trajectories (Strauss et al., 1997).

As a common information space (Bannon and Bødker, 1997), eCare is a system in which all caregivers generate permanent records about patients. They routinely generate these records, both as an archive (of what has been done to the patients) and guidance (plan) for future treatment. In the previous sections of this chapter, I have presented several cases to provide an understanding of doctors' documentation behavior. As noted in these cases and in perspectives from interviewing various caregivers (ED doctors, primary care physicians, practice management and social workers), there are various issues in making patients' records reusable from a long-term perspective, such as what should be in the records, how to write it, how to interpret it, and how to make it more visible.

All documents generated in eCare are meant to be shared across institutional boundaries. A doctor's admission note, for example, includes the comprehensive description (history of present illness, diagnosis, family and social history, assessment, medication, treatment, etc.), which is generated after the diagnostic interview. It serves as guidance for projecting activities. All other care activities, carried out by other groups,

nurses, pharmacists, and practice management, will be arranged based on the plan made in this document. During a patient's hospital stay, various other records will be generated and documented in eCare as a means for clinicians to share information. Clinicians from different communities of practice read one another's documents as a way of knowing. For instance, nurses need to read doctors' notes to get a better understanding of patients from a historical perspective; social workers need to read doctors' notes first and then interview patients to further address their social and psychological concerns; doctors read social workers' notes to get more background, since social workers are very good at "probing questions" and getting patients to open up.

From the information sharing perspective, the documents generated in eCare meet Star and Griesemer's (1989) original definition of a boundary object (Berg and Bowker, 1999). In this section, I will use this theoretical construct to analyze the medical records documentation practice. I will address some additional considerations about the boundary object concept. This is also an attempt to inform the better design of electronic health records.

7.7.1. Nuance and Relevancy

For each type of document in eCare, there are standard categories of information that should be included, normally with a template built into the system. These required categories reflect what clinicians should do in care activities. From this perspective, the documents, that is, the boundary objects, play the role of standardizing processes (Bowker and Star, 1999; Lee, 2007; Lutters and Ackerman, 2007). Within each category, however, doctors always have to make some conscious choices about what information is

relevant for understanding the patient's case and how much nuance they want to put in the records.

In following the template, some doctors write very condensed information, leaving most of the context out. For instance, when doctors review a patient's past medical records, they often find that the original admission note did not make it clear why this diagnosis would lead to that treatment. The rationale between diagnosis and treatments, a doctor's thinking, is often unstated in the records, assuming other fellow doctors would understand. This may not be an issue for doctors with professional competency in most cases (Goodwin, 1994, 1995). However, when a patient has several interrelated chronic diseases, it may be very important to explain the rationale underlying each of the treatments. Whether there is a rationale between diagnosis and treatment written in the records is often considered as a standard to distinguish a good admission note from a poor one. "Rationale" is not listed as one category of required information; however, it is the glue to set up the documents for future readers. To make the boundary object understandable for people who are not familiar with the context (without investigating the patient in person), condensed information should be elaborated (Mambrey and Robinson, 1997; Henderson, 1999; Lutters and Ackerman, 2007). However, the writers who know the situation well often think the elaboration is redundant (Brown et al., 1996), or when professional work is busy, people only include very little elaboration (Hertzum, 1999). The lack of elaboration determines that patient records may not be appropriately reused later. In documenting a patient's ongoing psychosocial issues, nuance in records can be a key for future doctors to understand the situation and make an informed decision. I presented two cases in Section 7.3, where nuanced information was

missing and doctors had to investigate the patients multiple times before definite evidence was captured and written in the records.

This view of relevancy also determines whether a piece of information should be in the records. As shown in the previous sections, a social history investigation from a diagnostic interview often turns out a huge amount of information. How to weigh this information can be a challenge, as a piece of information looks trivial at first but can be critically important in the future (for example, “living in an old church” can be critical to understand the cause of a lung condition).

When one decides what information should be put in a boundary object and how much nuance should be included, anticipated downstream use is critical. If there is no clear anticipated downstream use, or the doctor is not clear how the information will be used or potentially misused, they will leave the information out in the records (Ackerman, 1996; Hertzum, 1999). As shown, the doctor did not put a patient’s obvious drug-seeking behavior into the records because he did not want that patient to lose the chance to be seen by other doctors, since the patient might indeed have pain issues. For this doctor, drug-seeking is a behavior, but the pain is the medical cause, although it can be a combination of psychosocial and medical and the level of pain is very subjective. As well, doctors usually do not put criminal information into the records because they do not want other people to be biased to the patients; on the other hand, doctors often put the original quotes in the records when a patient is verbally aggressive as a way to protect themselves and warn their colleagues of a potential risk of escalating behavior.

In the context of medical records, the standardization of a boundary object is indeed a requirement, but nuance and relevancy are critical for others to understand the

meaning conveyed by the boundary object, and thus make the records reusable. However, nuance does not simply mean “more text”. In Heath and Luff’s (1994) study, the doctor left the cause of “bruise” out as a way to imply a possible abuse might be involved. In this case, less text conveys more nuances. In medical settings, since a boundary object often involves descriptions of a human being, conscious and deliberate explicitness and implicitness by writers are dual characteristics in medical records.

In Section 7.5.2., I showed through various situations that doctors always stick with “facts”, which they believe are objective data. However, sometimes they just cannot get *the* piece of evidence to make a claim (e.g., the patient is not in pain) for the diagnosis, then they need to use the art of language to describe the facts in a way to support their “belief”, a subjective interpretation. They write facts very explicitly that imply their belief. This explicit versus implicit writing has a significant impact on how a boundary object can be used by other communities, because it requires a reader to be very mindful in order to get the real meaning from this carefully crafted boundary object. As one attending doctor put it, you always need to “read between the lines”.

Reading between the lines requires professional competency. If a doctor listed clearly *all* negative test reports and ended with a “pending making diagnosis” for a patient with a chief complaint of chest pain in the record, it is a way to implicitly say that the patient was perhaps faking the symptoms. Doctors do not want to accuse patients of anything. In this tricky situation, they write “passively” instead of “actively”. An outsider, such as the patients themselves, would not be able to tell. Patients often request their own medical records, and they sometimes want doctors to remove the part they do not like. .

However, in some situations, this read-between-the-lines strategy does not work even for professionally competent people. When an ED doctor has only a couple of minutes to react in a case, they just need an explicit “shout-out” or “pop-up” message to tell them exactly what is going with this patient. They do not have time to read between the lines. Even the floor doctors, who have more time to explore a patient’s past medical records, when facing a large volume of text, are very likely to miss the implicit meaning that a writer tries to convey.

When boundary objects are created and used within the patient’s stay, there are fewer issues because caregivers from different groups or communities make phone calls or send messages to one another’s pagers to exchange information about a patient. For complicated cases, pharmacists and practice management staff often join the doctor team during morning rounds. In addition, nurses also periodically wait for the doctors in the hallways during morning rounds – they report to doctors when there is an issue, or doctors specifically ask them to watch for certain situations. All of these face-to-face interactions and live conversations provide contextual information for them to understand the patient. When they need to use the records for guidance, they have that background (contextual) information in mind (Mambrey and Robinson, 1997; Henderson, 1999; Lutters and Ackerman, 2007).

7.7.2. Episodes vs. Trajectory

In analyzing the boundary objects created to support the repairing of aircraft technical problems, Lutters and Ackerman (2007) extended the original concept of boundary objects to address three additional concerns. They noted that tensions often occurred between the standardization of the boundary objects (and process involved) and

their use in routine work; a boundary object represents a unique event that is created at one point in the sequential time of an entire situation (punctuated crystallization); the use of a boundary object is situated in a historical context and the process of use involves implicit negotiations (meta-negotiations and even streams).

The boundary objects in eCare, the information objects and the process around the objects, reflect the attributes identified by Lutters and Ackerman (2007) in many ways. For instance, I have discussed in last section how nuance and relevancy are embedded in the standardization of medical records, which are highly situated, individualized, and subjective for interpretation.

Most of the medical records in eCare are routinely created: an admission note should be ready by the post on-call day a couple of hours before morning round, so the attending doctors have enough time to review it and provide feedback to the resident; a progress note is made every day; a nursing SOAP note is generated every two days; a social worker consult note should be prepared within 48 hours after the consult is conducted (but social workers often immediately type it into the system); a discharge planning note should be expected after talking with the attending doctor and meeting with the patient (the policy is 48 hours; when the patient case is complex, it may need more time); a discharge note is usually drafted earlier and then changes are made as needed, but it should be ready for a patient's leaving at least a couple of hours ahead.

From this perspective, the boundary objects in medical settings are more routinely created as compared to the event documentation in Lutters and Ackerman's study termed as "punctuated crystallization", where the boundary objects are created at the point in a process. The time requirement in medical context for creating each document is also

loose, that is, no specific time is required but it should fit the workflow. For instance, a patient may decide to go home for a holiday without planning ahead. In this situation, if the patient's health situation is such that it is okay for them to leave, the resident will rush up to create a discharge document for the nurse to use for the education of the patient.

Incidental crystallization also occurs in the situation where a patient has a serious event, like a fall. When this incident happens, nurses are required to immediately write the detailed information in nursing SOAP notes and notify the doctors. This documentation may delay their time to be able to go home (See Section 5.2.5.). There is a tension shown here between routinized and incidental crystallization. In fact, when a charge nurse makes the assignment, she has to take care not to assign four patients who all need to have SOAP notes that day to the same nurse. As well, the residents often help the interns prescribe orders so that the interns have enough time to focus on the documentation (admission note and discharge note). From this concern, the creation of boundary objects reflects the work arrangement in the process.

All these boundary objects created during a patient hospital stay constitute a collection of records. It is very hard to pick one single boundary object that can be understood without others, because each boundary object is built over the other.

There is a time sequence, and there is also interrelationship. The chain usually starts with an ED doctor's short note, then the admitting doctor's admission note, progress notes daily, and a discharge note. Along this chain, other notes, such as nursing SOAP notes, a discharge planning note, a social worker note, a special consult note, and a physical therapy note, enter at different times along the trajectory, based on the treatment plan made in the admission note or in later progress notes. These notes serve the purpose

of both archive (what has been done, and what has been found out) and plan (what will be done next). Then, how are these boundary objects used to get an idea about a patient as a whole? For instance, how does a reader, who is not involved in the care activities at this moment, know whether a patient has received a *new* diagnosis during the hospital stay?

While the admission note is often considered to be the most comprehensive document serving as guidance for the work activities during a patient's entire hospital stay, it can be "misleading" if one wants to understand the patient case only within itself. For instance, the diagnosis and treatment are usually made during the post on-call day in this note. If there is a new diagnosis discovered and new treatment provided along the trajectory, this new information will not be reflected in the very first admission note (i.e. not continuous crystallization, Lutters and Ackerman, 2007). It will be written into the progress note on the day of the new discovery. While the discharge note is meant to summarize what has happened to a patient during her hospital stay, it has to be precise and only includes highlights, so it does not include all details from day one. In fact, in most cases, the discharge note will not provide a complete idea of how a patient's condition or medical work is detailed around the condition progressed during the patient's hospitalization. To understand how a new diagnosis is made, one has to read the progress notes. There is no shortcut in this situation. On the other hand, a progress note is made assuming the reader has an understanding of the current situation - it only includes the progress information based on the day before. Without knowing the patient's situation the day before, a progress note does not make good sense to a later reader, because it is a decontextualized object to the person who is not in that situation.

With this collection of boundary objects, if a doctor wants to get a quick idea about the patient, they need to read the admission note, a few progress notes, and then the discharge note. Often, a consultant note also is an indicator and has the key information in making a new diagnosis. When the patient has complicated psychosocial issues, poor insurance, or home care difficulties, discharge planner and social worker's notes often provide additional details regarding how the problem might be solved, which may include a detailed long-term care plan, social programs in which the patient might be interested, and so on. From a psychosocial perspective, even though a social worker's note is often highly valued, the information from the note is never added or reflected in the doctors' notes.

This situation shows a complex web of boundary objects created within just one single episode of a patient visit. When a chronically ill patient comes back over and over during her life span, the records about the patient grow. This extensive collection of boundary objects makes medical information reuse particularly hard.

There are two levels of trajectory in this collection for a patient. One is how a patient's acute condition progressed and was managed within one episode, during her one single visit to the hospital; the other is how a patient's chronic disease is developed and maintained through her life span (Charmaz, 1993), which is an accumulation of the records from all hospital stays and visits to the primary care doctors. If each of the boundary objects reflects only one piece of the story about a patient, then how can better use be made of the entire collection of records in a more efficient way, other than just reading it one by one?

While each boundary object has its critical role within an episode, some are used more from a long-term perspective (across multiple episodes) by other communities, but others are left untouched. For instance, both ED doctors and primary care physicians like to start with the discharge summary note from the last episode to get an initial idea about what happened to the patient most recently; inpatient doctors always read the admission notes and discharge summary notes from the last several episodes. Progress notes are often skipped. In certain situations, when a patient shows some questionable behavior, social workers' notes are reused.

From the discussions above, one can see that the construction of the boundary objects in medical settings shows a strong episodic nature. How to provide information reuse with a trajectory perspective has been a challenge. According to one attending doctor, an ideal admission note should include a precise description of all issues (medical and psychosocial) that the patient has experienced in a historical context, rather than just a focus on the current episode. This does not mean a simple copy and paste of the information from earlier records. This requires a doctor who constructs the admission note to review the earlier records, discusses them with the patient, make a careful assessment, and then write about the patient as a whole. The construction of records about a patient should be complete and updated, rather than a simple accumulation of fragmented pieces. This raises an interesting question: how to build one boundary object over the other, and how to make a collection of boundary objects into an information object that describes a patient from a long-term trajectory perspective.

The organization of the collection of boundary objects is key to making reuse more efficient, when a large amount of the boundary objects are interrelated to one

another. One possibility could be a navigation mechanism that shows the connection of these boundary objects, such as indexing on a patient's chief complaint, primary and secondary diagnosis, and surgical information, and so on. As mentioned, in eCare, there is a function called Problem Summary List (PSL) that allows the doctor who discharges the patient to highlight the major issues from the current visit. This list has been helpful to some doctors from other communities, such as ED doctors and primary care physicians, despite its poor design issues (see the next chapter for a more detailed discussion). It serves a navigation to guide them in which document they should go for, although the navigation function is very limited (based only on diagnosis).

7.7.3. eCare as an Information Assemblage

I have attempted to use the theoretical construct of boundary objects to gain a better understanding of shared information objects (patient records) in inpatient settings. The analysis from this investigation in the medical field has broad implications for information science.

First, it illustrates that while boundary objects are supposed to be made understandable to different groups of people who potentially need to use them, in a medical context, doctors are often extremely careful to craft the objects when psychosocial information is involved. They use relevancy to determine whether certain psychosocial information should be included, they sometime leave the nuance out, or they make it implicit so readers have to read "between the lines" in order to fully understand the situation. From this perspective, politics of information are inherently embedded in boundary objects in medical settings, and nuance is the key for later understanding. Another attribute of boundary objects in medical settings is that one

object is often built over many other boundary objects and each individual object is interrelated with many others. These additional attributes of shared information objects, discovered from medical settings, suggest that patient records should be considered as extended boundary objects (Lutters and Ackerman, 2007).

Second, through the analysis of episodic nature versus a trajectory perspective regarding how each of the patient records are generated and accumulated as a collection captured in eCare, this study suggests conceptualizing eCare as an information assemblage.

eCare serves not only as a common information space, it also embeds various practices around how each of the records is generated and used by multiple communities. Patient records in eCare as a whole, a collection of boundary objects contributed by different parties, reflect how medical work is distributed and how each task is accomplished. The interrelationships among these objects (certain objects are always built over the other, some objects are always first created during a trajectory) are realized through the work processes involved by all parties.

Furthermore, eCare stores a patient's lifelong medical records. When a patient experiences an acute episode, clinicians in the context understand the connection of all medical records created within this episode. However, when the patient comes back to the hospital, new groups of clinicians may have a hard time getting a comprehensive understanding about this patient from prior medical records. This trajectory perspective of eCare requires a navigation mechanism that can help users with sense-making and understanding of a new patient's case. All of the information objects stored in eCare – notes generated by doctors, nurses, and other clinical groups, lab/radiology results,

medication lists, and the problem summary list (PSL) – should be considered as a meaningful *whole*, rather than as a simple accumulation of information objects.

Therefore, it is useful to conceptualize eCare as an information assemblage which embeds collections of boundary objects, practices around these objects (generation and use), work processes for each task, and navigation schemes to help interpret information across multiple episodes. This new conceptualization of eCare is critical to understanding information reuse from a long-term trajectory perspective.

7.8. Summary

In this chapter, I described doctors' work activities from several perspectives: morning rounds, information seeking, diagnostic interviews, interactions with others, and documentations. I used psychosocial information as a lens to examine doctors' documentation practice, which is situated in the larger context of their work. The analysis focuses on an understanding of how information is documented as a formal representation of work, and why certain information is left out, how the politics of information plays a role in determining what information should be documented or left out, and how missing representations may have an impact on the further understanding of a patient's case across multiple episodes or result in problematic situations in patient care. I also analyzed the nature of nuance, relevancy, episode, and trajectory inherently embedded in the medical records as boundary objects, which is an attempt to extend our theoretical understanding of the attributes of boundary objects. Building on the understanding of the complex use of and practices around eCare as a whole, I further suggested that eCare should be conceptualized as an information assemblage.

In the next chapter, I will provide some recommendations for organizational change and implications for better system design, built on my analysis from Chapters Five, Six, and Seven.

Chapter 8

Recommendations and Design Implications

8.1. Introduction

In the last three chapters, I examined both doctors' and nurses' information work, focusing on their documentation practice. In particular, I described and analyzed how nurses used group working documents to support their personal information assembling process, how local knowledge has largely vanished in its written format after the adoption of the CPOE, how the new workflow during a shift-change may result in some information gaps for nurses to get a full understanding of their patients, how doctors construct patients' medical records, and how the politics of information influenced their interpretation and subsequently determined whether or not certain information was documented.

Building on these understandings I gained from the field observation, in-depth analysis of nurses' working documents and doctors' formal patient medical records, and interviews with various clinicians, in this chapter I offer some organizational recommendations and draw implications from a system design perspective.

8.2. Recommendations to UMHS

8.2.1. Organizational Recommendations

From my analysis of doctors' work, it is clear that the specific problem of pain medicine abuse is exacerbated by the ED doctors' tendency to move patients through as quickly as possible, as well as by the lack of information visibility. From the organizational perspective, the tension between ED doctors and general medicine doctors should be discussed at both professional and administrative level.

In its weekly report of June 18, 2010, the Centers for Disease Control and Prevention showed that in the U.S. "the estimated number of ED visits for nonmedical use of opioid analgesics increased 111% during 2004-2008," and "the highest numbers of ED visits were recorded for oxycodone, hydrocodone, and methadone²⁷, all of which showed statistically significant increases during the 5-year period," despite efforts to control the problem. This situation appears to be occurring at my observation site as evidenced by the issues identified in this study.

It is true that as a large teaching hospital, many patients without good insurance come to visit and usually the hospital cannot decline the admission when the patients are indeed sick. However, since some doctors (both ED and inpatient doctors) tend to prescribe more narcotic medication, which may immediately ease the situation but cause a patient to become addicted or further dependent on a controlled substance, there is perhaps a need for a review of practice in this regard. For example, it is reasonable to review or investigate across the hospital to determine how the controlled substance is

²⁷ All are controlled pain medication drugs.

prescribed – that is, who is issuing prescriptions, what they are prescribing, and whether it is done appropriately.

Most doctors do not get systematic training in how to deal with pain issues during their education. At the study site, some doctors who specialized in other areas often complained that although they wanted to appropriately address chronic pain issues in their patients, they don't really know how to talk about it. If the doctors are not confident speaking about the issues related to pain medication, how can they convince the patients? Therefore, helping all doctors to improve their practice in the prescription of pain medication is a key concern.

In fact, the hospital has indeed started to change. The administration invites pain specialists to give lectures both online and in person. However, it seems this is a voluntary rather a mandatory program. The guidelines for controlled substance prescription are often sent to each doctor through e-mail with a link or attachment. According to the head of a committee in charge of the pain medication prescription practice, perhaps only 10% doctors have read these guidelines, even though 80% of all doctors should read it very carefully. Responding to this situation, the hospital administration should make education about chronic pain prescription a more serious ongoing endeavor, not only providing regular lectures and guidelines but also acknowledging the existing issues and awarding the doctors who pursue best practice. This is a large hospital, so it is not uncommon for suboptimal practices or problems to just disappear in the cloud. However, when issues accumulate, it can result in serious adverse outcomes.

Furthermore, the hospital may need to reconsider the incentives for ED doctors to hand off patients who are seeking drugs without admitting them. If the ED doctors have any concerns, the hospital should address those concerns first. These concerns may include, for instance, how to deal with patients who tend to use “chest pain” to exaggerate the situation²⁸. Of course, providing all doctors convenient access to critical information is a prerequisite for enabling such organizational change. However, if there is no incentive structure to ensure proper practice, even with the support of technology, best practice may not take place (Grudin, 1994; Orlikowski, 1992).

Regarding the issues identified from my nursing study, nursing administration may also want to consider an incentive structure for nurses to document more extensive nursing care information, resuming their group practice rather than preferring individualized work patterns. Prior to the CPOE, the conference room served as a common information space for collective information production (SRS use). After the CPOE, the common information space has been moved into CPOE on its Comments page; but sadly, the group practice became individualized. Therefore, from an organizational perspective, the visibility, convenience, and accountability of the group practice is warranted for nurses’ information sharing. How to reverse this individualization and foster the intended group practice should be a concern from both the organizational and technological perspectives.

²⁸ In one extreme case, the patient almost lived in the hospital, claiming he had severe pain and needed IV pain medication. However, people saw him playing Xbox and dining in the hospital cafeteria (designed for clinicians and patients’ family members and friends) during his hospital stay. Finally, the legal department of the hospital got involved and signed a contract with the patient, which made it clear – in the absence of an objective test finding, he would not receive IV pain medication and would not be admitted. This contract ensures the ED doctors that it is o.k. not to admit this patient. Since then, the ED doctors started to decline the admission when this patient showed up.

This study has discovered nurses' concerns about local knowledge sharing, and disruption or deviance on the workflow for documenting nursing care information. Acknowledging these concerns, perhaps leadership should consider a reward structure for documenting non-sensitive nursing care information to make full use of the Clinical Summary page Comments area, following the example from the reward structure of the Thank-you Notes lottery-draw with a \$10 incentive to encourage team-oriented patient care. Given that one nurse in the study site has already taken the lead in developing a template for documenting nursing care information, how to provide an organization-wide incentive structure should be considered.

8.2.2. System Integration

It is not uncommon that one hospital has several electronic systems in place, and the systems often do not talk to one another successfully (Østerlund, 2002). In this hospital, most of the time, ED doctors work in Centricity, inpatient doctors such as the MH team use eCare (CPOE when they need to do prescriptions), and nurses receive orders and document the results of medication administration via the CPOE. As the study discovered, some information gaps resulted from these disconnected systems, and clinicians are not likely to look at two systems when they are under time pressures. While it may take significant efforts to finally unify all systems into one, and while this goal may never actually be achieved (Greenhalgh et al., 2009; Østerlund, 2002), making partial and critical information available in all three systems is certainly possible and should be considered. I list three suggestions below:

- The ED doctors need to know more about a patient's past medical history in order to make an informed decision for admission. Currently, this information is only

stored in eCare and presented as doctors' notes. No one can really force ED doctors to look at these notes. Indeed, it is very hard for them to locate the right note and dig out the critical or warning information under distinct time pressures. The problem summary list (PSL) (See Figure 13) in eCare helps them only to some degree, and there are only some doctors who contribute to this list. The structure of PSL is problematic. It appears as a separate tab from 'Documents,' under which inpatient doctors who discharge patients can summarize each patient's medical and psychosocial issues and present them as a list. However, it captures too much replicated information. For example, the patient's diagnosis is often entered each time they are hospitalized, so the same diagnosis can appear multiple times on the list, which takes too much space and buries other critical information. In addition, the date for information entry determines the priority of display (which information is on the top to display), which may not always fit the need. For example, certain critical information may have been captured two years ago, but overshadowed by the most recent entries, which can be just repetitive diagnoses²⁹. If an ED doctor only has a few seconds to glance at this list, the critical information may be missed because this list can be several pages long with dozens of repetitive entries. This PSL should be improved with a better design, such as filtering out repetitive diagnoses and allowing doctors to assign the priority of each piece of information for display. In addition, instead of only some doctors using it routinely, every doctor should be encouraged to take advantage of sharing critical information through this channel. Furthermore, this

²⁹ One attending doctor has found this trick: if the information is not dated, it will stay on the top of the list. He has used the trick to keep an important psychosocial issue always at the top, so other doctors will never miss it. However, not many doctors know about this strategy.

PSL should be made available in Centricity, so the ED doctors will benefit from knowing more about the patients by just looking at the system they routinely use.

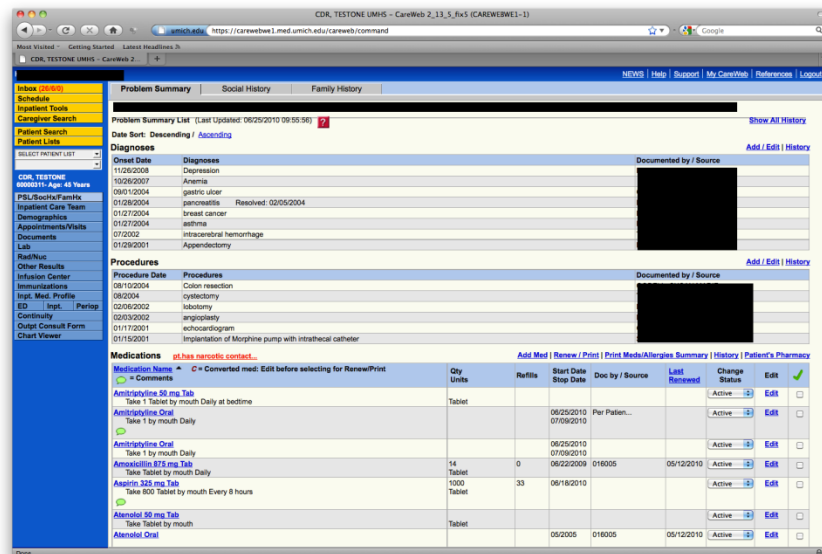


Figure 13 An overview of problem summary list (PSL)

- Many U.S. states have now implemented patient registry systems that maintain a comprehensive list of patients' prescriptions. Both ED and inpatient doctors will benefit a great deal by knowing a patient's history of controlled substance prescription. While this system, MAPS, is accessible to licensed physicians free of charge, it cannot be retrieved without considerable effort. Because it is completely independent, doctors need to enter various information to search for the patient and must wait for the results. This waiting time is often unacceptable given time pressures, particularly in the ED environment. Integrating such information directly into eCare or Centricity could help address the issues of information visibility and convenient accessibility. Currently, the information in

eCare, Centricity, and CPOE is largely public to all authorized users, which include doctors, nurses, pharmacists, practice management personnel (including social workers), administrative personnel, and various other caregivers. Since the prescription history information should be only accessible to licensed physicians, if the information of a patient's controlled substance prescription history gets integrated into the eCare, restricted or tiered access would be warranted.

- As discovered during field observation, nurses mainly use the CPOE during their information assembling process, which results in some information gaps in understanding patients in a larger context. Although CPOE has the information about a patient's primary and secondary diagnosis and sometimes their past surgical history, it lacks the details nurses need to get historical context about the patient's illness based on just several key words. If a CPOE can integrate a shortened version of doctors' notes currently stored in eCare, as was done with the original SRS, and present it in such a way that nurses can get this knowledge with just a glance in the CPOE when they prepare their personal sheet, nurses would gain a better familiarity of their patients with no extra effort. This solution requires that the original information receives some customization, because doctors' admission notes are often very long, and may include procedural details that nurses can wait until later to find out. Most importantly, since a majority of nurses tend to use only the CPOE during the information assembling process, providing more contextual information about a patient in the CPOE will benefit nurses' knowledge about their patients.

8.3. Support Local Knowledge Use and Informality

At a higher level, the findings from my investigation from the field have several broader implications for information technology development and deployment in healthcare settings. This study reiterates that while a new system may support and strengthen formal work processes (for example, standardizing order prescription), transitioning some of the practices to visible and permanent from their former status of invisible and temporary changes the nature of practice. In reality, these invisible practices are necessary to accomplish the work.

From a nursing perspective, the technical question is how to factor the local knowledge created in the paper environment into the design of computerization of medical information. In addition to the politics of local knowledge embedded in these working documents, the heterogeneous nature of local practices makes it very hard to computerize local working documents in a uniform format to meet the potentially different needs of each different nursing unit (for example, an internal medicine unit for adults as opposed to a pediatric unit). Local working documents are the informal representation of local practice. Computerization tends to formalize and make practice uniform, which is necessary in certain situations (such as enforcing best practice for medication administration); however, it should not ignore specific and unique nursing practices in different units.

In doctors' documentation practices, there remains an issue of whether and how to document psychosocial issues and problematic patient behaviors. Certain information can be open to interpretation; definitive evidence may not exist even though much other factual data seems to confirm the speculation. Doctors may share their understanding of

ta case with their colleagues but not put it in the formal documentation (patients' records). Currently, doctors often share this unwritten knowledge verbally, through a phone call or face-to-face interaction, so the information sharing scope is a limited transaction between individuals, which fails to get across to the caregivers who provide service to the same patient.

Documentation practice from both doctors' and nurses' work points to the need for the technical capability of recording subtle and sensitive information – which is often perceived as local knowledge or 'informal' information. The current generation of EHR systems, such as eCare and the CPOE used in this study site, is not only designed to support care processes but also to focus on the capture of billable, 'medicalized' information. The EHR systems lack the ability to document and use informal, provisional, and work-in-progress information, as argued in (Hardstone et al., 2004), particularly the information that sheds important light on patients' psychosocial issues. As shown from the description and analysis in earlier chapters, because of inadequate technical capabilities, such information was then mainly communicated only verbally.

From a practical perspective, the CPOE system design should perhaps give nurses control regarding what they want to do with nursing care information after a patient is discharged. Nurses should determine the life cycle of nursing care information, as was the case previously when the SRS was in place. This information space should be designed for nurses to share their knowledge with their fellow nurses rather than be captured as part of the permanent patients' records. By the same token, for doctors, the eCare should include an information space separate from the formal medical records. This information space is for doctors to note important issues for their colleagues, rather

than to document in a patient's records with legal and billable accountability. Nurses may also use this information space to notify doctors of any issues they observed, to compensate for potentially missing a face-to-face interaction during morning rounds. Presumably, this space will allow doctors to write their concerns that they may not comfortably address in the patient records, and these concerns may be shared among the care teams.

8.4. Support Long-term Information Reuse

The findings from doctors' documentation practice provide valuable insights into redesigning electronic medical records and suggest the importance of considering information long-term use broadly. At this study site, understanding the patient from a long-term perspective is difficult due in part to the technical difficulties of reusing patients' medical records across multiple episodes. When information reuse occurs within an episode, clinicians need explanatory details to help them understand and coordinate the work; when it occurs across episodes, they need to know key issues about the patient with a trajectory view. This reiterates the need for mindful considerations when constructing medical records for multiple purposes.

When patients come back, doctors often have to read an immense volume of past records (particularly when the case is complex), line by line, in order to identify the information they need. This issue is reflected in my numerous observations and interviews with ED, inpatient, and primary care physicians in an outpatient setting. Historically, the medical information about a patient captured in the system has been very episodic. There is no cognitive connection among each individual record that can help clinicians to efficiently achieve a good understanding.

Currently in eCare, various notes contributed by all caregivers are chronologically listed. The system has only a very limited filter function, which may categorize the notes based on the type of documents (ED notes, admission notes, progress notes, practice management notes, social workers' notes, nursing notes, special consulting notes, physical therapy notes, and so forth). However, this function is not used often, because there is not much information need for it. Not surprisingly, clinicians like to have search functions for specific inquiries. In addition, the indexing function of the documents can be very important, based on items such as a patient's 'chief complaint' or 'diagnosis.' When a patient shows up with 'abdominal pain' as a chief complaint, doctors may want to know how this chief complaint was investigated and treated during previous episodes. Some chronically ill patients may show up with the same chief complaints over and over, but others may show different symptoms. Furthermore, the same chief complaints may result in different diagnosis and different treatments. Therefore, how to present notes in a relevant context, building connections between and among notes, should be considered from a technical perspective.

The problem summary list (PSL) is an effort to make the information reusable from a long-term perspective, because it encourages the doctors who discharge patients to summarize the major issues about patients as a way for other doctors to quickly get an idea. In addition, the system also designs a space for documenting a summary of social history and family history, which is presented within PSL under the same tab (See the Figure).

However, as shown in the earlier section, the structure of the PSL is problematic. It is mainly designed to summarize the primary diagnosis and secondary diagnosis, along

with the medication prescribed for patients. The social history and family history are all left out. When asked, all residents responded that they never used the space for social history and family history, and they even wondered who should summarize that information. It is true that some attending doctors occasionally used the PSL to note psychosocial information, as shown in Section 7.5.2.; however, it is not fully used by everyone. Some residents admitted that they did not use it very often because they did not find it useful. Indeed, a lot of patients' PSLs are populated with just primary and secondary diagnosis and medication list.

An ideal PSL should be able to present a complete overview of a patient's illness trajectory, which may require each doctor to contribute a new understanding about the patient's illness when the patient has a new episode. The PSL should be updated, rather than a simple add-on that carries too much replicated information from each episode. The key challenge here is how to connect the dots (fragmented information from each episode) into a meaningful picture (understanding the patient's illness as a whole). This is perhaps essential to ensuring information reuse in a more meaningful and efficient way from a long-term perspective.

8.5. Summary

In this chapter, I attempted to offer several organizational recommendations to improve practice with a focus on incentive reward structures. I also discussed several design implications, which were drawn from my field observations and interviews with clinicians. These design implications include system integrations, supporting local knowledge and informality, and supporting information reuse from a long-term perspective.

In the next chapter, I conclude with a discussion of contributions, limitations of this study, and future work.

Chapter 9

Conclusions and Future Work

9.1. Introduction

In previous chapters, I used psychosocial information as a lens to examine both doctors and nurses' documentation practice. I also extended my analysis to include the work activities that were affected by the adoption of the Computerized Prescriber Order Entry system. The analysis of findings from my investigation of nursing work focus on a better understanding of how medical work can be significantly shaped by system intervention, in particular how local knowledge has largely vanished in its written format, how nurses' information assembling processes have changed and affected nurses' knowledge about their patients, how workload (and power) is redistributed, and how administrative control is facilitated. My investigation of doctors' work reveals nuances about how the politics of information is carried through the documentation of patient information, and how missing representation of patients may result in a big challenge for information long-term reuse and subsequently affect doctors' knowledge about complex situations.

In this concluding chapter, I want to first summarize the major findings from this study. Then, I will note the limitations resulting from the main research methods this study employed. I will conclude with a plan for my future work.

9.2. Study Contributions

During a seventeen-month period, I used three research methods: field observations, in-depth analysis of working documents and patient records, and semi-structured interviews, to examine medical information use and documentation. I employed an information science perspective to study issues in medical informatics. The findings and lessons learned from this investigation contribute to a better understanding of various issues in medical informatics and theory in information science. Furthermore, it has several implications for organizational and system design. In this section, I will summarize these contributions.

9.2.1. Contributions to Medical informatics

First, the findings from the nurses' use of paper working documents and the loss of psychosocial information in written format after the CPOE adoption suggest a common story about the politics of medical information. Computerizing patient information is not just a matter of understanding the workflows and work; it is also a matter of understanding the routinized agreements around that information. Some of those agreements are only "good enough" (Strauss et al., 1963; Strauss et al., 1997) to get the work done. They are working arrangements that may not carry full agreement. This "good enough" agreements change when the document becomes permanent, visible and goes across boundaries. The original written form of detailed nursing care information is

a systematic group practice and shared social arrangement. This group practice can vanish. In the case I observed, the automated common information space unintentionally hindered information sharing, which in the paper-based operation previously afforded contribution by everyone. After the psychosocial information, the local knowledge, is brought into play with the CPOE, the public information system, there is no easy way to put the shattered pieces of the arrangements back together again, despite the nurses' efforts for over two years. This may be an important contribution not only to medical informatics but also to collaborative information sharing overall, since status and politics often influence technology adoption.

Indeed, this study also serves as a caution. There are many well-intentioned efforts to attempt to computerize documents, records, or artifacts, assuming it is only a transition across media. I have shown from this investigation is that even when social context is taken into account, computerization may ignore the institutional arrangements that allowed those artifacts to exist in the first place.

Second, the findings from the investigation of nurses' individual information assembling provides a better understanding of how the change of workflow may result in information gaps, even though the information objects are all available and ready to use. In fact, it is not only the workflow; it is the computerization that reinforces the individual's performance in medication administration and system accountability. There is a constant push by the CPOE to ensure medication administration is carried out on time, which results in many nurses skipping the step of reading the doctors' notes before they go to see patients. In the previous paper environment, they learned about the patients in a broader context as part of the nurses' group practice immediately following the shift-

change meeting by reading the printout version of doctors' admission notes, or at least a summary of the patient's medical history written by the earlier shift nurses. Now, they only learn about the patients from the CPOE.

It is fair to say that the CPOE provides some basic information about each patient; however, there is little nuance other than several key words, such as primary and secondary diagnosis. Understanding patients in a broader historical context becomes a marginalized concern in the new operation. To reduce medication errors and administer medication on time are always an important concern, however, knowing patients better (in both their past medical history and as a person) before going to see them should also be part of a higher quality, humanized care. This lesson is important for medical informatics in that we should consider how to still maintain or even highlight human elements in the push for computerization of medical work.

Third, the CPOE has changed the nature of order practice in many ways. It reinforces standard order prescription and medication administration performance. Furthermore, it facilitates administrative control around order practice. While it is perceived as a successful move towards improving patient safety, the CPOE order practice embeds the issues with nuance, discretion, temporality, and human interpretation that original order practice assumes. These issues include removing the power for nurses to order lab tests, lacking the ability to deal with the temporal issues associated with procedural order, and forcing doctors to write mechanical orders rather than more easily understandable human orders. The rigidity of the machine order system has shifted some responsibilities and in fact caused extra workload for all parties. The findings from this analysis contribute to a bettering understanding of how nuanced medical order practice

functions in reality and what the computerization of medical order practice means to overall work arrangements and responsibilities for different communities of practice in an inpatient setting.

Lastly, the findings from a detailed analysis of doctors' information needs when they admit a new patient and how they subsequently construct admission notes reveal a complex view of doctors' documentation practices, particularly about how they deal with psychosocial information. The politics of information is embedded in their decision-making about what to leave out and what is considered relevant. This determines whether they write explicitly (for the factual data, objective) or implicitly (for their belief, subjective). Professional competency (reading between the lines) does not apply to situations such as ED doctors who need to find out about patients' past medical histories in order to make informed admission decisions. They work in an extremely time sensitive environment and often need records to convey a crystal clear message. Furthermore, doctors may not write down important psychosocial information because the definitive evidence is not yet present to support doing so, even though their speculations are strong enough. This missing representation often results in repetitive investigations and unnecessary admissions. Furthermore, even though key information may be captured, it can be buried somewhere in a large volume of documents, which certainly affects information reuse from a long-term perspective.

This study has broad implications for medical informatics. It suggests the need to re-conceptualize medical records as a representation of not only medical processes but also patients. While the information representation that supports ongoing medical processes remains critical, as they are needed to support routine activities, coordination,

legal, and billing purposes, what needs to be shared across multiple patient care episodes is not only the process-oriented information but also key information centered around the patient's lifelong illness trajectory, both medically and psychosocially.

The field investigation points to a new perspective that representation of information may need to be constructed to support a multiplicity of purposes. As shown, the conceptual models underlying current electronic health records (EHR) are largely process-centered, and do not accommodate multifaceted needs - and hence may adversely affect medical practice and diminish the reuse value of documented patient care information. My detailed analysis of how doctors use information in their sense-making process represents an attempt to examine whether focusing on one model may lead to the missing representation for continuity of care when a patient returns. It is part of an important examination of long-term information reuse and of work representations in both medical informatics and HCI/CSCW.

9.2.2. Contributions to Information Science

Research in Information Science has examined the concept of “boundary object” through rich description and analysis in organizational settings. These studies have contributed to a better understanding of boundary objects and also pointed out the limitation of this concept. Researchers, such as Ackerman and Halverson (2004), Lutters and Ackerman (2007), and Lee (2007) have pointed out the limitation of the concept and provided additional attributes (as described in Chapters 2 and 7).

In my study, I identified a number of interesting informational objects at different levels and in different media, such as (paper) Shift Report Sheet (SRS), (paper and electronic) Orders, (paper) MAR and eMAR, the CPOE, various clinical notes in eCare

(i.e. patient medical records), and eCare as a whole. As shown in my description and analysis of how each of these objects is used, these information objects do not comfortably fit into the concept of boundary objects even though they include attributes of boundary objects. In this section, I want to elaborate further about what needs to be added to the concept of boundary object. I propose a new conceptual unit, an assemblage, which can provide a better perspective for examining medical information, especially in computerized form.

The concept of information assemblage in this study derives from Watson-Verran and Turnbull's (1995) original use of the term. They defined "assemblage" as "the amalgam of places, bodies, voices, skills, practices, technical devices, theories, social strategies, and collective work that together constitute technoscientific knowledge/practices" (p. 117). However, Watson-Verran and Turnbull's "assemblage," emerging from the Sociology of Science literature, is too broad to be helpful for focusing on individual information objects, such as the SRS, the CPOE, and eCare. Instead, I propose a new definition of "assemblage" that scales down to these individual objects, including only the practices (generation and use) around these objects as well as the work processes and coordination mechanisms within these objects. This definition of assemblage has several important characteristics. First, the information organization of an assemblage is based on an individual patient; therefore, an assemblage has a trajectory along with a patient's illness development, either for an acute episode or throughout a lifelong span. Second, because of the trajectory, the creation and use of an assemblage interweave, meaning that new content is added in along with the use of previous information. Third, an assemblage may contain various information objects, or

information assembled from multiple sources and rearranged in a way to serve specific purposes. When multiple information objects with similar functions (such as a stack of patients' notes or a stack of medical orders) are aggregated together, it becomes a "collection" within the assemblage. Fourth, there are multiple parties who are involved in the creation of an assemblage. Each of them has different roles, and they use an assemblage in different and varying manners. Fifth, an assemblage embeds work processes. In paper form, these work processes may be embedded tacitly, but in computerized form, they are often part of the assemblage, controlled by the assemblage, or even control the assemblage. When work processes are automated, an assemblage needs to employ complex coordination mechanisms to accomplish time sensitive work activities and navigation schemes to help better indicate the interrelationships among information objects. Lastly, an assemblage may contain certain information (sometimes local knowledge) or features that are only intended for special groups even though the object as a whole is shared by multiple parties.

Note that the Watson-Verran and Turnbull assemblage is a superset of what I consider an assemblage. My assemblage is the specific context around an information object.

Similarly, I define a number of other ways to examine information objects. First, some objects are clearly boundary objects, just as Star and Griesemer (1989) defined them. For example, medical orders, particularly when they are used in paper operations, are boundary objects that are created by doctors and administrated by nurses, pharmacists, and lab/radiology technicians. Second, some objects should be considered as "extended boundary objects," as Lutters and Ackerman (2007) or as Lee (2007) defined

them. For example, medical orders in electronic operation embed different forms of the usages from the paper ones (such as pharmacists sometimes help doctors construct complicated electronic format orders), which require further negotiations for the use of boundary objects. Third, some objects should be considered as assembled information objects. The content within these objects is assembled elsewhere (other boundary objects) and then combined with additional notes, such as Kardex and SRS. These assembled objects are often temporary, and used for specific purposes; they will be discarded after a shift or a patient's stay. Finally, information objects (including boundary objects) may appear in "collections." That is, a "collection" includes multiple information objects. This is obvious for computerized systems such as eCare or the CPOE system, but they can also appear in paper form, such as an accumulation of the SRSs produced during a patient's stay in the hospital, or a pile of paper orders kept in a patient's permanent records.

Note that I have now defined a stack of conceptual framings: boundary object, extended boundary object, assembled object, collection, assemblage, and Watson-Verran and Turnbull's assemblage. Each of these concepts builds on and extends the previous one. I believe this stack of conceptual framings can serve to understand computerized records in a medical setting far better than can any single concept. This strategy of employing multiple conceptual framings at different levels of examination and analysis is parallel to "relaxing the boundaries" in a Distributed Cognition analysis (Ackerman and Halverson, 2004).

This allows us to understand those information objects that do not fit as boundary objects very well even though they are shared information objects. Next, I will elaborate

further why the SRS is an assembled object and the CPOE and eCare are a better fit as an information assemblage.

First, SRS is an assembled object. It is an information object shared among multiple shift nurses in one unit. Part of the content in this object is manually assembled by each unit nurse from doctors' admission and progress notes and lab results (which are boundary objects stored in eCare). However, nursing care information in this object does not come automatically. It requires nurses from each shift to contribute and share with one another. Each incoming nurse uses SRS to better understand her patients, but she also needs to contribute new knowledge about the patients into the SRS at the end of her shift. In addition, doctors' notes and lab results are also updated throughout a trajectory. The information use, assembling of new content from other information sources, and local knowledge contribution are interwoven processes embedded in this object. The collection of SRSs serves trajectory information to a competent nurse about how a patient has been since admitted.

As described earlier, the SRS was established in the transition period when doctors' notes and lab results had already been captured in eCare while order practice was still in paper operation. The three categories of information (doctors' notes about patient, newest lab results, and previous nursing care information) on this document, along with ongoing procedural orders on the paper Kardex, were considered the most critical knowledge for incoming nurses to become acquainted with during shift change. The invention of the SRS as a catch-all document to complement the Kardex was perceived as a successful move to accomplish the work more efficiently. However, due to substantial local knowledge embedded in this assembled object (contributed by individual

nurses), the SRS could not be conceptualized as a boundary object even though two categories of the information are indeed assembled from other boundary objects. It was used only for specific purpose among nurses within a ward, and was discarded after a patient was discharged. From this perspective, the SRS should be better perceived as an assembled information object.

Second, the CPOE is an electronic assemblage centering on order practice. It clearly has the attributes of a boundary object as its two major information objects, Orders and eMAR, are boundary objects that are shared by different communities of practice and used differently. Distinct from the boundary objects examined by earlier studies that often focused on individual material artifacts, the CPOE not only computerized these two information objects that closely rely on one another in medical order practice, it also automated the work processes around these two objects, including electronic prescribing from predetermined order sets (for doctors), automatically assembling patients' brief medical information and medical orders into various categories (for nurses), notifying new orders (for pharmacists, nurses, lab/radiology technicians), verifying orders (for pharmacists), recording medication administration results (for nurses), alerting new lab results (for all parties), and monitoring nurses' performance (for administration). All these automated processes with various workflows and work activities embedded require coordination mechanisms. As described in Chapter 6, this complex coordination (involving several communities of practice) is realized in the CPOE system by various types of color-coded flags, icons, and alerts. Most importantly, the CPOE is used in an extremely time-sensitive manner – without providing feedback about an earlier action, no further action can be taken. Furthermore, the CPOE also has

various functions that are only designated for certain groups despite their coexistence in the same information space.

Taking all these attributes of the CPOE into consideration, one can see that Star and Griesemer's (1989) classic concept of boundary objects would not be sufficient to understand the overall medical practice around the CPOE. Indeed, this theoretical concept was originally drawn from their museum study, during which (automated) work processes and time-sensitive coordination might not be a concern. Building on detailed analysis of order practice around the CPOE system as a shared information object, my study suggests that an information system may be better perceived as an assemblage that hosts heterogeneous information objects, interrelated work practices, coordination mechanisms, and special functions designated for different groups. This new conceptualization can be used to examine an information object that is built to be centered on certain boundary objects (such as Orders and eMAR in this study) while further enabling various automated work processes engaged by different communities of practice.

Third, eCare is an electronic assemblage centering on documentation practice of patient records. It serves as a common information space that has a collection of boundary objects generated from standardized requirements and formats by different communities of practice (doctors, nurses, social workers, therapists, and practice management staff). All these objects are shared across institutional boundaries.

In this study, I focused on doctors' admission notes (boundary objects) and analyzed how nuance and relevancy are embedded in the standardization of boundary objects, which are highly situated, individualized, and subjective for interpretation. It is

this nuance and relevancy that is critical for others to understand the meaning conveyed by each specific boundary object. I have also showed that while boundary objects in medical settings are more routinized in their crystallization, incidental crystallization also occurs in situations where a patient has a serious event. The creation of boundary objects often reflects the work arrangement in the processes. My analysis of the tension between standard forms versus nuanced use contributes a theoretical extension to the attributes of classic boundary objects. Then, how may we better understand eCare as a whole?

eCare displays a complex web of boundary objects. The organization of patient records in eCare is based on each individual patient, that is, each patient has a collection of medical records. For any patient, there are two levels of trajectories in their collection. One is how her acute condition is progressed and managed within one episode, and the other is how her chronic disease is developed and managed through her life span. The creation of any boundary object in this collection is always one built over the other. And they are interrelated with one another with the meanings they convey. When a chronically ill patient comes back over and over during their life span, the collection grows. This whole collection of boundary objects makes medical information reuse particularly difficult, because the creation of these boundary objects is episodic but understanding of a patient should be built from a long-term trajectory perspective.

However, it is precisely this two-level trajectory nature of medical records that determines that eCare should not be perceived as a simple collection of boundary objects. Within an acute episode, different communities of practice (doctors, nurses, social workers, practice management coordinators) generate notes in a way to contribute and share their understanding about the same patient. While the coordination of each clinical

activity via eCare is not extremely time-sensitive as is the CPOE, work arrangement is always made according to the information available in eCare at the moment. For instance, pharmacists often need to read doctors' admission notes before they verify medication orders; admitting nurses also need to learn doctors' diagnosis before they make nursing plan of care; and doctors need to access the newest lab results before they provide new treatments. During this acute trajectory, many process-oriented details are recorded in each boundary object in eCare, which is necessary to support the ongoing process. However, process-oriented boundary objects make it more difficult when eCare needs to serve as a life-span trajectory assemblage for patients. Therefore, there is a need for a navigation mechanism in eCare that can facilitate users' sense-making and understanding of these interrelated information objects as a meaningful whole. Conceptualizing eCare as an assemblage, rather than a simple collection of a patient records, allows us to examine how each of the boundary objects is created, what the interrelationships among these objects are, and what navigation scheme should be provided to provide better sense-making for the purpose of information long-term reuse.

To summarize, in this study, I found that Star and Griesemer's theoretical concept of boundary objects is insufficient for interpreting various new phenomena of information use in medical settings, particularly with complex electronic systems taking place. I proposed to use information assemblage as a new perspective to understand the nature and practices of the CPOE and eCare. Furthermore, I used a stack of conceptual framings to analyze a number of information objects, and illustrated that these conceptual framing together can serve to understand computerized records in a medical setting far better than can any single concept. This is my contribution to Information Science.

9.2.3. Implications to System Design

The findings from my study have several organizational and system design implications. First, from the organizational perspective, the tension between ED doctors and general medicine doctors should be discussed at both the professional and administrative levels. For example, it is reasonable to review or investigate across the hospital to find out how controlled substances are prescribed (who is prescribing, what they are prescribing, and whether it is done appropriately). Since most of the doctors did not receive systematic training about how to address chronic pain issues and pain medication prescription in medical school, these doctors should receive additional training to improve their overall practice in prescribing pain medication. The hospital administration needs to make the education of chronic pain prescription a more serious ongoing endeavor. Furthermore, the hospital may need to reconsider incentives for ED doctors to hand off patients who are seeking drugs without admitting them. More social workers may need to be involved in this situation, helping patients find chronic pain management and social programs to truly address the issues.

Second, due to information gaps resulting from these disconnected systems (the CPOE, ED system, eCare) and clinicians usually not looking at multiple systems when they are under time pressure, making critical information (about a patient) available in all three systems is certainly possible and should be considered. This information should include information about key issues from a patient's medical history, including both medical and psychosocial issues. Furthermore, patients' controlled substance prescription history should be made more convenient for ED doctors and inpatient doctors to access so problems can be discovered earlier.

Third, the system design should consider supporting local knowledge and informality. There are several technical design issues that should be addressed. These include the PSL structure, which is a relatively easy fix to improve information use from a long-term perspective. More broadly, there is a need to redesign the structure of electronic medical records and suggest the importance of considering information use from the perspective of a patient's life span trajectory.

9.3. Limitations

The limitations of this study are twofold. The first is rooted in the research method this study employs. Ethnography is good at discovering existence, rather than reliability. The ethnographically-based field observation takes place in natural settings and focuses on ongoing processes. It is impossible to accurately replicate the entire situation, and another researcher might generate different descriptions from the same field observation in the same ongoing process. So the validity of this type of research cannot be verified. In addition, it also has the issue of breadth. For instance, this study is only situated in an internal medicine department, and only within one hospital.

The second limitation stems from the study itself. Due to various constraints, I did not get the chance to observe ED doctors' work, which has made my analysis of doctors' sense-making process in understanding chronic pain patients somewhat one-sided. Since the tension often occurs between the ED doctors and inpatient doctors on this issue, it would be a great benefit if the study could be extended to include observation in the ED environment. To compensate for this, I conducted semi-structured interviews with three ED doctors about their work and asked them to explain the rationalization underlying

their thinking, such as why they repeatedly admitted drug-seeking patients to the hospital – an action which puzzled the inpatient doctors.

In order to get a broader understanding of the issues involved, particularly in the change of medical order practices, this study has extended the interviews to include doctors and nurses from other units.

Despite these limitations, this study has provided many deep insights about how medical work is accomplished, how information is used, and how technology intervention may impact overall practices. Furthermore, the analysis of findings from these descriptions allows extending the considerations to the theoretical constructs.

9.4. Future Work

9.4.1. Study of Workaround Issues

As a side project stemming from my thesis research, I have started exploring workaround issues from doctors, nurses, and pharmacists' perspectives. Workaround issues have been gaining attention in medical informatics due to the increasing adoption of the CPOE (Koppel et al., 2005; Campbell et al., 2005; Weir et al., 2007). A workaround develops when a new system is not designed in a way that can accommodate important user needs and, in fact, clinicians are masters of creating workarounds (Morath et al., 2005). While workarounds are necessary in certain situations to get the work done, they can also too casually bypass patient safety blocks leading to adverse events. By identifying and understanding the meaning of each workaround created by clinicians in different situations, research on this topic will contribute insights into medical work/process changes resulting from information technology intervention. More importantly, this research will have design implications for better medical systems,

theoretical development on workaround behaviors of individuals, and theoretical implications for how workarounds relate to group and institutional practices.

9.4.2. Study of Chronic Pain Information Use in Medical systems

According to the U.S. Substance Abuse and Mental Health Service Administration website, 9% of the U.S. population aged 12 or older, or 22.3 million people, were classified with substance dependence or abuse in 2007³⁰. In addition, based on my field observations, doctors estimate 40%-50% of the patients who visit the hospital report pain issues in their chronic illness from mild, moderate, to severe degrees, and this number is increasing. Doctors reported that they spent more time investigating psychosocial issues about these patients than thinking about medical diagnosis and treatment. Pain is one of the most common symptoms for chronically ill patients, caused by, or contributing to, serious psychosocial problems in their lives. There are no standard terms or classification scheme to describe the symptoms precisely. Overusing pain medication for patients at early stages can lead to unintended controlled substance dependence or abuse later. Building on the understanding of my thesis work, I am interested in exploring, both qualitatively and quantitatively, whether there is a better way to classify and document pain issues in medical practice and how improved understanding of chronic pain, documentation, and dissemination can help address this issue better for chronic pain patients before doctors can truly provide appropriate diagnosis and treatment.

³⁰ <http://www.oas.samhsa.gov>

9.4.3. Study of Healthcare Information Use from Patients' Perspective

During the exploration period of my thesis proposal, I was very interested in the topic of how patients manage their health records over their lifespan. In recent years, there is an increasing need for commercial software that helps consumers manage this information.

Personal Healthcare Records (PHR) are “an electronic repository in which a person can store his or her health-related information securely and privately, and also share that information with multiple health care providers or others at the patient’s discretion.”³¹ PHR applications are a hub, a central health data repository controlled by a patient and collectively contributed to by multiple healthcare providers. There are hundreds of PHR products now available on the market. It is believed that PHRs may offer unprecedented opportunities for patients and their care providers to manage chronic diseases collaboratively. Although promising, PHRs have many open social and technical issues to explore. These include, for example, whether healthcare organizations can access information in a patient’s PHR without their knowledge; how to incorporate patients’ experience and home-sensored treatment data into clinical encounters; whether PHRs fundamentally change the patient-clinician relationship because of the free exchange of information; and what incentives can encourage a physician to prepare patient data for other healthcare providers. Studies suggest that consumers express a clear preference for PHRs whereas physicians seem less likely to cooperate. Without physicians’ support, PHRs will not be successful because doctors are the major information contributors.

³¹ Perspectives on the Future of Personal Health Records, p2, , California Healthcare Foundation

This is a rich research topic. I am interested in investigating consumers' use of PHRs and the information exchange between EHRs and PHRs. In addition, I may also extend my doctoral thesis project by examining potential documentation behavior changes when physicians realize they are writing for patients (instead of writing mainly for their colleagues).

9.5. Concluding Remarks

The longer I stay in the field, the more questions I have and I want to explore further. Understanding medical work, information objects, practices, work arrangements, work processes, and social agreements about how things should be done is such a rich range of topics that I have developed a genuine professional passion for, after spending numerous days and nights over last two years with the clinicians in the hospital.

My thesis is only the beginning of my research journey in this field, but it is an important step. I hope that I will continue to contribute a better understanding of medical information use to both medical informatics and information science.

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