MAPPING THE GENRES OF HEALTHCARE INFORMATION WORK: AN INTERDISCIPLINARY STUDY OF THE INTERACTIONS BETWEEN ORAL, PAPER, AND ELECTRONIC FORMS OF COMMUNICATION

by

Lara Varpio

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Doctor of Philosophy
in
English

Waterloo, Ontario, Canada, 2006

AUTHOR'S DECLARATION FOR ELECTRONIC SUBMISSION OF A THESIS

I hereby declare that I am sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

Electronic Patient Records (EPRs) are becoming standard tools in healthcare, lauded for improving patient access and outcomes. However, the healthcare professionals who work with, around, and despite these technologies in their daily practices often regard EPRs as troublesome. In order to investigate how EPRs can prompt such opposing opinions, this project examines the EPR as a collection of communication genres set in complex contexts. In this project, I investigate an EPR as it was used on the Nephrology ward at a large, Canadian, urban, paediatric teaching hospital. In this setting, this study investigates EPR-use in relation to the following aspects of context: (a) the visual rhetoric of the EPR's user-interface design; (b) the varied social contexts in which the EPR was used, including a diversity of professional collaborators who had varying levels of professional experience; (c) the span of social actions involved in EPR use; and (d) the other genres used in coordination with the EPR.

This qualitative study was conducted in two simultaneous stages, over the course of 8 months. Stage one consisted of a visual rhetorical analysis of a set of genres (including the EPR) employed by participants during a specific work activity. Stage two involved an elaborated, qualitative case study consisting of non-participant observations and semi-structured interviews. Stage two used a constructivist grounded theory methodology. A combination of theoretical perspectives – Visual Rhetoric, Rhetorical Genre Studies, Activity Theory, and Actor-Network Theory – supported the analysis of study data. This research reveals that participants routinely transformed EPR-based information into paper documents when the EPR's visual designs did not support the professional goals and activities of the participants.

Results indicate that healthcare professionals work around EPR-based patient information when that genre's visual organization is incompatible with professional activities. This study suggests that visual rhetorical analysis, complemented with observation and interview data, can provide useful insights into a genre's social actions. This research also examines the effects of such EPR-to-paper genre transformations. Although at one level of analysis, the EPR-to-paper-genre transformation may be considered inefficient for participants and so should be automated, at another level of analysis, the same transformation activity can be seen as beneficially supporting the detailed reviewing of patient information by healthcare professionals.

To account for this function in the transformation dysfunction, my research suggests that many contextual factors need to be considered during data analysis in order to construct a sufficiently nuanced understanding of a genre's social actions. To accomplish such an analysis, I develop a five-step approach to data analysis called 'context mapping.' Context mapping examines genres in relation to the varied social contexts in which they are used, the span of social actions in which they are involved, and a range of genres with which they are coordinated. To conduct this analysis, context mapping relies heavily on theories of "genre ecologies" (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000) and "Knotworking" (Engeström, Engeström & Vähäaho, 1999). Context mapping's first three steps compile study data into results that accommodate a wide range of contextual analysis considerations. These three steps involve the use of a composite scenario of observation data, genre ecologies and the description of a starting point for analysis. The final two

steps of this approach analyse results using the theory of Knotworking and investigate some of the implications of the patterns of genre use on the ward.

Through context mapping analysis, this study demonstrates that EPR-based innovations created by a study participant could result in the generation of other improvisations, in a range of genres, by the original participant and/or by other collaborators. These genre modifications had ramifications across multiple social contexts and involved a wide range of genres and associated social actions. Context mapping analysis demonstrates how the effects of participant-made EPR-based variations can be considered as having both beneficial and detrimental effects in the research site depending on the social perspective adopted. Contributions from this work are directed towards the fields of Rhetorical Genre Studies, Activity Theory research, and Health Informatics research, as well as to the research site itself. This study demonstrates that context mapping can support text-in-context style research in complex settings as a means for evaluating the effects of genre uses.

ACKNOWLEDGEMENTS

First and foremost, I gratefully acknowledge the supervision support that I received from Dr. Catherine F. Schryer and Dr. Lorelei Lingard. I owe considerable thanks to Dr. Schryer, my primary supervisor. Dr. Schryer shaped and sharpened my theoretical views, taught me to trust in the methods of data collection and analysis, encouraged me to find 'my own voice' for reporting this study, and vetted this dissertation with constructive critical insights. Also, I am grateful especially to my second supervisor, Dr. Lingard. Dr. Lingard taught me how to construct a qualitative research project, introduced me to the Medical Education community, and mentored me through many 'foreign' situations ranging from visiting potential hospital research sites, to writing hospital ethics review proposals, to conducting observations on the ward and in the operating room. These are, of course, just some of the countless ways in which these two researchers supported my work. I consider myself lucky not only to have had the opportunity to work with both Cathy and Lorelei, but also to have moved gradually from supervisors and supervised, to colleagues and friends.

I also acknowledge the significant support that I received as a Research Fellow at the Wilson Centre for Research in Education (WCRE) at the University of Toronto's Faculty of Medicine. The WCRE was my daily workplace for the majority of this study. The research scientists, staff, and research fellows at the WCRE created a supportive and highly stimulating environment in which to work. I especially want to acknowledge the mentoring support I received from Dr. Glenn Regehr. I owe a great deal to his dedication in supporting the success of this research project and myself as a researcher. I can't thank Glenn enough for our early morning conversations and for making me feel at home both at the WCRE and in the field of Medical Education.

Health Care, Technology and Place (HCTP) [a strategic research and training initiative supported through a Strategic Alliance with the Change Foundation and the Canadian Institutes of Health Research (CIHR)] at the University of Toronto was another research centre where I received considerable support as a PhD Fellow. At HCTP, I was part of a multidisciplinary group of researchers. Through seminars, workshops, and courses, I was able to develop this research project further by investigating the many different ways that other fields of research could inform my work. I want to thank particularly Dr. Pascale Lehoux who was an HCTP Mentor on my project. Pascale's insightful comments have helped me to create a more thoughtful and multidisciplinary project.

I also wish to extend my thanks to Dr. David Goodwin and Dr. Dominic Covvey, both at the University of Waterloo. Dr. Goodwin, my third supervisor, was patient when drafts were long in coming, was quick to reply with comments on my work, and was generous with his support. Dr. Covvey, and the Waterloo Institute for Health Informatics Research (WIHIR), helped me to better understand the field of Health Informatics and encouraged me to participate in the community.

Next, I sincerely thank the invaluable support of the study participants and the members of the Health Informatics Department and Health Records Department at the research site. Without them, this project could not have come into being.

During this research project I have received generous financial support from the Ontario Graduate Scholarship program (in the form of scholarships), HCTP (in the form of scholarships and travel support), the WCRE (in the form of travel support), and the University of Waterloo (in the form of awards and travel support).

Additionally, I wish to acknowledge the support I have received privately. I thank Asia Nelson, Erin Foster-O'Riordan, and Mary and Brent Kahara for being great friends, sounding boards, and cheerleaders. I also thank my 'Grammar Committee' of Alice-Mae, Peter, and Michael Varpio for their meticulous attention to detail, their steadfast support, and the many hours of long-distance calls.

Finally, I thank my husband Johan for his love, patience, and unwavering dedication to encouraging me through every stage of this challenge. From Sweden to Stanford, you keep expanding my horizons. I too am looking forward to our next adventure.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ANT	Actor-Network Theory
AT	Activity Theory
EHR	Electronic Health Record
EPR	Electronic Patient Record
HI	Health Informatics
ICT	Information and Communication Technology
REB	Research Ethics Board
RGS	Rhetorical Genre Studies
SLL	Dr. Catherine F. Schryer, Dr. Lorelei Lingard, Dr. Pascale Lehoux
SPR	Scientific Peer Review
VR	Visual Rhetoric
WCRE	Wilson Centre for Research in Education

CHAPTER 1: INTRODUCTION

Nurse A goes to a computer terminal and accesses the EPR to make a data entry. Nurse A has difficulty finding the right EPR screen for this data input. Nurse A states:

> *"I wish I could sit down and request what I actually needed. That would be fantastic."*

Nurse A wants to change feeding tube information for a patient but can not find the screen for that data input. She locates a free-type data entry field and enters the feeding tube information there. Nurse A then repeats similar feeding tube free-type entries several times. Each additional entry has different specified times and dates. With these multiple free-type entries, Nurse A is creating a schedule of future care activities for the patient. The observer asks why she is making the multiple entries. Nurse A replies:

> *"I have a lot of orders in here but I want it to be blatantly obvious so the nurses don't get confused."* (Observation #1117)

Staff A is on the phone with an off-ward service, orally requesting an order to be completed. The conversation repeatedly comes back to the fact that the request is being made verbally, and not via the hospital's EPR. Staff A, still on the phone with the service, says:

> *"If you're waiting for me to get on [the EPR], you'll be waiting a long time."* (Observation # 1117)

1.1 Background

These two excerpts, taken from this study's observation data, illustrate the negotiations healthcare professionals regularly conducted to complete their daily work activities through, despite, and around an Electronic Patient Record (EPR) system. These examples demonstrate that the EPR often failed to meet the particular needs of healthcare professionals using the system. However, despite such instances of practical problems, EPRs have been lauded as "one of the keys to modernizing Canada's health system and improving access and outcomes for Canadians" (Romanow, 2002, p. 77). This disjunction between professionals' practical difficulties with EPRs and reported advantages presented by EPR-use was the starting point for my research project.

I learned of this disjoint and of EPRs in general while studying as a Research Fellow at the Wilson Centre for Research in Education (WCRE), at the University of Toronto Faculty of Medicine. While at the Centre, I learned of the problems and promises associated with EPR-use in the context of a large, urban, paediatric teaching hospital. This hospital had introduced an EPR into its daily record keeping practices over 15 years ago. Since then, the hospital has been transitioning from a fully paper-based record keeping system to one that included an EPR. This EPR did not replace all the functions previously completed via paper communications, nor was it adopted entirely by all sectors of the institution. Thus, a mixture of recordings and communications emerged that consisted of paper documents, oral conversations, and the EPR.

During my initial site visits, I was surprised to learn that the majority of the hospital's healthcare professionals strongly disliked the EPR and struggled to work with the system. However, once I saw the EPR's visual design, I immediately suspected that a rhetorical analysis of the system's visual interface could begin to explain the users' difficulties. The EPR employed a visually dense text-line interface that, as Nurse A indicates in the opening excerpt, required creative user interventions to convey clear information to colleagues. I was confident that a study based in the theories and methodologies of Visual Rhetoric (VR) and Rhetorical Genre Studies (RGS) would provide valuable insights. Such insights would be timely contributions for this hospital since, despite the negative professional reports, the hospital was in the process of purchasing and implementing an upgraded EPR. I was intrigued by this apparent contradiction and was interested in investigating EPR-use at this site. I hoped to gain insights into why this EPR was a catalyst for such incongruous opinions.

Through continued site visits and inquiries with key informants, I was fortunate to find several departments within the hospital that were supportive of my research. First, the Health Records Department assisted my research by locating historic patient charts and by approving my anonymization of them so I could use these documents as exemplars in my study. Second, the Health Informatics Department trained me in the use of the EPR and volunteered technical support time to create anonymous patients within the EPR for use in my project. Finally, the healthcare professionals working in the Nephrology Department (including physicians, nurses, dieticians, physiotherapists, and social workers) consented to act as study participants, thus allowing me to conduct my research on that ward. I am deeply indebted to these three departments and their staffs since their support facilitated my research greatly.

When this study was designed in May 2004, the hospital was preparing to introduce a new EPR into practice. I originally designed a four phase study to investigate the effects of this changeover. Phase one involved the visual analysis of the many genres that would be used on the ward during the course of the study. Phases two, three and four consisted of a series of three elaborated, qualitative case studies (Stake, 1995) that would illuminate the pre-, during- and post-EPR changeover. However, although the transition to the upgraded EPR was scheduled for November 2004, the transition did not begin until February 2006 due to unforeseeable delays. As a result, my project was limited to the first two phases of the original project plan: 1) the visual analysis of patient information genres; and 2) the pre-change case study. The case study involved non-participant observations (Bogdewie, 1999) and semi-structured interviews (Britten, 1995) with a range of healthcare professionals in the research setting.

1.2 Two Definitions: Information Work and Electronic Patient Records

Two definitions must preface my study. The first establishes the scope of healthcare work that is addressed in this research. The second defines a central distinction in this study.

1.2.1 Information Work

During initial research site investigations, I realized that, while patient care work required physically interacting with the patient (for example by taking vital signs), a core part of healthcare professionals' patient care activities entailed working away from the patient. This fundamental piece of patient care involved working with information about the patient. This information work included, but was not limited to: 1) collecting, organizing, reviewing, and thinking through patient data; 2) soliciting consultations from other healthcare professionals, receiving that consult information and discussing the patient with other healthcare professionals; 3) making care decisions; 4) placing care, test and/or medication orders; and 5) reporting patient developments to other healthcare professionals.

Information work involved both patient-based data (such as information about symptom development) and/or healthcare provider-based data (including, for example, medication orders coming from the physician, or nursing care information about patients transferred from another ward). These data existed, often simultaneously, in several different genres of various modalities. These genres and their modalities included, but were not limited to: EPR documents (some of which were available for printout), electronic laboratory result documentation (some of which could be printed out), the hospital's paper-based historic patient record, the ward's paper-based patient record, bed-side patient information paper-based documents, healthcare professionals' personal paper-based notes for daily care planning and activity scheduling, scrap paper-based notes and oral communications carried out in person or over the phone. In conducting their daily information work, individual healthcare professionals worked by creating, referring to or otherwise engaging with these genres in a variety of ways. It is this multi-modal and multi-genre information work that I address with this study. In fact, although the EPR was the original and primary focus of this project, my research perspective evolved over the course of my investigations to encompass the entire collection of genres involved in ward information work.

1.2.2 Electronic Patient Records

The healthcare professionals at this site work with an Electronic *Patient* Record. The emphasis on 'patient' highlights an important distinction since, within the field of Health Informatics (HI), notable differences exist between conceptions of Electronic *Patient* Records and of Electronic *Health* Records. Berg (2004) defines an Electronic *Patient* Record as follows:

> The EPR is primarily a database containing patients' information. Through its *retrieval* functions it should allow the health professional easy access to stored patient information. Through its *input* functions, it should allow adequate and easy storage of patient information. (p. 7)

Assumed in this description is the extent of an EPR's availability and its content. In general, access to EPR data is limited to hospital staff. Although information usually can be retrieved through any EPR-supported terminal in the hospital or via remote log in for authorised hospital staff, EPR information is not accessible to individuals without

hospital affiliation. Similarly, the data content of an EPR is restricted to the recording of patient care at a particular hospital.

In contrast to the EPR, Romanow (2002) defines the Electronic *Health* Record (EHR) as a collection of an individual's personal health information that is available for, and that records the activities of, any authorised healthcare provider, regardless of specific hospital affiliation. As Romanow explains, in the EHR, patient data are entered "every time they [patients] visit their physician, have a prescription filled, have a lab test, or go to the hospital" (p. 77). In short, the EHR "provides a systematic, historic record of every interaction a person has with the health care system" (Romanow, p. 77).

Comparing these records, Covvey (2006) notes that an important distinction exists between an EPR and an EHR. As Covvey explains, the EHR is "a comprehensive, patient-specific longitudinal record of all health-related information over a person's life, accessible at all points of care" and is, therefore, a document that extends from "womb to tomb" (slide 9). In contrast, the EPR, a hospital specific record, compiles only the care activities conducted and the patient information collected at a specific healthcare institution. The record used at this study's research setting is an EPR and thus only documents patient care activities and patient data collected at this hospital.

1.3 EPR Research: Literature Review

Existing research suggests that EPRs are rapidly replacing paper as mechanisms for integrating and distributing patient information among healthcare team members. Ball and Collen (1992) and Dick and Steen (1991) indicate that the use of EPR technology for pooling and sharing patient information is facilitating communication in healthcare. However, other recent research has found that EPRs have problematic effects on the day-to-day organization and execution of medical work (Sicotte, Denis, Lehoux & Champagne, 1998), on the collection of patient data (Patel, Arocha & Kushniruk, 2002), on physicians' reasoning (Patel, Kushniruk, Yang & Yale, 2000) and on physicians' decision making strategies (Kushniruk, 2001). Despite the wealth of research published on EPRs, searches of the HI and Information and Communication Technologies (ICTs) literatures reveal that research has largely ignored investigating the disjoint between perceived advantages and disadvantages of EPR-use in relation to the complex contexts of: 1) the EPR's interface designs; and 2) the multifaceted settings in which the EPR is used.

This disjoint between perceived benefits and disruptions associated with EPR-use may be related to user-interface designs. EPR studies tend to ignore differences in user-interface designs and thus implicitly assume that the visual design context of individual EPR's is not a significant contributor to the benefits and difficulties associated with EPR-use. In contrast, VR scholars generally acknowledge that specific visual design structures are meaning making constructs that influence the interpretation and use of information (Cooper, 1995; Kostelnick, 1994; Kress & van Leeuwen, 1996; Rosner, 2001; Tufte, 1990). A user's perception of an EPR's effectiveness could, by extension, be influenced by the EPR's visual designs. When HI and ICT studies address EPR user-interface design, these investigations tend to research issues of usability (Kushniruk, Patel & Cimino, 1997; Rodrigues, Murillo, Borges, Ortiz & Sands, 2002; Rose, Schnipper, Part,

Poon, Li & Middleton, 2005), of user-centered design (Johnson, Johnson & Zhang, 2005) and of human-factors engineering (Beuscart-Zephir, Anceaux, Crinquette & Renard, 2001). These investigations tend not to address issues associated with visually constructed rhetorical messages. My literature searches found no study that uses the theories and methodologies of VR to analyse EPR user-interfaces. An investigation into the visual designs of EPR user-interfaces, using the theories of VR, may enable a better understanding of the contradiction between the perceived advantages and disadvantages associated with the use of a specific EPR.

The second aspect of EPR-use that the current body of literature does not address is the broad range of contexts within which these systems function. Such considerations could encompass the social contexts in which these systems are used, the social actions that the EPRs enact, and the other genres that are used in conjunction with EPRs. HI and ICT based EPR studies tend to focus on a limited range of social contexts, investigating, for instance, the impact of EPR-use on the work of specific healthcare professionals such as individual physicians (Patel et al., 2002; Poissant, Pereira, Tamblyn & Kawasumi, 2005), or anaesthesiologists (Beuscart-Zephir et al., 2001). Current research has also limited the scope of context to the culture of communities restricted in size, such as small family medicine clinics (Crosson, Stroebel, Scott, Stello & Crabtree, 2005). Additionally, recent research generally restricts EPR-use analysis to a limited range of social actions completed by professionals, such as physician order-entry (Bates et al., 1998), medical record maintenance strategies used by microbiologists (Heard, Roberts, Furrows, Kelsey & Southgate, 2003), or pre-operative anaesthetic consultation (Beuscart-Zephir et al., 2001). Furthermore, the current body of research tends to focus on the EPR to the exclusion of all other genres of information utilized by healthcare professionals. Although other forms of communication may be employed in coordination with the EPR, these other documents and/or conversations often are not included in the factors potentially impacting on EPR-use.

In my literature searches, I was unable to find research that addressed the use of EPRs in relation to a wide range of social contexts, social actions, and other genres. In fact, research has not examined EPR-use in relation to the combined contextual considerations of: 1) varied social contexts, such as both physician and nurse users ranging in experience from novice to senior; 2) a span of social actions, ranging, for instance, from local tasks (such as medication order entry and delivery) to larger social activities (such as the promotion of patient safety or inter-professional communication); and 3) other genres of communication and information sharing used in coordination with the EPR. A study involving such a wide range of contextual considerations could begin to uncover some of the reasons behind contradictory findings around EPR-use.

1.4 Building an RGS Research Approach to EPR Research

This project considers a genre's context through a detailed and comprehensive approach to analysing an EPR's visual designs, its social context, its social actions, and the other genres used in collaboration with the EPR. To take into account these varied and complex considerations, my study relies on a RGS perspective and thus emphasizes EPRs as genres of communication that can be analysed using humanities derived theories.

With this study, I suggest that RGS research could provide valuable insights into genres through the careful examination of a genre's context. It may seem that this research would be oriented more appropriately as a social science rather than a humanities based study. However, my research highlights the communication work of genres in social contexts. I study how genres are at work in complex contextual settings and so investigate in depth text-in-context communications. To investigate social contexts critically, I do rely on concepts from social science theories such as Activity Theory (AT) and Actor-Network Theory (ANT). However, I bring these theories to this study in order to elaborate my humanities-directed research findings.

RGS research has a tradition of investigating a text's contexts since the field recognizes these contexts as "dynamic environments that simultaneously structure and are structured by the communicative practices of social agents" (Schryer & Spoel, 2005, p. 253). While the field of RGS generally accepts considerations of a genre's context as an important focus in research, these contextual considerations have been somewhat limited in scope in RGS applications. Spinuzzi's research (2003b) confirms that RGS studies have addressed a range of contextual aspects for a wide range of genres, but that these studies have focused their investigations at different levels of contextual scope to the exclusion of other levels. Spinuzzi calls for an integration of these different levels in RGS research, arguing that they are reconcilable and, in fact, "are ultimately intertwined" (2003b, p. 36). It is such an integrated and broad scope consideration of context that I hope to bring to my study.

In addition to integrating these levels of RGS research focus, my research also takes into consideration the other genres that healthcare professionals use in coordination with the EPR. Here my work follows closely that outlined by Spinuzzi in his "genre tracing" methodology (2003b). Spinuzzi's genre tracing draws on the methods of RGS and AT to study "users' experiences with official and unofficial genres and to compare them across communities and workplaces" (2003b, p. 22). In this methodology, Spinuzzi calls for RGS research to complement scope integration by examining the many genres that cooperatively mediate work in research settings. Through the concept of "compound mediation" (2003b, p. 47), Spinuzzi incorporates an appreciation for the ways in which genres are densely coordinated in genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000). Similarly, I, too, use genre ecologies to avoid looking at EPRs in isolation from other communication and information sharing genres used in information work. In this manner, I avoid assuming that the EPR is the "linchpin" (Spinuzzi, 2003b, p. 119) genre in this work setting.

While I agree with the theoretical underpinnings of Spinuzzi's genre tracing methodology (2003b), I do not employ this methodology in my study. Although I did attempt to apply this methodology in my research, I was unable to make use of it successfully due to the nature of the information work carried out by healthcare professionals in my research site. Ward information work is intensely collaborative. In this work, many collaborators, including several individuals from each of a variety of different professions, work together with a wide range of genres in order to accomplish joint work tasks. Spinuzzi's genre tracing does not support the analysis of such interprofessional collaborative work efforts. Through the genre tracing methodology, Spinuzzi studies work situations where different individuals and agencies use an electronic information database to transform data "in vastly different ways and for

different purposes as they labor in their discrete activities" (2003b, p. 72). These are instances of discrete agencies making use of the same electronic information system, in vastly different ways, for dissimilar purposes, to accomplish disconnected activities. Since ward information work involves interprofessional collaborative work on shared work activities, it is not surprising that I was unable to apply successfully genre tracing methodology to my study data. Therefore, although I owe a considerable debt to Spinuzzi for pushing my thinking about RGS theory and methodologies, his genre tracing methodology was not appropriate for my study site context.

To summarise, in this research, I investigate EPR-use at the research site in relation to the following aspects of context: 1) the visual rhetoric of the user-interface design; 2) the varied social contexts in which the EPR is used, including a range of professional collaborators (such as physicians and nurses) and of professional experience (from novice to senior staff); 3) the span of social actions involved in EPR-use; and 4) the other genres used in conjunction and coordination with the EPR. To accomplish this investigation, I conducted a study with two stages of analysis. In the first stage, I focused my analysis on the visual rhetorical analysis of the EPR interface. To attend to the remaining contextual considerations, in the second stage of the study, I developed a five-step approach for constructing a complex contextually informed understanding of the collaborative and multi-professional ward information work practices. Through both stages of analysis, I provide constructive feedback to the research site hospital and contribute to theory development in the field of RGS. In addition, findings from my research contribute to the research fields of AT, Medical Education, and HI.

1.5 Research Questions and Study Design Evolutions

As outlined above, this study seeks to take RGS's interest in a genre's context seriously. My decision to develop an in-depth approach to context arose out of findings from the study's first stage of analysis. In this first stage, I asked the following research question:

> How does the visual rhetorical design of the EPR user-interface and of the other genres used in ward information work influence the communication practices of healthcare professionals?

While working on this analysis and presenting findings to various healthcare audiences, I learned that the scope of my research needed to be widened. This first stage of analysis took into consideration the context of a genre's visual design, a set of the other genres used on the ward and reports from individual study participants. However, my work did not consider the role of communicative tasks within the larger scope of all work activities completed on the ward and of each profession's goals and ideologies. As a result, while my findings could explain problems associated with EPR-use at one level of scope, they did not explain how those same findings were considered beneficial at other levels. In order to account for the dissonance between benefits and problems associated with EPR-use, my research needed to open the scope of genre context analysis to include a larger span of social contexts, social actions, and concurrently used genres. Therefore, I needed to develop a broader research question and an analytical approach that would support a wider scope of scrutiny.

Consequently, to accomplish the goal of a larger context focus, I developed the following research questions:

1. What is the relationship between EPRs and the other genres used by professionals to complete information work in this multimodal and interprofessional collaborative healthcare setting?
2. What social actions are involved in the use of these genres?

In answering these questions in the second stage of this study's analysis, I acquired a better understanding of ward information work across an assortment of genres, social contexts, and social actions. This in-depth understanding informed my analysis of the beneficial and problematic ramifications of EPR-use. To answer these questions, I assembled a five-step analytical approach for investigating the concept of context in RGS research. This approach, that I called 'context mapping,' drew on analytical resources from RGS and AT to present the features of information work as it was carried out through multiple social contexts and genres, to realize a variety of social actions. Through context mapping I charted the relationships involved in ward information work between individual healthcare workers, the genres they engage with, the activities they endeavour to realize, and the wide range of social contexts informing those activities.

1.6 Study Findings

The study's first stage of analysis found that VR analysis of a genre's visual designs can inform usefully the understanding of a genre's social actions when complemented with observation and interview data. Since VR analysis of a genre's visual components has received little critical attention, these findings provide important contributions to the field of RGS inquiry. More research into the rhetorical functions of a genres' visual and non-linguistic representations promises to provide exciting and constructive insights into a genre's social actions.

This visual analysis also revealed that RGS research needs to consider multiple features of a genre's social contexts, social actions, and genre ecology context in order to provide a sufficiently nuanced understanding of the social actions of a particular genre. A generous perspective was needed in order to fully account for this complexity, a perspective that provided a "thick description" (Geertz, as quoted in Sarangi & Roberts, 1999, p. 1) of social contexts, of social actions, and of the many genres involved in ward information work. Therefore, the second stage of my study resulted in the development of context mapping, a five-step approach for in-depth consideration of a breadth of contexts in RGS investigations. Context mapping articulates one possible approach for broad scope RGS research, describing how to conceptualize a range of social contexts and actions, and how to analyse multiple genres across this span. This approach may have potential for application to future text-in-context style research of complex social settings where interprofessional collaborative teams work together on shared activities.

1.7 Dissertation Outline

This introductory chapter presents the disjoint between the advantages and disadvantages associated with EPR-use. It also outlines recent findings in EPR research, including a gap in that literature which, if addressed, may clarify the reason for this disjoint. This chapter also explains how an RGS-based study can contribute usefully to addressing this gap. This chapter details how this study builds on current RGS research and methodology, and it describes the evolution of the study's research questions and project design. Finally, this chapter provides definitions of terms that inform this study. Chapter 2 presents the theoretical constructs and bodies of research literature that theoretically frame this project. Thus, chapter 2 presents a literature review of RGS, of VR, and of Knotworking theory (Engeström, Engeström & Vähäaho, 1999), a recent theory development in the field of AT. Additionally, this literature review briefly describes ANT and the concepts of heterogeneous networks (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992), actants (Callon, 1991; Latour, 1988, 1991, 1999, 2005; Law, 1992), and punctualisation (Law, 1992) since these theoretical constructs inform some of the study's conclusions. Chapter 3 describes the methods used to support this research work. Chapter 4 presents the results and findings of the visual analysis stage of the study and describes how this research was a stepping stone towards the development of context mapping, an approach to context analysis that is extensive in its scope of considerations. Chapter 5 presents the results and findings of this context mapping analysis. Finally, this dissertation ends in chapter 6 with a statement addressing the project's limitations and with the conclusions drawn from this study.

CHAPTER 2: LITERATURE REVIEW

As described in chapter 1, this study investigates a wide range of contexts informing ward information work, including healthcare professionals' use of the hospital's EPR. To conduct this analysis, my study rests on the theories and methods of several different fields. First, I rely on RGS and its conception of a genre as a social action within a specific context. Therefore, I begin this review of literature with a brief historical overview of the development of RGS, including Miller's (1984) definition of a genre as a social action as well as the associated conception of a genre's social context. I then describe a current trend in RGS research that investigates healthcare communications.

Next, this review presents the theoretical underpinnings supporting the first stage of analysis in this study. This analysis investigates the rhetorical work done by visual, non-linguistic elements in text-based genres. The visual design aspect of a genre's context has gone largely ignored in the field of RGS research. Accordingly, I begin this portion of the literature review by articulating this gap in current RGS studies. I then present an overview of the field of VR since it is a potential means of redressing the gap. Next, I detail the theories of Kress and van Leeuwen (1996), whose grammar of visual design I employ in the study's first stage of analysis, giving particular attention to the concepts of Analytical Processes, and the Given/New, Ideal/Real, Salience and Framing compositional structures.

Through activities associated with my visual analysis work, I learned that my research had to examine more thoroughly the complexities of the contexts in which the genres of information work were used. To expand the range of contextual considerations informing my analysis, I turn to RGS's concept of genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000), to AT's theory of Knotworking (Engeström, Engeström & Vähäaho, 1999), and to ANT's concepts of patterned heterogeneous networks of materials (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992), of actors and actants (Callon, 1991; Latour, 1988, 1991, 1999, 2005; Law, 1992), and of punctualisation (Law, 1992).

To support the expansion of contextual considerations, I first examine recent RGS investigations into how individual genres exist in relation to an assortment of other genres. Such collections of genres, called "genre sets" (Devitt, 1991), "systems of genres" (Bazerman, 1994), or "genre ecologies" (Spinuzzi, 2003a, 2003b; Spinuzzi et al., 2004; Spinuzzi & Zachry, 2000) by RGS researchers, have been studied as working together in social settings to mediate an array of social actions. In my research, I include the group of interrelated genres used in ward information work in my contextual considerations by relying on the concept of genre ecologies. Thus, in this literature review, I present the development of genre ecologies by tracing its roots through genres sets and systems of genres. From this historically informed perspective, I describe how the concept of genre ecologies can grow in new directions.

Another current trend in RGS research is to complement analysis of genres with concepts from the field of AT. I integrate AT research, more specifically AT's theory of Knotworking (Engeström et al., 1999, p. 345), as a means of incorporating a theoretically informed analysis of the social context of ward information work into my study. Knotworking investigates professional work situations that involve continually changing teams of professionals who, together with numerous artefacts, complete work activities

over lengthy periods of time. Since ward information work is such a work situation, Knotworking analysis contributes another layer of meaningful input to the analysis of my study data. In this review, I first provide an overview of the historical development of the field of AT and then describe the recent growth of Knotworking theory.

Finally, I end this review with a brief introduction to ANT. Although I do not rely on this theory in the construction of either stage of this study, ANT research and theoretical constructs enrich the descriptions of my dissertation findings. Specifically, ANT's concepts of patterned heterogeneous networks of elements (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992), of actors and actants (Callon, 1991; Latour, 1988, 1991, 1999, 2005; Law, 1992), and of punctualisation (Law, 1992) can be usefully combined with aspects of both genre ecologies and Knotworking theory to build insights into the study data. Therefore, I end this literature review with a synopsis of these ANT concepts in order to frame the discussions that will appear in the concluding chapter.

2.1 A Brief History of RGS

Research in the field of RGS regularly inquires into the role that social context plays in a genre's[1] capacity to denote meaning. Miller's work (1984) was seminal in establishing this common line of inquiry by recognizing genres as socially situated actions. In this way, the RGS field directed the focus of genre analysis towards linking "linguistic and substantive similarities to regularities in human spheres of activity" (Freedman & Medway, 1994, p. 1). With Miller's re-framing of genre as social action, the activity of creating a genre was recognized as intrinsically tied to "socio-rhetorical situations" (Reither, 1985, p. 621). Genres were acknowledged as "types of communicative actions used by organizational members for particular communicative and collaborative purposes" (Yates & Orlikowski, 2002, p. 14). Consequently, RGS researchers began to examine individual genres as responses to the social contexts in which the genres were actively written and received. For example, Bazerman's analysis of scientific discourse (1988) exposes the regularized practices involved in its creation and, consequently, the production and reception regimes that provide writers with strategies for communicating within their fields of practice. In addition, Schryer's research is focused on specific genres within a variety of social contexts including insurance companies (2000, 2002), schools of veterinary medicine (1993, 1994), medicine (Lingard, Garwood, Schryer & Spafford, 2003; Lingard, Schryer, Garwood & Spafford, 2003; Schryer, Lingard & Spafford, 2005; Schryer, Lingard, Spafford & Garwood, 2003), optometry (Spafford,

[1] While researchers in the RGS field generally share a common conception of the term 'genre,' studies are often prefaced with a definition that the researcher will use. In order to keep with this tradition, I present the following definition of the term 'genre,' taken from Paré and Smart (1994), to ground the work of my research. In this dissertation, a genre will be defined as "a distinctive profile of regularities across four dimensions: a set of texts, the composing process involved in creating these texts, the reading practices used to interpret them and the social roles performed by writers and readers" (p. 147). This definition encompasses a broad range of communication tools as 'genres' available for RGS analysis and for inclusion in a genre ecology. Thus, in this research project, genres will include language-based communications in paper-, computer- and oral-based media that demonstrate the four dimensions of regularities.

Lingard, Schryer & Hrynchak, 2004), and social work (Schryer, Campbell, Spafford & Lingard, forthcoming). Such research within the field of RGS investigates the ways in which the social and the rhetorical relate and impact on one another.

Within the field of RGS research, Schryer's contributions are recognized as particularly significant in furthering the definition of genre (Artemeva, 2004). In her early work, Schryer observes that genres are "stabilized-for-now" or "stabilized enough" sites of social and ideological action (1993, 1994). Some critics argue that this observation inappropriately assumes that a level of stability exists in genre use (Devitt, 2000). However, Schryer's later works (2000, 2002) advance this conception of genre even further. As Artemeva notes, Schryer re-tools the word 'genre,' widening its definition from a noun to include a verb quality:

> we genre our way through social interactions, choosing the correct form in response to each communicative situation we encounter – and we are doing it with varying degrees of mastery. At the same time 'we are genred' (Schryer, 2002, p. 95) all the time; that is, we are socialized into particular situations through genres. (Artemeva, 2004, p. 13)

Such insights into the dynamic nature of genres that both shape and are shaped by their users lead Schryer to the re-conceptualization of genres as "structured structures that structure" (2002, p. 95). In this formulation, Schryer clearly harkens back to Giddens and his theory of structuration (1984). Schryer echoes Giddens's "duality of structure" (1984, p. 374) by acknowledging that just as a genre's structure limits the communicative actions of the rhetor, that same structure also and simultaneously facilitates the rhetor's expressions. The structural resources of a genre thus both "constrain and enable social action" (Schryer, 2000, p. 455).

However, Schryer does not condemn the rhetor to being eternally shaped by and forced to bear the weight of these structures. Instead, she lauds the agency of the individual rhetor to "improvise strategically" (Schryer, 2000, p. 456). Schryer theoretically grounds this ability to improvise in the work of Bourdieu and specifically on his concepts of habitus and of how agents interact with habitus. In his 1990 publication with Passeron, Bourdieu defines habitus as a "system of schemes of…perception, thought, appreciation and action which are durable and transposable" (p. 35). This system of schemes should not be understood as rigid nor as a set of imposed structures. Instead, to borrow, as Schryer does, from Thompson (1991) who quotes Bourdieu, habitus is "a set of *dispositions* which incline agents to act and react in certain ways" (Thompson, 1991, p. 12). Thus, habitus's schemes are dispositions which predispose agents to act and react in predictable ways and so are not absolute impositions that require agent adherence. In this way, "agents are neither totally free nor the mere puppets of objective social laws" (Lane, 2000, p.25). There is room for an agent's individual creativity and agency within the schemes that incline agents towards certain actions and reactions. In keeping with this view of habitus, Schryer expands on her definition of genres, this time explicitly referring to Bourdieu, stating that genres are "constellations of regulated, improvisational strategies triggered by the interaction between individual socialization, or 'habitus' and an organization, or 'field'" (2000, p. 450). Thus, though Schryer recognizes the influential power of the 'structured structures that structure' construction, she simultaneously supports the rhetor's ability to express his/her individual agency through a genre's flexible 'constellations of regulated and

improvisational strategies'. In this way, "even acting recurrently in a recurrent situation, one can express one's individuality" (Artemeva, 2004, p. 11).

Over the past twenty years, the field of RGS has solidified into a research tradition that embraces a genre as a social action with rhetorical functions working in social contexts. Recently, RGS researchers have been applying these theories to conduct research in health communications. Such RGS health communications studies include investigations into: the history of medical communication practices (Connor, 1994; Salager-Meyer, 1994; Tebaux, 1991); the communicative implications of specific documents such as clinical protocols (Bell, Walch & Katz, 2000), policy documents (Berkenkotter, 2001; Lay, 2000; McCarthy, 1991; Spoel & James, 2003), and records (Schryer, 1993); the rhetoric of clinical talk (Dunmire, 2000; Schryer et al., 2003; Segal, 2000), and of patient case presentations (Lingard, Garwood et al., 2003; Lingard, Schryer et al., 2003; Schryer et al, 2005); and clinical writing practices (Dautermann, 1997). However, these investigations do not address the increasingly common use of EPRs in modern healthcare practices, nor do they examine the complex communications and contexts involved in ward information work. As my study demonstrates, EPRs and information work are aspects of health communications that can be addressed usefully through RGS studies.

Although RGS research has conducted numerous investigations into the rhetorical functions of genres, I propose that one aspect of genres has remained relatively unexplored: the rhetorical work of visual or non-linguistic elements used in predominantly text-based genres. In this study's first stage of analysis, I address this lack by incorporating a specific body of work within the field of VR into my RGS based study. In the following review, I describe this gap in RGS research and explain how VR, and specifically the theories of Kress and van Leeuwen (1996), can help to fill this void.

2.2 Gap in RGS: Visual / Non-Linguistic Elements of Genres

My desire to address a genre's visual representations critically is not a call to attend to a genre's form. In "Genre as Social Action", Miller (1984) addresses the 'form' of a genre as the way in which the substance of a genre is comprehended abstractly. She echoes Burkean rhetoric, arguing that one part of a genre's form leads the reader to anticipate another part. In this way, the genre's form shapes the response of the reader to the substance contained therein by providing interpretation cues. Coe (1987) picks up this call to attend to a genre's form by proposing that a genre's form is a shaped emptiness that motivates the writer to fill in the absence. Coe argues that form is "generative because [it is] constraining" (p. 17). For example, Coe describes how the form of the 'five-paragraph essay' stimulates generation in that "the form, *because it has three* **empty** *slots,* motivates students to continue inventing until they have discovered subject matter to fill these three slots" (p. 18). Here, Coe refers to the 'empty slots' as vacant gaps within the abstract form of the five-paragraph essay. With this abstract understanding of form, students learn to fill in each gap according to the "thesis/support form" (Heilker, 1996, p. xix) of this academic genre. In his report of a longitudinal case study, Durst (1984) explains that the format of the five-paragraph essay is "so rigid and formulaic that students were often able to simply 'slot in' points, which took their shape

and plan from the overall structure" (p. 102). These 'empty slots' are not to be understood as visually presented gaps or blank lines, but rather as gaps that exist within the overall abstract form of the five-paragraph essay structure, directing attention to the absence of particular kinds of information. In this way, the form helps to guide the response and attitude of the genre's user. Moreover, a genre's form encourages the adoption of specific values and ideologies. For example, the five-paragraph essay structure "attempts to fix truth in certainty and to declare a definite and singular reality, one that is knowable from a single, immobile point-of-view" (Heilker, 1996, p. 5). In learning this generic form, students learn the epistemology and attitudes maintained by users of this scholarly genre. This abstract conception of the essay's form thereby leaves "its indelible stamp on the thinking and writing of generations of students" (Heilker, 1996, p. 1).

I propose that the idea of an 'empty slot' can be extended to the visual structures that are often part of the recurrent elements of a genre. Several genres frequently include and communicatively rely on regularly recurring visual, non-linguistic structures. These can include such visual representations as the framed shape of boxes on a checklist, the length of the horizontal line in fill-in-the blank records, and the line dividing memo header information from the text. These visual elements are part of the communicative means available to writers and are employed within a social context. They are neither random nor are they devoid of ideological import. Instead, the visual non-linguistic structures used in text-based genres are a part of the physically present form that guides function, part of the heuristic that directs the search for information, and part of the ideological message that constrains against or supports the communication of specific kinds of messages. A genre's visual elements are neither inevitable nor passive; instead, they carry socio-rhetorical meaning.

What is required for my study's visual analysis stage, then, is both evidence of the rhetorical functions of visual designs and a means through which to articulate the messages these non-linguistic representations convey. For these means, I rely on work in the field of VR.

2.3 A Brief Overview of VR

Recently, the field of VR has become the source of considerable research. Over the past ten to fifteen years, this research has given rise to a diverse collection of critical theories and methodologies. One common philosophical underpinning widely maintained by researchers in this field is the awareness that visual structures are rhetorical, that visual images and non-linguistic representations are not external "dress" (Kostelnic, 1994, p. 96) but, rather, are "constructions, powerful fictions" (Rosner, 2001, p. 392) that carry meaning. This field recognizes that visual, non-linguistic structures are not innocent interpretations nor representations of an external, objective reality. Instead, they are "products of the writer's interpretation" (Rosner, 2001, p. 394). The field commonly acknowledges that images make statements, produce meaning (Kress & van Leeuwen, 1996), and convey value-laden messages (Barry, 1997; Rosner, 2001).

The common interest in visual, non-linguistic representations as meaning making structures permits and encourages a variety of research directions in VR. Researchers

have developed several methods for analysing the ways in which visual designs are both ideological (Hodge & Kress, 1993; Kress & van Leeuwen, 1996) and epistemological (Barry, 1997; Cooper, 1995). In addition, numerous VR based studies investigate a wide range of theoretical propositions and design suggestions. For example, several VR theorists focus on developing an understanding of the relationship between cognition, textual language, and visual sensory input (Arnheim, 1969; Barry, 1997; Barthes, 1977; Hodge & Kress, 1993). Other theorists seek to address questions of embodiment, drawing on various theoretical resources to understand better human perception, including visual perception and physicality in relation to human cognition and subjectivity (Hayles, 1999; Johnson, 1987). Still others investigate the utility of metaphor as a visual-rhetorical design framework (Cooper, 1995; Erickson, 1990; Hackos & Redish, 1998; Spinuzzi, 2001). In yet another direction, researchers seek to develop practical, but theoretically grounded, approaches to informing design processes (Kostelnick & Roberts, 1998; Shneiderman, 1998; Tufte, 1990).

It is not within the scope of my dissertation to analyse the EPR's interface from each visual rhetorical perspective. Instead, this study's visual analysis draws on the work of Kress and van Leeuwen as presented in *Reading Images: The Grammar of Visual Design* (1996). I rely on this particular work since it provides a clearly articulated set of definitions of specific visual structures in relation to socially informed rhetorical meanings. With Kress and van Leeuwen's visual grammar, it is possible to scrutinize individual visual elements of a genre in relation to specific rhetorical functions.

2.4 Kress and van Leeuwen's *Grammar of Visual Design*

It is important to note that this review and subsequent analysis does not engage in a critical analysis of Kress and van Leeuwen's visual grammar (1996), nor does it condone a full, unchallenged acceptance of their theory and methodologies. Instead, this study's first stage of analysis seeks to contribute new insights to the RGS field by acknowledging how visual designs are part of a genre's social action. Kress and van Leeuwen's techniques provide a useful starting point for this discussion.

Kress and van Leeuwen's work (1996) is based in a social semiotics' perspective from which they create a grammar of visual design. Essentially, Kress and van Leeuwen's grammar consists of a descriptive framework that can be used as "a tool for visual analysis" (p. 12). The authors list and describe the elements of this framework, as well as analyse how these elements are used to produce meaning. Theirs is a descriptive grammar providing "inventories of the major compositional structures which have become established as conventions…and to analyse how they are used to produce meaning by contemporary image-makers" (p. 1). These visual compositional structures are regulated by social institutions (e.g., schools, government, media) via both written and unwritten social sanctions (p. 2). Their visual grammar addresses visual sign making, a process they highlight as important to meaning making. Kress and van Leeuwen acknowledge the diachronic and social variability of grammars. They note that, because there is no universal visual grammar, their grammar is applicable in contemporary Western culture (p. 3). Their signifiers include elements such as lines, colour, and camera angle. Their signifieds are the meanings these visual forms realize.

At the time the sign is produced, its maker's interests in the object and/or event are complex, arising out of the cultural, social, and psychological history of the sign maker and the specific context in which the sign is being produced. Therefore, for these authors, visual meaning is a result of individual and social forces. Out of that meeting of motivations, visual signs are created that are always the transformation of existing materials, individuals, and social materials. Visual depictions, according to Kress and van Leeuwen, are independently organized and not reliant on the linguistic mode for meaning making. Visual design has its own forms for meaning making and its own code and structure.

My analysis relies primarily on five different elements of Kress and van Leeuwen's (1996) theory: Analytical Processes, and the compositional structures of Given/New, of Ideal/Real, of Salience, and of Framing. Kress and van Leeuwen define Analytical Processes as representational visual structures that "relate participants in terms of a part-whole structure" (p. 89). Participants, what these authors define as the "'objects' or 'elements'"(p. 46) visually or textually depicted in visual documents, are organized into one of two categories. In Analytical Processes, Kress and van Leeuwen posit, there is "one Carrier (the whole) and any number of Possessive Attributes (the parts)" (p. 89). For example, in an EPR summary of patient information, the Carrier would be defined as the patient discussed in the summary information, and the Possessive Attributes would be the categories of information that are contained within the summary and the patient information details listed within each category. What is important to note about Analytical Processes, warn the authors, is that "analysis always involves selection. Some attributes or characteristics of the Carrier are singled out as criterial in the given context, or generally, while others are ignored, treated as non-essential and irrelevant" (p. 90). Thus, in the EPR patient summary document, some categories, such as active medication orders, are selected for inclusion; others, such as laboratory test results, are not included. In this way, Kress and van Leeuwen propose that the "visual 'this is'" (p. 93) statement of an Analytical Process is always a selection and a deselection of information. Analytical Processes can be further classified into different types.

Two types of Analytical Processes are important to my visual analysis: Temporal and Exhaustive. Temporal Analytical Processes "analyse it [time] into successive stages with fixed and stable characteristics" (Kress & van Leeuwen, 1996, p. 95). Kress and van Leeuwen identify time lines as "the essential characteristic of temporal analytical processes" (p. 95). In contrast, Exhaustive Analytical Processes are defined by the authors as visual depictions that "exhaustively represent the Possessive Attributes of a Carrier, so that all of the Carrier is accounted for" (p. 97). However, Kress and van Leeuwen warn that "the point is not, of course, that the analysis *is* [authors' italics] in fact exhaustive" (p. 98). Instead, "the point is that the analysis is presented *as though* [authors' italics] it is exhaustive, as though the Carriers have these major components and no others" (p. 98).

Secondly, through the compositional structures of Given and New, Kress and van Leeuwen (1996) discuss the information value of the left and right hand sides of a composition. The Given compositional structures appear on the left side of a visual design and signal the connotative meaning of being already known, previously recognized, and cultural 'givens'. In contrast, the right side of a visual design is the side of New information. Visual elements presented in the space of the New are visual

elements of importance that are previously unknown to the viewer, thus requiring attention. According to the authors, "broadly speaking, the meaning of the New is therefore 'problematic', 'contestable', 'the information at issue'; while the Given is presented as commonsensical, self-evident" (p.187).

Next, the information value of the top and bottom parts of the composition is discussed in the structures of the Ideal and Real. Ideal composition structures appear at the top of the visual design, while the Real appears at the bottom. Between these two structures, "there is a sense of contrast, of opposition" (p. 193). The structures located in the space of the Ideal are presented as the "generalized essence of the information" (p. 193). In contrast, the Real presents "more specific information (e.g. details), more 'down-to-earth' information (e.g. photographs as documentary evidence, or maps or charts), or more practical information (e.g. practical consequences, directions for actions)" (p. 193-4).

Salience refers to "the degree to which an element is visually separated from other elements" (Kress & van Leeuwen, 1996, p. 225). This degree of separation is achieved through a number of visual features such as visual framing devices, empty spaces between elements, and contrasts in colour. Through these mechanisms, visual weight is created and assigned to various elements of the composition. These varying degrees of visual weight create "a hierarchy of importance among the elements of spatially integrated texts, causing some to draw more attention to themselves than others" (p. 213). Elements with more visual weight have greater degrees of salience.

The last compositional structure of Kress and van Leeuwen's used in this study is Framing. This technique involves the use of visual design elements to group or separate information. Framing techniques visually organize relationships between represented information: visual elements are either framed apart, disconnected from each other via the use of strong visual framing, or they are connected, joined together by either weak or absent visual framing. Visual framing is, therefore, a matter of degree: elements of the composition may be strongly or weakly framed. The stronger the framing of an element, the more it is presented as a separate unit of information with a separate meaning or purpose.

Relying on these five elements of Kress and van Leeuwen's grammar of visual designs, I contrast the visual components of two sets of genres in the first stage of my study's analysis. One set of genres (the EPR-generated patient summaries used by nurses and physicians) is institutionally provided to the user, while the other set (nurse and physician manual transformations of these summaries) is a manipulation of the information within the first set of genres, created by individual users. This comparison highlights the visual design alterations that the users create in their manipulations of the EPR-generated genres, the means through which these alterations are realized, and the social implications of these transformations. Analysis using Kress and van Leeuwen's visual grammar establishes that a genre's social actions are realized, in part, through visual or non-linguistic means. In this way, these findings establish that work in the field of VR can contribute usefully to RGS's understanding of the rhetorical work of visual designs in genres.

However, these findings also reveal that a larger sense of context needs to inform this study's analysis. Thus, in the second stage of analysis, I develop context mapping. Context mapping is a five-step approach for expanding the scope of contextual

considerations informing data analysis. One of the steps of context mapping involves using genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000) as a means for investigating the interrelations between several ward information work genres in my data analysis.

2.5 Genre Sets, Systems of Genre, and Genre Ecologies

In recent years, the field of RGS has moved from researching single genres, to investigating how groups of genres co-exist and work together within a community. Artemeva, citing the work of Devitt (2000) and Yates & Orlikowski (2002), observes that "even though analyses of individual genres provide us with information necessary for the unpacking of community norms, practices, and ideologies, it is impossible to unpack complex communicative phenomena without studying interactions among genres" (2004, p. 14). Several theorists investigate these interactions, describing them as genre sets (Devitt, 1991), as systems of genre (Bazerman, 1994), and as genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi et al., 2004; Spinuzzi & Zachry, 2000).

Devitt introduces the concept of genre sets in her analysis of the textual and intertextual work of tax accountants (1991). The genre set represents the full range of texts that these professionals routinely produce in fulfilling their work activities. Devitt explains that the texts of the genre set "form a complex network of interaction, a structured set of relationships among texts, so that any text is best understood within the context of other texts" (p. 336). However, Bazerman critiques the concept of genre sets for being inappropriately limited since it represents "only the work of one side of a multiple person interaction" (1994, p. 98). Bazerman's systems of genre overcome this limitation by including "the full set of genres that instantiate the participation of all the parties…the full interaction, the full event, the set of social relations as it has been enacted" (p. 99). Bazerman defines his notion of systems of genre as "interrelated genres that interact with each other in specific settings" (p. 97). In his study examining the genre systems within the patent and legal system settings, Bazerman proposes that the actions created in one genre may be followed appropriately only by a limited range of other genres. Systems of genre thus reflect a broader conception of genre sets by encompassing "a complete communicative interaction including all social relations and the history of the interaction" (Artemeva, 2004, p. 15).

The concept of genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi et al., 2004; Spinuzzi & Zachry, 2000), while rooted in these earlier frameworks, seeks to add to these models a focus on the dynamic and unstable nature of the relations between genres in these sets and systems. "What sets genre ecologies apart," explains Spinuzzi (2003b), "is the focus on contingency, decentralization and stability (Spinuzzi & Zachry, 2000) as these dynamic ecologies gain, adapt, and discard genres" (2003b, p. 99). The genres of the ecology are "connected in multiple, complex, and often nonsequential ways" (Spinuzzi, 2003b, p. 100). Genre ecologies open up the notion of multiple genres working together by recognizing the continually changing structure of the ecology, the lack of a central organizing authority, and the adaptations, substitutions, and innovations used by individual rhetors. These ever changing and expanding ecologies are in continual state of flux as "workers draw on genres they have learned elsewhere and often

experimentally substitute genres during their work, particularly (but not simply) when they are dissatisfied with how work is performed" (Spinuzzi et al., 2004, p. 8). Furthermore, within genre ecologies, any given genre is considered a means for mediating a particular activity. However, no single genre within the ecology works alone. A single genre "does not and cannot do the work of mediation all by itself" (Spinuzzi, 2003b, p. 48). Instead, the entirety of the ecology is the mediator of activity within a particular community (Spinuzzi, 2003b).

Thus, in order to analyse how work is completed through genres, to appreciate the complexity of the relations between genres that mediate activity, and to support rich descriptions of these activities, genres should be explored as occurring, not in isolation, but in a context of multiple other genres which exist in a complex relation to each other. This study's second stage of analysis employs genre ecology analysis and diagrams to explore the many genres used within the research setting and to depict how those genres "interact as they jointly mediate an activity" (Spinuzzi, 2003b, p. 54). This analysis and associated diagrams facilitate an examination of one or more genres in relation to one or more other genres. As well, this analysis facilitates not only the tracing of destabilizations between genres of the ecology, but also the examining of user-generated genre-based innovations that contend with these destabilizations.

In addition to integrating genre ecologies into my context mapping approach, I also incorporate a social theory that supports analysis of multiple ranges of social contexts and social actions. In order to accomplish such an inclusion, I turn to AT. Recently, several researchers in the field of RGS have complemented their investigations with AT concepts and methodologies. Projects by researchers such as Russell (1997), Artemeva & Freedman (2001), and Spinuzzi (2003b) have made significant contributions to the field of RGS by incorporating AT into their investigations. My context mapping work also borrows from AT and, more specifically, from AT's recent work with the theory of "Knotworking" (Engeström et al., 1999). Since Knotworking is a recent development in AT, I begin the following review with a brief history of AT as a preface to a description of Knotworking.

2.6 A Brief History of AT

The cultural-historical theory of activity, or AT, has its roots in Soviet psychology of the 1920s and 1930s, founded in the work of Vygotsky (1978), Leont'ev (1981), and Luria (1978). In order to review the principal components and analytic perspectives of AT, this review follows the historical development of the theory[2] from its beginnings in Vygotsky's (and Luria's[3]) work, to the additions provided by Leont'ev, and finally to the contributions made most recently by Engeström.

[2] The temporal tracing of the development of AT is an approach commonly used in reviews of this theory. This chapter's review follows and rests upon this tradition (see Haas, 2005; Engeström, Engeström & Vähäaho, 1999; University of Helsinki's Center for Activity Theory and Developmental Work Research, n.d.)

[3] Luria was Vygotsky's closest collaborator and so many of the early developments in AT are attributed to the collaborations between both authors, and not solely to Vygotsky's publications (Haas, 2005).

The basic concepts of AT were articulated in English in the 1978 publication of Vygotsky's *Mind in Society: The Development of Higher Psychological Processes*. Here, Vygotsky proposes a new theoretical concept: artefact-mediated and object-oriented human action. With this concept, Vygotsky and Luria develop an approach to the understanding of human action where tool-use in human action is a crucial principle. These authors propose that only the most elementary actions can be undertaken in direct relation with natural surroundings, and so tools are a necessary requirement for all higher psychological processing (Cole & Scribner, 1978). The principle of a 'tool,' in this account, is developed in a twofold manner, addressing this concept as both a material and a symbolic mediational means. For Vygotsky and Luria, humans, in their efforts to control or affect their natural, physical surroundings, rely on material tools such as hammers or fishing rods. In their cooperative and collaborative interactions with each other, humans use symbolic sign systems (such as language) as tools to support functional activities. It is through the use of both these material and symbolic tools that consciousness is developed within individuals. The cognitive function of tools, or mediating artefacts, is clearly established in Luria's popularly cited assertion that "'man differs from animals in that he can make and use tools.' These tools 'not only radically change his conditions of existence, they even react on him in that they effect a change in him and his psychic condition'" (Luria 1928, as quoted in Cole & Engeström, 1993, p. 5). For Vygotsky and Luria, individual consciousness is not a so-called given, but is "develop[ed] historically through the individual's engagements, via tools, in practical activity and through the individual's interactions with others via language and other signs" (Haas 2005, p. 131). Culture is thus produced, and reproduced, via human use of mediational means. Since humans learn to use tools, both material and symbolic, from other humans, these mediational means "mediate between the individual and the larger culture, carrying forward for each new generation and each new user something of the residue of past actions" (Haas 2005, p. 131). In this way, "any local activity resorts to some historically formed mediating artefacts" (Engeström & Miettinen, 1999, p. 8).

Implied in this discussion of tools, action, and culture is the assumption that "other human beings, both those present to the senses and those of prior generations, play a crucial role in the formation of human cognitive capacities" (Cole & Engeström, 1993, p. 6). Indeed, Vygotsky and Luria's work supports the distributed nature of cognition, positing that human engagement with surrounding environments occurs first interpsychologically, in interactions with other humans. From this basis of joint collective activity, these authors posit that "interpsychological functioning allowed intrapsychological functioning to develop in individuals—again, through tool- and/or sign-mediated practical engagements with the material and social worlds" (Haas, 2005, p. 132) This process entails personal absorption of external social mediational means, both material and symbolic, by the individual into internal, intrapsychological "tools for thinking" (Haas, 2005, p. 132). Thus, in the process of using tools, the human users are psychologically transformed: "as they use these external means to regulate themselves, they begin to think and act differently" (Spinuzzi, 2003b, p. 38).

Leont'ev's contribution to AT relies on the view of human activity proposed by Vygotsky and Luria, and shares their interest in cognitive development. However, Vygotsky and Luria center their work on the idea of mediation. This idea is crystallized in Vygotsky's (1978, p. 40) famous triangular model of a mediated act (see Figure 2.6.a),

and is an "individually focused" (Engeström, 1999, 'Three Generations' section, para. 3) approach.

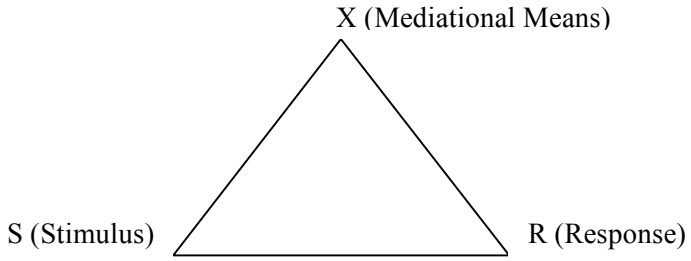


Figure 2.6.a: Vygotsky's mediational triangle (1978, p. 40). The description of 'X' as 'Mediational Means' is a common reformulation of this triangle, a reformulation often attributed to Leont'ev (Engeström, 1987; Cole & Engeström, 1993; Haas, 2005).

This individual-based focus is expanded by Leont'ev who further develops AT by explicitly focusing on social relations, distinguishing between actions mediated by other human beings or by genres, and individual action. According to Leont'ev, "activity is not a reaction or aggregate of reactions, but a system with its own structure, its own internal transformations" (1981, p. 46). In this structure, Leont'ev identifies three levels to practical human activity, distinguishing between activity, action, and operation: "The uppermost level of collective activity is driven by an object-related motive; the middle level of individual (or group) action is driven by a goal; and the bottom level of automatic operations is driven by the conditions and tools of the action at hand" (Engeström & Miettinen, p. 4).

In his oft-cited example of the "primeval collective hunt" (1981, p. 210) Leont'ev illustrates this three level model of activity, and demonstrates his consideration for division of labour:

> A beater, for example, taking part in a primeval collective hunt, was stimulated by a need for food or, perhaps, a need for clothing, which the skin of the dead animal would meet for him. At what, however, was his activity directly aimed? It may have been directed, for example, at frightening a herd of animals and sending them toward other hunters, hiding in ambush. That, properly speaking, is what should be the result of the activity of this man. And the activity of this individual member of the hunt ends with that. The rest is completed by other members. This result, i.e., the frightening of game, etc., understandably does not in itself, and may not, lead to satisfaction of the beater's need for food or the skin of the animal. What the processes of his activity were directed to did not, consequently, coincide with what stimulated them, i.e., did not coincide with the motive of his activity; the two were divided from one another in this instance. Processes, the object and motive of which do not coincide with one another, we shall call actions. We can say, for example, that the beater's activity is the hunt, and the frightening of the game his action. (1981, p. 210)

The activity of going on a hunt is motivated by a need for nourishment, a motive that is shared with others. The actions of the beater are driven by the goal of frightening the game towards the other members of the hunt. The automatic operations involved in this task might include waving his arms and yelling at the herd of animals being hunted in

order to drive them towards the other hunters. However, since operations are driven by the conditions and tools of the action at hand, the beater's operations would have been different if other conditions and tools were present. For example, if the hunter loses his voice, he will have to rely on other tools (such as rattles) to make sufficient noise to scare the animals. This three level model of human action is hierarchical since events at one level of the hierarchy (for example, an operation) at one point in time, may move to another level of the hierarchy at another moment (becoming an action or an activity). Also, the hierarchy is open to change at the macro- or activity-level: "When the need motivating an activity changes, a different activity emerges, as when hunting ceases to be motivated by a human need for food and becomes motivated by some human need for sport" (Haas, 2005, p. 136).

Leont'ev's consideration for the division of labour addresses an issue left implicit in Vygotsky's and Luria' work. Specialization within the group's division of labour can "lie a good distance in space and time from the principal activity under examination" (Haas, 2005, p. 137). In this way, Leont'ev begins to develop a model of a collective activity system as a larger unit of analysis. However, Leont'ev never graphically expands on the triangular model of human activity. That development comes from Engeström.

Engeström's work with AT has resulted in several important contributions to the theory's development. Foremost among these contributions is Engeström's modification of Leont'ev's mediational triangle. In this modification (see Figure 2.6.b), Engeström expands the human activity triad so as to facilitate analysis of complex interactions and relationships.

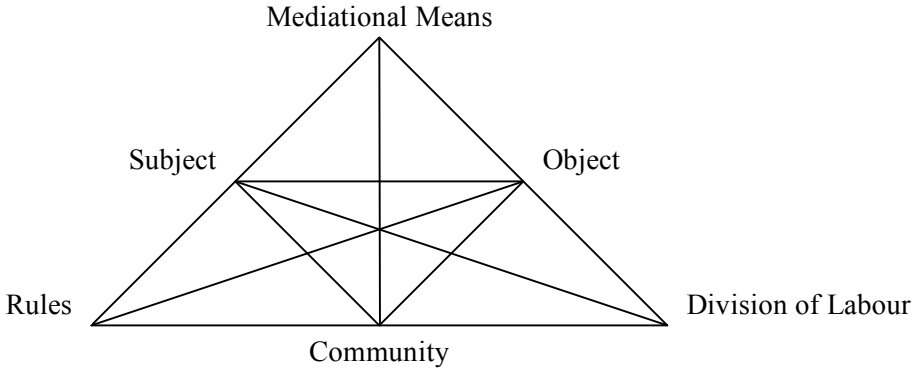


Figure 2.6.b: Engeström's expanded mediational triangle (adapted from Engeström, 1987, p. 78)

This new model accounts for socially distributed work and human interactions, thus refusing "monocausal explanations" (Engeström & Miettinen, 1999, p. 9) of social, material, and technological factors. Engeström's model represents the larger unit of analysis implied in Leont'ev's work: the activity system. As depicted below, in this model "minimum units of this system include the object, subject, mediating artefacts (signs and tools), rules, community, and division of labour" (Engeström & Miettinen, p. 9). This activity system model illustrates and refocuses AT on "the collective nature of human activities" (Cole & Engeström, 1993, p. 7), highlighting how individual human action is always already "embedded in collective activity systems" (Engeström, 1987, p. 304). In this model, Engeström adds three nodes to the triad model of human activity:

Community, Rules, and Division of Labour. Haas describes the motivation behind these inclusions, stating:

> Engeström included Community as a component of activity because individuals live in communities and participate in human activity in the context of those communities. The addition of Social Rules is intended to reflect the fact that rules, similar to mediating artefacts, specify and regulate work procedures and interactions among community participants, who are represented as a collective subject. A collective subject constituted within a community implies, in turn, a Division of Labor [sic], which points to the distribution of power and authority, tasks, and responsibilities among the participants (i.e., the collective Subject) in an activity. (2005, p. 138)

As AT continues to develop, its application to questions of human activity and work is spreading well beyond its roots in the field of Psychology. AT has had significant impact in several fields ranging from RGS (Artemeva & Freedman, 2001; Russell, 1997), to human-computer interactions (Kuutti, 1999; Nardi, 1996), to patient care in medical settings (Cole & Engeström, 1993; Engeström 2000, 1999; Engeström et al., 1999). However, beyond its ever expanding range of application, the theory itself is still recognized as growing, and in need of further development. The University of Helsinki's Centre for Activity Theory and Developmental Work Research proposes that the next generation of AT research "needs to develop conceptual tools to understand dialogue, multiple perspectives and voices, and networks of interacting activity systems"(Cultural-Historical Activity Theory, 2006). In the next section of this literature review, I will describe how Knotworking is a theoretical development that begins to advance this next generation of AT.

2.7 Knotworking

In 1999, Engeström, Engeström and Vähäaho introduced the concept of Knotworking to describe work situations requiring the "active construction of constantly changing combinations of people and artefacts over lengthy trajectories of time and widely distributed space" (p. 345). These authors propose that such collaborative efforts do not fit with the standard definition of a team, which is typically understood to be a stable configuration. Nor do they fit the common understanding of networks, which typically imply stable structures. Instead, Engeström, Engeström and Vähäaho argue that this new work organization involves "a rapidly pulsating, distributed and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems" (p. 346). This collaborative performance is the knot of Knotworking, a knot of pulsating movement, "of tying, untying and retying together otherwise separate threads of activity" (p. 346). Most importantly, in the pulsing, unstable, distributed and improvised collaborative work of Knotworking, the authors posit that "the center does not hold"(p. 346): the knot of collaborative work can not be reduced to any particular individual or organizational center of control. Instead, "the locus of initiative changes from moment to moment within a Knotworking sequence" (p. 346). As a result, analysis of such collaborative work can not assume a central coordinator or locus of control, nor can it assume a central "additive sum of the separate

perspectives of individuals or institutions" (p. 346-347). Instead, in Knotworking, "the unstable knot itself needs to be made the focus of analysis" (p. 347). Since the combination of people and the contents of tasks are always unstable, the importance of communication systems and artefacts can not be underestimated to the success of Knotworking.

Engeström, Engeström and Vähäaho (1999) contend that the knot in Knotworking is not a singular action, nor is it necessarily a combination of actions. The knot performs a tightly interconnected set of actions, and is capable of deliberately organizing and dissolving itself in order to perform and/or terminate actions. In this way, "the knot function[s] as a self-conscious agent" (p. 352). It is important to note that this self-consciousness does not reside within an individual agent involved in the actions or activity, nor within any other node of the activity systems involved. In Knotworking, "the subject is not fixed – the subject is the pulsating knot itself, or in other words, subjectivity is dynamically distributed within the knot" (p. 352). Again, the subject, as the assumed center, does not hold.

Furthermore, Knotworking can not be reduced to a single episode or a single knot. Knotworking is "a temporal trajectory of successive task-oriented combinations of people and artefacts" (Engeström et al., 1999, p. 352). Since it is intensely collaborative, time dependent, and reliant on the efforts of several people and artefacts spread across time and space, Knotworking is tenuous. Knotworking situations are unstable by their very nature: "Knotworking situations are fragile because they rely on fast accomplishment of intersubjective understanding, distributed control and coordinated action between actors" (Engeström et al., 1999, p. 352).

To illustrate Knotworking, Engeström, Engeström and Vähäaho describe a case of a "mental patient" (1999, p. 349) in which several different healthcare disciplines (physicians, nurses, and ambulatory crew), as well as community-based social services and private individuals (police, appointed custodian, and landlord) are involved in numerous actions directed towards the patient's care. As this example demonstrates, some actors within the Knotworking are individuals (such as the general practitioner [GP] and landlord) while others are collective (for example, the ambulance crew, and police). However, in Knotworking, "seemingly individual actors represent their respective collectives (e.g. the GP represents his health centre), and correspondingly, the collectives act through individuals" (p. 354). In this way, each participant in the knot is understood as a collective activity system. The analysis of Knotworking, therefore, is directed towards understanding "the internal dynamics and tensions of the activity systems that partake in a Knotworking trajectory" (p. 354). To visually represent Knotworking, the authors use diagrams of the various interacting activity systems. These diagrams visually depict the coordinating actions of the participating activity systems as well as the mediational means involved of the Knotworking situation (see Figure 2.7.a).

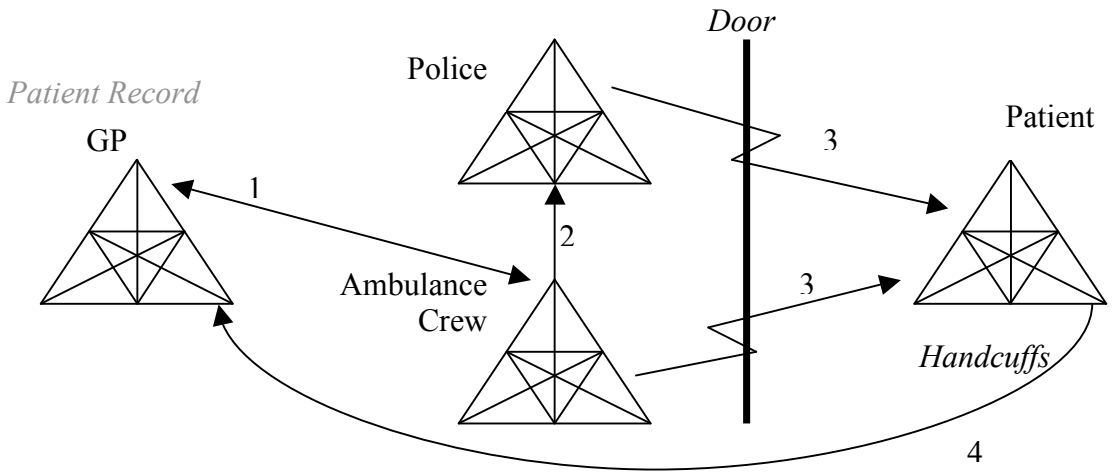


Figure 2.7.a: Example of a sequence of four steps in a Knotworking situation (Engeström et al, 1999, p. 355). In this figure, each agent and his/her associated collective is represented as an activity system and is labelled for identification. Mediational means are textually represented in an italicized font. Mediational means that are directly involved are in black font, while those that are indirectly involved in the knot are in grey font. Interactions between agents/activity systems and/or mediational means are represented by arrows and are numbered indicating Knotworking trajectory event numbers. Direct mediation lines indicate unproblematic mediations. Lightning shaped lines indicate tension-filled or problematic mediations. In this figure, event #3 involves problematic mediations through the mediational means of the door (the patient would not voluntarily open his apartment door to the Ambulance crew and the Police).

Engeström, Engeström and Vähäaho (1999) identify three dimensions to Knotworking that need to be taken into consideration during analysis. First, the authors point to the socio-spatial dimension which requires depiction of "the relations between the different activity systems involved in forming a knot at any given point in time" (p. 354). In Figure 2.7.a, this socio-spatial dimension schematically represents four activity systems involved in the attempt to physically contact a mental patient in the patient's home: that of the GP, the Police, the Ambulance crew and the patient. Four interactions are depicted in this figure. Step 1 is a phone call where the GP gives the ambulance crew permission to enter the patient's apartment by force. Step 2 is a call from the ambulance crew to the police requesting assistance in taking this patient to the hospital. Step 3 consists of the police and the ambulance crew entering the patient's apartment by breaking the lock and taking the patient into custody. Step 4 is the patient being brought to the health center where the GP is located. Involved in this socio-spatial dimension are several artefacts including, most notably, the patient's door. The door is the "key artefact mediating and triggering a disturbance" (p. 355) between the four activity systems. Other artefacts are also included. First, the handcuffs are an artefact that is directly involved since they are used to facilitate the transport of the patient to the GP. Also, the patient's record from the mental institute is an indirectly involved artefact (indicated as indirect by grey text formatting in Figure 2.7.a) in the Knotworking trajectory that influences the GP's judgement of the situation and possibly also the judgement of other participants.

Another dimension that Engeström, Engeström and Vähäaho (1999) include in the analysis of Knotworking is the temporal dimension. Figure 2.7.a depicts four successive

steps or events in the trajectory of Knotworking. However, several steps come before this set of events (including, for example, calls to the GP from the patient's custodian describing recent violent changes in the patient's conditions, and previous steps taken by the custodian, GP, landlord, and ambulance crew to have the patient volunteer entry into his/her apartment), and steps that come after these (including, for example, manic and incoherent utterances from the patient upon arrival at the health centre, consults from the patient's mental care facility, and the GP's writing of a legal statement attesting to the need to institutionalize the patient). Comparative figures of both earlier and later steps in the trajectory offer insight into "the evolution of the knot over time, from its initiation to its termination" (p. 355) revealing "how the combination of participating activity systems has shifted" over time (p. 355). Sequences of Knotworking figures allow for the visual depiction of the Knotworking trajectory's evolution.

The third dimension that these authors bring into Knotworking analysis is the ethical dimension. Knotworking "regularly calls for a redistribution and reconceptualization of control, responsibility and trust" (Engeström et al., p. 355) in the trajectory of steps. In the example of the mental patient, the GP is not able to control the situation at all points in the trajectory. However, this control is similarly unavailable to the custodian, the police, and the patient. In Knotworking, the "hierarchy and segmentation of organizational authority" (p. 356) is destabilized. Therefore, the ethical responsibility of participants and institutions should be part of the analysis of Knotworking trajectories.

As previously mentioned, RGS studies have begun to incorporate AT theories and constructs into genre studies to address issues of social context. However, Engeström, Engeström and Vähäaho's theory of Knotworking (1999) has not been part of this recent RGS trend. I incorporate the theory of Knotworking with RGS's concept of genre ecologies into the context mapping approach. Through context mapping, I investigate the communication practices involved in the research setting's interprofessional and collaborative information work. This approach facilitates the development of a nuanced understanding of the contexts in which ward information work is realized. Also, context mapping supports the identification of the ramifications of these communication practices. By combining Knotworking and genre ecologies, context mapping facilitates an analysis that respects the dynamic, improvised, and distributed nature of multi-professional, collaborative work.

While context mapping is a useful approach for data analysis, I found my study conclusions could be complemented insightfully by incorporating some theoretical constructs from the field of Actor-Network Theory (ANT). The following description briefly reviews ANT and describes the concepts that I use to inform this study's conclusions.

2.8 A Review of ANT

Scholars investigating the history and sociology of science and technology, including most notably Burno Latour, Michel Callon, and John Law, developed ANT. The theory aims "to describe a society of humans and non-humans as equal actors tied together into networks built and maintained in order to achieve a particular goal" (Stalder, 1997,

Introduction section, para. 3). ANT authors, like many researchers working in the sociology of science field, argue that knowledge is a social construct. For ANT researchers, the social construction of knowledge is "an effect of a network of heterogeneous materials" (Law, 1992, p. 2). Law explains that the heart of ANT lies in this metaphor of the 'heterogeneous network' since it suggests that "society, organizations, agents and machines are all effects generated in patterned networks of diverse (not simply human) materials"(1992, p. 2). For ANT researchers, knowledge is a product of many heterogeneous materials working together. For instance, scientific knowledge is the result of materials like Bunsen burners, microscopes, research scientists, other professional collaborators, trained hands, conference presentations, computerized simulators, x-ray machines, and other materials coming together into a patterned network. Knowledge is, therefore,

> material matter but also a matter of organizing and ordering those materials. So this is the actor-network diagnosis of science: that it is a process of 'heterogeneous engineering' in which bits and pieces from the social, the technical, the conceptual and the textual are fitted together, and so converted (or 'translated') into a set of equally heterogeneous scientific products. (Law, 1992, p. 2)

However, ANT researchers do not limit the application of the heterogeneous network metaphor to science and scientific knowledge. Computer technologies, the economy, families, business organizations: through the lens of ANT, each is an evolving product of patterned heterogeneous networks. As Law explains, what makes this such a radical claim is that it contends that "networks are composed not only of people, but also machines, animals, texts, money, architecture – any material that you care to mention" (1992, p. 2). Latour similarly acknowledges that ANT challenges sociologists since, in this theory, objects are accorded agency. As Latour explains, "the main reason why objects had no chance to play any role before was not only due to the definition of the social used by sociologists, but also to the very definition of actors and agencies most often chosen" (2005, p. 71). Thus, for ANT theorists, to investigate the social is to investigate matters that are not limited to human beings. Therefore the general argument put forth by ANT researchers is this:

> If human beings form a social network it is not because they interact with other human beings. It is because they interact with human beings and endless other materials too. And, just as human beings have their preferences – they prefer to interact in certain ways rather than in others – so too do the other materials that make up the heterogeneous networks of the social. Machines, architecture, clothes, texts – all contribute to the patterning of the social. And – this is my point – if these materials were to disappear then so too would what we sometimes call social order. Actor-network theory says, then, that order is an effect generated by heterogeneous means. (Law, 1992, p. 3)

Furthermore, ANT proposes that neither the humans nor the objects involved in a heterogeneous network are determinate – neither drives the other. Instead, both humans and objects are equally important and active, both are considered entities that are "endowed with the ability to act" (Holtorf, 2003, para. 2) and so have agency. Latour (1999) underscores this view by defining the term 'actant' in relation to his conception of 'actor.' Latour explains that "since in English 'actor' is often limited to humans, the

word 'actant,' borrowed from semiotics, is sometimes used to include non-humans" (1999, p. 303) in the discussion of agency within the network of heterogeneous elements. Within a heterogeneous network, every actor and actant is "connected with, depending upon, influencing, and strengthening the position of every other" (Holtorf, 2003, para. 3). Actors and actants impact upon and influence the development of each other. As Latour summarises, "contrary to the claims of those who want to hold either the state of technology or that of society constant, it is possible to consider a path of innovation in which *all the actors* co-evolve" (1991, p. 117).

The scope of inclusion in a heterogeneous network is broad, a breadth that Latour does not wish to limit stating, "the word network indicates that resources are concentrated in a few places – the knots and the nodes – which are connected with one another – the lines and the mesh: these connections transform the scattered resources into a net that may seem to extend everywhere" (Latour, 1987, p. 180). However, this breadth is not evident, generally, to an individual agent working within the network. The networks that support society, including the actors and actants involved, are often concealed from view. This is the result of simplifications that Law calls "punctualisations" (1992, p. 5). Law describes punctualisation work as follows:

> All phenomena are the effect or the product of heterogeneous networks. But in practice we do not cope with endless network ramification. Indeed, much of the time we are not even in a position to detect network complexities. So what is happening? The answer is that if a network acts as a single block, it disappears, to be replaced by the action itself and the seemingly simple author of that action. At the same time, the way in which the effect is generated is also effaced: for the time being it is neither visible, nor relevant. So it is that something much simpler – a working television, a well-managed bank or a healthy body – comes, for a time, to mask the networks that produce it. (Law, 1992, p. 5)

Through punctualisations, actors avoid becoming overwhelmed by the breadth of heterogeneous networks. Actors can efficiently complete their tasks without having to be aware of the hybrid of materials supporting their actions. In reliable, recurring situations, punctualisations offer actors simplified routines and resources that support efficient actions.

However, as Law notes (1992), there is a significant limitation to engaging primarily with these simplifications. Punctualisations can be considered reliable resources only when they work consistently and effectively. However, reliable resources can become unreliable. To review Law's examples: televisions break down, well-managed banks make mistakes, and healthy bodies get sick. In these situations, punctualisations can be seen as masking the heterogeneous networks that need to be examined. Without a sufficiently detailed awareness of the heterogeneous network, actors can attempt to circumvent these now unreliable resources by improvising creative solutions. However, since these improvisations are based on punctualisations, they can be insufficiently informed. Thus, when reliable resources break down, the simplifications of punctualisations can become troublesome limitations to an actor's ability to improvise effectively and/or appropriately.

Such an awareness of the simplifications that punctualisations support is important in ANT since, by their very nature, networks are unreliable and unstable. The social structure that a network supports "is a site of struggle, a relational effect that

recursively generates and reproduces itself" (Law, 1992, p. 5). As Latour confirms, there are no fixed social structures or groups: "for ANT, if you stop making and remaking groups, you stop having groups" (2005, p. 35). Consequently, ANT theory asserts that there is no central locus of social control or power that is absolute, there is no one single version of social order, and no agent is ever truly autonomous or complete. For ANT, "neither society nor the social exist in the first place" (Latour, 2005, p. 36) as fixed entities. Therefore, the object of ANT research is "to explore and describe local processes of patterning, social orchestration, ordering, and resistance" (Law, 1992, p. 5) which generate "ordering effects such as devices, agents, institutions, or organizations" (Law, 1992, p. 5).

ANT has been used to study many different settings, technologies, and work environments. For instance, Prout (1996) has suggested that ANT can be usefully incorporated into medical sociology, and has illustrated this incorporation through an ANT informed investigation of a metered dose inhaler. Fufimura (1995) has borrowed from ANT to investigate the links between practices, work routines, and theories that support a representation of cancer called the proto-oncogene theory. Callon has contributed through several works, including an exploration of the heterogeneous processes of social and technical change, especially as involved in techno-economic networks (1991), and a defence of ANT where he uses this theory to explain the existence and working of economic markets (1999). Latour has also made numerous contributions to ANT via discussions of Louis Pasteur (1988) and the processes used by scientists in their research work (1987).

2.9 Summary of Theoretical Resources

To summarise, this study relies on several theories to support investigation into a genre's context. In the first stage of this study's analysis, Kress and van Leeuwen's theory of visual grammar (1996) prove useful to analyse the rhetorical messages conveyed to users through the visual, non-linguistic designs of a set of genres. In the second stage of analysis, I develop the context mapping approach which combines the RGS concept of genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi et al., 2004; Spinuzzi & Zachry, 2000) and AT's Knotworking theory (Engeström et al., 1999). This approach facilitates the detailed charting of a genre's context and incorporates in its analysis considerations of a genre's social contexts, its social actions, and the collection of other genres that simultaneously and collectively support the mediated activities. In the study's conclusions, I discuss findings from both stages in relation to concepts from ANT.

CHAPTER 3: METHODS

As outlined in the Introduction, this research was conducted in two simultaneously occurring phases. In phase one, I collected a range of documents employed by healthcare professionals during ward information work and, based on thematic trends that emerged in the data, selected a limited set of these documents for visual rhetorical analysis (Hodder, 2000). Phase two was an elaborated, qualitative case study (Stake, 1995), involving non-participant observations (Bogdewie, 1999) and semi-structured interviews (Britten, 1995), that investigated the relationship between EPRs and other genres involved in information work. I carried out phase one and two data collection over the course of 8 months in order to attain sampling saturation (Kuzel, 1999). I used a constructivist grounded theory methodology (Charmaz, 2000) throughout the study and thus relied on an iterative approach to data collection involving "cycles of simultaneous data collection and analysis, in which the results of the ongoing data analysis inform the subsequent data collection" (Kennedy & Lingard, 2006, p. 103). In the following sections, I explain the methods I used in both phases. I detail the study's research setting, study participants, informed consent process, and the methods used for data collection and data analysis. These descriptions of the study's methods are prefaced with two procedural statements explaining how I acquired ethics approval for this study and how I came to analyse the study data in two stages.

This project received research ethics approval from the Research Ethics Boards (REBs) of both the participating hospital and the University of Waterloo. Obtaining these REB approvals was a lengthy and involved process. First, the participating hospital required that I submit my study for Scientific Peer Review (SPR). For the SPR, I prepared a research proposal for the study detailing several aspects of the project including: problem statements, background literatures, research questions, research design, methodologies, and significance. I submitted this proposal in April 2004. It was reviewed by a committee of three research scientists who were not involved directly in my project. On May 27, 2004, I orally defended this research proposal to this committee. At this defence, the committee compiled a list of revisions that needed to be implemented before the project could pass SPR. On May 31, 2004, I submitted the revised research proposal to the committee's chair who then granted SPR approval to the study. In June 2004, I submitted my ethics application to the hospital's REB. This submission included: the SPR-approved research proposal, the REB application forms, a letter of support from an academic supervisor, the consent forms that would be used with participants, and the SPR committee's review of the study, complete with the chair's signature of approval. On June 11, 2004, the hospital's REB reviewed my application and responded with several amendments that needed to be made before the study could be approved. After considerable work with a REB board member to amend this study, I received hospital REB approval on July 19, 2004. Next, I applied to the University of Waterloo REB for study approval on July 27, 2004. In August, 2004, I received REB approval from the university with a list of recommendation[4] for the study. I incorporated several of these recommendations into my study and submitted the revised study information to the university's REB for their files. Thus, not including the time required to prepare the

[4] These University of Waterloo recommendations were not amendments required for university REB approval of the study. Therefore, I did not need to re-submit my REB application for approval purposes.

original research proposal, receiving REB approval from both institutions was a 5 month long process.

Stage one of data analysis involved a visual rhetorical analysis of the genres used by healthcare professionals at the beginning of a shift. When I began conducting ward observations, I was surprised that study participants regularly began their workday activities by printing out patient information summaries from the EPR. Not only did participants print out patient summaries, they re-formatted these documents by making manual transformations of the patient data therein. These new paper-based documents had consistent, profession-specific visual designs. I wanted to analyse this activity in hopes of understanding why healthcare professionals consistently transformed EPR-based patient information into paper-based genres. Therefore, I conducted the first stage of data analysis to investigate the following research question:

> How does the visual rhetorical design of the EPR user-interface design and of the other genres used in ward information work influence the communication practices of healthcare professionals?

By answering this question, I sought to discover if visual rhetoric could inform an understanding of what participants were doing in making these paper-based transformations, and what was motivating this activity. In this first stage of analysis, I conducted visual rhetorical analysis of all the genres involved in this transformation activity, and complemented this analysis with observation and interview data.

While the findings from this analysis provided interesting insights into the transformation activity, they also highlighted the limited contextual scope that I had assumed in the study's first stage of analysis. In presenting findings to healthcare audiences, I learned that, through a wider contextual lens, significantly different conclusions could be drawn from my study. While these audiences confirmed that my original conclusions were valid, they posited that other contrasting conclusions were equally valid. Based on this new input, I decided to develop a second stage of data analysis that would involve addressing a broader range of contextual considerations. I developed the following research questions to explore this new perspective:

1. What is the relationship between the EPR and the other genres used by professionals to complete information work in this multimodal and interprofessional collaborative healthcare setting?
2. What social actions are involved in the use of these genres?

To answer these questions, I developed an approach for the contextual analysis of genres that I call context mapping. Context mapping supported the inclusion of a wide range of contextual considerations in the analysis of data. Through this five-step approach, I analysed the study's observation and interview data in order to understand information work across multiple social contexts, social actions, and genres. In this second stage of data analysis, I mapped the relationships involved in ward information work between individual healthcare workers, the genres they engage with, the activities they endeavour to realize, and the wide range of social contexts informing those activities.

3.1 Setting

The study took place at a large, Canadian, urban, paediatric teaching hospital and focused on a single in-patient ward. The Nephrology ward was selected because of this specialty's intense use of the EPR for medication and test order entering, and its extensive use of electronically accessed laboratory results. Additionally, this ward involved a multidisciplinary team-based practice that incorporated the work efforts of 6 staff physicians, 8 fellows, 65 nurses, 3 dieticians, 2 physiotherapists, 1 social worker, and 2 administrative officers. For over 15 years, the Nephrology ward had employed the EPR that operates through a text-line user-interface. While the system was available to and used by participants, it did not replace all the functions previously completed via paper or oral communications. As a result, hospital staff carried out a complex mixture of recordings and communications through various media, including paper-based documents, the EPR, and oral communications. The EPR was the only system available on the ward for conducting most daily care activities, including patient locating, patient data retrieval, and pharmaceutical order entry. On this ward, both nurses and physicians made extensive use of the EPR system.

3.2 Participants

The study investigated the information work of many healthcare professionals including physicians, nurses, social workers, dieticians, administration officers, and physiotherapists. While data were collected regarding the practices of all these professionals, the following chapters report on the practices of physicians and nurses only. Although the social workers, dieticians, administrative officers, and physiotherapists were observed during the study, their presence on the ward was unscheduled and periodic in nature. Consequently, their participation was limited and resulted in an insufficient collection of data for thorough analysis. However, nurses were constantly available for observation on the ward (present on the ward during each of the study's 38 observation sessions) and the physicians were nearly as available (participating in 34 of the study's 38 observations sessions). Therefore, the following chapters only address nurse and physician related data.

Fourteen physicians consented to participate in the study, representing 100% participation of the physician population available to work on the ward during the study period. While no physician participants were excluded from the study, ward rotation scheduling resulted in some participants not being present on-ward during the study. Consequently, 9 of the 14 consented physicians actively participated in the study. Sixty-two nurses also consented and participated to varying degrees. This represents a 95% participation rate of the nursing population who worked on the ward during the course of the study. Both physician and nursing participants represented a range of professional experience, from residents on their first ward rotation and novice nurses working their first hospital shift, to senior staff physicians and nurse ward leaders. A breadth of computer expertise was represented ranging from novice to expert, evaluated by self-report and observer assessment. Informed consent from each participant was obtained prior to participation in the study.

3.3 Informed Consent

I presented the study to the ward participants in several different venues. I typically met participants in group settings including morning nursing meetings where 10-15 nurses were present, and patient care 'rounds' discussions where several different healthcare professionals were present. I also met participants individually, particularly physician participants who were not readily available to consent in group settings. In these settings, I presented the study background and methods. I emphasized that their participation was voluntary and that they could consent to any, all, or none of the situations in which their involvement was requested. I also emphasized that they could withdraw from the study at any time and that measures would be taken to protect their confidentiality. The outline of their participation was described as follows in the consent forms. In agreeing to take part in this study, participants were requested to:

1. potentially be observed during different periods of your regular work day by me while you are interacting with patient records in all forms, including paper charts, electronic paper records, and all laboratory result viewing software;
2. be interviewed by me for 45-60 minutes to discuss your experiences with all forms of patient records. You will be invited to participate in an interview at a time and place convenient for you. With your permission, the interview will be tape-recorded and transcribed for purposes of data analysis.

At the end of the presentation, I invited the healthcare professionals to participate in the study and distributed information letters and consent forms. I asked those professionals who wished to participate to leave signed consent forms either with me or at the central nursing station desk. I made one follow-up contact with individuals who did not return forms to ensure that the forms had not been lost.

3.4 Data Collection

Three data sources informed this study. First, I collected anonymous examples of patient information genres commonly used on the ward for analysis. From this collection, I selected a limited range of documents for visual rhetorical analysis. The other two data sources were non-participant observations (Bogdewie, 1999) and semi-structured interviews (Britten, 1995) of a range of healthcare professionals. These last two data collection methods provided a balance between 'objective' outsider descriptions of behaviour and 'subjective' insider perceptions of meaning (Sarangi & Roberts, 1999). I combined the non-participant observations and interviews to construct an elaborated case study (Stake, 1995) of ward information work practices. I used a constructivist grounded theory methodology (Charmaz, 2000) in this study and so relied on a theoretical sampling method (Strauss & Corbin, 1998) to inform data collection duration. Data were collected and analysed until theme saturation (Strauss & Corbin, 1998) was achieved.

In this study, I achieved triangulation[5] in four ways. First I triangulated data by having a wide range of participants in the study. Participants came from two different professions (physicians and nurses) and ranged in experience from novice to expert. Secondly, I incorporated investigator triangulation by having three other researchers[6] participate in the coding and analysis of the data. Although I was the sole data collector, data analysis was supported by these three additional researchers who vetted portions of the data coding during regular group meetings. Next, I ensured theory triangulation by using several different theories and concepts to inform analysis. These theories and concepts came from the fields of RGS, VR, AT, and ANT. Finally, I realized triangulation of methodology by incorporating multiple methods in my investigations (i.e., visual rhetorical analysis, non-participant observations, and semi-structured interviews). In the first stage of data analysis, all three data sources are used. In the second stage, I relied solely on observation and interview data. In these four ways, triangulation was achieved in this study.

A statement about myself as researcher in this study must preface the following description of the data collection methods. In describing the work of qualitative researchers, Vidich and Lyman (2000) posit that, "as observers of the world they [qualitative researchers] also participate in it" (p. 39). I recognize that, in my data collection work, I participated in the research setting. As a result, I acknowledge that the data I collected reflect both who my participants perceived me to be and who I am. First, participants perceptions of myself were potentially influenced by the way I was presented to these participants. I was introduced into the research setting by two key informants: a senior Nephrology physician and the director of child health services for the ward. These key informants introduced me to the staff and gave me access to group meetings where I presented my study to participants for consenting purposes. Consequently, it is inevitable that participant perceptions of myself as a researcher were influenced, at least in part, by the status of these key informants.

Secondly, I acknowledge that my individual subjectivity influenced the data collected. As Angrosino and Mays de Pérez (2000) explain, when conducting in situ observations and interviews, "members of the community are reacting to *this particular ethnographer* [authors' italics] and the cues he or she generates" (p. 689). I endeavoured to mitigate my generation of these cues by being as unobtrusive a presence in the ward as possible (for instance, by wearing nursing scrubs while on the ward and avoiding research jargon in conversations with participants). However, other cues "are simply part of the package (e.g., gender, race/ethnicity, relative age)" (Angrosino & Mays de Pérez, 2000, p. 689). Thus, I acknowledge that different researchers "might well stimulate a very different set of interactions, and hence a different set of observations leading to a different set of conclusions" (Angrosino & Mays de Pérez, 2000, p. 689). However, I

[5] Stake (2000) defines triangulation as "a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation" (p. 443). In the 1970s, Denzin identifies four basic types of triangulation. Janesick (2000) summarizes these four types as follows: "1) Data triangulation: the use of a variety of data sources in a study; 2) Investigator triangulation: the use of several different researchers or evaluators; 3) Theory triangulation: the use of multiple perspectives to interpret a single set of data; and 4) Methodological triangulation: the use of multiple methods to study a single problem" (p. 391).

[6] The three additional researchers were Dr. Catherine F. Schryer, Dr. Lorelei Lingard, and Dr. Pascale Lehoux. Henceforth referred to as SLL.

remained alert to this influence during data collection and noted instances where participant behaviours seemed affected by my presence. I also acknowledge that my educational background and training in research methods influenced my data collection since the data I collected reflects my "distinctive talents and limitations" (Angrosino & Mays de Pérez, 2000, p. 676). As Vidich and Lyman (2000) explain, social scientist investigators are observers who "make their observations within a mediated framework, that is a framework of symbols and cultural meanings given to them by those aspects of their life histories that they bring to the observational setting" (p. 39). I am a qualitative researcher with a theoretical background in RGS,VR, AT, and ANT. I do not have either quantitative methods training nor medical training. These 'distinctive talents and limitations' are part of the 'framework' that mediates my data collection. I took these influences into account during data collection by being aware of these factors, by endeavouring to minimize their influence when possible, and by carefully recording self-reflective commentary when these factors could not be minimized.

3.4.1 Document Collection

I selected documents for visual analysis through observation and interview data such that only those documents used during theoretically relevant episodes were analysed. These episodes became the contexts within which I assessed documents for similar meanings thus enabling my selection of comparable texts (Hodder, 2000). The document types I chose for analysis were the EPR-based printouts of patient summary information and the manual transformations of these summaries by nurses and physicians. Once I had selected the EPR- and paper-based documents for analysis, I created one anonymized example of each document type.

To construct the anonymized EPR-based patient record, the Patient Records Department at the hospital pulled five representative patient records from their historic record files. This selection was based on two criteria. First, these five records represented Nephrology patients who were on the ward for a minimum of 3 days but for no more than 7 days. With this time frame restriction, I avoided gathering patient records that were insufficiently detailed, or those that were too large to be anonymized efficiently. Secondly, these five records represented the patient illnesses that I observed most commonly on the Nephrology ward. I confirmed the common illness by verifying that the same 'reason for admission' was listed in each patient record. After this selection was made, I manually anonymized the five representative records by blacking out patient and hospital staff identifying information. Once I had completed this anonymization work, a manager from the Health Records Department verified my work and signed-off the records as completely anonymized.

Following this anonymization work and with the assistance of the hospital's Health Informatics Department, I compiled the five records into one representative EPR-based patient record entry. In this EPR record, I collected as many details as possible from the five representative patient records. For instance, although only 2 of the 5 representative patients had food allergies, the patient created in the EPR record had food allergies. In this way, I detailed as many fields as possible in the composite computer-based patient record. Finally, once the EPR patient entry was created, I printed the

summaries from the EPR that participants used in their daily work activities. In this way, all patient record documentation used for analysis was anonymous but still representative of the kinds of genres used by healthcare professionals on the ward.

I created anonymous examples of the manual transformations of EPR patient information summaries by compiling observation data describing these genres into a set of composite documents. Thus, I generated examples of the nursing and physician hand-made summaries by reviewing all observations of this document and compiling these observations into sample documents. I rendered any patient-specific information anonymous. Each sample of the manually created texts was a composite of more than five patients, ensuring patient anonymity in the example genres I generated.

3.4.2 Non-Participant Observations

Over the 8 months of the study (November 2004 to June 2005), I conducted 80 hours of non-participant observations (Bogdewie, 1999) of the daily interactions with all paper-, computer-, and orally-based patient related communications and record keeping practices. During these observations, I recorded the information work activities of the healthcare providers present on the ward. The 80 hours of observations resulted in 191 pages of detailed, structured field notes that recorded the content and context of conversations, the participants' interactions with various forms of communication, and the intended audience for relevant comments. As the observer, I minimized observer effect by employing unobtrusive recording equipment (clipboards similar to those used on the ward), by blending into the participant group through similar dress, age, and comportment (Bogdewie, 1999), and by being routinely present for long periods of time in the research setting (Hammersly & Atkinson, 1995). All field notes were rendered anonymous.

The study began with 3 weeks of descriptive observations that enabled me to gain a general understanding of how healthcare providers interacted with relevant record formats. I observed primarily in the nursing station area of the ward where both computer and paper records were housed. I also followed individual participants to other parts of the ward (including hallways and the ward staff room) when relevant communication activities were conducted in these settings. I did not enter patient rooms or follow participants off the ward. Observation sessions occurred at various times during the day. Since the day shift (8 a.m. till 6 p.m.) was the period of most frequent interactions with patient records, the majority of the observation sessions occurred during those hours. Observation sessions took place 2 to 4 times per week and lasted 3 to 5 hours. I did not interrupt the work practices of study participants, but was receptive to dialogue if initiated by a participant. I initiated dialogue with participants only if there was a natural break in their work processes and limited these dialogues to asking specific clarification questions regarding the work activities in which they had been engaged recently. I used standard field note methodology (Bogdewie, 1999) to describe observed activities, with reference to subjects by professional role only. I kept these detailed, structured field notes during the observations in order to record the content of conversations, the context of discussions, the participants and the intended audience for relevant comments, and the non-verbal nuances that accompanied these interchanges

(Hammersly & Atkinson, 1995). I did not record any identifying patient data in the field notes. Immediately following each session of observation, I elaborated upon the field notes in light of emerging analytical considerations in order to produce a set of reflective field notes (Hammersly & Atkinson, 1995).

Following initial analysis of the field notes from the descriptive observations, the project moved to focused and selective observations in order to concentrate on the areas of theoretical interest emerging from the ongoing data analysis. I discussed these areas of focus with three other researchers (SLL) prior to moving forward with focused and selective observations.

3.4.3 Interviews

I conducted semi-structured individual interviews with each of the nine physician participants and with 11 nurses, purposefully sampled (Kuzel, 1999) to include a breadth of professional nursing experience (novice to expert), until theme saturation (Glaser & Strauss, 1967) occurred. I conducted interviews based on participant availability resulting in a convenience ordering. Interview participants overlapped with participants in the observations. Interviews began in the third month of the study and then were distributed throughout the remainder of the study. The interviews ranged between 45-90 minutes in length and resulted in 202 pages of anonymized transcription. All participant-identifying features were removed during the transcription process. During interviews, I assumed an open-minded researcher stance in order to avoid as much as possible imposing my own structures and assumptions on the data collected (Britten, 1995).

I developed the interview script during observational data collection and analysis in order to explore emergent trends. Open-ended questions probed users' understandings of their use of electronic and paper records and, more broadly, their perceptions of the impact of record use on their work practices. Interview prompts were developed from the analysis of the observation field notes. Appendix 1 is a copy of the protocol I used during the interviews. I arranged follow-up interviews when participants were willing and when it was necessary to probe complex or conflicting issues.

3.5 Data Analysis

I analysed the field notes from the non-participant observations and the transcripts from the semi-structured interviews for emergent themes using a constructivist grounded theory methodology (Charmaz, 2000). In the grounded theory tradition, preliminary data analysis occurs in conjunction with data collection in an iterative and constant comparative process (Strauss & Corbin, 1998). Using this approach, I read all observation and interview transcripts recursively. As I identified emergent themes, sample portions of the data set were discussed with three additional researchers (SLL) to refine, challenge, and elaborate the developing thematic structure (Glasser & Strauss, 1967). These research meetings were held approximately every four weeks during the data collection and analysis process. At these meetings, we resolved discrepancies through referral to specific examples in the data. I ensured confirmability (Denzin &

Lincoln, 2000) by maintaining an audit trail of all analytical memos, minutes of the meetings with the additional researchers, and revisions to the coding structure. Through this recursive, constant comparative method, ten versions of the coding structure were developed. Appendix 2 is the final version of the coding structure that forms the basis of this study's data analysis. I applied this final coding structure to the complete data set, using a qualitative data analysis software (NUD*IST – N6) in order to facilitate cross-referencing (Kelle, Prein & Bird, 1995).

In the constructivist grounded theory tradition, I recognize that "the narrowing of research questions, the creation of concepts and categories, and the integration of the constructed theoretical framework reflect what and how the researcher thinks and does about shaping and collecting the data" (Charmaz, 2000, page 522). Therefore, I acknowledge that my research is informed by my theoretical background in RGS, VR, AT, and ANT; however, I actively and explicitly sought to bring in theoretically informed perspectives during data analysis only. The emergent themes were not overtly theoretically informed. In fact, the contributions of AT and ANT to the understanding of the study data were realized only after the complete set of emergent themes had been identified and saturated. In this way, this study avoided the grounded theory pitfalls of applying predetermined themes rather than seeking emergent ones (Kennedy & Lingard, 2006).

CHAPTER 4: THE FUNCTION IN THE DYSFUNCTION

In this chapter I report on this study's first stage of data analysis. During ward observations, I realized that every physician and nurse participant organized their daily work activities by referring to EPR-based patient information summary documents. However, instead of working with these genres within the EPR, each participant accessed printed versions of these genres and then manually transformed the printed data into new paper-based documents. In these manually created genres, participants adhered to profession-specific visual design commonalities. In this chapter's visual analysis, I investigate the collection of genres involved in this transformation work using the VR theory of Kress and van Leeuwen (1996).

In this chapter, and the remainder of this dissertation, I call these participant-made, visually re-formatted genres "Transformations." I use this label since these genres are not simply transcriptions of data from one medium to another, but are transformations of the original EPR-based patient summary data into new visual formats, in another medium. These Transformations relied on the EPR-based patient information as a data source, but users consistently altered the EPR-based summaries according to profession specific guiding principles.

4.1 Results and Discussion

In this visual analysis, I investigate the genres used consistently by nurses and physicians when conducting the daily activity of collecting and organizing patient summary information. Thus, for both nurses and physicians, I review the content and visual properties of: 1) the computer-based EPR patient information summary used by each profession; 2) the paper-based EPR printout versions of these same summaries; and 3) the two Transformation formats produced by participants of each profession. The following description highlights the guiding principles used in each profession's Transformations. Following these descriptions, I report on interview data that illustrate the participant explanations of why they regularly created these Transformation genres. I first describe results related to nursing activities, followed by those related to physician activities.

4.1.1 Nursing Observation Data

This section first describes the computer-based EPR patient summary, called the Patient Care Summary, provided for nurses to complete their task of organizing their daily care activities. Next, I describe the paper-based printout of the Patient Care Summary, and then explain the nurse-created Transformations. These Transformations were of two different formats: Complete Written Overhauls and Marginalia Additions. I address each of these Transformations in turn.

4.1.1.1 Computer-Based EPR Patient Care Summary

At the beginning of every shift, each nurse was typically assigned 3 patients who were to be under her care during that shift. Each nurse I observed during the study started his/her daily work activities by obtaining a Patient Care Summary for each of his/her patients. These Patient Care Summaries were obtained from the EPR. Appendices 3-14 present an anonymized example of the entire collection of EPR screens of a Patient Care Summary for a single patient. The amount of information visually available to users per EPR screen was fixed at a specified number of lines and so there was no scrolling function available. As a result, once users had accessed the first screen of the Patient Care Summary, they had to use the mouse to select the 'Next' function, located at the bottom of the screen, to access subsequent screens (See Appendix 3. To ease reading, this screen shot is reproduced in Figure 4.1.1.1.a).

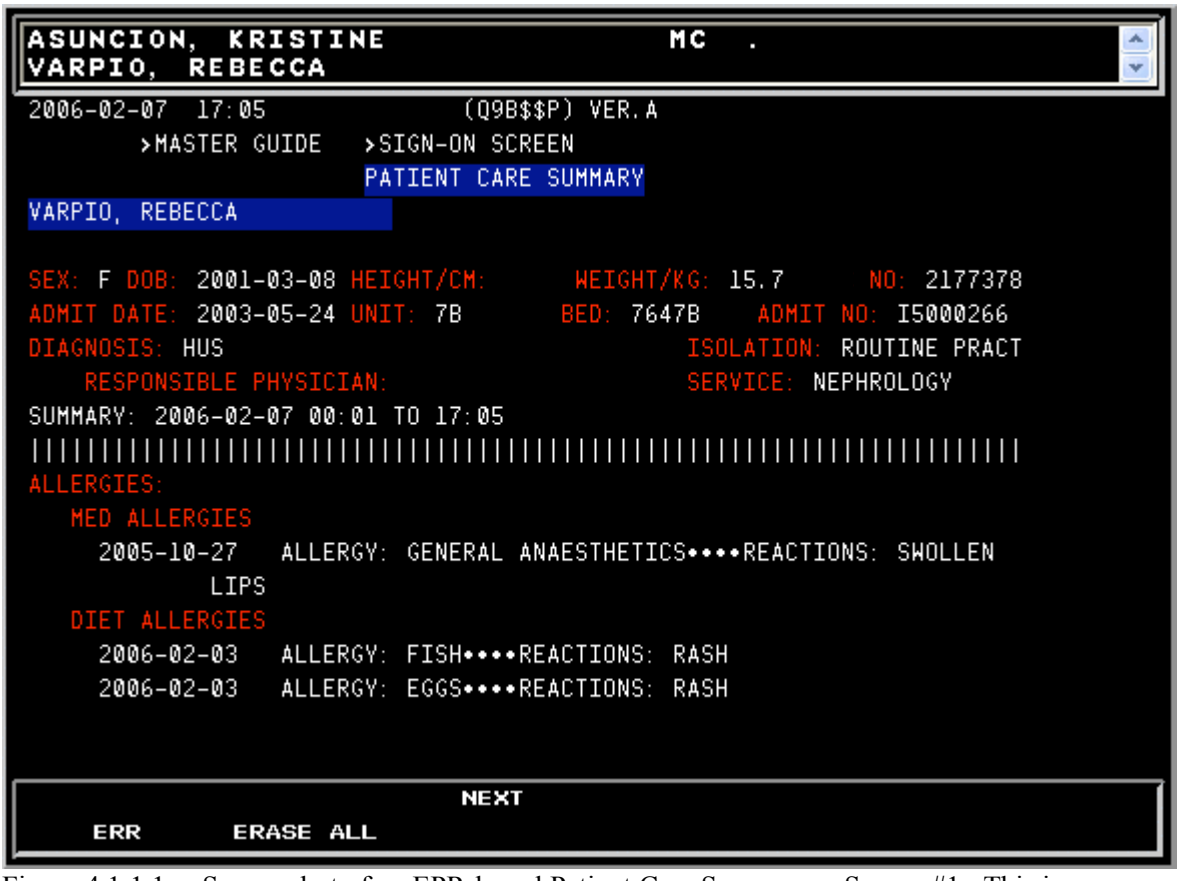


Figure 4.1.1.1.a: Screen shot of an EPR-based Patient Care Summary – Screen #1. This is an anonymous patient sample.

The screens and the categories of patient information found within these screens appeared in a pre-determined order. To navigate through the summary information within the EPR, the user progressed screen by screen, either forward via the 'Next' function or backwards via the 'Back' function.

As Appendix 3 and Figure 4.1.1.1.a illustrate, the EPR-based Patient Care Summary began with general patient data including the patient's name, sex, date of birth,

room number, and name of the responsible physician. This information was separated visually from the rest of the patient information by a horizontal slash line. Vertically following this visual separation, a series of headings highlighted by red font colour listed categories of patient information. Under each heading appeared text-based patient information relating to that topic. The general patient information was followed first by the "Allergies" heading and then its subheadings "Med Allergies" and "Diet Allergies." Accessing more summary information required moving ahead one screen via the 'Next' function. The next screen in the Patient Care Summary (see Appendix 4 and Figure 4.1.1.1.b) is a continuation of the "Allergies" information, with the "Other Allergies" subheading.

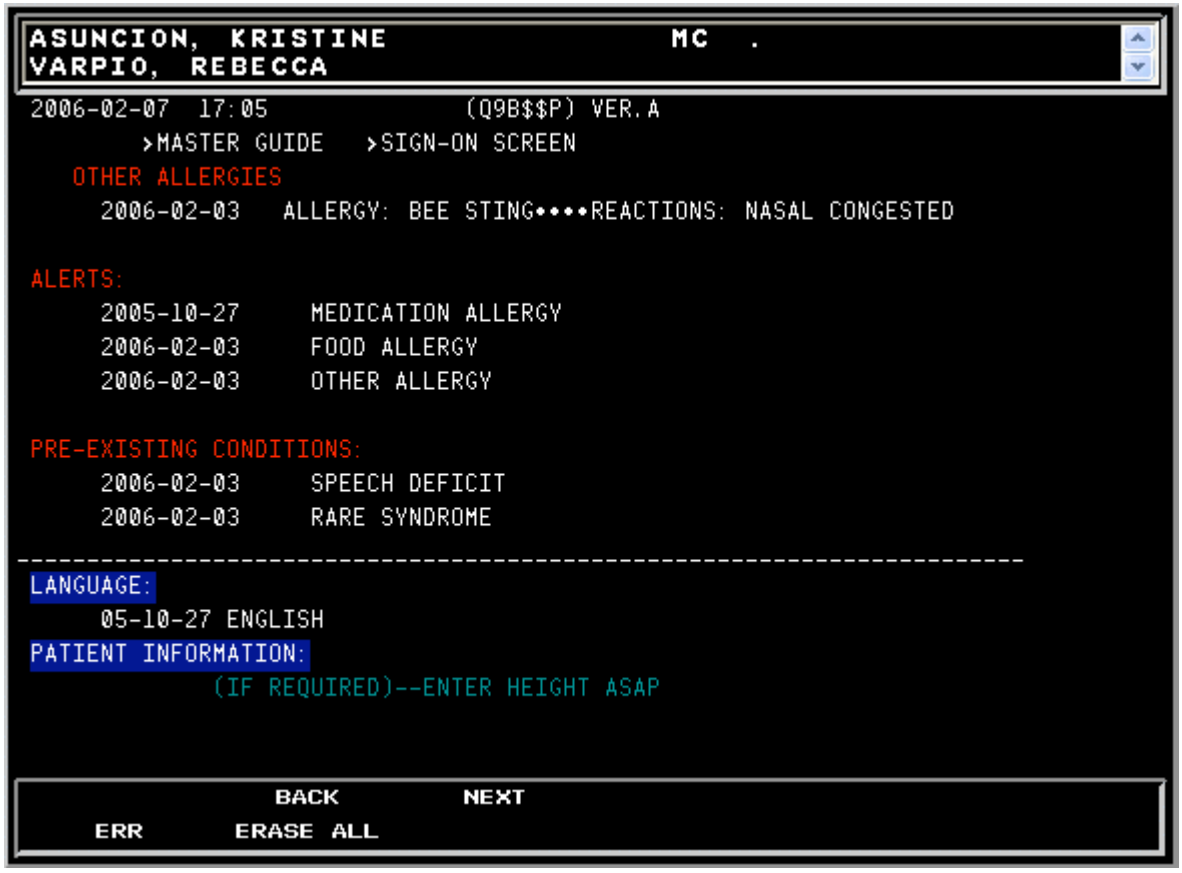


Figure 4.1.1.1.b: Screen shot of an EPR-based Patient Care Summary – Screen #2. This is an anonymous patient sample.

The second screen of the Patient Care Summary continued with the "Alerts" category heading, and then by the "Pre-Existing Conditions" heading. A dashed line then appeared, separating the "Allergies," "Alerts," and "Pre-Existing Conditions" categories from the rest of the Patient Care Summary. The second screen continued with lists of categories of patient information, first listing "Language," then "Patient Information" headings. To access the next screen of the summary, the nurse, again, had to use the 'Next' function. The screens of the Patient Care Summary continued in this categorical organization of patient information in a pre-determined, sequential ordering. The following list itemizes the headings used in the Patient Care Summary and indicates the

Appendix number for which an example of this information could be reviewed. The headings, from the first line of the Patient Care Summary to the last, progressed in the following order:

Table 4.1.1.1.a
Patient Care Summary Headings and Subheadings with Appendix reference number.

Patient Care Summary Heading (Level 1)	Subheading (Level 2)	Appendix #
Allergies	Med Allergies	3
	Diet Allergies	3
	Other Allergies	4
Alerts		4
Pre-Existing Conditions		4
Language		4
Patient Information		4-5
	History	5
Blood Product Information		5
Nrsg to Nrsg (Patient Care) Communication	Patient Profile	5
	Bathing	6
	Clothing	6
	Child Life	6
	Misc Nurse to Nurse	6
All Current Medical Orders	MD to Nursing Orders	6
	Misc MD to Nursing	7
	Nursing Procedures	7
	Vital Sign/Special Observations	7
	Unit Tests	7
	Transfer/Discharge Orders	7
	Nutrition/Food Orders	7-8
	Fluids	8
	IVs	8-9
	Scheduled Medications	9
	Unscheduled Medications	9
	Diagnostic Imaging	9-10
	Professional Services Orders & Referrals	10
	Lab Orders -- Haem/Biochem/TDM/Coag/Genetics	10-14

This sample Patient Care Summary is 12 screens in length and follows the EPR-prescribed order of headings. As a patient's stay in the hospital extended, the Patient Care Summary grew in length. The order of the headings remained constant throughout the patient's stay at the hospital, but information was added under each heading. As care activities were carried out, staff inputted patient data into the EPR. Then, the EPR automatically updated the Patient Care Summary details under the appropriate heading, listed in chronological order. The Patient Care Summary sample provided in Appendices 2-14 represents a 4 day long stay at the hospital.

Even though the EPR-based Patient Care Summary was a thorough collection of patient information, the nurses did not start their work days at the computer screen. Instead, they began their work at the printer. At the beginning of every shift, each nurse

received a paper printout of the Patient Care Summary for each patient under his/her care. With these printouts, the nurses manually began re-organizing the patient information into a different visual structure than that of the EPR's categorical divisions of sequentially ordered information. It was these manually created, re-organized paper-based documents that nurses used throughout the day to structure their work activities.

4.1.1.2 Paper-Based EPR Patient Care Summary

Since most nurses were responsible for three patients during a shift, the nurse generally started his/her work day activities with three different paper-based versions of the Patient Care Summary – one for each patient. The paper-based Patient Care Summaries were exact versions of the categorical and sequential listing of the patient information visually presented in the EPR (see Appendices 15-19). For the anonymous patient example used in this study, the 12 screen Patient Care Summary generated a five page printed document.

With the Patient Care Summaries for his/her three patients in hand, each nurse on the ward started his/her shift by creating a Transformation. Every nurse manually transformed the Patient Care Summary's categorical sequential visual presentation of patient information into a different visual layout. Nursing Transformations always followed one of two formats: nurses either created a Complete Written Overhaul (Appendix 20) or they wrote Marginalia Additions in the blank spaces of the paper-based Patient Care Summary itself (Appendix 21). Although Complete Written Overhauls were the format most commonly used by nurses, both formats will be described here since they shared notable similarities. Both formats followed a common visual re-organization that centered on one specific guiding principle: the creation of a single page timed-task driven schedule. This timed-task driven schedule emphasized tasks to be completed, when they should be completed, and for which patient. The following descriptions articulate how and why these re-designs and their guiding principles, consistent across both formats, constituted significant changes to the Patient Care Summary.

4.1.1.3 Nursing Transformation: Complete Written Overhaul

When creating a Complete Written Overhaul of the Patient Care Summary, the nurse began with a blank piece of paper upon which he/she drew a time-driven table (see Appendix 20). In the left hand column, he/she created a series of rows, one for each hour of the shift. Next, the nurse drew a series of columns to the right of the hourly breakdown, one for each patient. With this time-driven table created, the nurse continued by reading the paper-based Patient Care Summary for his/her first patient (Patient A) and translating that patient's information into the hourly chart. For example, as illustrated in Appendix 16, the paper-based Patient Care Summary stated, under the 'Vital Sign/Special Observations' heading, that the patient was to have his/her temperature, pulse, respiratory rate, and blood pressure measured every 4 hours (T-P-R-BP Q4H). The nurse transformed this information into the time-driven table by manually writing an entry for these vital signs to be collected at 4 hour intervals throughout the shift (see entries at 0800, 1200,1600, and 2000 hours on Appendix 20). Each entry took the form of a small, handwritten box followed by the abbreviation 'VS' (for 'Vital Signs'). This

box was later used as a checkmark box. At 0800 hours, when the vital signs for the patient were taken and recorded, the nurse entered a checkmark in the 'VS' box, indicating that the task had been completed. For every task that the nurse needed to carry out for a patient, be it for medication delivery, IV changes, imaging, flubotomy work to be arranged, etc., a checkbox entry was written into the chart, under that patient's name, at a specified time. As these care activities were completed, the nurse checked off that item on the Complete Written Overhaul, thus tracking the progress of nursing care for that patient during the shift.

At the bottom of the timed-task driven chart of the Complete Written Overhaul, the nurse regularly left an un-timed row below the last hour of the shift. Here, the nurse wrote tasks that needed to be completed that day but not at a specified time, and/or pertinent pieces of information about the patient's status that should be kept in mind throughout the shift. For instance, as illustrated in Appendix 20, Patient A needed a culture to be taken at some point during the shift, but not at a specified hour. Thus, at the bottom of Patient A's column, a checkbox entry entitled 'Culture' was written in the un-timed row. Or, again as illustrated in Appendix 20, Patient A had a PVL line as opposed to a PIV[7] line inserted. So, in the un-timed row for Patient A the nurse included the following entry: 'PVL.' Since there was no action required by the nurse, no checkbox preceded this entry. The visual representation of an un-timed care activity was similar to that of a timed-task, with an abbreviated textual description of the task being preceded by a manually created checkbox. In contrast, reminder items were visually represented in a different way. The PVL information had no preceding visual marker, only the textual abbreviation.

Once every item for the first patient was transferred to the Complete Written Overhaul, the nurse moved on to read the next patient's Patient Care Summary and to complete the next column of information (Patient B in Appendix 20). The nurse repeated this activity for each of his/her patients, transforming the paper-based Patient Care Summary information from a categorical, sequential order, to a single page overview of timed-tasks for specific patients. Once the nurse had created the Complete Written Overhaul Transformation, he/she did not retain the original Patient Care Summary. Instead, the nurse usually discarded the original EPR produced paper document for shredding.

4.1.1.4 Nursing Transformation: Marginalia Additions

In the second example of nursing Transformation, the Marginalia Additions, a similar timed-task driven information re-design was created manually (see Appendix 21). However, instead of producing a single page overview summarizing information on all the patients under the nurse's care during the shift, this Transformation created a single page overview for each individual patient. This overview took the form of Marginalia Additions to the front page of individual Patient Care Summaries. The same visual re-design of Patient Care Summary entries into checklists, both hourly and unscheduled as seen in the Complete Written Overhaul, was completed manually. However, in

[7] PIV (peripheral intravenous line) and PVL (peripheral venous catheter line) are two different kinds of intravenous lines that can be used for a patient. The distinction is often a significant one for physicians when they are placing orders for Nephrology patients.

Marginalia Additions, the individual patient 'to do's were created in the margins or other available blanks spaces of the Patient Care Summary's front page, not in a separate document. Nurses who created Marginalia Additions had some individual variation in their transformation strategies. For instance, using the previous vital sign example, the nurse may have used checkboxes similar to those seen in the Complete Written Overhaul (see Figure 4.1.1.4.a) or may have written a similar textual cue followed by a list of hours to be crossed-off (see Figure 4.1.1.4.b).

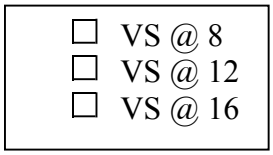


Figure 4.1.1.4.a: Marginalia Addition Checkbox Style

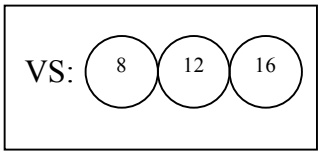


Figure 4.1.1.4.b: Marginalia Addition Cross-off List Style

As this example illustrates, visual transformations of individual entries may have differed in style between individual nurses but the change of visual organizational structure was common across all stylistic variations.

Nurses began creating the Marginalia Additions Transformation by reading the Patient Care Summary paper-based printout for their first patient. As they found entries describing tasks to carry out that day, they created a cross-off list of entries in the margins, or other blank spaces, of the Patient Care Summary's first page (see Appendix 21). For example, the 'Vital Sign/Special Observations' entry in the Patient Care Summary (see Appendix 16) for the sample patient calling for the monitoring of temperature, pulse, respiratory rate, and blood pressure every 4 hours (T-P-R-BP Q4H) was transformed into a cross-off list with four entries reading: "VS: 8, 12, 16, 20" each number enclosed in a circle. The circled number later served as a cross-off list. When the task was completed at the specified hour, the nurse crossed off that circled entry thereby indicating that that task had been completed (see example of hours 8 and 12 in Appendix 21). For every task that the nurse found within the text of the Patient Care Summary, similar timed-task Marginalia Additions were created. Thus, on the first page of the Patient Care Summary, the Marginalia Additions nursing Transformation created a time-driven overview of all nursing activities to be completed during the course of the shift for that patient.

As with the Complete Written Overhaul, Marginalia Additions transformed the EPR's visual organization of Patient Care Summary information from categorical divisions listed in a sequential order into a list of timed-tasks for the particular patient. Although the majority of the information the nurse required was present in the Patient Care Summary, the data was not visually presented in a manner that the nurse relied upon throughout the work day. In the Marginalia Additions example, the nurse used the Patient Care Summary as a source of information. This data was retained but it was visually transformed following this profession's guiding principle of organizing data into a timed-task driven schedule. In keeping with this guiding principle, Marginalia Additions highlighted what care tasks were to be completed, when, and for which individual patients.

4.1.2 Nursing Interview Data

During interviews, nursing participants regularly stated that Transformations were 'normal' parts of their daily work activities. Not only did participants regularly assume that nursing Transformations were common, but they also considered these documents to be self-evident pieces of their daily practices, requirements for making information easier to use. To illustrate, Nurse Z reported that "we [nurses] all do it [make Transformations]. Some people write everything on another page [i.e., make Complete Written Overhauls] with all this on it, but I like everything here on the front page [points to her Marginalia Additions]. That's easier for me" (Observation #0502). As Nurse F confirmed, the underlying reason for this practice was not a lack of available information in the EPR-produced Patient Care Summary printout. Instead, Transformations were associated with ease of use: "All the information is in the Patient [Care] Summary, but this is easier for me to use" (Observation #1118). When participants were asked to describe what made their Transformations 'easier to use,' participant responses, as highlighted below, addressed a common theme: visual clarity.

> Nurse Z: "This way, when there's lots to do, *I can see it* [italics added] and check it off and I put things here at the start of the shift. You know, read it all, and highlight. We all go through them like that. But then I can use the front page so *I can see it fast* [italics added]." (Observation #1118)
>
> Nurse BB: "I just always, just gaze at my care plan *so I see what everything is going on* [italics added]." (Interview)
>
> Nurse O: "It just helps you sort of *look at the day* [italics added]", "It's *easier to see* [italics added], I find, that is why I do it" (Interview)
>
> Nurse E: "I come on [shift], get my care plans, read them through, and then I make my cheat sheet so I can *visually see* [italics added] kind of what my day is going to entail" (Interview)

When asked to compare the EPR-produced Patient Care Summary printout with their nursing Transformations and to explain how the Transformations increased visual clarity and ease of use, the nursing participants described the information within the Patient Care Summary as presented in a way that did not enable them to carry out daily work activities quickly. By making either Complete Written Overhauls or Marginalia Additions, the nurses explained that they were visually reorganizing patient information in ways that let them successfully carry out their workload. As Nurse RR explained, the Transformations ensured not only that nurses did not miss patient care items (such as changing an IV) but also provided a system for recording the completion of tasks:

> It [the Patient Care Summary] is black and white on the paper, so looking at everything, and there are no spaces between a lot of things, so the lines are kind of squished and so you might forget that it is a day for an IV change or a dressing of some sort that is on that day (pause) and the writing part just helps me organize my day and it will say in one part, it will have on [the Patient Care Summary] your vital signs, and the next page might have your medications, so instead of looking to see it is 9 now (pause) flip, flip (pause) what do I have to do? *If it is all written out on every hour of the day you write down what you have to do. It's just easier to mark off what you have done* [italics added]. [Interviewer: "Right."] Just *visually I find it easier to be organized* [italics added]. (Interview)

As illustrated and highlighted in this excerpt, nursing Transformations were equated with increased ease of use of patient data and visual clarity. These, in turn, were equated with efficient personal organization. To know what they had to do, for whom and when, nurses had to see it. Performing nursing work in an organized manner required transforming the Patient Care Summary printout's categorical sequential visual organization of patient information into a timed-task visual organizational structure. As Nurse K summarized, the Patient Care Summary's visual organization was problematic, "it is just awkward to try and get exactly the information you want, and just that information" (Interview). The guiding principles of nursing Transformations supported that selectivity by presenting 'to do' entries, in hourly segments, divided by patient. These Transformations were easier to use as they were visually clearer presentations of patient data, thus facilitating professional work organization.

4.1.3 Physician Observation Data

Nurses were not unique in this transformation work. Physicians on the ward also actively transformed EPR patient summary documents in order to collect and organize patient information in ways that better supported their professional daily care work activities. In the following, I describe the computer-based EPR patient summary document, called a Medical Summary, that physicians used to start the task of organizing their daily care activities. Next, I describe the paper-based EPR Medical Summary, followed by the Transformation genres created by physicians. As with nursing Transformations, physician-produced Transformations were of two different formats: Complete Written Overhauls and Marginalia Additions. However, as the following illustrates, physician Transformations followed principles very different from those informing nursing Transformations.

4.1.3.1 Computer-Based EPR Medical Summary

The physicians started each day at the EPR computer terminal, accessing patient summary information. The summary physicians used, called a Medical Summary, was a categorically organized, sequential list of patient information. Appendices 22-29 present an anonymized example of the EPR screens of a Medical Summary for a single patient. As seen in the Patient Care Summary used by nurses, the amount of information visually available in the Medical Summary screens was fixed at a specified number of lines. Therefore, the physician used the 'Next' and 'Back' functions to navigate through the screens of patient information.

As Appendix 22 (to ease reading, this screen shot is reproduced in Figure 4.1.3.1.a) illustrates, the Medical Summary began with general patient data including the patient's name, sex, date of birth, room number, and the name of the responsible physician.

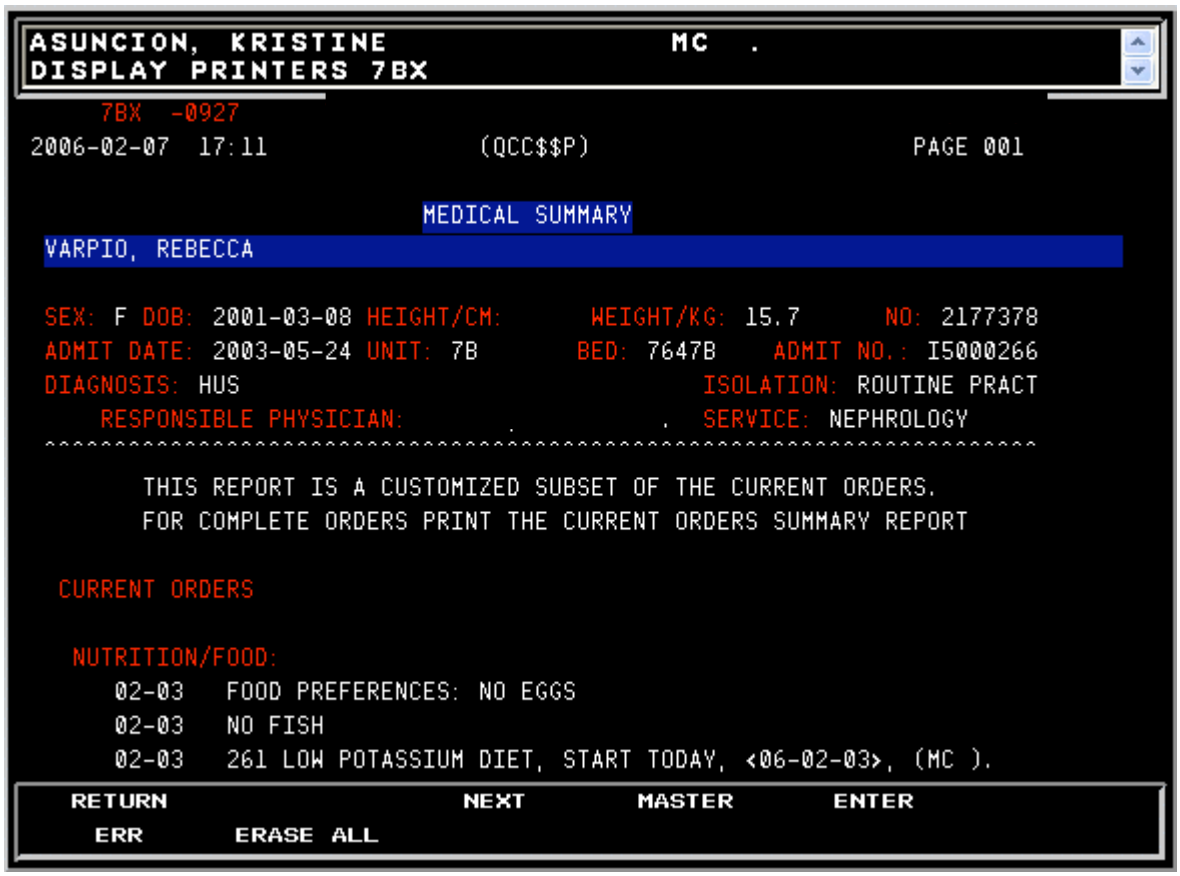


Figure 4.1.3.1.a: Screen shot of an EPR-based Medical Summary – Screen #1. This is an anonymous patient sample.

A horizontal dotted line visually separated this data from the rest of the patient information. Vertically following this visual separation appeared a series of category headings, emphasized by red coloured font. The general patient information was followed first by the heading “Current Orders,” and the subheading “Nutrition/Food.” The physician then used the ‘Next’ function to access the next screen of the Medical Summary (see Appendix 23 and Figure 4.1.3.1.a).

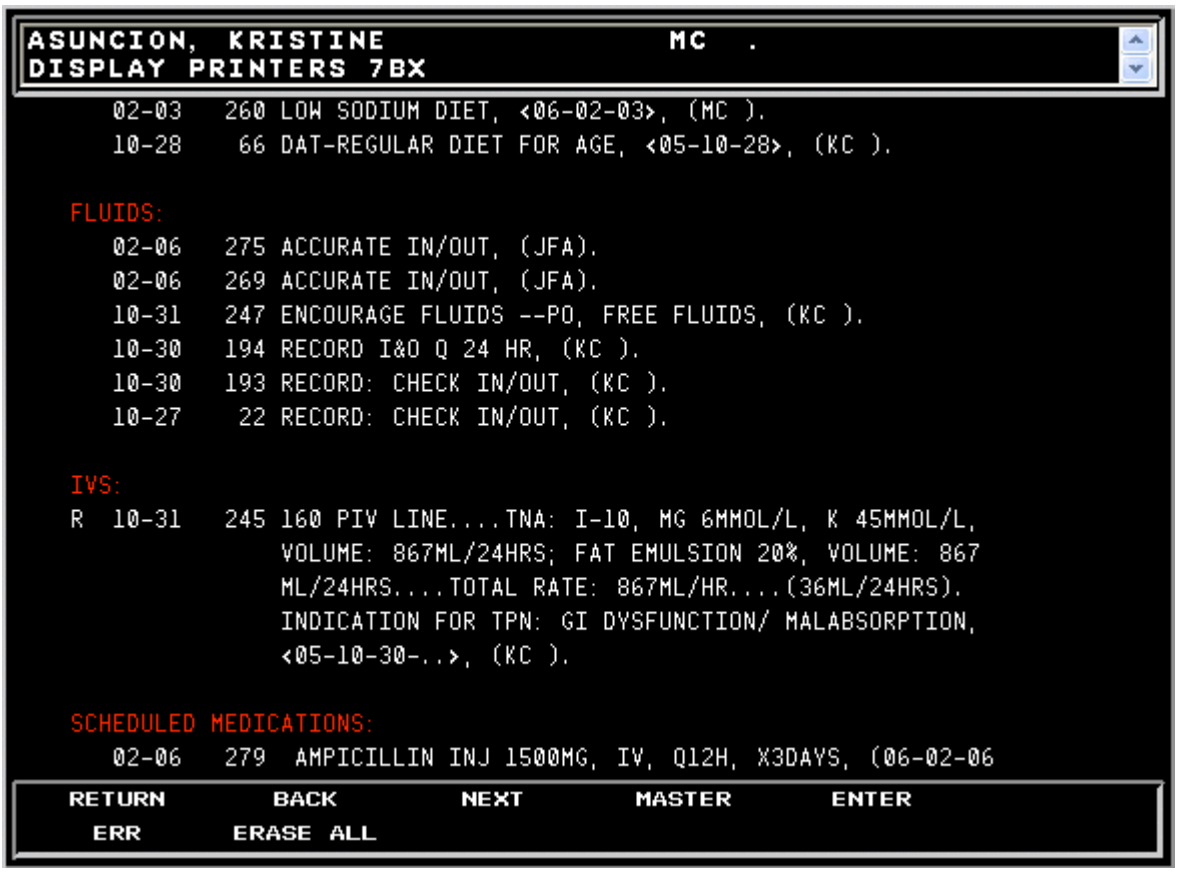


Figure 4.1.3.1.b: Screen shot of an EPR-based Medical Summary – Screen #2. This is an anonymous patient sample.

The summary information continued with the "Current Orders: Nutrition/Food" category and then advanced to the "Fluids," "IVs," and "Scheduled Medications" subheadings. The Medical Summary screens progressed through this categorical organization of patient information in a pre-determined sequential ordering. The order of these headings, from the first line of the Medical Summary to the last, was as follows:

Table 4.1.3.1.a
Medical Summary Headings and Subheadings with Appendix reference number.

Medical Summary Heading (Level 1)	**Subheading (Level 2)**	**Appendix #**
Current Orders	Nutrition/Food	20-21
	Fluids	21
	IVs	21
	Scheduled Medications	21-22
	Unscheduled Medications	22
	Laboratory	22-27

This sample Medical Summary was eight screens in length and followed the EPR's prescribed order of headings. Furthermore, like the Patient Care Summary, the Medical Summary grew in length as a patient's hospital stay extended. However, regardless of length of stay, the order of the headings in the Medical summary remained

constant. As physicians and nurses carried out care activities, they electronically recorded information under each heading, detailing decisions and activities in a chronological order. This Medical Summary example represents a 4 day long stay at the hospital.

Like nurses on the ward, physicians began their work processes at the printer, printing out paper copies of each patient's Medical Summary. From these printouts, physicians began collecting and manually reorganizing the patient information into a visual structure different from that of the EPR's categorical divisions of sequentially ordered information. Physicians used these re-organized paper-based Transformations throughout the day to structure their work activities. The guiding principles driving Transformations were to collect key pieces of patient data in a concise visual format and to separate them from 'to do' entries.

Complicating physician Transformations was the fact that the EPR-produced Medical Summary printout was not an inclusive overview of all the information that physicians required to organize their day. While the EPR's Medical Summary did include many important pieces of patient information needed for the planning of medical care, several patient data items that were crucial to care planning were not available. For example, a patient's fluid intake and output values, his/her current weight, blood pressure, and other significant clinical pieces of information were only available at the patient's bedside. Patient laboratory results also were not found within the Medical Summary and had to be accessed either through another EPR-based genre (i.e., EPR Laboratory Results) or through another electronic laboratory viewing system (i.e., Electronic Laboratory Results). Thus, important information for physician decision making was not accessible through the Medical Summary. Consequently, physicians augmented their Transformations of the Medical Summaries with additional information collected through various sources.

4.1.3.2. Paper-Based EPR Medical Summary

Each physician started workday activities by printing out a paper copy of the computer-based Medical Summary for each of his/her patients. The paper-based Medical Summaries were exact versions of the categorical and sequential listing of the patient information visually presented in the EPR. As Appendices 30-32 illustrate, the visual organization of information in the Medical Summary followed the same set of pre-determined categories and was displayed in the same sequential order as the EPR screens. For the anonymous patient example, the eight screens of the Medical Summary resulted in three printed pages.

For each patient, the physician manually transformed the Medical Summary's categorical sequential visual presentation of information into a paper-based, single page overview of key patient information and medical action items presented in a visually concise context. Physician Transformations, like nursing Transformations, can be sub-divided into two classes: Complete Written Overhauls (see Appendix 33) and Marginalia Additions (see Appendix 34). The following explains how and why these manually created visual re-designs significantly altered the visual organization of patient information within the Medical Summary. Although Marginalia Additions were the most

commonly created physician Transformations, I will describe both formats since they shared significant re-design features.

4.1.3.3 Physician Transformation: Complete Written Overhaul

To create a Complete Written Overhaul, as illustrated in Appendix 33, the physician started with a blank piece of paper, most often the flip-side of the last page of the patient's Medical Summary. In the top left-hand corner of the page the physician wrote the patient's name. Then, in the top right-hand corner, removed from the rest of the document data by hand-drawn lines, the physician noted the patient's most current vital signs. The remainder of the top two-thirds of the page consisted of a bulleted list of particularly key patient information. For example, key information entries might read: "abdo soft," "looks dry," and intake/output values. This information listed on the top two-thirds of the physician's Complete Written Overhaul was collected both from the Medical Summary and from other sources, such as clinical notes kept at the patient bedside or electronic laboratory result systems. The physician began by reviewing the information within the Medical Summary and transferring particularly significant pieces of patient data to the Complete Written Overhaul. Then, the physician collected and transcribed other pertinent pieces of patient information from other sources. Therefore, the top portion of the Complete Written Overhaul constituted a single-page overview of key pieces of information for an individual patient.

The bottom portion of the Complete Written Overhaul, delineated from the rest of the Transformation by a hand-drawn line, was reserved for the 'to do' items the physician created for the patient's care. These 'to do' entries were sometimes created while the physician was collecting and transcribing 'to know' entries, but also when the collection of 'to know' data was completed. The 'to do' or 'plan' items were regularly preceded by checkboxes. These checkboxes were checked-off throughout the day as the physician completed the tasks. For instance, in Appendix 33, the physician created a text entry reading 'DC acetaminophen' preceded by a small hand-drawn checkbox. This entry indicated that the current acetaminophen order for this patient had yet to be discontinued.

Appendix 33 illustrates one composite recreation of a Complete Written Overhaul physician Transformation. Occasionally, physician participants used other Complete Written Overhaul formats. These other formats could vary somewhat in visual structure from this example. For instance, other physician-made Complete Written Overhauls sometimes were less visually structured in terms of locating specific kinds of information in the top right corner of the page in a lined-off area. Some physicians compiled the vital sign information along with the other pieces of key patient information on the top two-thirds of the page. Another variable was the size of the paper on which the Transformation appeared. Instead of this sample's 8 ½" x 11" sized page, some physicians used cue card sized scraps of paper, while others used ringed notebooks ranging in size from 4½" x 8½" lined notebooks, to 11" x 25" unlined artist's sketchbook. However, regardless of the differences in visual structures or size of pages, consistent across all physician-created Complete Written Overhauls were the guiding principles of delineating between 'to know'/'to keep in mind' information and 'to do' information. Be it via a hand-drawn line or a visual gap between these categories, or be it via a preceding dash rather than a preceding checkbox, 'to do' items were always visually

distinct from 'to know' pieces of patient information. In this way, regardless of individual differences, physician Complete Written Overhauls consistently relied on the guiding principles of creating concise, single-page overviews of key patient information items and medical action items.

4.1.3.4 Physician Transformation: Marginalia Additions

In Marginalia Additions physician Transformations, a similar single-page overview of 'to know' and 'to do' patient information was created. In Marginalia Additions (see Appendix 34), physicians used the first page of a patient's printed Medical Summary to create a single-page overview of patient 'to know' information and 'to do' items. In the left- and right-hand margins of the first page of the Medical Summary, physicians manually noted key pieces of patient information, whether these items were transferred from within the Medical Summary itself, or from other, external sources of patient information. The bottom margin of the page was reserved for the 'to do' checklist, again complete with hand-drawn boxes for checking off. Different styles of bullets were used by physicians to differentiate pieces of patient information as either 'to know' or 'to do' entries. For example, when listing key pieces of patient information, such as fluid input and urine output levels, physicians often started the entry with a small arrow or without any preceding marker. Items within the 'to do' plan in the bottom margin were followed regularly by a checkbox. When a physician noted that a question had to be asked of someone, for example from a consultant from another service or department, he/she often used a question mark instead of a checkbox in the bottom margin 'to do' space.

Interestingly, even if the information that the physician required was within the pages of the Medical Summary printout, the physician still moved those pieces of patient information to the front page of the document. Thus, regardless of its original source, physicians who created Marginalia Additions, like those who created Complete Written Overhauls, followed the guiding principles of collecting 'key' patient information items together, visually, on a single page and visually differentiating them from 'to do' items.

4.1.4 Physician Interview Data

During interviews, I asked physicians to reflect on their Transformation practices. Participants regularly reported not only that these Transformations were commonly made documents, but also that they were necessary creations since they enabled the physician to manage the collection of, the organization of, and the reflection upon patient information.

As part of each interview, I asked the physician for his/her thoughts on the frequency of use of Transformations on the ward. Physician participants commonly replied that the creation of Transformations was a standard physician practice. The ward's senior staff physician explained that "every fellow and every staff doctor, I think every single one of us, use them [Transformations]. Of different sizes - but it is paper." The observations of less senior physicians supported this frequency of use. As Resident A explained, Transformations were not only common, but also an important part of a physician's practice: "Everyone uses it [Transformations]. It's a way of keeping track of

who's here [under your care] for the day. It's really useful. I make notes on it, lists of what I need to do, who I need to look in on, where I am in my day. It's part of my checks. Yeah, it's really useful to me, to everyone" (Interview). When I asked participants to elaborate on the usefulness of Transformations, to explain why Transformations were particularly helpful in their daily work practices, a recurring theme echoed throughout the interviews: the cumbersome visual organization of information produced by the EPR. As Staff A summarized, the visual design of EPR generated information was "cumbersome and unfriendly" (Interview). Physician responses, as emphasized below, confirmed the troublesome and unwieldy visual nature of EPR produced information displays:

> Staff D: "[The EPR] does have some good things. Like I can print these [Medical Summaries], but *I can't look at meds properly* [italics added]. They're in alphabetical order which makes no sense." – later that same observation session - "I need to know the whole order summary. Their labs and meds and diet. Everything. *There are so many pieces of information that I need and they're all here* [indicating the Medical Summary]. *Somewhere… I have to make sense of all of this* [italics added]" (Observation #0216)
>
> Fellow B: "I usually try to gather everything on the same paper, so what I see with the vital signs and all that stuff, I put everything down and special blood work I think of, I put it in the front page and then when I write my follow up I have *all the information in front of me* [italics added]." (Interview)
>
> Staff C: "I try when I am on the ward, or when I am doing consults, to kind of have *a page for each person* [italics added] that gives me some kind of *running idea of what the issues are and what information I am looking for* [italics added]." (Interview)
>
> Fellow C: "This is the plan…. This is where I put information from all different places… but this is the plan" – later that same day – "This [handmade overview] is *everything I need to know and my plan. All the pieces are here* [italics added]." (Observation #0302)
>
> Staff B: "like when I say I am doing a little flow sheet, so because *I am trying to put all of the information in one sheet* [italics added] (laughs) instead of having all of those different sources" (Interview)

These physicians noted, as italicized, both the need to have patient information visually available and the efforts they made to create single-page summaries enabling visual access to 'to know' and 'to do' information. Participants reported that the Transformations addressed the need to accomplish two goals: first, the physicians required the visual collection of key pieces of information into a single-page visual organization; second, they needed to interpret the collected information in a specific way in order to achieve their professional goals. As these physicians reported, in Transformations 'all the pieces' came together on a single page so that they could 'make sense' of the patient's status and needs.

Additionally, as these excerpts indicate, Transformations supported diagnostic work. Staff E explained that having all this information in one place was necessary for making appropriate diagnostic and care planning decisions for a patient. Staff E began this explanation by illustrating how various categories of information are required by a physician in order to understand a specific patient's case:

> If it is a new patient that is being admitted and a staff physician is hearing about this patient for the first time, or if the patient has been admitted within the last 24 hours, I might write down more detailed information regarding the history of admission, because that may require, you know, some thought in trying to determine the diagnosis, and so that additional information I consider maybe more important, if particularly the diagnosis is unclear. ….And then, from that point onward I will record the blood tests, the daily blood results in that book, so that I will have a sort of a daily running tabulation of those tests. (Interview)

As Staff E further explained, the Transformation process compiled on one page the various categories of information that needed to be collected, i.e., Patient History, Diet, Lab Results, Current Medications. Further, the Transformation also put patient data from within each category in visual relation to each other:

> …it really becomes context dependent. So that, so the information, the sort of the formula again that I use to process that information is, having established the formula, I know exactly how to, where to look and how to process that information, so I will want to know about fluids and electrolytes and typically I have sort of a system in my book so that I will write down the date, I will make a series of, I will write down say litres for blood test results like symbols or like, very early in our medical training we are taught to use sort of a geometric table and fill things in, which don't really have labels but we know that in this box we have sodium and in this box we have potassium chlorium, whatever and so I will write that down and then on, relative to that box I will put numbers that correspond to ins, outs, weights, and blood pressures. (Interview)

The Transformation document was a valuable visual context for the physician. This text, that brought specific pieces of patient information together into a visual context, supported diagnostic work and enabled a physician to organize information in a visual manner that was 'clear' from his/her professional perspective.

4.1.5 Results Summary

As these results indicate, in each profession, guiding principles shaped user Transformations. For nurses, the guiding principles were 1) to become acquainted with a patient's care requirements for that day (creating 'to do' notes) and 2) to structure their activities (organizing timing of each 'to do'). Nursing Transformations consisted of hourly schedules of tasks for each of their patients. For physicians, these principles were 1) to become acquainted with key pieces of patient data (collecting 'to know' information) and 2) to structure tasks (creating 'to do' notes). Physician transformations were overviews of key patient information items placed visually along side, but differentiated from, medical action items.

Both nurses and physicians indicated that the creation of Transformations was common professional practice and that these documents supported their professional work. Nursing Transformations were described as providing visual clarity, making it easier for the nurses to 'see' their day and the work required at each hour of the shift, for each patient. For nurses, their Transformations were equated with efficient professional work organization. Physicians similarly reported the need to make Transformations since

they required single page overviews of key patient data from which they could work diagnostically. By making Transformations, the physicians collected concisely all the key patient data so that they could 'make sense' of the patient's status and needs.

4.2 VR Analysis Results and Discussion

To better understand how re-designs of Patient Care Summaries and Medical Summaries created visual clarity for both nurses and physicians, I conducted a visual rhetorical analysis of both professions' Transformations. To narrow the focus of this discussion, I limited analysis of the nursing and physician Transformations to those most commonly used in each profession[8]. Thus, the following analysis examines the nursing Transformation of Complete Written Overhauls and physician Transformations of Marginalia Additions. Before examining these Transformations, I analysed the Patient Care Summary and the Medical Summary. For this analysis, I used the visual rhetorical tools of Kress and van Leewuen (1996).

4.2.1 Patient Care Summaries and Medical Summaries: All-Inclusive Collections of Equally Important and Interrelated Patient Information Items

The Patient Care Summary and the Medical Summary visually construct patient information as comprehensive assemblies of data. Within these all-inclusive collections, patient data are depicted as being of uniform significance and interconnected. This meaning is realized visually through an Analytical Process (Kress & van Leewuen, 1996, p. 89) that rejects framing devices (Kress & van Leewen, 1996, p. 214) and uses similar saliency cues (Kress & van Leeuwen, 1996, p. 212) for category headings.

The EPR printouts of the Patient Care Summary and the Medical Summary are examples of visual constructions that Kress and van Leeuwen call Analytical Processes (1996, p. 89). In visuals relying on Analytical Processes, the depicted participants, or visual information items, are portrayed in a "part-whole structure" (p. 89). In both the Patient Care Summary and the Medical Summary, the patient can be considered the 'whole' and the categories of information the 'parts' of the whole. Using Kress and van Leeuwen's terms, the Carrier (p. 89) is the patient who is described. The categories of patient information (such as 'Allergies' and 'All Current Medical Orders: Misc MD to Nursing' in the Patient Care Summary and 'Current Orders: Fluids' and 'Laboratory' in the Medical Summary), along with the details provided in each of these categories, are the Possessive Attributes (p. 89). Through this analytical visual presentation, the categories of patient information and the details within each category are presented visually to allow the users to examine critically the data, to "scrutinize the Carrier's Possessive Attributes" (p. 90). Thus, the patient is constructed visually as consisting of a collection of data categories and details.

[8] The other Transformation formats (i.e., nursing Marginalia Additions and physician Complete Written Overhauls) were so similar in their visual rhetorical analysis that narrowing the focus of this discussion to those Transformation formats most commonly used by each profession eliminates unnecessary repetition.

The Analytical Processes in these documents can be defined further as Exhaustive Analytical Processes (Kress & van Leeuwen, 1996, p. 97). Kress and van Leeuwen classify Exhaustive Analytical Processes as visual structures that "exhaustively represent the Possessive Attributes of a Carrier, so that all of the Carrier is accounted for, all of its space taken up by Possessive Attributes" (p. 97). Both the Patient Care Summary and the Medical Summary are constructed visually to convey to the user that these summaries are exhaustive, that all of the categories of patient information are represented in the printouts. When using the summaries, the individual user does not select categories for inclusion in the printout, nor their display order. Instead, the patient information categories are pre-selected and are displayed in a pre-determined order. Although users may not require data from every category, the complete set of categories is provided in every summary printout. And, while the user may wish to collect other categories of data from within the EPR (such as lab test results), there are no means through which to include more patient information categories in the summaries. Thus, the design of the EPR-provided summaries implies that all of the summary categories are significant and that other potential inclusions are of less consequence and thus can be omitted. This sense of exhaustive inclusion is reinforced visually since the pre-determined and previously ordered categories and content encompass the entire space of each summary page. In both documents, the space of the Carrier is filled completely with Possessive Attribute information. There is very little blank space within the text of the summaries, visually implying that "all of the Carrier is accounted for, all of its space taken up by Possessive Attributes" (Kress & van Leeuwen, 1996, p. 97). The analytical process of presenting information for scrutiny is Exhaustive.

Further supporting this construction of summary documents as comprehensive are the continuation cues at the bottom of summary pages. In both summaries, each successive page ends with the word "Continued," signaling that more pages of information follow, that more space is required for the full description of the patient. The listing of Possessive Attributes needs to 'continue' in order to define the whole of the Carrier. When the last line of the last category of patient information is listed, both summaries end with the phrase "Last Page." If any space remains on this last page, it is left blank. In marking the end of the summary information, the phrase 'Last Page' signals to the user that the remaining space is irrelevant and unintentional. The reader has come to the end of the exhaustive description of patient information. Beyond the borders of these categories, there is no pertinent information. In these ways, both the Patient Care Summary and the Medical Summary act as Exhaustive Analytical Processes that thoroughly present the patient through the detailed and comprehensive list of patient information categories.

However, as these authors recognize, "analysis always involves selection" (Kress & van Leeuwen, 1996, p. 90). The Exhaustive Analytical Processes present information "*as though* it is exhaustive, as though the Carriers have these major components and no others" (p. 98). By comparing the categories of information available in the Patient Care Summary to those presented in the Medical Summary, it is evident immediately that, in these 'exhaustive' summaries, a selection and a deselection of Possessive Attributes has occurred. For example, the sample Patient Care Summary (Appendices 15-19) lists 28 headings and subheadings for the sample patient. However, in this same patient's Medical Summary (Appendices 30-32), only six headings and subheadings appear. Thus,

categories of patient information are available in the Patient Care Summary that are not available in the Medical Summary. However, this does not necessarily imply that the Patient Care Summary is exhaustive. For instance, in neither the Patient Care Summary nor the Medical Summary is there a category providing details from Physiotherapy or Social Work notes. These professionals use the EPR to record patient information, but their records are not represented in these summary documents. In these ways, the summary documents are both selections and deselections of patient information. However, the summaries present the Carrier and Possessive Attributes 'as though' they provide an exhaustive description.

Through their overall composition, the Transformation documents also visually convey an equality of value among the categories of patient information and their interrelated nature. In the visual layout of the Patient Care Summary and the Medical Summary, header and footer information are constant in that they are repeated on each page of both summaries. In the header space, both summaries begin each page by identifying the following: the name of the summary type, the patient's name, sex, date of birth, height, weight, hospital patient number, admission date and number, location in the hospital in terms of ward, bed number and service, diagnosis, isolation levels, and responsible physician. In the footer space, the patient's name, hospital patient number and the name of the summary type are repeated on each page of both summaries. These header and footer descriptions become anchors for the information in both texts. The consistent reappearance and unchanging structure of these anchors weakens their relative saliency, making them visual elements that are not accorded great visual importance. Instead, visual importance is accorded to the patient information that is presented between these anchors, in the space where patient data is listed and evolves between each printout. Here, no framing lines divide the categories of patient information. Instead, only blank spaces separate Possessive Attributes from each other. The lack of strong framing devices implies that these items belong together, that together they compose "one unit of information" (Kress & van Leeuwen, 1996, p. 215). Without frame lines, categories of patient information are presented visually as related and connected.

This connection between categories is constructed again as a relation among equals since each category shares a similar level of saliency with the other categories in the summary. In the Medical Summary, all headings and subheadings are in the same font size and all are bolded, differentiating the headings from the content data. In this genre, each heading has the same visual weight and, thus, the same level of saliency. In the Patient Care Summary, category headings and subheadings similarly use a consistent font size and bold function. Although some first-level headings use a larger font size, this distinction is used only in a few instances (5 of the 28 headings). Since saliency is assessed as "a complex trading-off relationship between a number of factors" (Kress & van Leeuwen, 1996, p. 212) and since other factors are relatively similar between all the headings in this genre (i.e., having only occasional and slight deviation in size, having similar tonal contrast, and having similar placement in the visual field), all the headings in this document can be considered as having relatively equal visual weight. The categories of information are thus presented as being of relatively equal saliency and of equal importance. In practice, however, not all patient data is equally relevant to a healthcare professional's work. Some data (for instance food allergies) may be particularly important to some professionals (such as the nurse who feeds infant patients),

but not as relevant to others (including, for instance, the physician who orders a CAT scan for the patient). And yet, in the summaries of patient information, no particular Possessive Attribute is depicted visually as more important to the care of the patient, to the understanding of the Carrier's condition, than another. In this equality, the Patient Care Summary and the Medical Summary offer the viewers the complete complexity of patient information for analysis, allowing viewers to view critically all the Carrier's Possessive Attributes as equals and thus all potentially significant.

In these ways, the Patient Care Summary and the Medical Summary visually construct their content as all-inclusive collections of equally important and interrelated patient information data. It is these visual constructions that are re-worked in professional Transformations.

4.2.2 Nursing Complete Written Overhaul Transformations: Per Patient Timed-Tasks

Visual analysis relying on the work of Kress and van Leeuwen (1996) reveals that nursing Complete Written Overhaul Transformations (Appendix 20) make use of visual constructions significantly different from those of the Patient Care Summary. This nursing Transformation visually confirms the profession's guiding principles, considerations of 'what to do', 'when', and 'for whom.' Through the use of a Temporal Analytical Process (p.95), Given/New composition spaces (p. 186), and visual framing devices (p.214), patient data in the Complete Written Overhauls are changed into nursing care activity checklists, organized in an hourly schedule for sequential consideration.

The nursing Complete Written Overhaul Transformation is an example of a Temporal Analytical Process (Kress & van Leeuwen, 1996, p. 95). A Temporal Analytical Process is defined by these authors as a time line where information is presented "on an actual or imaginary line" (p. 95). In creating a Complete Written Overhaul, a nurse designs an actual "topographical" (p. 95) time line through the construction of a table of information. In this table, the far left-hand column lists each hour of the nurse's shift in a vertical line. Each hourly division is of equal visual size, "drawn to scale" (p. 95), reflecting the equal amount of time available per hour to complete the necessary care activities for all patients under his/her care. Each patient has his/her own column in the table. The patient's name is listed at the top of their respective column. In the individual cells of the table, the nurse creates checklists of activities. The nursing Complete Written Overhaul Transformation, thus, is a visual representation of a time line of care activities, presented in a "whole-part structure" (p. 89) where the 'whole' is the entirety of the shift in question, and where the 'parts' are the individual care activities to be completed.

The Complete Written Overhaul Temporal Analytical Process clearly reflects Kress and van Leeuwen's Given/New composition structure (1996, p. 186). In the Given (p. 187) space (left hand space) appear the hours of the shift, and in the New (p. 187) space (right hand space) are the columns of care activities for each patient. The hours of the shift are aligned in the space of the "agreed-upon point of departure" (p. 187). For these professionals, the hourly division of work activities is the "commonsensical" (p. 187) starting point for their professional work organization. In the space of the New is the information requiring "special attention" (p. 187) and, thus, the checklists of work

that nurses need to complete are appropriately located there. Within this patient driven timed-task table, more organizational divisions are realized through the frequent use of visual framing devices. In this Transformation's table, dividing lines of the columns and the rows separate each hour of the shift and maintain separation between and among each patient, as well as patient to patient care activities. The timed care activities for each patient are presented visually as separate units, highlighting the "individuality" (p. 215) of each patient's care and underscoring the need for "differentiation" (p. 215) between both the times when certain 'to do's should be completed and towards whom those activities should be directed.

By examining these Transformations using Kress and van Leeuwen's (1996) Temporal Analytical Process, Given/New composition spaces, and visual framing devices, nursing Complete Written Overhauls can be seen as visually supporting the nursing guiding principles of creating 'to do' notes, for each patient, in a time driven organization. It is such visual alterations that nurses described as having visual clarity – not surprisingly since the Transformation's visual elements mirror the profession's guiding principles. This visually altered genre organizes nursing work according to the 'commonsense' starting point of the hours of the shift, and structures the presentation of each patient's associated 'to do' activities as framed distinctly from those of other patients.

4.2.3 Physician Marginalia Additions Transformations: Concise Collection of 'To Know' Removed from 'To Do'

Analysis using Kress and van Leeuwen's visual grammar demonstrates that physician Transformations also reject the all-inclusive collection of equally important and interrelated patient data items of the Medical Summary and construct visually a different organization of data. Physician Marginalia Additions Transformations (Appendix 34) construct a more limited view of patient information, bringing together selections of key pieces of patient data in a succinct visual format and visually removing them from 'to do' entries.

The physician Marginalia Additions Transformation constitutes an Analytical Process (Kress & van Leeuwen, 1996, p.89), but one that visually relies on the composition structure of Ideal/Real (Kress & van Leeuwen, 1996, p.193) to realize that Process. In Marginalia Additions, the line at the bottom of the Medical Summary page that delineates the footer information from the rest of the patient data is used as a strong framing line. This line divides the top Ideal (p. 193) space from the bottom's Real (p. 193) space. In the margins of the Ideal space, a physician collects key pieces of patient data from various different sources (i.e., from the Medical Summary itself and from other genres on the ward) into a concise summary, not extending beyond the space of the first page of the Medical Summary. While the entries in the Ideal space constitute an all-inclusive patient data review, it is an inclusivity much reduced and vetted from that of the Medical Summary. In the Marginalia Additions' 'to know' entries, a physician transcribes only data points that are especially germane to the patient's current status and to the decisions for future care planning that need to be made. The depth of content reflected in the Marginalia Additions' space of the Ideal is limited to the "generalized

essence of the information" (p. 193). A physician uses the space of the Ideal to collect key patient data items that require his/her professional attention.

In the bottom margin of the page, visually framed off from the space of the Ideal by the footer's horizontal dashed separation line, a physician creates 'to do' entries. Here, in the space of the Real, the physician separates the 'to do' notes from the 'to know' entries. In the composition space of the Real, these 'to do' notes are presented as "more specific information (e.g. details)" (Kress & van Leeuwen, 1996, p. 194) than the Ideal's 'to know' entries, and as "directions for action" (p. 193). In Ideal/Real driven compositions "there is usually less connection, less ongoing movement, between the two parts of the composition" (p. 193). The physician Marginalia Additions Transformation relies on this lack of connection to distinguish 'to know' data from 'to do' entries. While the 'to do' entries are based on the information collected and recorded in the space of the Ideal, the professional activities implied in these 'to do' entries are markedly different than the 'to know' entries. Through this reliance on the spaces of Ideal and Real, the physician Marginalia Additions Transformation support the professional guiding principles of collecting 'to know' information and creating 'to do' notes.

Kress and van Leeuwen's (1996) Ideal/Real composition structures help to explain how physician Marginalia Additions visually support the profession's guiding principles. In creating this Transformation, a physician is able to "make sense" (Staff D, Observation #0216) of the depth and breadth of patient information provided in the Medical Summary. Through this re-visualization of information, physicians increase the visual clarity and organization of the patient data as per the needs of the medical profession. As Staff E summarises: "I will set up my own little computer page, if you will, on my page, and that will have my information for me, it will allow me to organize my thoughts clearly on that patient" (Interview).

4.2.4 VR Discussion: Summary

As this analysis illustrates, the visual designs of the user-made Transformations support each profession's guiding principles. In this way, the nursing and physician Transformations visually present information in ways that better support users' professional work. A consideration of the EPR's function provides some insight into this disjoint between EPR-based summaries and the professional Transformations. Mann and Williams (2003) state that a medical record, including an EPR, serves two functions: primarily, it supports direct patient care and, secondarily, it acts as a medico-legal record. As Sarangi and Roberts (1999) suggest, an information system like an EPR needs to support institutional functions but also needs to be used by individuals to support professional functions. This chapter's rhetorical analysis shows that the Patient Care Summary and the Medical Summary are oriented visually to prioritize the social actions of comprehensive data inclusion, of equality of data importance, and of the interrelated nature of all patient information. These EPR-generated summaries could be associated with an institutional goal of maintaining a patient's medico-legal record. Through this visual organization, these summaries visually signify the comprehensive collection of patient information and act as the eternal memory of patient data collected within the hospital.

However, this same visual organization does not correspondingly facilitate professional work activities. As this discussion demonstrates, nurse and physician Transformation genres visually prioritize the social actions of organizing patient information to further care, be that work to complete nursing care activities in a timely manner or to collect pertinent patient data to make future care decisions. These Transformations could be associated with professional goals of supporting daily patient care activities. More research is required to investigate the potential root cause(s) underlying the disjoint between EPR-based summaries and user-made Transformations. This future research might investigate the explicitly described and implicitly expected functions of the EPR within a range of contexts, from the individual experiences of the healthcare professional user, to the application requirements of the professions, to the requirements of the hospital as an institution. Such investigations would add valuable insights to our understanding of the disjoint between the EPR-based summaries and the Transformations users create from those summaries.

Regardless of future research considerations, the analysis from this stage of the study demonstrates that visual representations and designs used in a genre convey messages to the users. Furthermore, this analysis illustrates that the visual designs of user-made Transformations make visual statements supporting professional guiding principles. Thus, the visual representations of a given genre can provide important insights into the social actions of the genre.

In general, the rhetorical analysis of the visual components of patient records has gone unattended and has been assumed to be objective 'givens.' This stage's analysis helps to demonstrate that visual structures of patient records function rhetorically. Important contributions to the understanding of genres can be achieved by bringing context, visual rhetorical, critical awareness to bear on patient records.

4.3 Conclusion: Automation of Transformations vs. the Function in the Dysfunction

Since both nurses and physicians on the ward regularly rejected EPR-based patient summaries in favour of creating their own Transformations, and since these Transformations followed specific guiding principles both in terms of content and visual designs, I concluded that automating the Transformation documents would be a beneficial re-design suggestion to present to the hospital and the EPR-system support staff. This re-design suggestion of centralizing the creation of Transformations is in keeping with a common "fieldwork-to-formalization" method (Spinuzzi, 2003b, p. 21) that works to formalize worker innovations. As Spinuzzi explains, such methods "tend to normalize behavior and tools to produce centrally controlled, official solutions" (p. 21). By automating Transformations, these user-based solutions would be adopted by the hospital and incorporated into the EPR.

This re-design proposition, if implemented, could benefit users by removing the onerous task of making Transformations from their daily work activities. This stage's findings indicate that the creation of Transformations was an additional work load for each healthcare professional. Creating each Transformation was a time consuming task and was an additional cognitive action to be completed by the healthcare professionals before their daily care activities could begin. The time devoted to creating

Transformations was especially troublesome in cases of particularly ill patients. As discussed in the results, as a patient's admission grew in length, so did the information entered into the EPR. Consequently, when a patient was hospitalized for an extended duration, his/her summary documents could become overwhelmingly long. As one nurse commented while working with one particularly dense Patient Care Summary: "Her care plan is eleven pages long! That's a lot to read through" (Nurse N, Observation #0302).

With this visual analysis completed, and with findings and re-design suggestions discerned, I conducted several presentations to report back to users and to medical research communities. It was during the question periods of these presentations that audience members challenged my re-design suggestions. Although the disjoint between the summaries' institutional purpose and the Transformations' clinical purpose seems dysfunctional and in need of a 'fix' to save professionals' time, audience members commented that the transformational activity may have some functionality. As they created Transformations of their patient summaries, the physicians and nurses acquainted themselves with the particularities of each case and, based on those details, they organized their care activities for the day. This process served the important cognitive function of enabling healthcare providers to assimilate large quantities of patient information. While the act of creating Transformations required extensive examination of patient data, this cognitive reviewing function was not acknowledged explicitly by most participants. Participant rationales for the transformation process focused only on the cumbersome visual design and on the need to renovate the data presentation in order to complete their daily work.

User-created Transformations likely were motivated by a need both to re-visualize patient information and to review those same data. Therefore, while automating Transformations designs through the EPR could decrease professional workloads, the process of creating these documents may be important to patient care and perhaps should not be circumvented. Thus, although the re-design suggestions were supported theoretically by the visual analysis findings and the results of observation and interview data, these re-designs would not necessarily fulfill the promise of being beneficial to users. Automating Transformations may have the paradoxical effect of making physicians and nurses less acquainted with their patients since they would not have to review patient data as intensively as they did in this study. Had these re-design suggestions been implemented by the hospital, the benefits associated with the manual creation of Transformations could have been lost.

These findings of persistent nurse- and physician-created Transformations show that that the current visual organization of EPR-based information results in an increase in professional work load demands and thus may be incompatible with professional work. However, the pervasiveness of this activity – conducted by all observed physicians and nurses at the beginning of every observed shift – suggests that Transformations could be a critical bridge between the patient data an EPR generates and the use of those data in the work of care delivery. Therefore, this first stage of analysis suggests that there may be a function in Transformation 'dysfunction' that should not be ignored.

4.4 Conclusions Revisited: A Problem of Scope

The findings from this first stage of analysis revealed that, while conclusions and re-design suggestions from the visual analysis were sound and held the promise of impacting on professional practices beneficially, the practical implications of their implementation potentially could have been detrimental to those same professional practices. These conflicting findings revealed that the critical and analytical scope of this first stage of analysis was too narrow. This stage's analysis includes several contextual considerations surrounding the professional healthcare workers' task of collecting and organizing patient information in order to structure daily patient care work. These contextual considerations are: the full range of genres associated with this task (including the computer-based EPR patient summaries, the paper-based versions of these summaries, and the different formats of user-made Transformations), observations of participant interactions with these genres in the ward setting, interviews probing the use of these genres and other communication structures and systems in the setting, and a visual rhetorical analysis of the non-linguistic structures of the genres used to complete this task.

However, this contextual scope was insufficient. The analysis failed to take into consideration: 1) the role of the particular communicative task being examined within the larger scope of other healthcare related activities taking place on the ward; 2) each profession's work-related goals (goals that extended beyond the scope of the task at hand to encompass the larger goals of the profession itself); and 3) the larger context of inter-professional work and communication requirements of the ward. In order to develop a sufficiently complex and contextually informed understanding of ward communication practices, including professional and inter-professional ramifications, I needed to develop an approach for supporting a broader scope of analysis. The next chapter describes and exemplifies the analytical approach I apply, called context mapping, to address this requirement.

CHAPTER 5: CONTEXT MAPPING

This study's first stage of analysis demonstrated the need to explore the concept of a genre's context more fully in data analysis. To fulfill this need, in the second stage of data analysis I develop context mapping, a five-step approach to data analysis that generates a complex and broad-scoped appreciation of the social contexts, the social actions, and the other genres influencing ward information work. This approach supports the description of some of the professional, inter-professional and practical implications of information work practices.

Context mapping needs to address several considerations in order to relate to study data. First, study data demonstrated that physician and nurse daily information work did not center around, nor within, any single genre. Ward information work was carried out through a variety of interconnected genres. Second, no single care team member controlled information work. Although some individual healthcare professionals were more active in a patient's information work at certain times than others, no one individual was solely responsible for a patient's information work. Instead, ward information work was conducted in an intensely collaborative work environment that involved a constant change of team members. In fact, information work was achieved through the coordination of many genres and the work efforts of several different collaborators. Thus, context mapping needs to respect the distributed nature of information work. Further complicating the realization of ward information work was the fact that, in completing their daily information work, participants persistently generated several different genre-based innovations. Although these healthcare professionals frequently used genres produced by the hospital, they also regularly modified these genres and/or created new genres to meet their information work needs (as seen in the creation of Transformations[9], discussed in chapter 4). Context mapping has to address these user-generated improvisations.

---

[9] In many studies, the term "workaround" is used to describe the transformation activities I observed. However, I avoid using this term in my research. Gasser (1986) describes workarounds as means of "intentionally using computing in ways for which it was not designed" (p. 216) or of avoiding the use of a particular computer technology and instead "relying on an alternative means of accomplishing work"(p. 216). More recently, Pollock (2005) notes that the alternative means that Gasser describes ranged "from users entering inaccurate data to bypass weaknesses in existing systems, to users simply manually carrying out the procedures the computer system is meant to do" (p. 511). Pollock proposes that this definition of the term workaround is an account of "how actors, through deploying some forms of effort or skill, are able to overcome a difficulty or a constraint imposed by a technology" (p. 511). A workaround in these terms thus represents an active resistance on the part of the user and an intentional effort to overcome a weakness in the technology.

I avoid using the term 'workaround' in this research project for three reasons. First, the term's definition assumes that a workaround points to a problem or weakness in the technology that should be addressed critically in an effort to overcome a design flaw. Traditionally, computer researchers have created these solutions in the form of fieldwork-to-formalization interventions (Spinuzzi, 2003b, p. 11). Typically, these interventions involve the institutionalization of the worker-created workaround into the computer system. In this first stage of study data analysis, I found that, while implementing such a fieldwork-to-formalization solution might improve a design flaw at one level of context, such implementation could prove to be detrimental at another level of context. Thus, I want to avoid using terminology that implies a necessary link between the creation of workarounds and the need to change the computer system to obtain improved outcomes. I feel that workaround, as it is currently defined, does not make room for the function in the dysfunction.

The first three steps of context mapping compile study data into results that accommodate a wide range of context considerations. In step 1, I construct a composite scenario describing a typical sequence of inter-professional daily information work events, activities, and patterns that recurred in a typical shift. The scenario illustrates the collaborative nature of ward information work and the variety of genres used by collaborators. In the second step, I build two genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000) from the genres most commonly used in ward information work by physicians and nurses. A separate ecology is constructed addressing each profession. These genre ecologies detail the genres used professionally on the ward, their mediatory roles and relationships, and contextualize how users rely on existing genres to generate genre-based innovations. In step 3, I identify starting points for analysis. It is beyond the scope of this investigation to address, in detail, every genre and every genre-based, user-created improvisation employed by healthcare professionals in their information work. This study's original focus was EPR-based communications and, since study data revealed recurrent patterns of user-created variations involved in tension-filled interactions with these communications, I rely on EPR-based tension-filled interactions and their associated modifications as starting points for this second stage of analysis. These starting points should not to be mistaken as the focal points of analysis; instead, they are sites for initiating a broader scope analysis of information work.

The fourth and fifth steps of context mapping involve analysis of the results described in the first three steps. Steps 4 and 5 seek to answer the following question:

> When an EPR-based communication innovation occurs, what are the ramifications of genre-based improvisations across genres of the ecology, and across the interdisciplinary information work activities of the ward?

I begin to answer this question in step 4 by analysing the results from steps 1, 2, and 3 through the theory of Knotworking (Engeström, Engeström & Vähäaho, 1999).

Secondly, as Gasser's (1986) and Pollock's (2005) definitions indicate, the term workaround is applied primarily to problems with computer technologies. My research shows that study participants needed to work around not only design flaws in the computer-based EPR, but also flaws in written communications. Consequently, I avoid the use of the term workaround in order to prevent a computer-only application bias.

Finally, the field of RGS research commonly acknowledges that part of an agent's ability to work with genres, and through genres with others, is founded on shared perspectives, values and ways of acting. These parameters, shared by community members, allow "individuals who understand the genre to predict, anticipate, respond to, and negotiate the 'moves' of other participants" (Coe, Lingard & Teslenko, 2002, p. 6). Genres are not static structures that must be adhered to absolutely but instead "embody situational expectations and ranges of potential strategic responses" (p. 6). To use a genre in a novel way is not necessarily to 'work around' a weakness; instead, novel genre uses can be considered a means of negotiating a new 'move' within the community. Therefore, I avoid the use of the word workaround in order to provide for such novel genre-based social actions.

Consequently, instead of using the word 'workaround' in this or the remaining chapters, I have relied on words such as innovation, improvisation, alteration, tinkering, modification and variation. I use these terms to address two situations. First, I use these synonyms to label actions where a study participant, confronted with problems in using any one genre, creates a novel solution via the same or another genre. Secondly, I also use these terms to address situations where a participant, contending with the effects of such a novel solution generated by someone else, must create their own communication innovation. Both of these participant actions are examples of genre-based innovations, improvisations, alterations, tinkerings, modifications and variations.

Knotworking analysis supports a broad critical focus, one distributed across participants and across genres used in information work. This step's analysis identifies ward information work as an instance of Knotworking and reveals how innovations at one node of a genre ecology result in the creation of more alterations across other nodes of both the physician and nurse ecologies. Additionally, step 4 investigates some of the implications of these multiple and distributed innovations. The fifth and final step returns to the composite scenario of step 1 and maps out the findings of the Knotworking-based analysis.

This context mapping discussion needs to be prefaced with a comment about the diverse team of healthcare professionals involved in the information work for each patient. This diversity was both intra- and inter-professional in nature. Intra-professionally, different physicians, nurses, and other healthcare professionals carried out information work both throughout the patient's stay in the hospital, and throughout a single shift. Physicians rotated through the ward on a monthly basis. Therefore, if a patient's stay lasted longer than a month, or if it extended over the change from one month to another (for example, from the end of May to the beginning of June), the patient would be under the care of more than one physician. Nursing rotations realized a similar diversity of care team membership. Nurses did not regularly have the same patients under their care from shift to shift. And, during the course of a single shift, other nurses cared for individual patients due to lunch and other breaks. As a result, several different physicians and nurses carried out information work for a single patient. The following analysis, particularly the Knotworking analysis of step 4, takes into account such intra-professional diversity as part of the social context informing information work.

5.1 Step #1: The Composite Scenario

The first step of context mapping constructs a scenario of a typical sequence of information work events as they occurred during a standard day-shift on the ward. In this scenario, I describe information work as a sequence of enumerated events relating to the care of a single patient. This scenario is not an exact or an inclusive reproduction of any single observation session from the data set, nor does it represent the order in which events necessarily had to transpire. Instead, it is a comprehensive account of the most commonly occurring sequence of information work events and associated genres noted during the study's observation sessions. As a result, the genres used by participants in this scenario represent one potential selection of information work means, not a required genre selection. Furthermore, this scenario is limited by the scope of the study's observations. Since I did not conduct observations in patient rooms or off the ward, information work events that occurred in these locations are not included.

In the composite scenario, events are listed chronologically from the beginning to the end of the shift. Exact times are not supplied for each event but a timeline is provided to differentiate between beginning-of-shift/morning events, afternoon events, and end-of-shift/evening events. The scenario's events represent both unproblematic and problematic events that occurred regularly during information work processes. While these events are common examples taken directly from observation sessions, the

participant identifiers have been modified to create a coherent scenario[10]. To preserve data authenticity while protecting participant anonymity, when examples of dialogue occur, exact but anonymous phrasings are taken from observation sessions. In the events that include such dialogue, the observation number is cited. This composite scenario preserves the anonymity of the patients since these events result from a compilation of information work associated with nearly twenty different patients.

In the following composite scenario, abbreviations anonymously represent professionals. A staff physician participant is denoted with 'SP', a resident physician participant is denoted with 'RP', and a nurse participant is denoted with 'N'. Although student nurses were often part of the observation sessions, novices were always accompanied by more senior nurses who supervised and directed the work of the novices. These novice/senior nursing teams participated in information work situations in much the same way as individual, experienced nurses. To simplify the following scenario description, a single experienced nurse is used to illustrate a nursing participant. When other healthcare professionals were involved in the patient information work, their full professional title appears.

Information work events in the scenario are divided along participant, genre, and specific task lines. In the data, when a participant worked on a particular task (for example, a nurse created a Transformation scenario event #2), this information work involved a participant (i.e., N1), completing a specific task (i.e., manually creating a Transformation), with a specific set of genres (i.e., a Patient Care Summary and a Nursing Report Sheet). In analysis of this work, the composite of participant, genres, and task constitutes the basis for the event. Thus, when one or more of these event components of the scenario changes, a new event number is created. For example, in scenario event #4, the nurse (N1) sought additional oral information about the patient from the nurse (N2) who was handing over care from the night shift. Analysing this event reveals that there is a change of participant (i.e., N2 is added to a previously solitary event) and of genre (i.e., Oral Conversation with Other Nurses is used). Thus, these changes require the creation of a new event in the scenario. In the data, these two events were separated by another event (#3) where nurse N1 participated in the morning nursing meeting. In this meeting, although her patient was discussed, the nurse did not use this information in the creation of her Transformation. However, participants changed from event #2 to event #3 since the night shift's lead nurse participated in giving patient information to N1. Thus, in the construction of scenario event divisions, this change requires a new event number. Similarly, the event division criteria of participant, task, and genre are also applied to inter-professional collaborative events. For example, in the data's event #13 a nurse (N1) and a resident physician (RP1) worked together to discuss patient care decisions. Here, the participants were constant throughout the event (i.e., N1 and RP1), the task remained the same throughout the event (i.e., collaborating on patient care decisions), and the genres were constant (i.e., Oral Conversation with Nurse/Physician, Transformations, and the Patient Care Summary). Therefore, this collaborative work is collected within a single event.

In addition to these defining characteristics, events are differentiated according to considerations of time. For instance, in event #11, the resident physician (RP1) went into

[10] For instance, although over a dozen different nurses participated in the original observations used to construct this composite scenario, they are reduced to five representative nurse participants in the scenario.

the patient room to conduct a physical exam. After several minutes, the physician exited the room and made notes on her Transformation. In the composite scenario, to accommodate for this passing of time, a new event (#12) is created when the physician exits the patient room. When ward information work events occurred simultaneously but independently (e.g. in event #5), this simultaneous nature of events is noted through a shared event number with internal differentiation (i.e., N1 going into the patient room to collect patient data is event #5a, while RP1's arrival on the ward and accessing of the patient's Medical Summary is event #5b).

At times, event divisions are also subjectively determined. For instance, it was not always possible to observe a definitive change of task, nor was it always clearly evident if a new genre was being added to the event or if the genre was always part of the event. Also, the amount of time required to elapse before a new event started was not quantitatively determined. Therefore, there are occasions in this scenario when such subjective changes in events are created.

5.1.1 The Scenario

Beginning-of-shift / Morning of day shift – 7:00 a.m.

1. Nurse 1 (N1) arrives on the ward and takes three EPR Patient Care Summary printouts from the desk that have her name written on them. With each of these Summaries is a Nurse Report Sheet for that patient. One of these patients is a Nephrology patient (now referred to only as 'the patient'). N1 takes these documents and goes to the nursing staff room.
2. During morning nursing meeting, N1 reads the Patient Care Summary printouts and the Nursing Report Sheets and makes her Transformation, including a Transformation of the patient information.
3. In the morning nursing meeting, N1's patient is orally discussed by the night shift's lead nurse, who reports that the patient was particularly ill (vomiting and fever reported) over the night shift.
4. After the morning meeting (*7:30am*), N1 goes out to the central nursing station where N2 is waiting. N2 was the patient's nurse over the night shift. N2 orally updates N1 about the patient. N1 asks clarification questions for which N2 provides details. N1 makes additional notes on her Transformation from the information provided by N2. N2 leaves the ward.
5. a. N1 goes to the patient room with the Patient Flowsheet in hand, enters room and transfers patient information to the Flowsheet.
   b. Resident Physician (RP1) arrives on the ward and goes to a computer terminal. RP1 accesses the patient's file, and accesses the EPR-based Medical Summary. RP1 prints out a Medical Summary for the patient.
6. RP1 accesses EPR-based Laboratory Results for the patient and prints them out.
7. RP1 reads the Medical Summary and the printed EPR Laboratory Results, then makes a Transformation of the information from those two documents for that patient.

8. RP1 accesses the Electronic Laboratory Results (not the same genre as EPR-based Laboratory Results) for the patient and transcribes information from the screen to the Transformation.
9. N1 has collected patient morning medications and verifies the medications against orders as described in both the Transformation and the Patient Care Summary.
10. RP1 goes to the patient's room, takes the Patient Flowsheet and transcribes information from the Flowsheet to the Transformation.
11. RP1 goes into the patient's room to examine the patient.
12. RP1 comes out of the patient's room and makes notes on her Transformation from physical exam findings.
13. RP1 and N1 meet outside the patient room and discuss the patient's care for that day. RP1 and N1 orally decide on three medications and a lab test to be ordered for the patient, through the EPR, by RP1. Both N1 and RP1 make note of these decisions on their individual Transformations. Then N1 comments that she has found a contradiction in the patient's Patient Care Summary stating: "And you still want him to have potassium oral *with* the infusion?" [italics represent participant's emphasis] (Obs. #0420). RP1 asks to see the patient's orders on N1's Patient Care Summary. RP1 reviews the orders and states that she didn't enter that order yesterday (another RP (RP2) was covering for RP1 who was not on ward yesterday). RP1 says that she'll check that order with RP2 and report back to N1.
14. RP1 pages RP2 and clarifies the order, finding out that RP2 had difficulty discontinuing the phosphate IV order when she entered the oral phosphate order. [Note: There is a 'reprimanding' tone to RP1's comments to RP2 about the need to finish discontinuing orders in the EPR.]
15. RP1 orally informs N1 that the phosphate IV order should have been discontinued, that she will discontinue that order in the EPR and clarifies that the patient should receive the oral phosphate only.
16. RP1 makes a note on her Transformation for the patient to discontinue the phosphate IV order for the patient: 'DC IV K' [DC= discontinue, IV= intravenous, K= phosphate].
17. N1 goes to a computer terminal and accesses EPR Information Entry. N1 enters the report of the patient's current weight into the EPR and signs off medications that have been given this morning.
18. N1 makes checkmarks on her Transformation.
19. N1 speaks with N3 who will be covering for N1 as she goes on her morning break. N1 asks N3 to keep an eye on the patient's fever, warns N3 that the patient was vomiting last night but has been fine this morning, and gives N3 the phosphate that the patient will need to have while she's gone on break with notice of the explanatory discussion that N1 had with RP1 about the phosphate order. N1 leaves for her morning break.
20. RP1 goes to a computer terminal and accesses the patient's file in the EPR. RP1 discontinues the phosphate IV order, enters three orders for other medications to be given and for blood work to be done [Note: These are the orders that N1 orally received from RP1 during their conversation earlier this morning].

21. RP1 makes several checkmarks on her Transformation, including checking off the box for 'DC IV K.'
22. RP1 reviews test results in the Electronic Laboratory Results for the patient who had just come into the system [Note: These were not in the system this morning during her first accessing of patient lab results. They were originally listed as 'pending.'] RP1 transcribes that lab result data onto her Transformation.
23. RP1 looks for N1. N3 informs RP1 that the patient is under her care while N1 is on break. RP1 asks if there has been a change in the patient's fever. N3 replies: "I don't know" explaining that "I'm covering break" (Obs. #0208a). RP1 and N3 refer to the Flowsheet to see the patient's temperature then enter the patient's room.
24. N3 and RP1 come out of patient room. N3 makes an entry on the Flowsheet with the patient's current temperature.
25. RP1 goes to a computer terminal and accesses the patient's file. RP1 enters an order for an additional medication.
26. N1 returns from break. N3 gives oral update of change in the patient's status including information regarding the administration of the phosphate order.
27. N1 goes to the printer at the central nursing station desk and finds five Medication Orders for her patient. She takes them to the patient's ward chart and places them in the binder. N1 signs four of the Medication Orders (one of which is the discontinuation of the contradictory phosphate order) but is troubled by one order and takes that Medication Order out of the binder.
28. N1 tries to find RP1 but RP1 is not on the ward. N1 asks the supervisory nurse on the ward (N4) about the medication order in question, explaining that she's worried about the timing of the medication in relation to the patient's dialysis schedule. N4 confirms that the medication could be dialysed out if not given early enough but informs N1 that the timing for the order seems appropriate, so it should be fine to give it now. N4 tells N1 to page RP1 and tell the physician of her actions.
29. N1 pages RP1.
30. N1 goes to patient's room and gives the medication for the order at issue. When she leaves the room, N1 checks off an item on her Transformation and signs the Medication Order for that order.
31. RP1 returns to the ward and asks who paged her. N1 takes the troublesome Medication Order to RP1, tells RP1 about the discussion with N4 and the decision to give the medication to the patient. RP1 asks: "When is his dialysis today?" (Obs. #0113). RP1 confirms that the medication won't be dialysed out and confirms the original order.
32. RP1 makes an entry in the patient's Progress Notes for today.
33. N1 goes into the EPR and begins to remove information from the EPR so that that data will not appear on the Patient Care Summary the next day and so that orders appear in a certain sequence. Note that she takes careful consideration of how the troublesome order will appear. N1 explains: "I have a lot of orders in here but I want it to be blatantly obvious so the nurses don't get confused" (Obs. #1117).

Noon

34. N1 goes into patient room with Flowsheet in hand. Comes out and fills out several fields in the Flowsheet.
35. N1 speaks with N3 who will be covering for N1 as she goes on her lunch break. N1 informs N3 that there are no medications to give but that flubotomy[11] should be coming to take a blood sample from the patient and that the patient needs to go to dialysis before N1 returns from break. N1 leaves for her lunch break.
36. RP1 goes to patient's room, takes the Flowsheet and transcribes recent values from the Flowsheet to her Transformation.
37. RP1 accesses the patient's file in the EPR and goes to discontinue a medication order. RP1 goes through several screens of information, going back and forth through several screens. RP1 explains: "I don't know how to discontinue the order. I can't find it" (Obs. #0302). RP1 finds a free type entry space in the Nursing Orders space and manually types in that the medication should be discontinued after this afternoon's dose has been administered.
38. Flubotomy comes and takes blood samples from patient.
39. Dietician (D1) comes on the ward, finds RP1 and discusses the patient's nutritional needs. RP1 and D1 decide to continue the current nutritional course of care for the patient unless vomiting continues at which point more IV nutrition will need to be ordered. RP1 says that she'll make a note of that in the patient's EPR file and D1 says she'll enter it into the patient's Progress Notes.
40. a. D1 makes entry in the patient's Progress Notes regarding the nutritional care decision.
    b. RP1 makes a free-type entry in the EPR under nutritional notes concerning the decision not to change nutritional course of care unless vomiting recurs.
41. N3 takes patient to dialysis.
42. N1 returns from break and receives oral information about the patient from N3.
43. N1 finds Medication Order in the patient's ward chart for discontinuing medication that RP1 inputted earlier. N1 signs the Medication Order, then takes out her Transformation and crosses off an entry on her Transformation.
44. N1 brings patient back from dialysis.
45. N1 gives afternoon medications to patient, verifying them against both her Patient Care Summary and her Transformation. When she comes out of the room, N1 checks off a set of items in her Transformation.
46. N1 goes to computer terminal and accesses EPR Information Entry. Enters into the EPR and signs off medications that have been given this afternoon.
47. N1 finds RP1 and asks if a medication can be ordered for the patient: "You know, the cream you put around the tube?" (Obs. #0208b). RP1 is surprised there isn't an order there already, but N1 confirms that there isn't by showing RP1 her Patient Care Summary. RP1 says she'll order it right away.
48. RP1 accesses the patient's file in the EPR to order the cream as requested. She searches through several lists of medications but can't find the name she's seeking. Another resident (RP3) is at another terminal. RP1 asks RP3 for advice for entering the order. RP3 gives RP1 another name for the cream. RP1 finds the

[11] Flobotomy is the division of the hospital responsible for collecting and testing patient blood samples.

name in the medication list and orders the medication for the patient. She explains: "There's so many different names for everything" (Obs. #0208b).

49. Staff Physician (SP1) comes on ward to cover for RP1 who has to go to educational meetings. RP1 orally informs SP1 of the patient's case. During their discussion, SP1 decides that the patient should be on a more aggressive antibiotic. SP1 says that he'll make the necessary changes and orders. RP1 leaves the ward.
50. a. N1 goes to a computer terminal and accesses the patient's EPR Laboratory Results and the Electronic Laboratory Results. N1 makes notes on her Transformation of new lab test results.
    b. SP1 goes to a computer terminal and accesses the patient's file in the EPR to discontinue the current antibiotic order and to create a new antibiotic order. First, SP1 successfully discontinues the current antibiotic, then works to enter the order for a new antibiotic. However, while SP1 is able to find the medication, he is not able to find the timing and pathway specifications he wants. SP1 enters the order without the appropriate specifications.
51. SP1 goes to the Medication Order printer and takes the Order to N1 and explains that the order is confusing as it stands on the Order. SP1 explains to N1 what he wants the order to be. N1 makes changes to her Transformation during the conversation.
52. SP1 makes an entry in the patient's Progress Notes about the change of medication, the justification for that change, and the order entry problem.
53. N1 goes to the EPR and enters a Nurse-to-Nurse free-text entry about the medication change, explaining what should be given to the patient despite what's written in the order.

End-of-shift / End of day shift – 5:30pm

54. RP1 returns to the ward. SP1 orally informs RP1 of the patient's status and changes made to the course of care. RP1 makes entries on her Transformation during the conversation. SP1 leaves the ward.
55. RP1 accesses Electronic Laboratory Results and gets the test results from the blood work she ordered earlier. She transcribes these values to her Transformation.
56. RP1 makes a Progress Report entry in the patient's ward chart while referring extensively to her Transformation, including both the 'to know' and 'to do' entries therein.
57. RP1 leaves the ward.
58. N1 administers evening medications to patient, verifying them against both her Patient Care Summary and her Transformation.
59. N1 returns to the patient room. When she comes out, she makes several entries to the patient's Flowsheet.
60. N1 accesses EPR Information Entry at the computer terminal. Enters into the EPR and signs off medications that have been administered this evening.
61. N1 makes a Progress Note entry in the patient's ward chart and writes up a Nurse Report Sheet for the patient.
62. The next shift's nurses arrive on the ward and go into the nursing staff room for the nursing meeting.

63. N5 is the next nurse to be responsible for the patient. N1 waits for N5 to come out of the meeting and then orally conveys important information about the patient to N5.
64. N1 leaves the ward. (*7:30pm*)

5.2 Step #2: The Genre Ecologies Involved in Ward Information Work

The genres used in the composite scenario were the mediational means (Spinuzzi, 2003b) that supported and facilitated ward information work. To illustrate the complexity of interactions among these genres and the innovations that were carried out through them, in the second step of the context mapping approach I construct one genre ecology (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000) for physicians and another for nurses. These ecologies depict: 1) how each genre was used characteristically by each profession on the ward; 2) how some genres were shared, but used in varying ways, by both professions; and 3) how genres of the ecologies related to each other. These ecologies demonstrate how a variety of genres and professional efforts came together to complete ward information work.

I present these genre ecologies separately for each profession (physicians and nurses) and illustrate them in individual Appendices (Appendix 35 is the genre ecology used by physicians and Appendix 36 is that used by nurses). The descriptions of the ecologies detail each genre's media, outline the kinds of information that was available within the genre, identify what were the most common means of professional use of the genre, and report the impact that activities within one genre had on other genres within the ecology. Considering the varied nature of information work, it is beyond the scope of this investigation to represent all the generic alternatives available in every information work situation. Instead, in keeping with the composite scenario's limitations, this second step of the approach discusses the most common information work activities and the set of genres used most frequently by study participants.

Two caveats must precede this discussion. First, each genre within the ecology was rich in information content, containing more data than could be captured in this description. Secondly, many of the genres in the ecologies were accessed in multiple ways by each profession, thus making a detailed reporting of each of these possibilities beyond the scope of this investigation. The details about each genre in the ecologies are limited to the most commonly used information items in each genre and the means of access most regularly employed by participants. The media of each genre was relatively stable; but, if a genre was routinely accessed via another media, that media change is discussed in the description and represented in the accompanying Appendices.

The genre ecologies presented for both the physicians and nurses are limited to the genres used for the information work associated with one patient. For each patient on the ward, the same genres were generally used and the same relations between genres commonly existed. It is important to highlight, however, that the information work for each patient was carried out regularly through genres specific to that patient. For instance, the EPR Laboratory Results for each patient on the ward were accessed separately since test results were organized by individual patient within the system. The healthcare professional needed to exit one patient's file before being able to access

another patient's file. In these ways, each patient had his/her own genre ecology associated with the information work involved in his/her care. Consequently, for each patient on the ward, a physician or nurse worked within that patient's genre ecology.

5.2.1 Physician Information Work Genre Ecology

Physician information work was mediated by several different genres (See Appendix 35. To facilitate referencing, the ecology is repeated in Figure 5.2.1.a), each used at varying times throughout patient care activities and with varying frequencies depending on the information required.

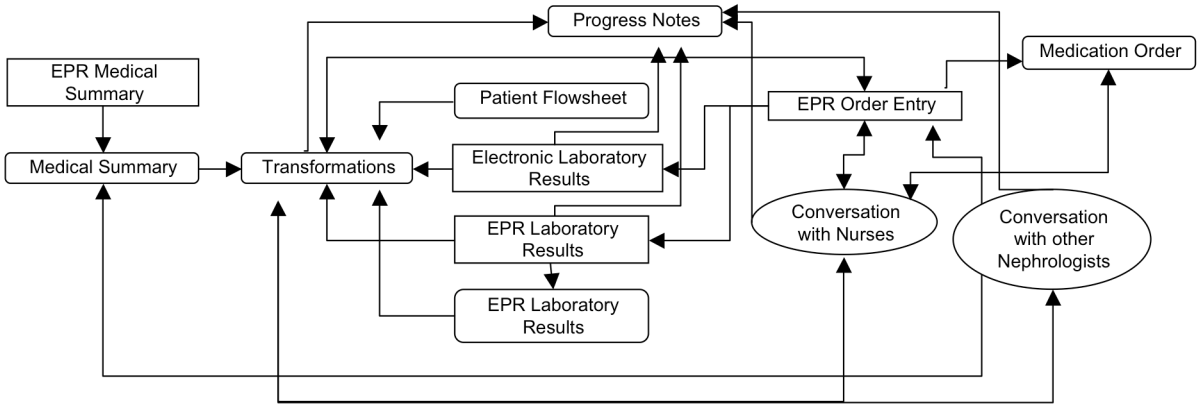


Figure 5.2.1.a: Physician Genre Ecology Diagram. This genre ecology illustrates combinations of ecology nodes and mediatory relationships (Spinuzzi, 2003b)[12]. For each genre within an ecology, a different visual shape is used to represent its media. A rectangular textbox denotes a computer-based genre, an oval textbox signifies an oral genre, and a rectangular textbox with rounded corners depicts a paper-based genre. The textual label used within each shape identifies the genre. Each shape and its label constitute a visual depiction of an ecology node. The relations between nodes are represented by means of connecting lines. These mediatory relationship lines show directionality by indicating when one node within the ecology regularly contributes to the creation and/or use of another node within the ecology. The distance between nodes in the visual design, and the subsequent lengths of mediatory lines, is not representative of degrees of relation strength, nor is the location of nodes within the visual depiction of the genre ecology intentionally designed to convey qualities of relation.

As discussed in the previous chapter, physicians regularly accessed certain genres at the beginning of every shift. When a physician first came on the ward, he/she used one of the computer stations located behind the ward's central nursing station to access a patient summary from within the EPR. This summary, called a Medical Summary within the

[12] This study's definition of ecology nodes relies heavily on Spinuzzi's "ecological niches" (2003b, p. 120) which refer to genres used by study participants in a given genre ecology. However, Spinuzzi's "ecological niches" do not visually depict the media of the different genres in use. Therefore, this study uses "ecology node" as a terms that compliments Spinuzzi's "ecological niche" with a consideration of genre media.

EPR, is identified as EPR Medical Summary within this discussion (see Appendix 35 or Figure 5.2.1.a). The EPR employed a text-line user-interface, had a fixed number of lines available in the display, and did not have scrolling functions. Thus, in order to navigate through the Medical Summary within the EPR, a physician used the 'Next' and 'Back' functions displayed at the bottom of the screen to move forwards or backwards through screens of patient information. A patient's EPR Medical Summary required several screens to display visually the accumulated information. As illustrated in chapter four's sample Medical Summary (see Appendices 22-29), a four day stay in hospital resulted in eight screens of Medical Summary information. The patient information within the EPR Medical Summary was organized into a series of categories of information that were displayed sequentially. The category headings are summarized in Table 4.1.3.1.a of chapter four. Accessing the EPR Medical Summary is illustrated in scenario event #5b.

Once the EPR Medical Summary was accessed, each physician printed out a paper copy of each patient's Medical Summary. In this ecology, this paper-based printout is referred to as a Medical Summary. In the composite scenario, the Medical Summary printout is created in event #5b. The Medical Summary was an exact reproduction of the content of the EPR Medical Summary, following the same organization of pre-determined categories and displayed in the same sequential order as in the EPR Medical Summary. The length of the Medical Summary was related to the patient's length of stay. Chapter four's sample Medical Summary resulted in a 3 page printout. A patient's EPR Medical Summary and subsequent Medical Summary grew in length as a patient's stay extended since, presumably, more information would be inputted into the EPR and thus to the subsequent Medical Summary printout.

With the paper-based Medical Summary in hand, the physician began manually transforming patient information from the Medical Summary into a new paper-based document that the physician designed, using a different visual organization. As discussed in chapter 4, these transformations were either Complete Written Overhauls (see Appendix 33) of, or Marginalia Additions (see Appendix 34) to the Medical Summary. In this chapter's discussion, both kinds of transformations will be collected within one ecology node named Transformations. The creation of a physician Transformation is exemplified in event #7 of the scenario. The Transformations were paper-based, single page overviews that physicians created from the Medical Summary. In this Transformation the physician collected and visually organized key pieces of patient information as well as medical action items. Within the Transformation, key pieces of patient information ('to know' items) were made visually distinct from action entries ('to do' items). After having created the Transformation, the Transformation became the document that the physician used extensively throughout his/her daily information work. The physician would continually update the Transformation by adding more information, both 'to know' and 'to do' items, to the document during the course of his/her daily information work (see, for example, scenario events #16 and 22). These additions could be generated from a variety of sources including other genres within the genre ecology, such as Electronic Laboratory Results (see scenario event #8 and 22), Patient Flowsheets (see event #10) and Conversation with Nurses (see event #13) and from direct contact with the patient (see event #12). As the physician completed certain care activities, the 'to do' entries on the Transformation were regularly marked as completed through the use of checkmarks and strike-throughs (see event #21). In these ways, the

Transformation was a central document for the physician since it tracked his/her use of patient information and care activities during his/her information work.

After the Medical Summary had been used to create the Transformation, the physician usually retained the Medical Summary as a reference document during the course of his/her shift. However, neither the Transformation nor the Medical Summary were retained for future reference by either the physician or the hospital. The physician generally discarded these documents for shredding when the information therein was no longer current (usually at the end of the shift but occasionally two, three, or four days later).

After creating their Transformations, physicians generally continued their information work by repeatedly accessing three specific nodes in the ecology: EPR Laboratory Results, Electronic Laboratory Results, and Patient Flowsheets. Physicians regularly used each node prior to going on to other nodes, but there was no common pattern to the order in which these three nodes were accessed.

Physicians accessed EPR Laboratory Results via a computer station to view patient lab results on-screen through the hospital's EPR. The lab results in the EPR were organized in alphabetical order and listed test results for the patient in chronological order. Again, as with all information within the EPR, test results were displayed via a text-line interface. Each patient generally had several screens of test results in the EPR Laboratory Results. The physicians navigated through these on-screen results by using the 'Next' and 'Back' functions to locate particular test results. Then, the physicians regularly transcribed these results into the Transformation document for that patient, visually characterizing these entries as a 'to know' item. In this action, the physicians moved patient data from the EPR Laboratory Results screens into the Transformation document[13]. While working with the patient test results, physicians also regularly created 'to do' entries within the Transformation but these entries were physician-generated and not direct transcriptions from the EPR screens. These 'to do' entries included action items such as ordering additional tests, ordering specific medications, and seeking a consult from another physician or service. Throughout the course of their shift, physicians would regularly return to the EPR Laboratory Results node to find results from tests that were either pending when the node was first accessed or were ordered after having originally viewed these screens.

While physicians could access the EPR Laboratory Results on-screen, they usually printed out these results and transferred them to the Transformation from that paper-based document (see events #6 and 7). In the ecology, this paper-based document is also labeled as EPR Laboratory Results but is differentiated from the computer-based document by its textbox shape. As seen with the computerized document, physicians regularly moved EPR Laboratory Results information from the paper-based document directly to the Transformation document and repeatedly created 'to do' entries on the Transformation while working with the patient test results. The directly transferred entries were noted as 'to know' items, while the physician-generated additions were 'to do' items. In these ways, working with the EPR Laboratory Results genre, either on-screen or in paper-based printouts, were similar activities. The notable difference was that physicians often retained the paper-based EPR Laboratory Results as reference

[13] This transcription work is mediated through a printed document in the composite scenario. The visual access method discussed here is not exemplified in an event.

documents throughout the shift. These paper-based documents were usually discarded for shredding at the end of the shift when the results were no longer up-to-date. While physicians regularly accessed the computer-based EPR Laboratory Results throughout the day for updated test result information, they would not generally print these results a second time. The paper-based EPR Laboratory Results were either generated by physicians at the beginning of the shift or not generated at all.

The EPR Laboratory Results were not the only means available to physicians for collecting patient test result data. Another computer system was also used on the ward for viewing test results. In this ecology, this other computer system's node is called the Electronic Laboratory Results. The patient test results in this computer system were displayed in a graphic user-interface, using a graph structure to organize patient test results. The names of individual tests were listed separately in the cells of the graph's far left-hand column, and test results were then listed across the screen in individual rows. These rows of test results were divided into columns by the date on which that test was completed. It was possible, in the Electronic Laboratory Results, to request a limited display of patient data. Unlike the computer-based EPR Laboratory Results, the Electronic Laboratory Results could be used to request a display of patient results for a specific time frame, including limits such as the past week, month, or six months. In addition to the capacity to delimit the number of results displayed, the Electronic Laboratory Results had scrolling functions. The Electronic Laboratory Results also enabled the user to click on a test result name to highlight that particular row of results, a feature not available in the EPR-based system. While it was possible to print the results from the Electronic Laboratory Results system, this action was rarely undertaken and so is not represented in this ecology. As seen with the computer- and paper-based EPR Laboratory Results, physicians regularly transcribed patient data from the Electronic Laboratory Results to the Transformation document (see event #8, 22 and 55) as 'to know' entries and created 'to do' entries that were not transcriptions from the Electronic Laboratory Results. In these ways, working with the Electronic Laboratory Results involved activities similar to those of working with either the on-screen or paper-based EPR Laboratory Results.

The third node physicians commonly accessed following the creation of a Transformation was the Patient Flowsheet. A Patient Flowsheet was a densely formatted form, provided by the hospital and compiled by nurses on the ward to track patient information hourly. Generally, this data was not electronically monitored. The Patient Flowsheet information was not available commonly within the EPR. The information recorded by nurses in a Patient Flowsheet included, but was not limited to, the following: fluid intake and output; fluid balance; current and previous weight; weight gain/loss; assessment of items such as pain and chest sounds; IV lines, their solution, and volume; and hourly breakdowns of temperature, blood pressure, heart rate, and respiratory rate. These large, 3 page, double-sided, fold-out forms were kept in a small binder located in a basket outside the patient's room door. A Patient Flowsheet was completed for each day that the patient was on ward, and each one was retained in this binder until the patient's discharge. At discharge, Patient Flowsheets were filed into the patient's historic record. Physicians regularly accessed a Patient Flowsheet early in the day, and transcribed values found therein into the Transformation document (see event #10). Physicians regularly created 'to do' entries on the Transformation while working with Patient Flowsheets but

these ‘to do’ entries were physician-generated and not direct transcriptions. These physician-generated ‘to do’ entries included a variety of action items such as verifying specific lab results, ordering medication changes or additions, or ordering additional tests for the patient. Occasionally, physicians would work directly from the Patient Flowsheet to the computerized ordering system (see the EPR Order Entry node description) without using the Transformation as an intermediary step. This was a rare occurrence and thus not included in the scenario. Throughout their shift, physicians would return regularly to the Patient Flowsheet node to access up-to-date patient information collected by the nurses (see event #36).

After accessing these nodes, physicians used the remaining genres in the ecology in no commonly shared order. Therefore, the following description will present the remaining genre ecology nodes in the order which they were retrieved most frequently by physicians. In descending order, from the nodes most frequently used to those used least often, the following ecology nodes are addressed: EPR Order Entry, Medication Order, Conversation with Nurses, Conversation with other Physicians, and Progress Notes.

One of the most commonly accessed nodes of the genre ecology was the EPR Order Entry node. Physicians spent several hours per shift at computer stations working with patient files within the EPR system in order to place or modify orders (see events #20, 25, 37, 40b, 48, and 50b). The EPR Order Entry node, like the other EPR computer-based nodes, interfaced with the EPR that employed a text-line user-interface. The EPR Order Entry screens of information were restricted in size and were without scrolling functions. EPR Order Entry thus required physicians to employ ‘Next’ and ‘Back’ functions displayed at the bottom of the screen to navigate through the order screens. To place an order within the EPR, physicians had to navigate through the EPR via several pathways presented as textually presented links. These textually presented links enabled physicians to access various order entry functions within the EPR. Physicians could place several different kinds of orders for a patient through the EPR. The orders most commonly created by physicians included orders for: blood work tests; x-ray or other imaging tests; consults from other services; medication changes, discontinuations or additions; food/nutrition changes, discontinuations or additions; and patient discharge. Each order was placed via the EPR system and could be considered as an individual genre accessed by physicians. All of these order functions were collected within the EPR Order Entry node. To demonstrate, Figures 5.2.1.b and 5.2.1.c illustrate two of the several screens of the EPR Order Entry node that a physician would have to navigate through to place an order for acetaminophen for a patient (the entire set of screens involved in this process are illustrated in Appendices 37-44). Figure 5.2.1.b is a list of Common Medications from which the physician would select the medication name to be ordered. Figure 5.2.1.c is the dosing selection screen from which physicians would select the route and schedule for the acetaminophen order.

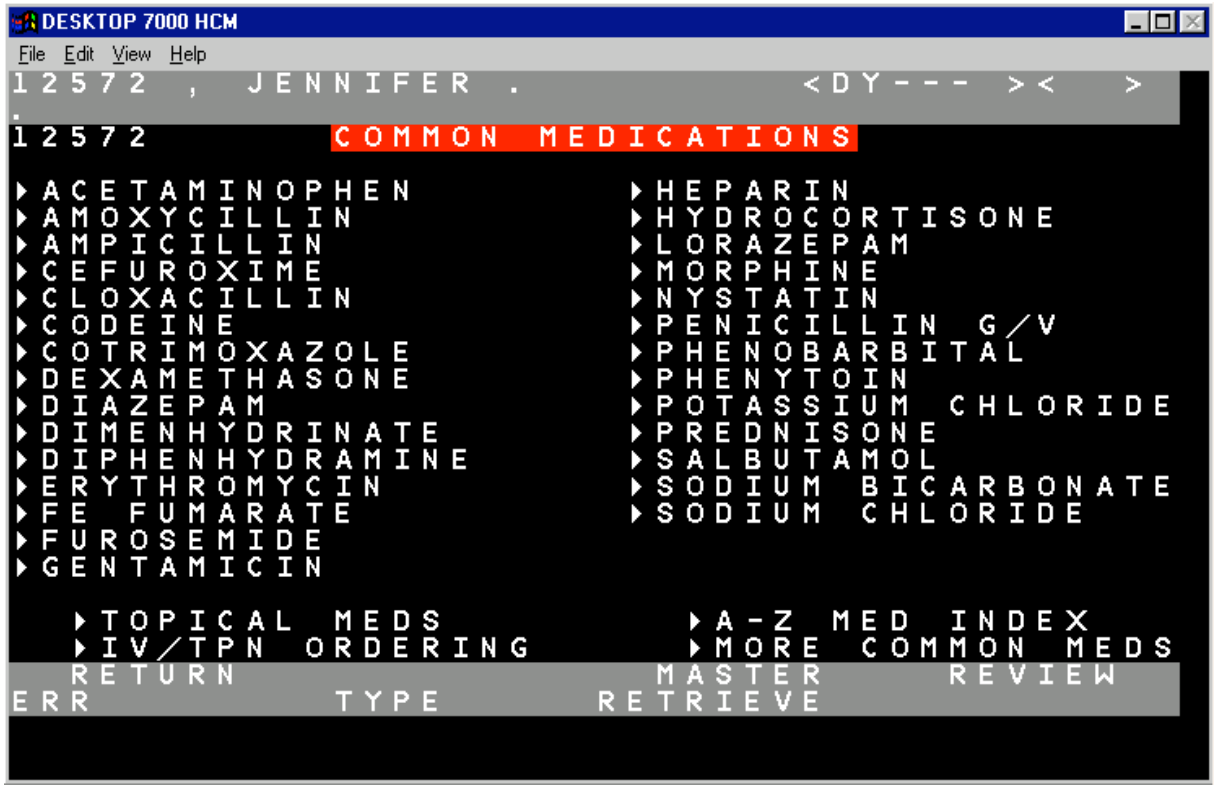


Figure 5.2.1.b: EPR Order Entry Common Medications Screen

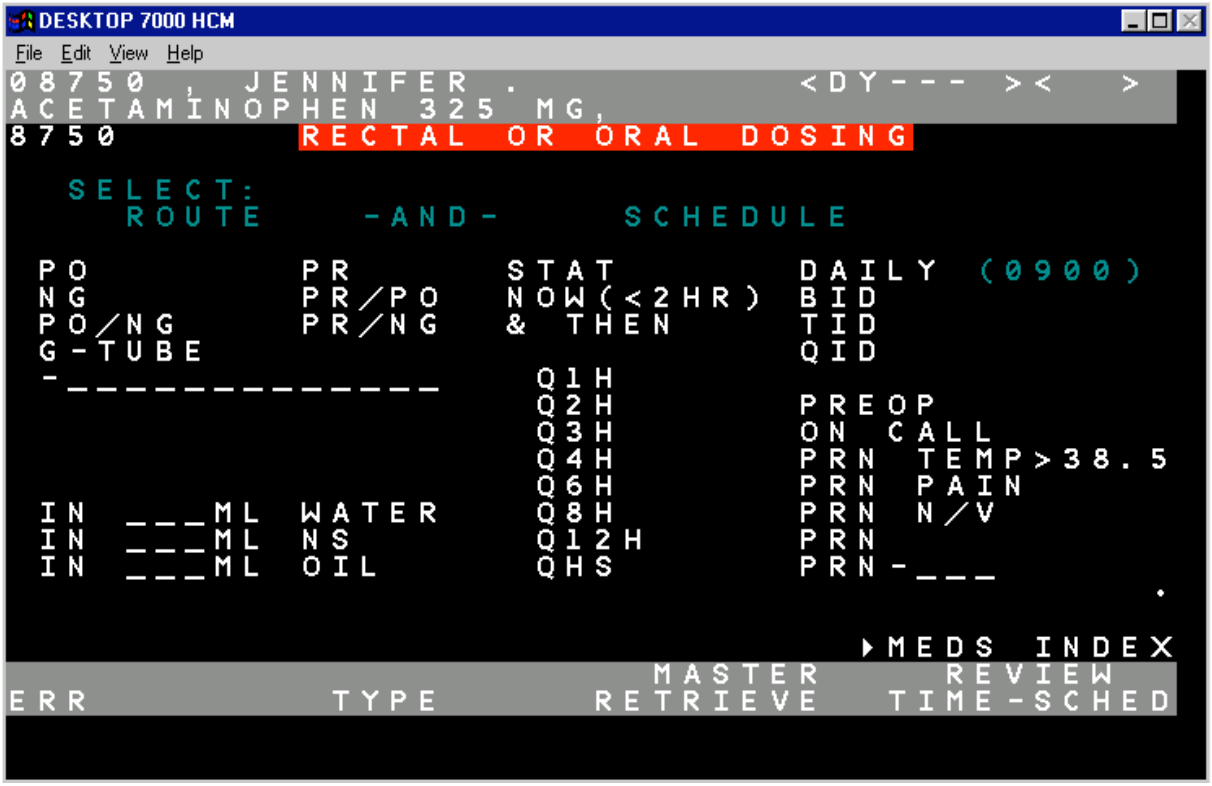


Figure 5.2.1.c: EPR Order Entry Rectal or Oral Dosing Screen

It is important to note that physicians often found navigations difficult because they could not find links consistently nor could they always make the specifications they desired. For instance, if the medication the physician required was not common and so was not listed on the Common Medications screen (Figure 5.2.1.b), the physician would have to find the medication name by following other pathways. Or, for example, if the physician wanted to deliver the acetaminophen on a Q7H schedule (i.e., every seven hours), he/she would have to find a pathway to make that specification. These and other such difficulties will be addressed later in this chapter.

Each order that the physician entered for a patient had subsequent results and specific impacts on other genres within the ecology. For instance, physicians regularly created patient orders while referencing the Transformation genre associated with that patient. As previously noted, during the course of their information work, physicians regularly created 'to do' entries on a Transformation document. These 'to do' entries were physician-generated notes that often related to orders physicians wanted to enter into the EPR system. Thus, after creating these 'to do' entries, the physicians would access the EPR Order Entry screens and carry out the aforementioned 'to do' activities. After entering these orders, the physicians would make alterations to their Transformation to indicate that the 'to do' activity had been completed. These alterations commonly consisted of check marks either beside 'to do' entries or within 'to do' entry checkboxes, or simply crossing off the 'to do' (see event #21). For example, after reviewing the patient's potassium levels via the computer- or paper-based EPR Laboratory Results node or the Electronic Laboratory Results node, the physician could have decided to test that level again to see if a particular medical intervention had ameliorated that level. Thus, while working with these results, the physician may have created a 'to do' entry in the Transformation that called for the potassium test to be ordered for the patient for later in the day. When the physician began EPR Order Entry, and used the EPR system to order the potassium test, the physician would typically cross-off or check-off that 'to do' item on the Transformation. Another possible alteration resulting from the physician's order entry could be the creation of new 'to do' entries on the Transformation.

Other genres influenced by the physicians' creation of an order within the EPR Order Entry node included the EPR Laboratory Results and the Electronic Laboratory Results nodes. It was common for physicians to order blood work for a patient through the EPR Order Entry node. By entering that order, the physicians set in motion a set of activities for collecting a blood sample from the patient and for analyzing that sample. When the test had been conducted, the results of the test were posted in the EPR Laboratory Results and the Electronic Laboratory Results. To determine the results of the ordered test, physicians accessed the results via the EPR Laboratory Results and/or the Electronic Laboratory Results nodes (see events #22 and 55). In this way, activity within the EPR Order Entry node had direct impact on the EPR Laboratory Results and the Electronic Laboratory Results nodes.

Physicians also commonly made medication orders. These orders had direct impact on other genres within the ecology. Medication orders involved changes to, discontinuations of, or additions to the medications a patient was receiving. With the entry of any such medication order, the EPR immediately generated a paper printout

detailing the medication order. This printout was distinguished by being printed on yellow paper and by being generated by a centralized printer dedicated to that purpose and located within the main nursing station desk (see events #27, 43 and 51). This printout, indicated in the ecology by the node entitled Medication Order, was a communication directed towards the nurse on the ward who was caring for the patient that day. The Medication Order was the means through which nurses were informed of medication changes, deletions or additions for their patients. This particular EPR Order Entry activity and the associated Medication Order were often accompanied by oral communications between the nurse and physician (see events #31 and 51).

The next node frequently accessed by physicians within the genre ecology was the Conversation with Nurses node. These oral exchanges between nurses and physicians occurred constantly throughout a shift, and were instigated regularly by both physicians and nurses (see events #13, 15, 23, 31, 47 and 51). These conversations served several functions. If the conversation was instigated by physicians, the most common purposes included: information-seeking by the physicians (see event #23); physicians informing the nurse of medication order entries made or planned (see event #51); and collaborating with the nurse to determine care plan decisions (see event #13). Physician activity within this node was regularly associated with activities in other nodes. For instance, Conversation with Nurses activities often dealt with medication orders. As previously noted, when physicians created medication orders through the EPR Order Entry node, a Medication Order page was created which informed the nurse of the change in medication plans. However, physicians often instigated conversations with the nurses when these orders were entered so as to update nurses orally (see event #51). This oral communication activity ensured that the order was received by the nurse in a timely manner, an important consideration since a Medication Order could be missed by a nurse (especially during shift changes or on days when there were several acutely ill patients on the ward) or be misplaced. Furthermore, these conversations ensured the clarity of the order, an important consideration since the ordered medication changes often had repercussions on other care activities scheduled for the patient that required clarification (such as timing of the new medication with pre-existing medication orders, or with scheduled procedures). If the physicians did not inform nurses orally of a medication order entry, nurses frequently instigated a conversation with the physicians in order to discuss the change of medication plans when they received the Medication Order (see event #31).

Another example of a Conversation with Nurses activity that impacted on other nodes within the ecology involved information-seeking conversations. Physicians often sought out a patient's nurse in order to clarify patient information that would affect an EPR Order Entry activity (see event #23). On this ward, details pertaining to a patient's fluid input and output were correlated directly to several care related decisions and activities. Several times throughout the day, physicians required the current fluid balance for the patient before a medication or blood test order could be entered into the EPR. Thus, it was often via a Conversation with Nurses that physicians could access this information most easily. This oral data was then transcribed regularly onto the physicians' Transformation as a 'to know' item.

Physicians frequently accessed the Conversation with other Physicians node of the genre ecology. There were several expressed purposes in these conversations

including: clarifying orders entered by other physicians (see event #14); seeking a consultation for determining the best care for a patient (not exemplified in scenario); and conducting rounds with a senior physician (event #49). This latter activity, rounding, was especially common since this was a teaching hospital and so the physician responsible for patient care was generally a student physician (i.e., either a fellow or resident). Consequently, during the course of the day, a senior physician would arrive on the ward in order to conduct oral rounds with the student physician. These conversations generally followed the case presentation structure of chief complaint, history of present illness, past history, family history, social history, physical exam, diagnostic impression and management plan. During these conversations, the student physician regularly referred to and cited information from his/her Transformations, and the Medical Summary (if the printout was retained). This Conversation with other Physicians activity regularly resulted in direct order entries via the EPR Order Entry node, and/or in additions made to the Transformation genre, especially several 'to do' entries.

Finally, the last node within the physician's genre ecology was the Progress Note. A Progress Note was a paper-based genre found within the active patient paper-based chart kept on the ward. The active chart should be differentiated from the patient's historic chart. The active patient chart, also known as the ward chart, consisted of current admission information. The patient's historic chart, in contrast, contained all patient information from every hospital admission except the current admission. The information from the active chart was placed within the historic chart upon patient discharge. The active chart consisted of a blue binder within which several documents were included, such as consultation notes from other services, Medication Orders, and Progress Notes. The Progress Notes were lined pieces of paper, labeled with the heading Progress Note at the top of the page and with the patient's addressograph[14] in the top right-hand corner. All professionals involved in the patient's care used the Progress Notes as a place to write details regarding the patient's care during the course of that day. Physicians generally entered point-form notes for the patient (see events #52 and 56), in a format similar to that of the case presentation structure, using headings such as Complaint, Physical Exam, Diagnosis, and Plan. Physicians created detailed bulleted lists beneath each heading. The details of these lists were frequently created by drawing on information from other nodes of genre ecology. To write a Progress Note, physicians regularly referred to and transferred information to the Progress Note from Transformations, EPR Laboratory Results, Electronic Laboratory Results, Conversation with Nurses, and Conversation with other Physicians (see event #56).

5.2.2 Nursing Information Work Genre Ecology

Like the activities of physicians, nursing information work was conducted through several different genres (See Appendix 36. To facilitate referencing, the ecology is repeated in Figure 5.2.2.a), many of which were shared with physicians. When these common genres are addressed in the following description, abbreviated descriptions of the nodes will be presented highlighting nursing interactions.

[14] The addressograph was an imprint of the patient's hospital card.

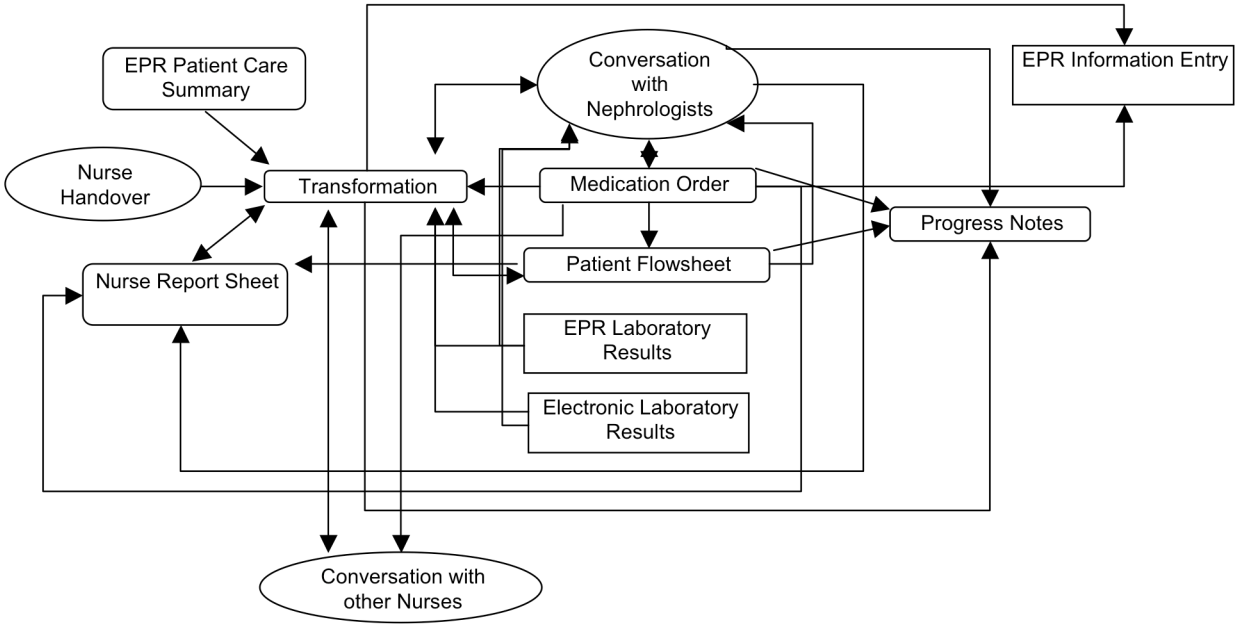


Figure 5.2.2.a.: Nursing Genre Ecology Diagram. Like the Physician Genre Ecology figure, this genre ecology illustrates combinations of ecology nodes and mediatory relationships (Spinuzzi, 2003b). For each genre within an ecology, a different visual shape is used to represent the media of the genres. A rectangular textbox denotes a computer-based genre, an oval textbox signifies an oral genre, and a rectangular textbox with rounded corners depicts a paper-based genre. The textual label used within each shape identifies the genre. Each shape and its label constitute a visual depiction of an ecology node. The relations between ecology nodes are represented by means of connecting lines. These mediatory relationship lines show directionality by indicating when one node within the ecology regularly contributes to the creation and/or use of another node within the ecology. The distance between nodes in the visual design, and the subsequent lengths of mediatory lines, is not representative of degrees of relation strength, nor is the location of nodes within the visual depiction of the genre ecology intentionally designed to convey qualities of relation.

As described in chapter 4, nurses accessed certain genres at the beginning of every shift, and then used other genres within the ecology with varying frequency throughout the rest of their daily information work. At the beginning of every shift, nurses started their information work by accessing a summary of patient information, obtained via the EPR, for each patient under their care. In this ecology, that summary is represented as the EPR Patient Care Summary (see event #1). The EPR Patient Care Summary (see Appendices 15-19 for a sample EPR Patient Care Summary) was a paper-based printout automatically created by the EPR prior to the nurses' arrival on the ward. Although the Patient Care Summary was a computer-based genre, since the nurses did not interact with that summary within the computer, it is not represented as a computer-based genre in this ecology. Instead, the ecology begins with the genre the nurses received upon arrival on the ward – the paper-based EPR Patient Care Summary. The EPR Patient Care Summary was a listing of patient information, organized in a pre-set order of categories within which was detailed patient information (see Table 4.1.1.1.a for

a summary of the category headings). As with the physician's Medical Summary, the length of this paper-based document was directly related to the length of time the patient had been in the hospital.

With these printouts, the nurse began manually re-organizing the information within the EPR Patient Care Summary into a different visual structure. Within this ecology, the manually created, re-organized paper-based document created by the nurse is entitled a Transformation. The Transformation was either a Complete Written Overhaul (see Appendix 20), or Marginalia Additions (see Appendix 21) to the EPR Patient Care Summary; however, in this discussion, unlike in the previous chapter, both kinds of transformations will be collapsed within the Transformation node (see event #2). A nurse Transformation consisted of a visually concise paper-based overview of patient information organized into a timed schedule of care activities. Within the Transformation, the nurse reorganized patient information into 'to do' items planned at specific hourly time slots. Occasionally the nurse also included 'to know' entries for particularly pertinent patient data items. Nurses used the Transformation throughout the day to structure work activities and to track the progress of these activities. This tracking was conducted in a manner similar to physicians. As activities were completed throughout the day, the nurse would mark that 'to do' activity as 'completed' by using a checkmark or by striking the item on her Transformation (see events #18, 30 and 45). In addition to tracking completed activities, the nurse often created additional 'to do' entries to the Transformation throughout the day as patient care plans were modified (see events #13 and 41). Information for these additions could come from a variety of sources including the other nodes within the genre ecology or from direct contact with the patient. The Transformation documents were not retained after the nurse completed his/her shift. Instead, they were disposed of for shredding.

Another genre was used at the beginning of a shift to support the creation of the nurse Transformation: the Nurse Report Sheet. The Nurse Report Sheet was a paper-based formatted form, provided by the hospital, and used by nurses to supplement the information detailed in the EPR Patient Care Summary (see event #1). Each report form on the Nurse Report Sheet was a half page in length and so four forms were available on each double-sided Nurse Report Sheet. The nurse handing off care to the next shift nurse completed a Nurse Report Sheet for each patient. This report included the following patient information details: weight changes; feeds; vital signs, including temperature, blood pressure, pulse and respiratory weight; fluid intake and output; dialysis information; IV data; procedures, specimens, and labs; as well as noteworthy patient events. The nurse coming on shift reviewed this record and then created additional entries to the Transformation document where appropriate. The Nurse Report Sheet was retained and, at the end of the shift, the next form on the sheet was completed by the nurse and handed to the incoming shift (see event #61). To complete these forms, nurses referred to and transferred information to the Nurse Report Sheet from the following nodes of the ecology: Transformation, Patient Flowsheet, Conversation with Physicians, and Medication Order.

Once the Transformations had been created, nurses used the genres in the ecology in no commonly shared order. Their use of ecology nodes was specific to the requirements for each patient's care needs. This description will thus present the remaining ecology nodes in relation to the frequency with which nurses used each genre.

In descending order, from the nodes used most frequently to those used least often, the following nodes will be addressed: Patient Flowsheet, Conversation with Physicians, Medication Orders, EPR Laboratory Results, Electronic Laboratory Results, EPR Information Entry, Conversation with Other Nurses, and Progress Notes.

In their daily information work, nurses frequently used the Patient Flowsheet. As previously discussed in the physician ecology, the Patient Flowsheet was a densely formatted form, provided by the hospital, and used by nurses on the ward to track several categories of patient data (see events #5a, 23, 24, 34 and 59). The following patient information was recorded in the Patient Flowsheet: fluid intake and output; fluid balance; current and previous weight; weight gain/loss; assessment of items such as pain and chest sounds; IV lines, their solution, and volume; and hourly breakdowns of temperature, blood pressure, heart rate, and respiratory rate. These large, 3 page, double-sided, fold-out forms were updated repeatedly throughout the shift by a patient's nurse, recording changes in these patient data categories. As the nurse entered the necessary data points on the Patient Flowsheet, he/she would update his/her Transformation by indicating with a checkmark or strike-through that the 'to do' task of updating the Patient Flowsheet had been completed. If the nurse noted a significant change of value when collecting the required data for the Patient Flowsheet, he/she would frequently orally update the physician of this change in patient status.

Another important and recurrently accessed node of the nurse ecology is the Conversation with Physicians node. This node was nearly as frequently accessed as the Patient Flowsheet node. These conversations, as indicated in the Conversation with Nurses node of the physician ecology, were either physician or nurse initiated and served several different functions. If the conversation was nurse initiated, the most common purposes included informing the physician of a change in the patient's physical status (generally an update of data stemming from the Patient Flowsheet node); requesting specific actions from physician (i.e., requesting a medication order for a patient, conveying a request from the patient's family to the physician, etc.); seeking clarification regarding a medication order (see event #13); and seeking information regarding the timing of specific care activities for a patient (see event #31). Information work within the Conversation with Physicians node often resulted in activities in other nodes of the ecology. For instance, if the nurse informed the physician of a significant change in patient physical status, this conversation often resulted in new medication orders for the patient that were created by the physician. Regardless of whether the physician orally reported the medication plan change to the nurse immediately or if the physician relied on the Medication Order to update the nurse, these orders were incorporated into the nurse's Transformation at some point after the Conversation with Physicians. Another common example of these conversations occurred when the nurse received a Medication Order but found that the information within that genre conflicted with standing patient medication orders. It was through the Conversation with Physicians' node that the nurse could clarify the new order and resolve the conflicting orders (see event #13). Significant information stemming from Conversation with Physicians activities was often recorded in the Report Sheet and Progress Note nodes of the nurse ecology.

The Medication Order is an additional node within the nurse genre ecology that was frequently accessed and that had significant impact on the other nodes within this ecology (see events #27, 31, 43 and 51). As described in the physician ecology, a

Medication Order was produced by the EPR system when a physician entered a medication order for a patient. The details of the medication order were conveyed to the nurse through a Medication Order, a paper-based document, printed automatically by the EPR system. This document was generated by physicians, but was directed towards informing nursing information work. Immediately after the physician produced a medication order, the EPR system automatically printed a Medication Order. Soon afterwards[15], administration staff filed the Medication Order into the patient's active, paper-based chart. When entering the Medication Order into the active chart, the administration staff 'flagged' the chart by pulling out a red, plastic flag located within the binder. Part of a nurse's information work was to check regularly these charts for flags in order to learn about new Medication Orders. Nurses could easily miss these flags. Since physicians and other healthcare providers on the ward often used the active charts in order to read information therein, or to contribute information to the binder, these charts were frequently in use by other professionals and thus not always easily accessible to the nurses. This inability to find the charts and their flags reflects the importance of repeated Conversations with Physicians since it was often through these conversations that nurses learned of medication orders that were entered or that were soon to be entered into the EPR. This oral update proactively warned of upcoming Medication Orders. In addition to these conversations, the Medication Order often instigated several other activities including the need for: specific order clarification conversations with physicians (see event #13); modification of timings and 'to do' activity notations in the Transformation document (see event #41); Conversations with Other Nurses (see event #28); for signing off these medications within the EPR when they had been given (see events #17, 46 and 60); additional inputs to the Patient Flowsheet; and documentation in the Report Sheet and Progress Notes to be created at the end of the shift (see event #61).

In addition to these nodes, nurses also used the EPR Laboratory Results and the Electronic Laboratory Results nodes to access patient test results. These were the same nodes used by physicians, and described above. To review, both these lab result viewing systems were computer-based nodes that nurses and physicians could access to view patient test results. The notable differences between these systems was that the EPR Laboratory Results had a text-based user-interface, and listed all tests in alphabetical order, and displayed all patient test results from the patient's admission date. The Electronic Laboratory Results system, in contrast, used a graphic user-interface that displayed patient test results in a graph divided in rows of tests with columns of date-differentiated results. Users could restrict the historic overview of results to a specified timeframe. While physicians made extensive use of these nodes, nurses only occasionally accessed them. The results that the nurses reviewed were generally transcribed into their Transformation as 'to know' entries (see event 50a). If a result was particularly noteworthy, the nurse would orally update the physician through a Conversation with Physicians.

Another computer-based ecology node used by nurses was the EPR Information Entry node. As part of their daily duties, nurses used the computer stations on the ward to access patient files within the EPR, and to update information therein. The EPR Information Entry activity, like the other EPR computer-based activities, was information

[15] Since administrative staff had many other tasks requiring their attention, the filing of 'Medication Orders' was subject to delays.

work carried out via the text-line user-interface of the EPR. As seen in other EPR related nodes, the screens of information within the EPR were size restricted and did not have scrolling functions and so required the nurses to use the 'Next' and 'Back' functions for navigation. To enter information into the EPR, the nurse used several pathways identifiable by their textual cues to navigate through the system. Unlike physicians who often found this navigation process problematic, nurses were generally quite adept at locating the links to the specific screens that they required for their information work. The most common information activities carried out via this node included signing off medications as having been given to a patient (see events #17, 46 and 60) and creating nurse-to-nurse info-grams (see event #53). The impact this information work had on other genres was apparent primarily in the patient's EPR Patient Care Summary that the next nurse would receive, since this is where the nurse-to-nurse info-gram would appear. An info-gram was yet another means available to a nurse for giving updated information to the next shift nurse.

Nurses also engaged in Conversation with other Nurses regularly during their information work. There were several expressed purposes for these oral conversations including: discussing administration procedures for specific medications (see event #28); handing over care of patients to other nurses for lunch and other scheduled breaks (see events #19, 26, 35 and 42); teaching novice nurses about professional and ward practices; seeking and being given advice and/or support for handling activities for care intensive patients (see event #3); and handing over care at shift change (see events #4 and 63). During these conversations, nurses regularly referred to and cited information from their Transformation documents and Medical Order sheets. These conversations did not regularly result in the use of other ecology nodes for carrying out information work. Instead, these conversations were generally used as a means of clarifying or supporting information work that was initiated in other genres. These conversations were carried out regularly with reference to other genres. For instance, when a nurse sought out the advice of another nurse to discuss how to administer a particular medication, the Medication Order was often brought to the discussion for common reference (see event #28).

Finally, the last node used by nurses during their daily information work was the Progress Note node. As indicated for the physician Progress Note node, nurses used the same paper-based genre to write details regarding the patient's development and care during the course of that day (see event #61). This document, kept within the active patient paper-based chart, consisted of a lined piece of paper labeled with the heading Progress Note and the patient's addressograph at the top of the page. Nurses generally created entries using full sentence format and so did not regularly use headings or other organizational structures in their manual entries. Nurses generated these entries at the end of their shift by collecting details from other nodes of the genre ecology, specifically from the following nodes: Transformation, Medication Order, Patient Flowsheet, and Conversation with other Physicians.

5.3 Step #3: Tension-Filled Interactions with EPR as Starting Points

Steps 1 and 2 of the context mapping approach demonstrate a noteworthy professional practice on the ward: no single genre, nor no one participant was the center of ward information work. Consequently, there is no one particular genre nor one professional participant that should be the assumed starting point for context mapping analysis. It is beyond the scope of this research to analyse every genre and every genre-based, user-created innovation involved in ward information work. Therefore, while I must select a starting point for analysis, I must also explicitly state that this is a selection from a range of possible launching points.

Initially, this study's data collection focused on the role of the EPR in ward information work. As a result, study data favours using the EPR as a starting point for analysis. In the study data, interesting recurring patterns of tension-filled interactions[16,17] emerged around the use of the EPR and the Electronic Laboratory Results. I use these patterns of tension-filled interactions, and their associated genre-based improvisations, as the starting points for analysis and thus as the basis of the third step of context mapping. This analysis addresses the following questions: What are the characteristics of physician and nurse tension-filled interactions with the EPR and with the Electronic Laboratory Results systems? What trends are evident in these interactions?

There are a total of 54 examples of physician and nurse tension-filled interactions in the study data. I categorize these interactions into the following three sub-categories of innovations: 1) abandoning the systems; 2) forcing the systems; and 3) submitting to the systems.

5.3.1 Abandoning Working with Computer Technologies

In 6 of the 54 tension-filled interactions, users innovated by abandoning working with the computer technologies. A user is considered to have abandoned the use of computer technologies when I observed that the user actively and intentionally stopped working with the computer system because the system itself impeded his/her work progress. I categorize the act of abandoning the tension-filled interaction as a user-generated innovation employed to circumvent the EPR-based problem. I group these instances of physicians abandoning working with the computer technologies into two sub-categories: technologies were abandoned either because the systems were too slow/taking too long to load or the physicians could not find what they were looking for within the system.

---

[16] An important caveat must preface this discussion of tension-filled interactions with computerized information systems. In order for an interaction with a computer technology to be identified as tension-filled, the interaction must have been *observably* so. Since the study observations were conducted by a researcher who was not medically trained, several potentially tension-filled interactions that were present in the data set could not be conclusively categorized. Although these questionable interactions could have been discussed with consultant nurses or physicians, the observation notes themselves are limited by the observer's skills. As a result, the following discussion only includes observably tension-filled interactions.

[17] Fluent interactions with computer technologies were also evident in the study data. Although these fluent interactions are not selected as the starting point for analysis, the description of these fluent interactions is presented in Appendix 45 for comparison.

In the three cases of physicians abandoning interactions because the computerized information systems were too slow, I documented the length of time the users deemed to be 'too long to wait.' In these three cases, the delayed durations were noted as approximately 1 minute, 2 minutes, and at least 6 minutes. In each case, the user openly expressed frustration with the system. The following example, from observation #0119b, shows a staff physician abandoning the computer technologies:

- (2:03pm) When observer arrives on ward, Staff B is sitting at a computer terminal behind the central nursing station, working with the EPR viewing discharge orders for a patient. Staff B is deleting certain elements of a discharge order but the system isn't allowing her to click on a set of items that are visibly 'clickable' items. The EPR is refusing to accept her command, although it is an allowable action within the system.
- Staff B sighs loudly and says to observer: "I'm trying again."
- Staff B closes the EPR window and re-enters the system, logs into the EPR again, and accesses the patient file. She enters the Master Guide screen and selects the Discharge orders function. She is back at the screen where she was frustrated before, at a screen where she should be able to delete a specific section of the discharge orders that appear automatically unless deleted by the discharging doctor. But, again, the EPR won't accept her deletion command.
- Staff B comments to observer: "There's a problem. I can't click here" [Staff B uses the cursor to indicate the item she wants to select for deletion]. Staff B sighs loudly again and tries to exit the screen but to no avail. "Nothing is working. Everything is ... [pause] Now I can't even go to the menu bar. [pause] So at some point you give up. But I hate that because I want to change something but I can't." (2:09pm)

In this case, the physician grudgingly admitted to giving up working with the system after 6 minutes of frustrated action. It should be noted that when this observation began, the staff physician had already been working on the EPR and so the delay could be longer than the time indicated.

The other three cases of abandoned interactions with computer technologies involved physicians being unable to find the access node within the EPR for a function that they were seeking. In these cases, the physicians who deserted working with the EPR were student physicians. The illustrative case below, from observation #0503, shows a Fellow unable to find the order she wanted to discontinue. She was able to find the DC Current Orders function, but was unable to locate the order she wished to have discontinued within the list of orders available:

- Fellow C is at a computer terminal and has accessed a patient's file within the EPR. Fellow C is in the DC Current Orders function and is scrolling through several screens, each listing currently active orders for this patient. Fellow C exits the DC Current Orders functions and enters into laboratory testing screens. She uses 'Next' function to scroll through several screens of information. Fellow C sighs and reads the Medical Summary she has open in front of her. Fellow C uses her finger to point to a particular entry in the Medical Summary, then returns her attention to the computer screen and starts scrolling through the active orders.
- Fellow C turns to observer and states: "I can't find it."
- Observer: "What can't you find?"

- Fellow C: "See, here [points to Medical Summary, Lab Orders section, to the following entry:
  5-01 2017 TDM - vancomycin through, Daily, until DC'D, Starting tomorrow, (05-05-02)]
- Fellow C: "See on the first, we ordered vancomycin, but I can't find it. I can go two ways [Fellow C looks to the EPR and goes back to Master Guide page where several possible pathways are listed]: Laboratory or DC. I'll go Laboratory [she selects that pathway]. So I'll go 'Next' [uses 'Next' function at bottom of screen], and 'Next,' and 'Next,' but look, there's no 05-01. It's not there. So I'll go DC [Fellow C exits back to Master Guide screen and selects the DC pathway], I look 'Next' [uses 'Next' function], and 'Next,' but no TDM. It disappeared. It just disappeared. Oh, well."
- Observer: "You want to get rid of the TDM order?"
- Fellow C: "I should try to DC it since we're not giving him vancomycin. We don't need that TDC anymore. And we're taking from the budget, but I can't DC it. I can't find it. So we'll wait till tomorrow and see what comes up."
- Fellow C exits the EPR and leaves to talk with a physician from another service.

Here, although the physician openly acknowledged that this order was not going to be given to the patient, and although she also commented that the order would be fiscally wasteful, she abandoned working with the system as she was unable to find the pathway for discontinuing this order. Here, as in the abandoned interactions due to delay, the physician actively and intentionally withdrew from using the EPR.

5.3.2 Forcing the Computer Technologies

The second set of tension-filled interactions involved healthcare users forcing computer technologies to bend to their professional intentions. The 10 instances of users forcing computer technologies can be grouped into two sub-categories. The first sub-category, of six cases, involves interactions where modifications were made through free-text entries, requiring the system to comply. The second group of four cases collects interactions where physicians and nurses innovated by removing information from the EPR. In this action of cleaning out the record, these healthcare professionals were forcibly removing data from the EPR that was confusing or contradictory to the patient's active care plan.

All six instances of forcing through free-text entry involved physician-users working with the hospital's EPR. In these cases, like in the abandoning cases, the forcing activity involved the user's workflow and/or care activities which were impeded by the computer system. However, instead of abandoning the task altogether, physicians navigated their way through the EPR until they found a free-text entry space within the record. The physicians then used this unrestricted data entry space to make notations regarding the problematic entry. For instance, in observation session #0302, staff physician E wanted to enter an order to change a patient's diet information but was unable to find a pathway that addressed the new feeding additives:

- Staff E is working on the ward this afternoon. He pulls an active patient chart and reads some progress notes from within the chart. He goes to a computer terminal

with the chart in hand and accesses the EPR and the Electronic Laboratory Results system. Staff E initiates conversation with observer about the study.

- Observer uses this conversation to ask about the work he is currently doing on the computer: "Can you tell me what you're looking for in the progress notes?"
- Staff E: "Sure, this patient is on [medication] but this antibiotic has not been effective so I'm about to change it. So I checked the notes to see if there's a particular reason why they used this antibiotic, which is rather unusual. So I want to know if there's a reason why this drug was used as opposed to something else. The note doesn't say so I'll just change it. And I also want to change this patient's feeds but I want to make sure I change what I want to change. This might take me a minute"
- Staff E makes a few notes on his Transformation then returns his attention to the EPR. Staff E selects the Nutrition Information pathway and begins to read carefully the screens of pathway options using the cursor as on-screen reading guide. Staff E can't seem to find the link he's looking for so he uses the 'ERR' function to go back to the Nutrition Information selection screen and chooses a new pathway option. Staff E follows that pathway through a few screens, then 'ERR's back again to the selection screen. He chooses yet another option from the list and follows that pathway. Again, he 'ERR's back to the Nutrition Information selection screen. He repeats this action of selecting another pathway, following it, then returning to the original selection screen twice more. Staff E then finds a free-type function in one of the pathways and types in text information about the patient's diet change in that space.
- Staff E then comments to the Observer: "This has got to be an error on me since there has to be a pathway to include these additives. But it wasn't apparent to me so I've included it this way."

Here, as this physician expressly admitted, there was probably a pathway within the EPR designed to create the nutritional changes desired. However, since the physician was unable to find the pathway, he actively and intentionally forced the computer system to follow his professional aims by creating a free-text entry. Although his order was entered successfully into the system, it may not have been in a location within the EPR or in a format that was anticipated or recognized by other professionals. This potential for confusion and perhaps even error was acknowledged openly by the physician during this observation session. After entering the free-type order, Staff E began looking for the patient's nurse, explaining that: "So I've created an order that I think will create confusion so I wanted to explain it to [Nurse O]". Once he found the patient's nurse, he clarified orally the order stating: "Ok, so I just wrote an order for [the patient] but I want to make sure you understand that we continue with the other *and* [participant's emphasis] add this to it". Staff E thus orally emphasized the supplemental component of the new order. This need to complement forced entries with oral or other forms of communication was a common response to tension-filled computer interactions.

The second sub-category involves forcing by cleaning cases, where healthcare professionals imposed their professional goals onto the EPR by actively and intentionally deleting or reformatting information within the EPR. Physicians and nurses thus 'cleaned up' the record so that patient information would be accessible and understood more readily. These four forcing by cleaning interactions were evenly spilt between physicians

(two cases) and nurses (two cases). Since the cleaning work conducted by both groups of professionals was similar, the discussion of this activity will not be divided along disciplinary lines. Instead, the following nursing example, from observation #0302, illustrates cleaning activities. In this example, Nurse N was working with the EPR to remove old insulin orders that were showing up erroneously as active, and was removing a contradicting 'dwell' time for another medication order:

- Nurse N is using a computer terminal inside the central nursing station desk. She is working in the EPR.
- Observer: "Can I ask what you're doing?"
- Nurse N: "I'm getting rid of some insulin orders cause it has to be ordered every day. If they [physicians] put it times one [x1] it would automatically come off. But they don't. So there were 5 insulin orders on my care plan. Just sitting there. It says right in the order it must be re-ordered but it just takes up pages on my care plan so I'm getting rid of them"
- Nurse N uses the Orders function in the EPR and attempts to delete five insulin orders. Note that she is required to type in 'reason for deletion' for each deleted insulin order. The EPR refuses the deletion orders that Nurse N entered.
- Nurse N: "It won't let me do that. It says its conflicting with something else so I'll 'complete' the orders instead of 'deleting' them. This is actually easier now that I think of it but I don't like to 'complete' them cause at least when I 'delete' them I can give a reason for why I'm doing it. When I 'complete' them they just disappear. But now I'm waiting for today's order."
- Nurse N finishes completing the orders on the EPR.
- Observer: "When there are extra orders, is it harder to work with the care plan?"
- Nurse N: "YES!! [The patient's] care plan is eleven pages long. That's a lot to read through. So now I'll do dialysis. I'll get rid of the dwell and this four hour one. So this is the right one and only it will show up so we don't confuse anyone else."

As this nurse explained, by 'getting rid' of old and conflicting orders that have been inputted into the EPR, she ensured both that 'we don't confuse anyone else' and that there were fewer pages to the Patient Care Summary making that document easier to use. In this example, the nurse had to submit to using the 'complete' pathway allowed by the EPR despite the fact that she wanted to use the 'delete' pathway. Regardless of this obstacle, she forced the EPR actively and intentionally to remove out-dated and conflicting orders.

5.3.3 Submitting to the Computer Technologies

The remaining 37 tension-filled interactions with computer technologies involved cases of physicians and nurses submitting to working with these computer systems. When submitting to the computer technologies, users actively and intentionally yielded to computerized structures, either by waiting for the technology to load/work or by resigning themselves to using the navigational structures provided by the EPR. These were innovations of surrender. It should be noted that submitting to delay was seen in interactions with both the EPR and the Electronic Laboratory Results system, but

submission to navigation was evident only in interactions with the EPR. In each of these sub-categories, the submissive interactions completed by both physicians and nurses were similar and so the activities of both professions will be addressed together.

During data collection, 10 cases of delay-induced submissive interactions with computer technologies were observed. Of these, 7 were physician-user interactions and 3 were nurse-user interactions. It is not surprising that the majority of these cases involved physicians and not nurses since, in order to make medication orders, test orders, or other patient care orders, physicians regularly relied on test result information as the basis for their care decisions. Consequently, physicians often were required to wait for either the EPR or Electronic Laboratory Results system to load and display those results. In the following example, from observation #0119, Staff B was working on the care plan for a patient who was particularly ill, and thus had been on the ward for several months. Time notations from the field notes are included below to illustrate the length of delay the physician experienced:

- (2:19pm) Staff B is working at a computer terminal, accessing the Electronic Laboratory Results system and calling up the results for a patient. While waiting for information to display, she calls a consult and has a brief discussion. By the time Staff B has finished this conversation, the Electronic Laboratory Results system has not yet displayed the test results. The results come up on the display soon afterwards (10-15 seconds later). Staff B then changes the viewing command in the Electronic Laboratory Results system and requests more historic information – the results for the past 6 months. Again, Staff B needs to wait for the Electronic Laboratory Results system to upload the patient results. While waiting, Staff B activates the EPR window and begins to review recent lab values for the patient in the EPR display. Staff B transcribes a value from the EPR screen to her Transformation, and continues to wait for the Electronic Laboratory Results. When the Electronic Laboratory Results have loaded, Staff B activates the Electronic Laboratory Results screen, highlights a row of results by clicking on one of the value fields in that row, making the entire row turn blue. Staff B then begins to scroll right in order to see historic values within that field.
- (2:29pm) Staff B then requests the last 12 months worth of results from the Electronic Laboratory Results system.
- While waiting, Staff B goes back to the EPR discharge screens for this patient and deletes a set of items. Staff B then uses the EPR to video access recent lab results for this patient. Staff B then uses a medication reference book and calculator [two resources so commonly used on the ward that they are chained to the desk] to make calculations while referring to the EPR lab results. Staff B enters in a discharge medication order for the patient using the resulting calculation.
- The Electronic Laboratory Results system has been updated. Staff B reactivates that window, and again highlights a row by clicking on a value field within the row of results that are of interest. Staff B scrolls to the right in order to view previous results for that particular test. Staff B then changes the information request dates for the Electronic Laboratory Results system, and waits for the display to update.
- Observer: “Can I ask you a question while you wait?”
- Staff B: “Sure”

- Observer: “I notice you often use both [the EPR] instead of [the Electronic Laboratory Results system] to view lab results. Can you tell me why?”
- Staff B: “[laughs and points at the screen] It’s faster with [the EPR]. I want [test name] results from six month ago so I have to use [the Electronic Laboratory Results system]. For day-to-day, [the EPR] is faster. But I want long history, so I have to wait for [the Electronic Laboratory Results].”
- The conversation continues about other topics.
- The Electronic Laboratory Results have updated and Staff B returns her attention to the computer terminal. After quickly reviewing the results, Staff B walks down the corridor and enters the patient’s room. (2:34pm)

To make her care decisions, this Staff had to wait for the Electronic Laboratory Results system to provide patient test results. Since Staff B wanted to review historic results from 6 and 12 months ago, she was forced to wait for 15 minutes for the computer system to load and display those values. As this example illustrates, when the EPR could be used to access more recent results, physicians switched over to that program. Later in the observation session, Staff B also explained that certain results were not available for viewing in the EPR and so she had to access those particular results via the slower Electronic Laboratory Results system. Furthermore, while Staff B was waiting for that particular result, she also stated: “Another reason I use [the Electronic Laboratory Results]. Today I need to order a special drain. If I have to use [the EPR], I have to scroll through many labs and orders and blood results. I think that would take longer.” As this comment illustrates, physicians were endeavouring consciously to avoid unnecessary delays in their work practices and so used the computer systems that would expedite their work. However, while physicians could select the system that would provide the required information in the fastest possible time frame, they were still required to submit to delays.

The remaining 27 instances of users submitting to the computer technology were cases of users having to contend with the navigational pathways that structured interactions with the EPR. The majority of these interactions (23 of the 27) involved a physician user. Again, this prevalence of physician user submission does not indicate that this group of users were inept EPR users, but rather that they used the EPR more extensively during their daily care activities. Physicians spent several hours during each shift at the computer doing order entry. Since nurses did not have to interact with the EPR as frequently, and since their interactions were commonly repeated during each shift, nurses were less likely to be in situations where they had to submit to ‘hunting-and-pecking’ through the EPR. This physician practice of having to submit to complicated navigation through EPR pathways was frustrating since it was a time consuming activity and often led to more work later in the shift. The following two examples illustrate these frustrations.

Observation session #0216 illustrates the time consuming nature of having to submit to the navigational pathway structure of the EPR. Here, a physician was creating discharge orders for a patient who had been on the ward for a number of months. To create these orders, the EPR pathway architecture required the physician to create several free-type entries in a series since the system had a fixed number of lines available within that free-type field. Thus, to input all the required information, the physician had to input text, enter it into the system (which then resulted in the user being sent to the main page of the patient’s EPR file), re-access the discharge screens, find the text entry screen, input

another textual addition, enter it into the system, and so on until all the data was inputted. The physician then had to create discharge medications. To do that, the EPR pathway structure required the user to review all the medication orders for the patient that had been entered since the patient's admission date. Time notations from the field notes are included in this example to illustrate the effect of this submission to the EPR's pathway configuration. It should be noted that when the observation session began, the physician was already in the process of creating the discharge information for this patient:

- (12:20pm) Fellow B is on the ward, working on the EPR at a computer terminal behind the central nursing station. She has the patient's active chart open in front of the computer and also has her Transformation on hand. She is writing a 'Hospital course/result' entry within the discharge order menu. This is a free-text entry space and the physician is creating a long, sentence structure format entry. She inputs this entry and arrives at the review screen. At this screen, this entry is listed as the third paragraph style entry that she has made. Fellow B enters this information and navigates back to the same free type screen to make another entry.
- Fellow B is interrupted by Nurse II who has a question about another patient.
- (12:35pm) Fellow B has finished her conversation with Nurse II and has returned to writing the free-text entry in the 'discharge' information for this patient. Fellow B then reviews and inputs this entry, and returns to the free-type screen to make yet another entry. She continues to create three more text entries into the discharge orders.
- Fellow B is interrupted by Nurse P who has a question about another patient.
- When Nurse P leaves, Fellow B returns to entering discharge information but is done with the free-type text entries. Fellow B is making discharge orders by going through current medications. She is discontinuing some orders and making changes to some, while skipping over others completely. While going through the medications, Fellow B is referring to the Transformation. While going over each medication on screen, she is making check marks on each medication listed on her Transformation.
- Fellow B spontaneously starts to talk to the observer while going through the patient's discharge medications: "That's the worst part, having to go over all the medications. Even if he's not on it anymore, I have to go through it. For each medication that he's been on during this whole admission. Every single one since he's been admitted, and this guy's been here for several months. I have to go through each. But there's no way around it. I have to do this. Read each one. So, he may have been on [medication name] ten times. I have to go through each one of them now. It's the worst part."
- Medications are entered and now Fellow B is typing up 'Follow-up Plan' information in discharge information in the EPR. She is creating a numbered list in this free-type space [note that the system isn't structured for list making – it is a free-type space permitting paragraph style entries]. She reviews the information and then enters it into the system. Fellow B then enters another 'Follow-up Plan', highlighting it by writing 'caution' in capital letters at the start of the entry. Fellow B then prints up information from the EPR and walks away from the computer terminal (1:04pm)

Creating the discharge information and orders for this patient took nearly 40 minutes and required the physician to enter information into the EPR at several intervals. With each entry, the computer system pathway design sent the user back to a main screen, thus requiring the physician to re-access the discharge screens with which she was working. The structure of the EPR pathways required the physician to review the many medication orders the patient had received during his/her stay in the hospital. Although the task of discharging patients was lengthy in and of itself, the cumbersome pathway architecture worsened the situation.

Submitting to the pathway design of the EPR also resulted in physician frustration in that it often led to additional work. As the following example shows, taken from observation session #0302, physician users often had to 'hunt-and-peck' their way through the EPR to find the necessary pathway. And even finding the pathway did not necessarily mean that the order would be successfully entered:

- Fellow C is working on the EPR to enter a PCA pump order for a patient. She is working with the Transplant Fellow to enter a lockout time. The EPR system isn't letting her enter in this information.
- Transplant Fellow: "That doesn't look right. It should have…" [Transplant Fellow doesn't finish her statement here – trails off]
- Fellow C: "I need to get to those fields [pointing to the EPR screen where there are pathways listed but she can't activate them]. It won't let me."
- Transplant Fellow: "Let me look over here and see if I can do it" [goes over to another computer and tries to make the order entry for Fellow C]
- Fellow C: "Thanks"
- Fellow C then starts going through other EPR screens, entering other medication orders for the patient.
- Transplant Fellow: "No, its not working for me either. I guess we'll have to free type it in although you're not supposed to be able to do that."
- The Transplant Fellow and Fellow C work together on Fellow C's computer to input the order.
- Fellow C: "Can I do them separately?"
- Transplant Fellow: "Well, technically yes, but it would look like 2 morphine orders. Not everybody would know what you mean."
- Fellow C continues to try to find the appropriate pathway in the schedule/PCA/lockout screen: "I'm just trying each field now." Fellow C clicks on every pathway within this section of the EPR, accessing each available screen in turn.
- Fellow C decides to enter the order despite the Transplant Fellow's warning saying: "It is the only choice I have!"
- Transplant Fellow: "I don't know. I still think that will look like two orders"
- Fellow C continues with the order but at the lockout options, tries again to click on pathways listed but is unable to access them.
- Transplant Fellow: "I'd free type it in. You've entered the morphine as continuous drip so you have to write 'Bolous close and lockout.'"
- Fellow C continues to work with the order, despite the Transplant Fellow saying: "I don't know. What do you think they'll read from it?"

- Fellow C: “I’ll enter for the time being first and then ask someone else to help me after”
- Transplant Fellow: “OK” [note that this is a hesitant statement]

This example is but one illustration of how physicians entered erroneous information or inaccurate orders into the EPR during such submitting interactions. Afterwards, the physician had to ‘correct’ the entry in some way. That corrective activity could have involved orally informing the patient’s nurse (or another healthcare professional) of the error and the intended action, or re-accessing the EPR later in the day to focus more time on the task.

- Fellow C: “I’ll enter for the time being first and then ask someone else to help me after”
- Transplant Fellow: “OK” [note that this is a hesitant statement]

This example is but one illustration of how physicians entered erroneous information or inaccurate orders into the EPR during such submitting interactions. Afterwards, the physician had to ‘correct’ the entry in some way. That corrective activity could have involved orally informing the patient’s nurse (or another healthcare professional) of the error and the intended action, or re-accessing the EPR later in the day to focus more time on the task.

5.4 Step #4 – Part 1: Ward Information Work was Knotworking

Step four consists of analysis that demonstrates that ward information work was an instance of Knotworking (Engeström, Engeström & Vähäaho, 1999). As illustrated in step one’s composite scenario and step two’s physician and nurse genre ecologies, ward information work was completed through the collaborative efforts of several individuals, from different professions, and through the mediation of many different genres. These descriptions suggest that ward information work met the ‘who’, ‘what’, ‘where’ and ‘when’ criteria of Knotworking.

Engeström et al. (1999) characterize Knotworking as “work that requires active construction of constantly changing combinations of people and artefacts over lengthy trajectories of time and widely distributed in space” (p. 345). Ward information work matched each aspect of this definition. First, information work involved a ‘constantly changing combination of people.’ During the day shift described in the scenario, information work involved in the care of one patient included the contributions of 5 nurses, 2 resident physicians, 1 staff physician, 1 dietician, and 1 representative from Flobotomy. It was these collaborative, inter-professional efforts that met a patient’s information work needs. Secondly, information work was accomplished through a ‘constantly changing combination of artefacts’, or mediating genres. The composite scenario demonstrates this aspect of Knotworking since 10 genres from the physician genre ecology and 11 from the nursing ecology were actively employed by participants. Next, the information work for one patient spanned a ‘lengthy trajectory of time’ since it was accomplished over the entire duration of a patient’s stay. As step 1 illustrates, the first events of the scenario’s information work involved a hand-off from the previous shift. The scenario ended with a hand-off to the next shift that continued the information work. Thus, information work was continuous, cycling forward through the efforts of

many professionals over the entire course of the patient's stay. Furthermore, information work was 'widely distributed in space' since it involved, in the composite scenario example, physicians not present on the ward and representatives from Flobotomy who did their blood analysis in a lab off the ward. In these ways, information work on the ward met the 'who', 'what', 'where' and 'when' characteristics of Knotworking.

To continue discussing how Knotworking (Engeström et al., 1999) was realized in information work, the central term of the theory must be defined: the knot. The authors define the knot in Knotworking as "a rapidly pulsating, distributed and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems" (p. 346). The composite scenario demonstrates that information work was such a collaborative, improvised, and distributed orchestration of rapidly progressing work efforts. However, before analysis of this orchestration can be undertaken, the connection between actors and activity systems must be vetted. In the scenario data, although many of the actors seemed to be individual agents, each participant "represent[ed] their respective collectives" (Engeström et al., 1999, p. 354) and "the collectives act[ed] through individuals" (p. 354). Thus, each thread of activity in the scenario's Knotworking trajectory is a representation of an individual agent's activity and their associated activity system. In the knots of Knotworking analysis each actor is best represented with his/her associated activity system. In Figure 5.4.a, scenario events #13, 14, and15 are illustrated[18] as an example of a knot of information work activity involving the collaborative work efforts of several agents and their associated activity systems.

[18] See page 122 to review these events involving the effects of RP2's failing to remove a potassium order from a patient's EPR file.

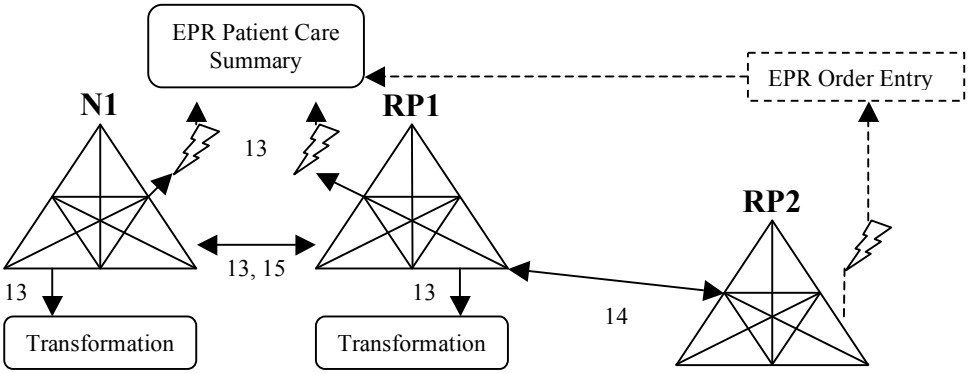


Figure 5.4.a: Events 13-15 of the scenario's Knotworking situation. Each agent and his/her associated collective are represented as activity systems. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in these events. Dotted arrow lines represent interactions and communication structures indirectly involved in these events. Direct mediation lines indicate unproblematic mediations. Lines interrupted with lightning arrows indicate tension-filled or problematic mediations. Each interaction is labelled with the number of the scenario event that it represents.

As depicted in this figure, the work involved in this knot of events can not be reduced to the efforts of one collaborator or his/her associated activity system. Here, this set of events is not contained within a single activity system since the participants did not share a stable motive nor a common community. In events 13, 14, and 15, the resident physician (RP1) and the nurse (N1) on shift, and the resident physician (RP2) from the previous day's shift were all involved in the knot, in the "tying, untying, and retying" (Engeström et al., 1999, p. 346) of threads of activity. In these events, the object-related motive for participants was not sufficiently stable to constitute a constant component of a single activity system. In event #13, N1 and RP1 could be interpreted as sharing an object and motive. This object could be judged as the patient's orders and care plan for the day, and the motive could be considered as appropriately meeting the patient's care needs during this shift. However, in event #14, both RP1 and RP2 might equally be interpreted as motivated by a need to pass their residency requirement. Thus, they may have been motivated by a need to avoid creating medical error or to avoid being reported to supervisors should an error occur. While RP2 initially created contradictory orders for the patient, both RP1 and RP2 failed to discover the contradictory orders. Therefore, both of these physicians could have been motivated by a need to rectify the contradiction without drawing supervisory attention. This motive would not have been shared by N1 who was not in a training level position. Thus, in this knot, no one stable motive was shared across all three collaborators.

Furthermore, the communities involved in the three activity systems of this knot were neither common nor stable. N1, RP1, and RP2 were all part of the community of the hospital. However, the simple fact of having shared participation in the larger institution does not seem sufficient to identify them as having been part of the same

activity system since many other and different communities also informed these participants. For instance, RP1 and RP2 were both part of the school/training community in which they were students. However, they were not both part of the same immediate community since RP1 was part of the ward community but RP2 was not involved directly in that community at the moment of these events. Like RP1, N1 was part of the ward community but she was also part of a different professional community (nursing as opposed to medicine). Furthermore, N1 was an experienced professional and thus not part of a novice or school/training community. Therefore, the communities to which these participants belonged were neither sufficiently shared nor adequately stable to constitute part of a common activity system. Thus, events #13 14, and 15 should be analyzed as having involved three different participants, who represented their own activity systems, and who worked together in an intensely collaborative setting.

With this link between actors and their associated activity systems established, Knotworking analysis of information work's "rapidly pulsating, distributed and partially improvised orchestration of collaborative performance" (Engeström et al., 1999, p. 346) can begin. Engeström, Engeström and Vähäaho (1999) posit that the first focus in Knotworking analysis has to be each individual, unstable knot of the Knotworking sequence (p. 347). The first knot of information work's trajectory that this analysis examines encompasses events #13 through to and including #15 of the composite scenario. In these three events, Knotworking analysis does not reduce work efforts to a single action. Instead, in this analysis the knot of these events is characterized by "a pulsating movement of tying, untying, and retying together otherwise separate threads of activity" (Engeström et al., 1999, p. 346). The threads of activity tied, untied, and retied together included: 1) discussing the care events that were planned for the patient for that day; 2) deciding on that day's course of action for the patient's care; 3) reviewing contradictory orders in the patient's record that needed to be reconciled; 4) clarifying the contradicting orders; and 5) relaying the reconciled order decision to others. In this example, the knot tied together the actions of RP1 and N1 in their collaborative work to plan the care activities for the patient. The knot of planning patient care was made problematic, or untied, in event #13, when N1 brought up the contradictory orders and when RP1 orally suspended (i.e., placed a 'hold') the orders. This event also questioned, or untied, the original order entry activity from RP2. The knot resolved these tensions, and thus retied the threads of activity, through two conversations: first between the two residents in event #14, and secondly between RP1 and N1 when clarification was provided. These events constitute a "partially improvised orchestration" (Engeström et al, 1999, p. 346) since there were no expressly pre-planned or choreographed actions. Each participant performed his/her own actions, improvising on the basis of his/her activity system's rules, in order to meet the needs of the situation.

The pulsating, uniting, and dissolving of this knot of collaborative work was "not reducible to any specific individual or fixed organizational entity as the center of control" (Engeström et al., 1999, p. 346). Although RP1 can be perceived as the central agent of control in these three events, analysis demonstrates that this resident was not. In event #13, N1 and RP1 collaborated to determine the best course of care for the patient, jointly deciding on the medications and tests to be ordered. RP1 did have the authority and power to make orders and to decide on the course of care, but RP1 chose to collaborate with N1, perhaps to take advantage of her experience and expertise. Furthermore, in

event #13, N1 initiated the review of the contradictory orders. RP1 responded to this concern, confirmed, and sought out the information necessary to determine the appropriate order information; but, N1 called into question the order, stopped that care action, and thus can be interpreted as having partial control of this event. In event #14, RP2 was part of the locus of control of events since this physician's input was required to ascertain why two phosphate orders were entered. RP2 created the contradictory order and so was part of making current care decisions. In this way, RP2 was also partially in control of these events. In event #15, RP1 reported her discussion with RP2 to N1. This report transferred information and decision rationale provided by RP2. Since RP2's input was still central in event #15, RP1 was only partially in control of making decisions about the patient's course of care. In these ways, across the knot of events #13, 14, and15, control over the patient's care was distributed among N1, RP1, and RP2. There was no overtly present locus of power. Instead, "the locus of initiative change[d] from moment to moment" (Engeström et al., 1999, p. 346).

This distributed nature of control was not localized to these three events. Subjectivity and control were distributed across the trajectory of Knotworking, throughout the entire scenario. Between knots there was no single locus of control just as there was no locus of control within each knot. None of the collaborators was the centre of initiative: "the center just did not hold" (Engeström et al., 1999, p. 352).

Furthermore, ward information work as a whole was not reducible to the work of one single knot. Events #13, 14, and 15 exemplify one knot in a continuum of knots that got ward information work done. In continuing to track the interactions involved in giving the patient the phosphate order, another knot can be seen as forming to continue this information work. This new knot, seen in events #19, 20, 26, and 27, completed the set of actions and operations needed to carry out the larger activity. This knot is illustrated in Figure 5.4.b:

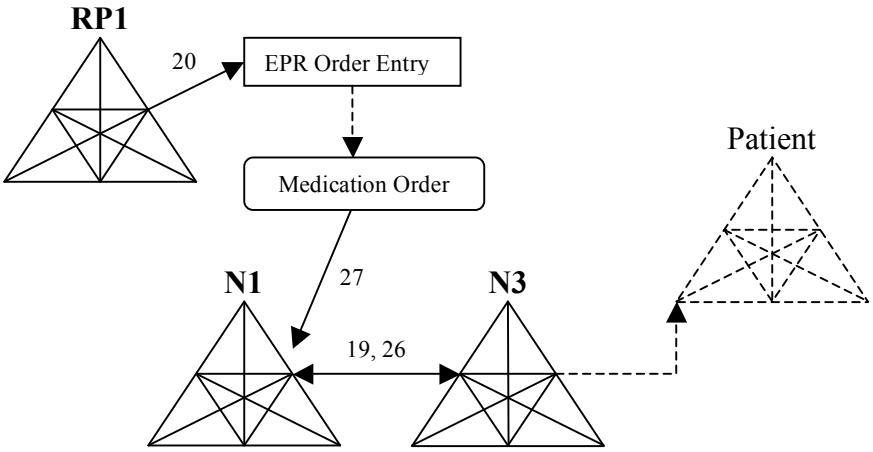


Figure 5.4.b: Events 19, 20, 26 and 27 of the scenario's Knotworking situation: the next knot of the phosphate order work. Each agent and their associated collective are represented as activity systems. An activity system represented with dotted lines represents a system that is not physically present during these events. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in these events. Dotted arrow lines represent interactions and communication structures indirectly involved in these events. Direct mediation lines indicate unproblematic mediations. Each interaction is labelled with the number of the scenario event that it represents.

In the scenario's data, this knot performed several actions to tie together the work efforts of RP1, N1, and N3 in order to give the correct phosphate order to the patient and to record that work in the patient's records. These actions included: 1) discussing the specification of the order to be given to the patient; 2) giving the order to the patient; 3) removing the contradictory order from the EPR; 4) orally confirming that the patient received the appropriate order; and 5) textually confirming the discontinuation of the contradictory order. The knot tied together the original erroneous order entry (from RP2) in RP1's actions in event #20 and again in N1's actions in event #19. In event #20, RP1 retied RP2's abandoned action of discontinuing the patient's phosphate order by completing that task through the EPR. In event #19, N1 retied the same abandoned action by orally informing N3, who was covering the patient's care during N1's break, about the phosphate order change. The knot also retied RP2's abandoning action in event #27 when N1 updated the patient's record by signing the Medication Order for discontinuing the contradictory order. In these events, each participant improvised his/her own actions in order to give the patient the correct medication order. These actions were directed towards retying the order change that RP2 had begun untying the day before. As seen in the knot of events #13, 14, and 15, there was no single locus of control in this knot's series of actions. Control over patient care, over the giving and recording of the correct phosphate order, was distributed across N1, N3, and RP1 with the locus of initiative changing from event to event. As illustrated in this follow-up example, the ward information work was not reducible to a single knot. In caring for this patient, and

even when limiting that care to a single order, at least two knots were involved. In these ways, ward information work is an example of Knotworking since this work has to be traced across a continuum of knots in the trajectory of work activities.

Just as information work was not reducible to a single action, nor to a single locus of control, nor to a single knot, no single artefact or genre acted was a linchpin in the events. In events #13, 14, and 15, the genres involved included: nursing Oral Conversation with Physicians, physician Oral conversation with Nurses, nursing Transformations, physician Transformations, physician EPR Order Entry, and the nursing EPR Patient Care Summary. In events #19, 20, 26, and 27, the important genres included: nursing Oral Conversation with Other Nurses, the physician EPR Order Entry, and the nursing Medication Order. None of these genres held the events together, nor was any one genre more important to the work of the individual knots than any other. The genres collectively contributed to the distributed, pulsating, and improvised work of the knot. Similarly, across the trajectory of Knotworking in ward information work, no one genre was the locus of control. As evident in both the composite scenario and the physician and nurse genre ecologies, the completion of the Knotworking trajectory requires the coordination and mediation of several genres.

Participants confirmed this distribution of control across genres in their interview responses to questions about the most important, reliable, accessible, and used genres in their daily practice, and about what was the definitive patient record. Across participants, no one genre was reported as being more important, more reliable, more accessible, nor more frequently employed than others, nor was one document consistently named as the definitive patient record. In the following interview excerpts, nurses pointed to several different genres as being important, reliable, accessible, and used in their daily work. They also signalled that a variety of genres were considered 'the' patient record:

> Nurse DD: (Interviewer: What source of information is the most important [is cut off by participant)] "The care plan [Patient Care Summary[19]]." (Is the most important?) "Yeah, and then the Flowsheets… It [Patient Flowsheet] is like a bible."
>
> Nurse E: (Interviewer: Can you tell me what is the most important source of information for you in your day?) "Um, I think the verbal feedback that I get from the nurses [Conversation with Other Nurses] in the morning and, um, I guess, like I think that for me [pause] because if get to talk with them and ask questions I really get a sense how and what their day has been like or what this kid has been like if they have had them a lot, then I think that gives me a lot of information."
>
> Nurse F: (Interviewer: What's the most reliable information?) "Um, well [pause] the source is really your most reliable, like the doctor [pause] they should be your most reliable [Conversation with Physicians]"
>
> Nurse N: (Interviewer: Can you tell me what is the most important source of information?) "The care plan [Patient Care Summary], that's key. I'd just die without it…for us, for nursing, the care plan [Patient Care Summary] is the patient chart."
>
> Nurse O: (Interviewer: Can you tell me in your mind what is the patient record,

[19] When participants refer to genres by names other than those used in the genre ecologies, the genre ecology node name equivalent is provided in brackets.

like 'the' record.) "The patient record? Would be the Flowsheet [Patient Flowsheet]."

Nurse RR: (Interviewer: What do you find to be most accessible or readily available kind of way of getting information about a patient?) "Well the computers are great when they are available [laugh] it is more availability so, cause you can get, if you need to know a quick lab and you send stats, labs or anything and you want to look up anything about your medication… I think the computers, when they are available, they are probably the fastest source, just because you can get everything that you need that way."

Physicians also expressed reliance on several different genres to complete their daily work:

Resident A: "The most reliable source of information would be the [Electronic Laboratory Results]."

Fellow B: (Interviewer: What is the most reliable) "The Flowsheets [Patient Flowsheet]."

Staff A: (Interviewer: So, how you get important information about a specific patient?) "Well, the vast majority of information I get is verbal. It will be verbal, from families -direct. It will be verbal from the nurses [Conversation with Nurses], and it will be verbal from the trainees [Conversation with Other Physicians]."

Staff B: (Interviewer: What is *the* [interviewer's emphasis] patient record?) "Well, I think it is part of… [the EPR] is part of the patient record in some ways, but when we just think about the patient record it is usually just more like the paper thing you know because of history, but now I think it is really both."

Staff C: (Interviewer: What information is the most current? Up-to-date?) "Not the [the EPR]. I use that [Medical Summary and printed EPR Laboratory Results] as a means of looking at what is the most [important] sort or, particularly in the morning, what is that patient's care plan [pause] what are we doing to them, what are their IV fluids, what are their medications and how does that impact on their blood work."

Some respondents confirmed explicitly that no one genre was central to their daily information work activities. These respondents acknowledged the importance of all the genres at their disposal:

Nurse FF: (Interviewer: What do you think is the most reliable source of information for you as a nurse?) "Ah, I don't think it is only one [pause] You know, it is a combination of everything because we rely on the care plan [Patient Care Summary], and we rely on the nurses [Conversation with Other Nurses], and we rely on the physician [Conversation with Physicians] and we rely [pause] you know it's not one thing."

Fellow C: (Interviewer: Can I ask you what is *the* [interviewer's emphasis] patient record?) "Ah, there's no good answer." (Why is there no good answer?) "You get [pause] yeah, you get patient records from everywhere."

Staff F: "You get different pieces of information I think, from all of those

different sources [oral-, paper-, and computer-based information sources], and I think that you need all of them to decide or make decisions about patient care."

As demonstrated in these excerpts, just as many combinations of people shared Knotworking control, several different genres successively and collaboratively acted together to realize this kind of work. As Engeström, Engeström and Vähäaho (1999) confirmed, such comments and scenario examples "highlight the importance of communicative actions and tools for the success of Knotworking" (p. 353).

To conclude, ward information work is classified appropriately as Knotworking (Engeström et al., 1999). Information work was not reducible to the events in one knot, nor was there one participant or genre that acted as the locus of control. Caring for patients on the ward was "a temporal trajectory of successive task-oriented combinations of people and artefacts" (Engeström et al., 1999, p. 352).

5.5 Step #4 – Part 2: Tracing Innovations Across Knotworking Trajectories

Since the first part of step four's analysis identified ward information work as Knotworking (Engeström et al., 1999), analysis can now address the ways in which user-created innovations impacted on the genres of the nursing and physician ecologies, as well as on the interdisciplinary work activities of ward information work. By using the improvisations of abandoning, forcing, or submitting to the EPR as starting points, the second part of step four's analysis maps the effects of these improvisations across the composite scenario's knots of actions, and across the professional genre ecologies. This tracing across the Knotworking of ward information work follows the composite scenario, starting with the first noticeable indication of the effects of an EPR-based innovation. For each knot where an EPR-based variation was used, the effects of that user-altered genre are traced across the knot in which it was involved and across the subsequent knots where ramifications were evident. Diagrams will illustrate the tracing of these ramifications. These illustrations are intended to support the understanding of this complex analysis and should not be mistaken as visually depicting necessary links between genres and/or participants.

The following discussion and the associated figures do not address all the social influences impacting the interconnections between genres and/or participants, nor do they address all the other communication options available to complete information work tasks. Instead, this analysis focuses on demonstrating that: 1) worker-made innovations happened in multiples, not in single instances; 2) a genre-based improvisation made by one worker, with one genre, resulted in other alterations in a variety of genres; 3) subsequent genre modifications regularly involved other collaborators in the Knotworking trajectory; and 4) a range of ramifications resulted from the creation of these modifications. While some effects can be considered as predominantly negative, especially at an operational level, innovations can also result in positive effects.

The first noticeable EPR-based interaction improvisation is found in event #13 when N1 questioned a contradictory order within her Patient Care Summary. The nursing Patient Care Summary, as described in the ecology, was a document generated by the EPR. Part of this summary was a list of all the current medications to be given to the

patient during the course of that shift. These medication lists were the result of physician EPR Order Entry actions. Event #14 reveals that a contradictory order had been created by RP2 during an earlier shift. It is not clear from the conversation between RP1 and RP2 what problems RP2 encountered when trying to discontinue the IV phosphate order. However, from the discussion of tension-filled EPR Order Entry examples in step 3, RP2's problems can be assumed to be an example of abandoning working with computer technologies since there was no evidence of RP2 forcing her way of working onto the EPR (i.e., there was no evidence of a free-text entry explaining an inability to discontinue the IV order), nor of her submitting to the EPR (the order would have been discontinued via submission to the EPR's pathway system). Instead, from analysis of the scenario description, it is reasonable to infer that RP2 innovated by abandoning the EPR, thus giving up on the computer system and abandoning the task of discontinuing the phosphate order.

Consequently, as illustrated in Figure 5.5.a, part of the impact of RP2's abandoning innovation was the presence of contradictory phosphate orders in the EPR, and in the subsequent EPR-generated Patient Care Summary. Although RP2's innovation was observed only indirectly in the scenario, RP2's actions are presented in Figure 5.5.a since this physician's genre alterations impacted N1's Patient Care Summary and her discovery of a contradictory phosphate order therein.

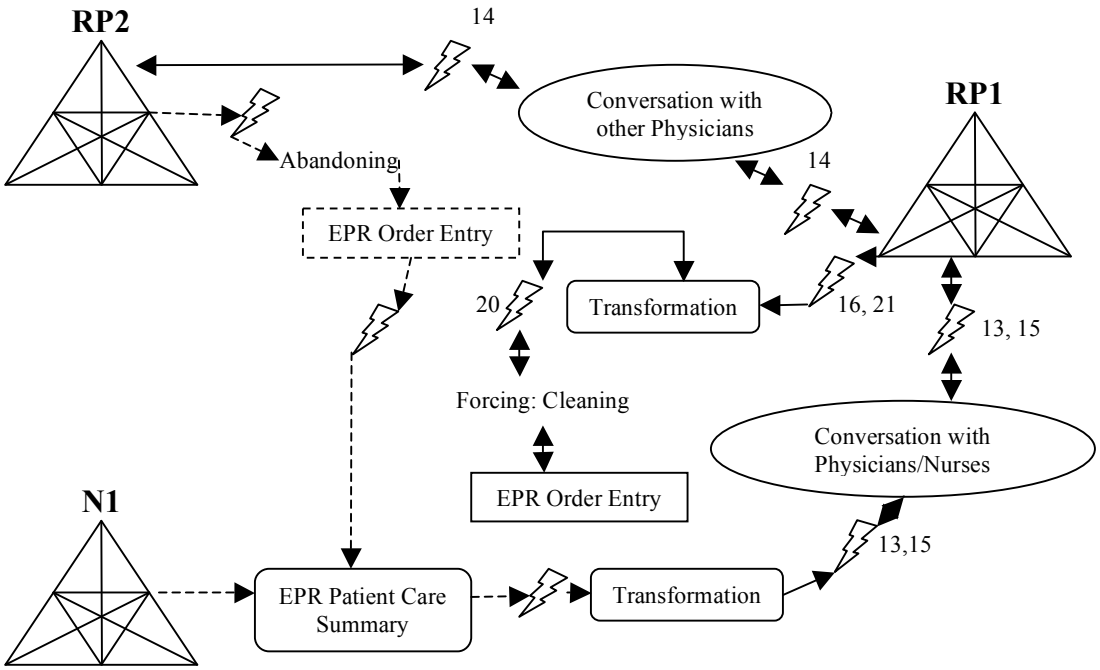


Figure 5.5.a: Effects of EPR-based innovations on the knot of events #13-16 and #20-21 of the scenario's Knotworking situation. In this illustration, lightning arrows indicate the effects of innovations being traced along the associated mediational means. As in earlier illustrations, each agent is represented as an activity system. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Oval textboxes indicate oral genres. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in the illustrated scenario events. Dotted arrow lines represent interactions and communication structures indirectly involved in the illustrated scenario events. Direct mediation lines indicate unproblematic mediations. When applicable, interactions are labelled with the number of the scenario event they represent.

The ramifications of RP2's improvisations can be mapped across the knot of events #13, 14, and 15 through a series of unorchestrated oral conversations. The contradictory order in the Patient Care Summary resulted, in this particular knot, in a nursing innovation where N1 orally discussed the contradictory order with RP1, who in turn innovated through another oral conversation with RP2 to confirm the original order requirements. With the clarification provided by RP2, this new information was then passed back to N1 by RP1 through another oral conversation. In addition to these oral modifications, RP2's abandoning improvisation also resulted in RP1's tinkering with her Transformation document. N1 made a 'to do' entry in her Transformation for discontinuing the contradictory phosphate order that remained in the EPR. In these ways, RP2's abandoning innovation resulted in a series of required genre modifications from other participants who were removed in time from the original innovation. Further, although RP2's genre variation was based in the EPR, the effects of that genre modification were experienced not only in the EPR itself and in the documents that were generated by that system (i.e., the EPR Patient Care Summary), but also across the genre ecologies of both

RP1 and N1. Thus, RP2's innovation resulted in the creation of other alterations, by other participants, and in other genres of the ecology.

The effects of RP2's innovation extend to event #20 and 21 where RP1 had the opportunity to make the necessary discontinuation orders thorough the EPR Order Entry genre as a forcing improvisation. In event #20, RP1 cleaned the EPR, removing the contradictory order, and thus innovating by forcibly removing contradictory data. Then, in event #21, upon completion of the discontinuation order, RP1 completed the improvisation by checking-off the "DC IV K" 'to do' item on her Transformation. Here again, the outcomes of RP2's genre alteration are evident across the Knotworking trajectory. In these events, the effects of RP2's modifications were experienced by RP1. Here, unlike in the knot of events #13-16, only one actor was involved in contending with the results of the original innovation through additional modifications. RP1 needed to make an EPR-based revision (i.e., forcing by cleaning) in order to address RP2's EPR-based alteration of abandoning.

However, the limit of the ramifications of RP2's innovation have not been reached. As Figure 5.5.b illustrates, several other nursing improvisations resulted from this physician-made genre modification.

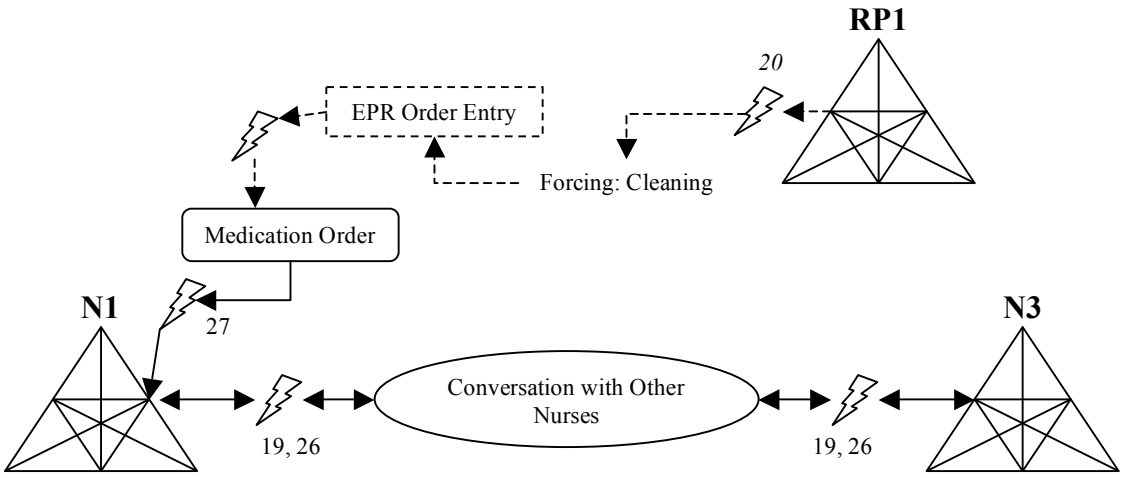


Figure 5.5.b: Effects of EPR-based innovations on events #19, 26 and 27 of the scenario's Knotworking situation. In this illustration, lightning arrows indicate the effects of innovations being traced along the associated mediational means. As in earlier illustrations, each agent is represented as an activity system. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Oval textboxes indicate oral genres. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in the illustrated scenario events. Dotted arrow lines represent interactions and communication structures indirectly involved in the illustrated scenario events. Direct mediation lines indicate unproblematic mediations. When applicable, interactions are labelled with the number of the scenario event they represent.

In event #19, N1 left the ward to go on break and needed to innovate by orally informing N3 of the change of the phosphate order. When she returned from break, in event #26,

N3 had to inform N1 orally of the phosphate order that was given to the patient. In this way, RP2's EPR-based alteration resulted in a nursing improvisation in the nursing Conversation with other Nurses genre ecology node. Furthermore, the result of RP1's tinkering by cleaning the EPR (from event #20) was the production of a Medication Order, a genre that N1 had to acknowledge and confirm, as seen in event #27. This Medication Order, that discontinued the IV phosphate order, was a document that did not necessarily need to be part of RP1's and N1's information work. This Medication Order was yet another genre alteration that was needed to resolve RP2's tinkering. With this Medication Order signed-off by N1, the effects of RP2's genre modification were not evident again during this shift, thus marking the end of the consequences of this innovation in this scenario.

As this analysis illustrates, the combination of innovations created by N1, N3 and RP1, extending from event #13 to #27, and involving a wide variety of genres, is a collection of improvisations that these participants created to contend with the effects of RP2's genre alteration. The innovation of RP2's abandoning the EPR resulted in the creation of multiple modifications by several other participants in the knot.

The next EPR-based innovation began in event #37 with the rest of that knot of activity coming in event #43. In this EPR-based alteration, RP1 worked to discontinue a medication order for the patient, a medication that she did not want administered in the afternoon. However, from examination of the scenario data, it is evident that this physician was experiencing difficulties in locating the order and the appropriate discontinuation pathways in the EPR. To resolve this tension, RP1 innovated through a forcing interaction by creating a free-text entry in the EPR. In this free-text entry, RP1 included the specifications for the discontinuation that she was unable to enter into the EPR via the pathways that she found. In this way, RP1 innovated to create the order with the specifications that she wanted, but did not do so according to the structured navigation pathways provided. As Figure 5.5.c illustrates, this innovation had effects on the Medication Order that was created by the EPR for the discontinuation. It should be noted here that the Nursing Orders free-text entry was not included in the Medication Order.

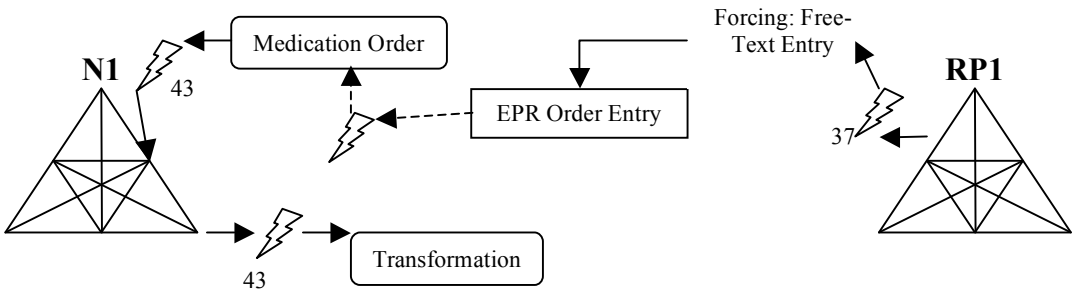


Figure 5.5.c: Effects of EPR-based innovations on events #37 and 43 of the scenario's Knotworking situation. In this illustration, lightning arrows indicate the effects of innovations being traced along the associated mediational means. As in earlier illustrations, each agent is represented as an activity system. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in the illustrated scenario events. Dotted arrow lines represent interactions and communication structures indirectly involved in the illustrated scenario events. Direct mediation lines indicate unproblematic mediations. When applicable, interactions are labelled with the number of the scenario event they represent.

In event #43, when N1 found the Medication Order for the discontinuation, she crossed off the 'to do' entry on her Transformation. N1 was, presumably, unaware of the free-text entry specifications. The scenario data showed no evidence of RP1 orally informing N3 of this change of medication. It is reasonable to assume, then, that N3 was unaware of the change of medications and thus did not inform N1 orally of the discontinuation in the oral handover when N1 returned from break. N1 and RP1 did not have any conversations between events #37 and #43 so those specifications could not have been delivered orally by RP1. Also, since N1 did not access the EPR after returning from her break in event #42, nor before giving afternoon medications in event #45, it is reasonable to assume that N1 did not find the free-text entry before administering the afternoon medications. Thus, from analysis of these events, it is not clear whether N1 discontinued the medication before or after afternoon medications were given. It is clear from RP1's entry that the afternoon medications were to be given before discontinuing the order, but it is not clear if N1 received that information in time to act upon it.

Forcing the EPR through free-text entry, as illustrated in event #37, was a common innovation involving physician users. As this composite scenario analysis demonstrates, it is difficult to know if free-text entry information always reached the nurses in a timely fashion when the physician did not duplicate this information orally.

Events #47 and 48 are the basis for the next Knotworking knot where an EPR-based innovation is used. In this knot, N1 initiated action by requesting that a medication be ordered by RP1 for the patient. When RP1 questioned whether an order was already in the EPR system for this medication, N1 justified her request by mediating their conversation with the EPR Patient Care Summary genre (see Figure 5.5.d).

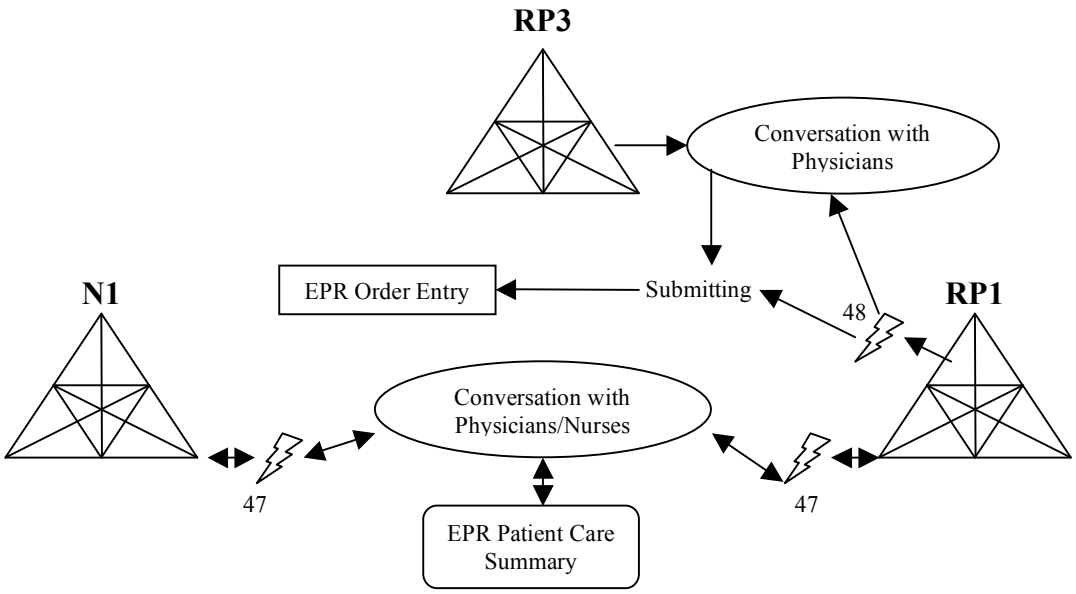


Figure 5.5.d: Effects of EPR-based innovations on events #47-48 of the scenario's Knotworking situation. In this illustration, lightning arrows indicate the effects of innovations being traced along the associated mediational means. As in earlier illustrations, each agent is represented as an activity system. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Oval textboxes indicate oral genres. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in the illustrated scenario events. Direct mediation lines indicate unproblematic mediations. When applicable, interactions are labelled with the number of the scenario event they represent.

By demonstrating to the physician that the medication was not a currently active order for the patient, N1 was able to initiate order entry action by RP1. The innovation occurred in event #48 when RP1 was unable to locate the medication to be ordered within the EPR. She innovated by submitting to the EPR, 'hunting and pecking' through the list of medications. In this work, RP1 was frustrated. She then innovated again through a Conversation with Other Physicians (RP3). RP3 was able to give RP1 another name for the medication in question and, with that additional information, RP1 successfully entered the medication order.

In this example of innovating by submitting, eventually RP1 was able to enter the medication order. RP1's delay was minimized by RP3's fortuitous presence at the computer terminals at the time that RP1 was entering the medication order. In this composite scenario, the submitting innovation resulted in a successful EPR Order Entry and did not require further tinkering. In the study's data set, submitting interactions often did not require further improvisations since this particular form of genre modification resulted in the successful entry of information into the EPR. It was an innovation that was time consuming, but not necessarily one that generated more genre alterations. However, while submitting did not often necessitate the creation of more alterations, upon occasion it did demand more innovations. In the following example, the submitting

innovation required further alterations, both for the physician creating the submitting entry and for the nurse involved in the Knotworking activity.

In events #50b-53, illustrated in Figure 5.5.e, the staff Physician (SP1) who temporarily replaced RP1 on the ward needed to change a medication for the patient, but was unable to create the specifications he desired. Thus, SP1 placed an order through the EPR's pathways without his specification requirements. SP1 then immediately followed this submitting improvisation with another genre alteration through the Conversation with Nurse node of the genre ecology (event #51). SP1 took the Medication Order generated by this submitting alteration, gave it to N1 who was responsible for giving the medication to the patient, and orally informed N1 of the necessary specifications. During this conversation, N1 innovated by making changes to her Transformation document, detailing the information provided orally by SP1. In this way, the additional information required for the order, but missing in the submitting genre-based innovations, was provided to the nurse by the physician.

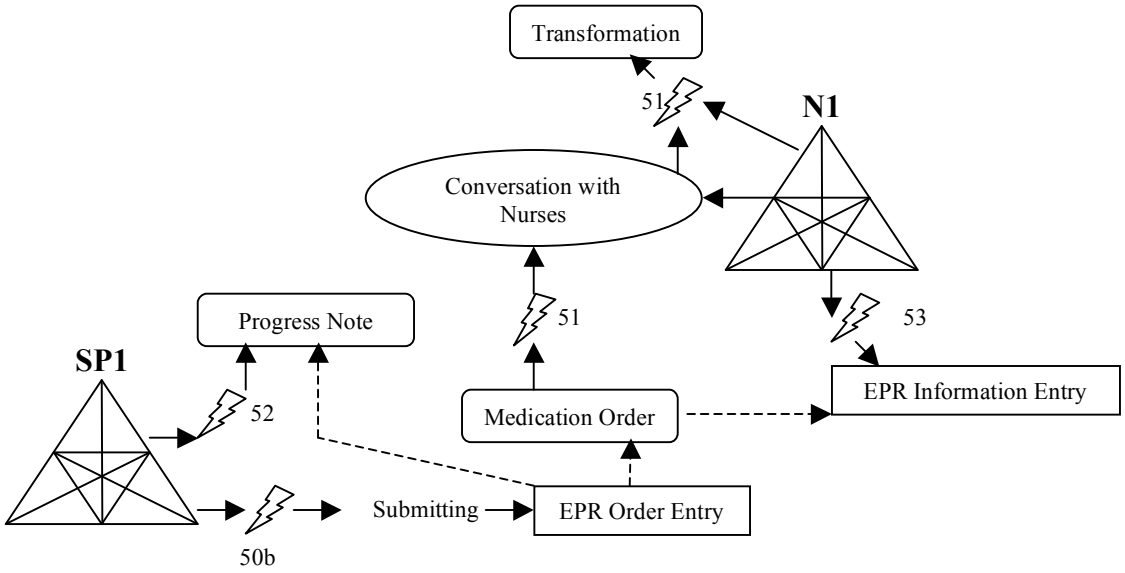


Figure 5.5.e: Effects of EPR-based innovations on events #50b-53 of the scenario's Knotworking situation. In this illustration, lightning arrows indicate the effects of innovations being traced along the associated mediational means. As in earlier illustrations, each agent is represented as an activity system. Mediational means are represented as text boxes. Rectangular textboxes represent computer-based mediational means, while rounded rectangular textboxes represent paper-based mediational means. Oval textboxes indicate oral genres. Interactions between agents/activity systems and/or mediational means are represented by arrows. Solid arrow lines show interactions directly involved in the illustrated scenario events. Dotted arrow lines represent interactions and communication structures indirectly involved in the illustrated scenario events. Direct mediation lines indicate unproblematic mediations. When applicable, interactions are labelled with the number of the scenario event they represent.

However, event #51 does not mark the end of the genre modifications generated by this submitting innovation. In this exemplary scenario, SP1 innovated again in event #52 by creating an entry in the patient's Progress Notes where he detailed the missing information from the order created in the EPR. Additionally, N1 innovated in event #53

by creating a Nurse-to-Nurse free-text entry in the EPR explaining the medication details for the order created by SP1. As this example illustrates, submitting genre-based variations generated other participant genre alterations.

As analysis of these knots demonstrates, a worker-generated innovation regularly resulted in the creation of other improvisations by this worker and by other workers involved in the Knotworking trajectory. Thus, genre-based alterations generally did not occur in singular, independent instances in Knotworking, but instead occurred in multiple, interrelated instances. Furthermore, in information work's trajectory, those multiple modifications were spread across the actions of the variety of participants involved. In keeping with this multiple and distributed nature of innovations, the ramifications of these genre tinkerings were also multiple and distributed in nature.

The effects of these innovations appear, at first glance, to be primarily negative in nature. In abandoning interactions, such as those exemplified by RP2's actions described in and inferred from event #14, negative effects can be interpreted as resulting from this physicians' decision to abandon working with the EPR. In this knot of information work, the abandoning improvisation caused delay for N1, who required clarification of the contradictory orders before being able to act on the information presented in the Patient Care Summary, and for RP1, who had to contact RP2 to acquire explanatory information. Also, RP2's alteration resulted in contradictory orders being present in the Patient Care Summary. Had this contradiction not been discovered by N1, a medical error could have resulted since the patient could have received twice as much phosphate as required. These delays and the potential medical error can be seen as unnecessary and so as negative ramifications of the abandoning interaction.

Similarly, submitting innovations regularly resulted in significant time delays. As illustrated in event #48, submitting modifications often required lengthy interactions with the EPR on the part of physicians. Such delays can be considered negative repercussions of submitting interactions. In addition to delays, submitting modifications can result in incomplete orders being entered into the EPR. Event #50b is an illustration of a submitting variation where an incomplete medication order was inputted into the EPR. Both the physician and the nurse involved in this event completed several genre alterations to ensure that the order was clarified via other genres (i.e., Oral Conversation with Nurse, Progress Notes, EPR Information Entry). While these efforts attempted to compensate for innovation, the incomplete order remained in the EPR and potentially could cause confusion for other participants removed from the current Knotworking trajectory (as RP2's abandoning interaction created confusion for other participants in event #14).

Finally, in both variations of forcing, negative effects resulted from these tinkerings. First, forcing by cleaning, as exemplified in event #20, required additional work from participants to clarify information within the EPR. RP1 had not created the contradictory order that needed to be cleared from the EPR. However, it was this physician's responsibility not only to forcibly remove the order from the EPR but also to ensure that the correction information was shared inter-professionally. These tasks were additional duties, requiring time and cognitive attention that could have been directed elsewhere. In forcing through free-text entry, as indicated in the discussion of event #43, order entry information and specifications can be easily missed if the worker creating this modification fails to follow up this action with another modification (i.e., via a

Conversation node). When physicians entered medication specifications through free-text entry, those data were not always accessed by nurses. Or, if those data were accessed, the physicians were not ensured that the update was received in time. Thus, this form of tinkering left workers susceptible to missing important medication information.

However, the multiple alterations, distributed across participants, also held the potential to positively affect ward information work. One example is a shared sense of responsibility for ensuring the accuracy of all patient medication orders. Variations of abandoning, forcing, and submitting often resulted in medication orders being inputted without sufficient details or incorrectly in other ways. Participants regularly commented on the need to verify medication information that came solely from the EPR. For instance, in observation session #0118, Nurse E was mentoring a novice nurse, Nurse EE. When they were preparing medications for administration to a patient, Nurse E explicitly taught Nurse EE to be cautious of the data in the EPR Patient Care Summary. While they were preparing the medications, Nurse E pointed to the EPR Patient Care Summary volume numbers and began making a calculation in the margin explaining: "I always check the calculations cause you give it so you're responsible. It's your butt on the line." As evidenced here, nurses expressed and taught responsibility for medications given to a patient. If there was a miscalculation in the EPR, or any other confusing order information, it was a nursing 'butt on the line.' Thus, it is possible that the frequent use of EPR-based innovations reinforced among nurses the need to verify carefully patient medication orders.

Similarly, physicians expressed a responsibility for ensuring order clarity. This sense of responsibility is illustrated in step 3's discussion of forcing computer technologies when a staff physician created a medication order that he considered confusing and unclear. In that example, in order to ensure that the nurse involved in the patient's care was aware of the inaccurate information, Staff E began looking for the patient's nurse, explaining that: "So I've created an order that I think will create confusion so I wanted to explain it to [Nurse O]" (Observation #0302). Fellow C confirmed that physicians and nurses share the responsibility for informing each other of medication changes, stating that when she made several medication order changes, oral conversations were required to support EPR-based data:

> The only problem is, with the [EPR], when you put them [changes in medications] down in the care plan, some of them might not get printed out immediately and then they [nurses] might not get notified when this plan gets printed out ….If you are going to make a lot of changes, like for only one nurse, then you ought to tell them [since] they [the orders] might be quite difficult….Sometimes if you put in an order, and I will stay quite late as well, by the time you finish and put in the orders it is 1 or 2 pm and by the time you get the print out [the Medication Order] it is about 3 pm 4pm so…Some orders do get missed because of that as well. (Interview)

However, not all physicians shared this sense of responsibility. As Nurse T explained, some physicians were better than others at letting nurses know about medication order specifications, like preferred timings: "I mean, some doctors are very good at coming to tell you especially if they need something done right away. You know, 'I have just put in

this order for this medication, can you start this as soon as it is available from the pharmacy'" (Interview).

Thus, participants did express an awareness of the potential inaccuracies present in medication order entries, even though they may not have been explicitly aware that such inaccuracies were often a result of genre-based improvisations. Participants also acknowledged that responsibility for ensuring the accuracy and the timely delivery of medication order information was shared inter-professionally. Consequently, part of the effects of genre-based innovations may be a shared sense of responsibility for ensuring the accuracy of patient medication orders. This could be a positive consequence of the creation of improvisations.

Another positive consequence of these modifications is a promotion of inter-professional communication. As exemplified in all of the scenario events listed here, save only events #37 and 43 that follow up on the IV phosphate order knot, all of the EPR-based variations resulted in oral interactions across professions. In interviews, participants repeatedly highlighted the importance of interprofessional communication in ward information work. Physicians expressed intense reliance on verbal communication with nurses to complete their daily work: "I use verbal communication a lot to relay [to nurses] what I want" (Fellow A: Interview); "The vast majority of information I get is verbal. It will be verbal from families. It will be verbal from the nurses. And, it will be verbal from the trainees" (Staff A: Interview); "I always try to talk to the nurses too, the nurse that has looked after, that is looking after, the patient to see if there are any issues, because sometimes things are not written [pause] I mean things are happening where there are issues that are not actually written down in the chart" (Staff F: Interview). Physicians thus expressed the importance of oral communication for collecting information and for relaying patient data and orders inter-professionally.

However, the nurses on the ward regularly expressed a frustration that physicians did not engage in sufficient oral communications with them. For the nurses, further promotion of inter-professional communication was required. As Nurse DD explained, "Quite often doctors forget to tell you that they have ordered something. So, sometimes it is a couple of hours later, and then you see the order and you think "now why didn't they tell me - they were standing right there, and I was right there and they didn't tell me!" (Interview). Nurses also reported that their efforts to exchange information verbally with physicians were regularly frustrated. In her interview, Nurse E explained that patients often get more and better information about course of care than the nurses. She also explained that trying to catch up verbally with a physician was a tension-filled interaction for nurses:

> I find that the doctors talk a lot to the parents about changes that are going to occur -a lot more than they talk to the nurses. And we will see it in notes [Progress Notes] if we have time to read them, or sometimes in the orders [Patient Care Summary], but if you don't [pause] if you have missed an order and then at the end of the day you realized that you missed this big important thing, then it is really frustrating when you know that you have seen the doctor on the floor. So I find that really irritating and I do try to track down the doctors in the morning if I see them, and I just kind of say like "what's the plan for the day?" …. my purpose in the morning is to try to contact the doctors at one point, and I like to do it on the floor, I don't like to page them just to find out what is going on for the

day, but I try to just get them when they look like they are kind of in a relaxed mode and they are not in their chaotic mode, just to kind of find out what the plan is [pause] because then you can get any little questions in, that you don't feel are important enough to page them for, but you still would like to know the answers because then you know, it could lead to something else and you could pass it on to the next nurses and you know [pause] just to kind of get an idea of why this kid is still here or [pause] because sometimes you are thinking they should be going home, but meanwhile the doctor is like, 'Oh no, we found out that they had la la la la la la so they are going to be [pause]' you know, and you are like 'wow [pause] here I thought they were like done"….So [pause] I kind of like to touch base with them, and then if you don't [pause] like some doctors never stay on the floor and they really don't seek you out, and then you get it through the orders and you just 'oh', missed that!"

From accounts like these, it is clear that oral communications between physicians and nurses were important contributors to successful ward information work and were valued by both physicians and nurses. In fact, as the accounts from nurses indicate, these oral communications needed to be encouraged and to be realized more consistently. Consequently, the verbal communications that were generated in response to EPR-based modifications can be considered beneficial effects of these improvisations. It was when these oral communications did not accompany innovations that problems and concerns were expressed.

To conclude, in ward information work, understanding the effects of user-created improvisations must be informed by a wide variety of factors, including analysis of the many genres through which effects will be realized, and across the many factors that are involved in the work at hand. As this step's discussion has established, the effects of the multiple and distributed innovations that result from EPR-based alterations can be seen as having both positive and negative consequences.

5.6 Step #5: Summary of Findings by Means of a Revised Composite Scenario

In Table 5.6.a, I summarise context mapping findings in a revised version of the composite scenario. The table's left-hand column lists the events of the composite scenario, including only those involved in the knots of the scenario's Knotworking (Engeström, Engeström & Vähäaho, 1999) trajectory. Individual knots are separated from each other in this column by double border lines that frame each knot. The central column details analysis findings. These findings include the starting point used to begin analysis of the knot, and the innovations associated with this initial improvisation. The starting point alteration is defined as an example of abandoning, forcing or submitting innovations. The associated modifications are described according to which professional group created the innovation and which genre of their ecology was used to complete the improvisation(s). The alterations are placed visually alongside the event in which they were created. The right-hand column lists some of the potential ramifications of these variations, differentiating between effects that could be classified as positive or negative. These ramifications are linked with the entirety of the knot discussed and so are not

aligned visually with specific event numbers. Instead, ramifications are listed at the beginning of each knot.

Table 5.6.a
Summary of Context Mapping Findings

Composite Scenario Events	Analysis Findings	Ramifications
65. RP1 and N1 meet outside the patient room and discuss the patient's care for that day. RP1 and N1 orally decide on three medications and a lab test to be ordered for the patient through the EPR by RP1. Both N1 and RP1 make note of these decisions on their individual Transformations. Then N1 comments that she has found a contradiction in the patient's Patient Care Summary stating: "And you still want him to have potassium oral *with* the infusion?" [italics represent participant's emphasis] (Obs. #0420). RP1 asks to see the patient's orders on N1's Patient Care Summary. RP1 reviews the orders and states that she didn't enter that order yesterday [RP2 was covering for RP1 who was not on ward yesterday]. RP1 says that she'll check that order with RP2 and report back to N1.	Starting Point #1: Abandoning Innovation [not present in scenario] Innovation #1: Nursing – Oral Conversation with Physicians	Negative: 1. Causes delay in work processes for N1. 2. Causes delay in work processes for RP1. 3. Results in the presence of contradictory medical order information in EPR and in EPR-based genres (i.e., the Patient Care Summary). Positive: 1. Increases inter-professional awareness and responsibility for reviewing medical order information. 2. Promotes inter-professional oral information sharing.
66. RP1 pages RP2 and clarifies the order, finding out that RP2 had difficulty discontinuing the phosphate IV order when she entered the oral phosphate order. [Note: There is a 'reprimanding' tone to RP1's comments to RP2 about the need to finish discontinuing orders in the EPR.]	Innovation #2: Physician – Oral Conversation with other Physicians	
67. RP1 orally informs N1 that the phosphate IV order should have been discontinued, that she will discontinue that order in the EPR and clarifies that the patient should only receive phosphate orally.	Innovation #3: Physician – Oral Conversation with Nurses	
68. RP1 makes a note on her Transformation for the patient to discontinue the phosphate IV order for the patient: 'DC IV K' [DC= discontinue, IV= intravenous, K= phosphate].	Innovation #4: Physician – Transformation	
19. N1 speaks with N3 who will be covering for N1 as she goes on her morning break. Asks N3 to keep an eye on the patient's fever, warns N3 that the patient was vomiting last night but has been fine this morning, and gives N3 the phosphate that the patient will need to have while she's gone on break with notice of the explanatory discussion that N1 had with RP1 about the phosphate order. N1 leaves for her morning break.	Innovation #5: Nursing – Oral Conversation with other Nurses	
20. RP1 goes to a computer terminal and accesses the patient's file in the EPR. RP1 discontinues the phosphate IV order, enters three orders for other medications to be given and for blood work to be done [note that these are the orders that N1 orally received from RP1 during their conversation earlier this morning].	Innovation #6: Physician – EPR Order Entry, Forcing Innovation: Cleaning	

21. RP1 makes several checkmarks on her Transformation, including checking off the box for 'DC IV K.'	Innovation #7: Physician – Transformation	
26. N1 returns from break and N3 gives oral update of change in the patient's status, including information about having given the phosphate order to the patient.	Innovation #8: Nursing – Oral Conversation with other Nurses	
27. N1 goes to the printer at the central nursing station desk and finds five Medication Orders for her patient. She takes them to the patient's ward chart and places them in the binder. N1 signs four of the Medication Orders [one of which is the discontinuation of the contradictory phosphate order] but is troubled by one order and takes that Medication Order out of the binder.	Innovation #9: Nursing – Medication Order	
37. RP1 accesses the patient's file in the EPR and goes to discontinue a medication order. RP1 goes through several screens of information, going back and forth through several screens. RP1 explains: "I don't know how to discontinue the order. I can't find it" (Obs. #0302). RP1 finds a free type entry space in the 'Nursing Orders' space and manually types in that the medication should be discontinued after this afternoon's dose has been delivered.	Starting point #2: Forcing Innovation: Free-Text Entry	Negative: 1. Creates potential that additional order information will be missed by other healthcare providers. Positive: 1. Increases inter-professional awareness and responsibility for reviewing medical order information.
43. N1 finds Medication Order in the patient's ward chart for discontinuing medication that RP1 inputted earlier. N1 signs the Medication Order, then takes out her Transformation and crosses off an entry on her Transformation.	Innovation #1: Nursing -- Transformation	
47. N1 finds RP1 and asks if a medication can be ordered for the patient: "You know, the cream you put around the tube?" [Obs. #0208b]. RP1 is surprised there isn't an order there already, but N1 confirms that there isn't by showing RP1 her Patient Care Summary. RP1 says she'll order it right away.		Negative: 1. Causes delay for RP1. Positive: 1. Increases inter-professional awareness and responsibility for reviewing medical order information. 2. Promotes inter-professional oral information sharing.
48. RP1 accesses the patient's file in the EPR to order the cream as requested. She searches through several lists of medications but can't find the name she's seeking. Another resident [RP3] is at another terminal. RP1 asks RP3 for advice for entering the order. RP3 gives RP1 another name for the cream. RP1 finds the name in the medication list and orders the medication for the patient. She explains: "There's so many different names for everything" (Obs. #0208b).	Starting point #3: Submitting Innovation Innovation #1: Physician – Oral Conversation with other Physicians	
50. b. SP1 goes to a computer terminal and accesses the patient's file in the EPR to discontinue the current antibiotic order and to create a new antibiotic order. First, SP1 successfully discontinues the current	Starting point #4: Submitting Innovation	Negative: 1. Results in the presence of confusing or

antibiotic. Then SP1 works to enter the order for a new antibiotic. However, while SP1 is able to find the medication, she is not able to find the timing and pathway specifications she wants. SP1 enters the order without the appropriate specifications.		incomplete medical order information in EPR. Positive: 1. Increases inter-professional awareness and responsibility for reviewing medical order information. 2. Promotes inter-professional oral information sharing
51. SP1 goes to the Medication Order printer and takes the Order to N1 and explains that the order is confusing as it stands on the Order. SP1 explains to N1 what he wants the order to be. N1 makes changes to her Transformation during the conversation.	Innovation #1: Physician – Oral Conversation with Nurses (with Medication Order) Innovation #2: Nursing – Transformation	
52. SP1 makes an entry in the patient's Progress Notes about the change of medication, the justification for that change, and the order entry problem.	Innovation #3: Physician – Progress Note	
53. N1 goes to the EPR and enters a Nurse-to-Nurse free-text entry about the medication change, explaining what should be given to the patient despite what's written in the order.	Innovation #4: Nursing – EPR Information Entry	

5.7 Conclusion: Context Mapping

To summarise, this chapter presents the five steps of the context mapping approach to data analysis. Context mapping supports a complex contextually informed analysis of ward information work and enables a description of some of the professional, inter-professional, and practical ramifications of these work practices. By creating a composite scenario, by relying on profession specific genre ecologies, and by selecting a starting point for analysis, the first three steps of this approach frame study data in formats that support this broad scope analysis. Step four then identifies ward information work as a Knotworking trajectory and traces the ramifications of the starting points for analysis through knots of activity of the composite scenario and across the physician and nursing genre ecologies. The findings of step four's analysis are visually summarised in step five's revision of the composite scenario.

CHAPTER 6: CONCLUSIONS AND FUTURE RESEARCH

This research has resulted in several interrelated conclusions. In this final chapter, I present these conclusions as contributions to: 1) the field of RGS, 2) the theory of Knotworking, 3) the field of Medical Education research, 4) the field of HI, and 5) the hospital setting where the research was conducted. These conclusions are based primarily on the results and discussions of the previous chapters. When conclusions draw on specific parts of these data, I reference the relevant chapter and section. However, some conclusions draw on additional data. In these instances, I discuss the supplementary data in relation to earlier findings. I also describe future research directions for each area.

Before I describe study conclusions, I want to acknowledge the limitations of this research project. The first limitation is related to the fact that I was the only researcher doing data collection for this study. As highlighted in chapter 3.4, my unique set of abilities thus influenced the data collected. I am a qualitative researcher with a theoretical background in RGS,VR, AT, and ANT, but I am not trained in any aspect of healthcare. This limited the scope of data collected in this study since, as Charmaz (2000) explains, "the narrowing of research questions, the creation of concepts and categories, and the integration of the constructed theoretical framework reflect what and how the researcher thinks and does about shaping and collecting the data" (p.522). As discussed in chapter 3, I took several measures to take this influence into consideration during my data collection and analysis. However, I acknowledge the unavoidable influence my "distinctive talents and limitations" (Angrosino & Mays de Pérez, 2000, p. 676) had on this study.

Related to this limitation is the difficulty of objectively determining whether genre-based innovation ramifications are beneficial or problematic on a global level. Every social perspective from which data is analysed will have its own conceptions of what constitutes a positive or negative impact. With my "distinctive talents and limitations" (Angrosino & Mays de Pérez, 2000, p. 676) and with the data set I was able to generate, I can identify a set of ramifications and an interpretation of their beneficial and/or problematic impact.

Additionally, this study is limited in that only theories from RGS, VR, AT, and ANT are brought into the data analysis process. Other bodies of research could also usefully inform this analysis, including: theories from healthcare-based research fields such as Health Policy, Health Management, and Health Economics; theories from technology-based fields such as Computer-Supported Work Studies and Human-Computer Interactions research; and other humanities-based theoretical works such as Narrative Theory and the Rhetoric of Science. However, the theoretical tools used in this study were selected to address emergent themes and so were not forcibly applied to the study data. In this way, this study avoids the grounded theory pitfall of "applying predetermined themes rather than seeking emergent ones" (Kennedy & Lingard, 2006, p. 105).

Finally, this study took place at a single ward in one hospital and involved only one EPR and the genres most commonly used in conjunction with this computer system. Healthcare professionals on this ward relied extensively on the EPR in their daily

practices. This may not be the case on other wards or in other hospitals. Further investigation is needed to understand how other wards within the same hospital and how wards in other hospitals use various genres to conduct patient information work. Future research should also address other EPR systems, inquiring into how other EPR visual designs are used by professionals and how they might influence communication practices. Preferably, this future research would systematically vary each of these parameters as independently as possible. Such variations could provide insight into which aspects of genre contexts are most influential on ward information work practices.

6.1 Contributions to RGS Research

A basic tenet in RGS research is that a genre needs to be analyzed in its social context. In both stages of this study, I carefully attend to the concept of a genre's context by taking into analytic consideration a broad scope of contextual elements. Results from stage one's visual analysis, described in chapter 4, find that a genre's visual designs constitute part of its context and convey rhetorical meanings to users (see chapter 4.2). RGS research has not significantly attended to analysis of the rhetorical work of a genre's visual components. However, chapter 4's analysis reveals that the visual structures of a genre function rhetorically and that visual rhetorical analysis can significantly contribute to the understanding of individual genres. Therefore, I contend that analysis of a genre's visual design context, using the theories of VR, and more specifically of Kress and van Leeuwen's *Reading Images* (1996), can provide useful insights into the social actions of the genre.

However, as the findings from chapter 4 also demonstrate (see especially sections 4.3 and 4.4), visual rhetorical analysis of genres (and perhaps all genre research) may need to be embedded in a broader scope of contextual considerations. Although the visual rhetorical analysis of the project's first stage incorporates observation and insider interview data, the findings of this first stage of analysis contribute to the development of EPR re-design suggestions that are insufficiently contextualized. These re-design suggestions, had they been implemented, could have resulted in the loss of important genre functions. Therefore, the first stage of this investigation established that, in some research settings, study data needs to be situated in relation to a wide range of contextual considerations. To properly situate study data, the genres under examination may need to be studied in relation to the varied social contexts in which they are used, the span of social actions in which they are involved, and the range of all genres with which they are coordinated. Therefore, the findings from this first stage of data analysis demonstrate that VR informed analysis of a genre's visual designs, complemented with observation and insider interview data, can inform usefully the understanding of a genre. However, in order for such findings to be interpreted appropriately in complex communication settings, they should be framed within a broad scope of contextual considerations. In chapter 5, I develop context mapping as an approach to data analysis that incorporates a wide range of contextual considerations into its examinations. I do not include analysis of visual designs in context mapping. Future work with context mapping should redress this gap by investigating the possibility of incorporating an additional step in this approach that would involve the rhetorical functions of visual designs.

The second stage of this study's analysis, discussed in chapter 5, involves the development of context mapping. Context mapping extends my research focus to encompass a larger range of context considerations in the analysis of information work. This five-step approach expands my data analysis beyond the scope of one genre, of a single user, and of single profession's work tasks. Instead, this analysis included a variety of social contexts, an array of social actions, and a wide range of genres involved in information work. Ward information work involved multiple professionals from a range of professions, working collaboratively through several different genres to complete work tasks. In this setting, I limited my context mapping analysis to the tracing of information work from a narrow set of starting points. Without such limitations, the analysis could have become overwhelming. Thus, I used tension-filled interactions with the EPR as the starting point for my context mapping analysis.

This analysis, as described in chapter 5, revealed that, in the Knotworking (Engeström, Engeström & Vähäaho, 1999) setting of ward information work, EPR-based innovations created by one study participant often resulted in the creation of several other improvisations, in a range of genres, by the original participant and/or by other collaborators. Genre modifications did not occur in singular independent instances, but as multiple interrelated instances. Furthermore, the effects of these genre-based variations could be determined as having both beneficial and detrimental effects on study participants, depending on the social perspective adopted in the analysis of these ramifications. For instance, some genre-based innovations resulted in the input of inaccurate information in the EPR (see forcing interactions in chapter 5.3.2). From one perspective, this improvisation had negative consequences as it recorded false information in the patient's permanent record. And yet, this innovation was followed regularly by interdisciplinary oral conversations that clarified the inaccurate input. Thus, from another perspective, the EPR-based modification had the positive consequence of fostering interdisciplinary collaboration and communication. Therefore, depending on the social action being foregrounded, individual genre-based improvisations can be evaluated as having both beneficial and detrimental effects.

While context mapping supports the identification of a range of effects resulting from genre innovations, I posit that the full extent of these ramifications can not be predicted adequately through this, or any other, analytical approach since each improvisation had something of a butterfly effect[20] across the entire Knotworking situation. This butterfly effect metaphor is best described through the lens of ANT research. Ward information work can be identified as an effect generated by a patterned heterogeneous network of materials (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992). This heterogeneous collection of materials includes the many genres of the nursing and physician genre ecologies (Spinuzzi, 2003a, 2003b; Spinuzzi, Hart-

[20] My use of 'butterfly effect' is a metaphorical extension of Edward Lorenz's original use of the phrase. The 'butterfly effect' was first described by Edward Lorenz at the December 1972 meeting of the American Association for the Advancement of Science in Washington, D.C., in his description of chaos theory. Lorenz posited that "if chaos theory were true, a single flap of a single seagull's wings would be enough to change the course of all future weather systems on earth" ("Chaos theory," 2006). In later uses of this postulation, other researchers replaced the seagull with a butterfly. However, regardless of the choice of seagull or butterfly, through this example Lorenz illustrated "the impossibility of making predictions for complex systems" ("Chaos theory," 2006). My use of 'butterfly effect' borrows from this term the broad-scope of effects of a single action, and the impossibility of comprehensively predicting those effects.

Davidson & Zachry, 2004; Spinuzzi & Zachry, 2000). The collection ranges, for instance, from the EPR's computer-based genres to EPR-based printouts, from paper forms that are institutionally provided to scrap paper notes made by individual healthcare professionals, and from casual interprofessional oral exchanges to formal intra-professional rounding oral communications. As actants (Callon, 1991; Latour, 1988, 1991, 1999, 2005; Law, 1992) within the heterogeneous network, these genres "compoundly mediate" (Spinuzzi, 2003b) each other.

For instance, when a participant created a Transformation of an EPR-based summary (as described in chapter 4), patient data moved from one genre to another. But that transition was not without consequence. Through that move, the participants created a 'mediator' (Latour, 2005, p. 39) that "transform[ed], translat[ed], distort[ed], and modif[ied] the meaning or the elements" (p. 39) of that genre in multiple and often unpredictable ways. Furthermore, information work's patterned network of heterogeneous materials also consists of other actants and actors that are involved equally in this compound mediation. Included in this network are elements such as hospital regulations, health economics considerations, medical school tenants and obligations, professional practices concerns, interprofessional collaborative aims, government and regulatory body rulings, the physical layout of the ward, and individual professionals such as nurses, physicians, physiotherapists, social workers, and administrative staff. To tinker with a single element of information work's heterogeneous network of elements is to impact on the entire network's pattern. Therefore, a user-generated improvisation with a single genre could have ramifications for the entire heterogeneous network of information work. These effects, like Lorenz's conception of the beat of a butterfly's wings, are wide in their range and impossible to predict completely. This impossibility for comprehensive prediction is a result of the fact that a heterogeneous network has no specific limits. There are no clear boundaries restricting inclusion in an heterogeneous network. Therefore, to state conclusively where the ramifications of one user-created innovation begin and end is simply not possible.

However, this does not negate the importance of developing an approach for identifying and understanding as many of the effects of a user-generated improvisation as possible. As my study demonstrates, it is possible to map several of these effects across a range of contexts. By investigating a genre in as wide a range of contextual considerations as possible, an in-depth understanding of some of the work and effects of a genre within a patterned network can be achieved. In my research, I examine the patterned heterogeneous network that constitutes information work on one hospital ward, and I investigate how tinkerings with one genre impacts across the entire network that supports this Knotworking style work. I endeavour not to favour any one participant, genre, or other element of information work not only because this work has no central locus of control, but also because the entire network's collection of hybrid entities shapes the social reality of the ward. Consequently, to investigate the role of one genre in this setting demands a very complex and broad appreciation of context. Context mapping (illustrated in chapter 5) is one means for understanding and mapping how genres are part of these larger, heterogeneous networks. Context mapping supports the description of individual genres as part of the means that shape and are simultaneously shaped by the other elements of the heterogeneous network.

Although this description will always be incomplete due to the unbounded nature of heterogeneous networks, significant findings can be developed by doing genre analysis that respects the complexity of genre contexts. In doing RGS analysis of workplace communications in this way, researchers avoid the punctualisation of the heterogeneous network context. They avoid simplifying the network into "a single block" (Law, 1992, p. 5) that hides the complexity of heterogeneous elements, and so prevent focusing only on "the action itself and the seemingly simple author of that action" (p. 5). If RGS research strives to give practical and theoretically informed advice regarding communication practices in complex work settings, I argue that an approach like context mapping could be adopted in future research to ensure that theoretically informed suggestions take into account as many unpredictable and wide ranging network effects as possible.

Context mapping supports RGS investigations that respect the complex patterning of actors and actants involved in the heterogeneous network of elements that constitute information work. Future research using context mapping should continue to hone this approach by conducting similar studies investigating healthcare information work in other settings. In this way, not only could research continue to investigate the range of contextual considerations that need to inform genre analysis in such settings, but it will also contribute to RGS's work in healthcare communications. Additionally, the construction of links between the theories RGS, AT, and ANT is another promising area for future research. In my study, I discovered that RGS, AT, and ANT research could be combined to inform data analysis. Future RGS studies could profit from further investigations into the differences that separate and the ties that can be developed between these three fields of research. Such work holds the potential to discover more inter-theory connections and complementary research approaches.

6.2 Contributions to Knotworking Theory

My contributions to Knotworking are related primarily to the discovery of insufficiently vetted components of the theory. While developing context mapping, I realized that three concepts founding the theory of Knotworking (Engeström, Engeström & Vähäaho, 1999) are in need of further elaboration and revision. First, the concept of a single knot needs to be recognized as a necessary but artificial distinction in Knotworking. To analyse and discuss the work of a Knotworking trajectory, Engeström, Engeström and Vähäaho divide these trajectories into a series of knots described through a set of interrelated events. However, these knot divisions should be recognized as arbitrary constructions that are perpetually incomplete. A Knotworking knot is defined as a pulsating movement "of tying, untying, and retying together otherwise separate threads of activity" (Engeström et al., 1999, p. 346). A knot of work activity can be abandoned or relinquished by one collaborator at one particular moment, to be taken up by another collaborator immediately thereafter or at another future time. Threads of activity can be tied, untied and retied by an innumerable set of collaborators over an indefinite period of time. To track the trajectory of the work of any given knot would require an omniscient perspective, one that could follow the work of all current and potential collaborators involved in a knot for an unending period of time. Therefore, a definitive determination

of where one knot ends and another begins is unattainable. I propose that the definition of an individual knot of activity ought to be recognized explicitly in Knotworking theory as an artificial unit of analysis, one that assembles selections and deselections of elements.

However, the recognition of the artifice enabling the distinction of individual knots does not negate the contributions of Knotworking based analysis. In fact, this recognition reinforces the utility of complementing Knotworking research with ANT research. Through an ANT informed perspective, Knotworking knots can be recognized as consisting of a heterogeneous network (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992) of elements. To endeavour to construct limits to a knot would be akin to attempting to determine the boundaries of a heterogeneous network. Such absolute borders do not necessarily exist and the researcher should not endeavour to impose them. Instead, by explicitly acknowledging the impossibility of capturing the entirety of a knot or its network, research can artificially, but explicitly, create limits to their units of analysis. These limits enable researchers to provide contextually grounded and relevant conclusions without assuming simplistic punctualisations (Law, 1992).

Another Knotworking concept requiring further critical attention is the notion of the interrelated events that constitute knots of activity. Engeström, Engeström and Vähäaho do not describe the criteria justifying the separation of individual events of a particular knot. Creating a sequence of events describing Knotworking activities is a practical necessity for enabling analysis; however, researchers should articulate the rationale for the divisions of where one event ends and another begins. These constructed events supply an orientation for analysis, providing starting points and directions for the researcher. Since Knotworking analysis depends heavily on a study of individual events, the explanation for the demarcation of separate events should not be assumed to be inconsequential. Given the variability of individual work settings, it may be impractical to develop a universally applicable set of event delineation criteria. Nevertheless, in my research, I describe the criteria for event division in the introduction to the composite scenario in chapter 5.1. I offer this description as a sample set of criteria considerations that other researchers could use as an example of one means of delineating event separation. These criteria should be recognized as event division principles that were useful for this study's analysis and may not be applicable in other projects.

Finally, my investigations reveal a problem with the current formulation of the concept of Knotworking's ethical dimension. Engeström, Engeström and Vähäaho acknowledge an ethical dimension to Knotworking, but they do not investigate this dimension in any great depth. The authors define the ethical dimension explaining that Knotworking "regularly calls for a redistribution and reconceptualization of control, responsibility and trust" (p. 355). Therefore, the ethical dimension attends to issues surrounding the roles of, and changes in, the social power structures involved in a given Knotworking trajectory. From this definition, the authors then examine their example of the 'mental patient' intervention. These authors propose that no one participant is more authoritatively in control of the knot of activity involved in this intervention than another. Although the intervention includes the participation of a general practitioner, the patient's custodian, a neighbour, an ambulance crew, the police, a service technician, a psychiatrist, and the patient him/herself, "none of these [is] the center of control" (p. 352). Consequently, they contend that the Knotworking trajectory of this scenario

"shakes and makes questionable the given forms of hierarchy and segmentation of professional and organizational authority" (p. 356).

Engeström, Engeström and Vähäaho (1999) do not address the issue of the renegotiation of power in the Knotworking trajectory beyond this disclaimer or these brief descriptors. Significant questions concerning this ethical dimension remain unanswered. These questions include: In specific terms, how does Knotworking redistribute and reconceptualize control, responsibility and trust among participants and related social institutions? Why are these redistributions and reconceptualizations accepted by participants and/or related institutions? How is the hierarchy between professionals made questionable in this Knotworking trajectory? In what ways does Knotworking shake up the segmentation of professional and organizational authority? What are the ramifications of these changes in hierarchy and authority? How do such re-distributions of power impact on other parts of these professionals' work practices? Is an equality of power between different individuals and between artefacts truly realized? Are there other associated situations that negate these equitable relations?

I propose that the ethical dimension of Knotworking needs further investigation to answer these questions. Such research could provide a more thorough definition of the ethical dimension and a more detailed means for examining the issues of power and control in Knotworking trajectories. Research should not assume that social hierarchies are necessarily overcome by Knotworking practices, nor should it assume that such structures have no impact on Knotworking trajectories. In my research, I do not attempt to address these questions, nor to contribute to the understanding of the ethical dimension of Knotworking. However, this aspect of Knotworking theory is an important criteria in the understanding of communication practices in inter-professional collaborative work settings. Future research into the ethical dimensions of Knotworking would support the development of this understanding.

6.3 Contributions to Medical Education Research[21]

This study's findings can contribute to the field of Medical Education by questioning the implicit manner in which some communication strategies are taught to novices and the implications of that hidden curriculum (Jackson, 1968). My investigations reveal that the creation of Transformations was a pervasive activity on the ward, one conducted by all observed physicians and nurses at the beginning of every observed shift (see chapter 4.1). During interviews, I asked participants to reflect on how they had learned these Transformation strategies. Respondents from both professions reported that they had learned these practices informally. Novice physicians regularly indicated that they had noticed senior staff physicians making Transformations and had begun mimicking that process without explicit instruction. More senior staff physicians reported creating Transformations early in their training but did not recall having received direct instruction. Instead, they described the process of learning to make Transformations as an evolution of their personal practice. As one physician explained, his Transformations

[21] The field of Medical Education, in general terms, is dedicated to "educational scholarship and professional education consulting aimed at improving the education of future health professionals" (The Wilson Centre for Research in Education, 2006, "Vision" para.)

had undergone several "evolutions" to arrive at his current use of a small ringed booklet containing Complete Written Overhauls: "I am just more comfortable with that" (Staff E). Only one staff physician described intentionally passing on Transformation strategies to students, explaining that Transformations enabled better contextualization of patient data: "almost every day [I] print out the medical summary... and I try and train people in this way, [to] always look at your blood results in the context of medications" (Staff C).

Nurses also reported that learning to make Transformations was part of an informal curriculum. Novice nurses repeatedly recounted learning this practice on the ward from a preceptor or mentor. They reported receiving explicit instruction regarding Transformation practices during informal discussions with preceptors. Senior nurses confirmed this mentorship instruction, but also commented that Transformation practices evolved into systems that individual nurses tailored to meet their needs. As one nurse indicated, her preceptor had suggested making Transformations as a means of balancing case loads. As she gained experience, her practices evolved: "I revamped it every once and a while. It has become my thing that I do" (Nurse K). The senior nurse leader confirmed the intentional transferring of Transformation skills, explaining that every new nurse on the ward is taught to create these documents: "we are really just initiating them into that, as soon as they come on the floor" (Nurse R). And yet, she also emphasized both the individual nature of this mentoring ("you are assigned a mentor and you are following that person") and the flexibility allowed for individual organizational design choices ("however they want to arrange it") (Nurse R).

From an educational perspective, the lack of an explicit curriculum around such a fundamental discursive activity in the clinical setting is problematic. These Transformation moments harbour critical lessons for novices regarding how to value certain kinds of patient information over others, how to prioritize actions, how to organize clinical work, and how to negotiate collaborative practices. Other research suggests that when novices learn discursive strategies implicitly, they may misunderstand the professional values inherent in those strategies (Hunter, 1991; Haber & Lingard, 2001; Lindgard, Garwood, Schryer & Spafford, 2003). Since these Transformations were regularly dubbed 'cheat sheets' by their users, we might speculate that the implicit education regarding their use may be grounded in the perception that 'working off the record' is not legitimized by the institution or by professional governing bodies. Thus, explicitly acknowledging the process could be important for legitimizing the educational value of such Transformations and thereby legitimizing explicit training regarding the professional goals of creating these documents. This investigation suggests that there is a function in Transformation 'dysfunction' that should not be ignored and that might be cultivated productively for novice learning.

Medical Education research can also be informed by this study's context mapping analysis findings. Stage two of this study's research finds that ward information work had no central locus of control: no individual participant directed or coordinated the activities of all professionals, nor did a central genre coordinate these activities or centrally record all professional work efforts (as described in chapter 5). This distributed control required all participants to be responsible for patient care via information work and necessitated a high level of inter-professional reliance. Each professional shared the responsibility, not only of meeting his/her own profession's information work demands, but also of supporting the information work of other professionals. For instance, nurses

relied on physicians to advise them (orally, or via other genres) of problematic patient orders that resulted in physician innovations. Similarly, physicians relied on nurses to inform them of the changing status of patients, and to ask questions when orders were confusing or contradictory. As a result, a high level of inter-professional responsibility was required to maintain and advance ward information work.

And yet, during interviews, study participants asserted that individual professionals had varying levels of awareness of the distributed, interprofessional responsibility involved in ward information work. For example, as Nurse T explained, some physicians were more adept at sharing information inter-professionally than others: "I mean, some doctors are very good at coming to tell you especially if they need something done right away" (Interview). Nurse R developed this observation further by explaining that a professional's awareness of the distributed nature of control and responsibility often was related to their level experience. To illustrate, Nurse R recounted a sample conversation with a novice fellow: "Some of the new fellows have come up and said, you know, 'I ordered this at ten o'clock and it is now 12:30 and I still don't have the information.' Okay. Did you talk to the nurse about it? 'No.' But then you need to tell them" (Interview). Study observation data also indicate that novices were those participants most likely to be unaware of the importance of supporting the distributed nature of ward information work. As illustrated in section 5.1.3.2, when Staff E created an order that could cause confusion for a nurse, this physician sought out the nurse in question to orally inform him/her of the correct order information. In contrast to this, as seen in section 5.1.3.3, when Fellow C created a confusing order, this physician decided to leave the confusing order in the EPR and to return to 'fix' the order at a later time, despite a warning from a colleague that the order could be misinterpreted by others. These data examples illustrate how novices did not support consistently the distributed nature of responsibility involved in ward information work.

An ANT-informed analysis of this situation may explain, in part, why experienced healthcare professionals were better able to support the distributed, inter-professional responsibility involved in information work than novices. An ANT-informed analysis suggests that, in their daily information work practices, healthcare professionals did not contend with the entire heterogeneous network (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992) of materials that made up ward information work. To attend to the entire network would not have been feasible since the actor would have been overwhelmed by the sheer scope of materials operating in these networks. Instead, healthcare professionals most likely engaged with punctualisations (Law, 1992), allowing them to ignore much of the supporting network that enabled their work. This allowed them to work only with the routines and/or objects that truncated those networks. During ward observations, experienced healthcare professionals regularly appeared aware that their daily routines were punctualizations of heterogeneous networks. Experienced professionals were observed to be conscious of the network of elements that could be drawn on to help support their task, and to be attentive to the ramifications that their improvisations would have on others. In contrast, when novices encountered the same genre-based difficulties, they consistently displayed an inability to draw effectively on the underlying network and an unawareness of both the ramifications of their innovations and of the need to manage those effects. I propose that novices were unaware that they had been working with punctualisations and so mistakenly accepted

these simplified routines as representing the entirety of the heterogeneous network involved in information work. Due to their reliance on punctualisations, I argue that novice healthcare professionals were less effective in their efforts to support the distributed nature of control and responsibility involved in information work since they were unaware of the true complexity of the heterogeneous network involved.

The fact that novices experienced difficulties contending with the ramifications of their actions in relation to the distributed nature of control and responsibility in information work is not surprising. However, education researchers should consider investigating a number of questions in relation to these difficulties: How do novices learn about the distributed nature of ward information work and about the impact of their genre-based work activities across other professionals and across other genres? Or, in ANT terms, how do novices learn about the heterogeneous networks behind the routines and other punctualisations that they use? How do novices learn that their genre-based innovations have effects across the entire pattern of actors and actants involved in the network? Are these issues explicitly addressed or are they tacitly learned? If explicitly taught, who are the appropriate instructors for these lessons? Should inter-professional supervision be incorporated to address these issues? If tacitly learned, what are the effects of that teaching strategy? Are adverse patient events or near misses associated with the tacit learning of these lessons? It is beyond the scope of this study to investigate these questions, but future research into this area of medical education could provide interesting and constructive insights.

6.4 Contributions to HI Research[22]

The findings of this study can also contribute to the field of HI research. HI "explores how information and communications technologies (ICT) can support and advance health and the health system" (Waterloo Institute of Health Informatics Research, 2005, "What is HI?" para.). Although HI studies have investigated the use of EPRs in healthcare settings (see summary of research in chapter 1.3), I suggest that these studies have often been too narrow in their investigational focus. As my first stage of analysis shows in chapter 4, focusing the analytical scope too narrowly can result in insufficiently informed conclusions. Instead, in ANT terms, analysis should recognize that the EPR is just one actant (Callon, 1991; Latour, 1988, 1991, 1999, 2005; Law, 1992) within the patterned network of heterogeneous elements (Bijker & Law, 1992; Callon, 1987; Latour, 1987, 2005; Law, 1992) that supports healthcare communications. Determining if a specific EPR supports and advances health care requires that the EPR, as an actant, not be examined in isolation of other actants or agents. Instead, future HI research should investigate the role of an EPR as an actant used in the larger heterogeneous network of hospital communications. Context mapping could be used as a means of supporting such research. As chapter 5 of this study demonstrates, using context mapping as a means of examining EPR-use in relation to several contextual considerations enables researchers to investigate why EPRs are associated with both benefits and problems in hospital settings. Therefore, I propose that this analytical approach could usefully support future research

[22] The conclusions of this section are directed towards Health Informatics as a field of research and not as a department within a hospital.

in the field of HI since, as Berg (1997) warns, it is "only by focusing on the way these heterogeneous networks take shape and break down can we come to terms with the fundamental issues at stake in the production and use of technical systems in medical practices" (p.190).

This study's findings also point to a new direction in HI research that should inform the use of EPRs in healthcare settings: the changing role and status of the patient record in healthcare settings. Mann and Williams (2003) report that the primary function of a patient record, including an EPR, is to support patient care while its secondary function is to act as a medico-legal document that records patient care activities. However, the role of a patient record as supporter of patient care and recorder of care activities rests on the assumption that the information that is entered into patient record documents is accurate and error-free. As this study's findings indicate (see chapter 5.3), data inputted into this hospital's EPR was sometimes inaccurate. Since the EPR was part of this hospital's official patient record keeping system, the inputted inaccuracies resulting from forcing, submitting to, and abandoning the EPR call into question the reliability of patient record information. In interviews, participants commonly acknowledged that the EPR-based information was not consistently up-to-date or complete. As Nurse O explained, to know the current status for a patient, professionals needed to be suspicious of EPR-based information:

> I plan out my day according to the [Patient Care Summary] and what is on there. But the thing that I find sort of [pause] is that that tells you sort of like the medical stuff about the patient, but like what's actually going on with your patient and stuff, I find is more in the [nursing] oral handover, like when we get, like cause sometimes people are so busy and they forget to write on [the EPR] like 'oh something that happened' but they won't put things like 'they threw up' on [the EPR] and that is important things that we need to know, so that is what gets passed on there [nursing oral handover conversation]." (Interview)

As this nurse describes, patient data included in the EPR-provided summaries were frequently incomplete. Other forms of patient information sharing, such as oral communications, were required to compile a complete record of a patient's status. Nurse T, while lauding the variety of data maintained in the EPR, confirmed that the EPR was not always a complete accumulation of information: "the [EPR] does everything for you, in the sense that it provides all the information that you require, as much as is put in and as much as it has entered" (Interview). Based on these findings, I suggest that HI research investigate if EPRs are widely experienced as sites of incomplete and/or inaccurate patient information. Incorporated in such investigations would be complimentary questions about an EPR's ability (or inability) to support patient care and to act as a medico-legal document.

6. 5 Contributions to the Research Site

Finally, findings from this study provide informative feedback for the research site. The hospital where this study was conducted has recently purchased a new EPR system to

replace the current system. The Health Informatics Department at the hospital[23] describes the new EPR system as more user-friendly and intuitive than the current EPR design. However, regardless of the advantages of the new system, I suggest that user-created innovations will still be produced by hospital healthcare providers to facilitate their work with the new EPR. In this teaching hospital, the EPR is used in most wards and by most healthcare professionals. Therefore, this one system must meet the needs of a wide range of professions, perform numerous functions, and support novices as well as experts. It would be difficult for any one EPR system to meet the needs of each of these users with equal efficiency and efficacy. Consequently, I suggest that most users will continue to make genre-based innovations to support their work activities regardless of the specific EPR implemented in the hospital.

I do not suggest, however, that the continued creation of innovations is necessarily a problem that the hospital needs to rectify. In fact, I propose exactly the opposite. The hospital should not interfere with the creation of innovations by users as a matter of course. Instead, decisions to institutionally adopt, alter, or leave unchanged user-generated genre-improvisation practices are evaluations involving many contextual considerations. As chapter 5 demonstrates, tinkering with any given genre generates a wide range of ramifications that, depending on the perspective from which these effects are judged, can be seen as being beneficial and/or detrimental for users. Thus, I recommend that the hospital's HI Department observes the innovations that hospital staff create, and use an approach such as context mapping to determine the range of ramifications resulting from these innovations. Once these effects have been described as fully as possible, the hospital can take these effects into consideration when deciding if the innovation should be abandoned, institutionalized, or left unchanged. Several different goals, motives, and objectives are involved in information work. An innovation may not meet one particular goal, motive, or objective, but it may meet and support another. Therefore, I suggest that, before changes to current practices or to user-created improvisation are made, the objectives to be optimized need to be determined.

As a final illustration of the complexities involved in ward information work, the following excerpt demonstrates how the hospital's EPR usefully supported the information work tasks of study participants, while simultaneously requiring the participants to learn to work through, despite, and around the computer system. As Fellow C explained, once a healthcare worker gained sufficient expertise in making EPR-related innovations, participants often considered themselves savvy EPR users:

> Fellow C is waiting for her discharge orders to print. There seems to be a queue of jobs ahead of her print job. While waiting for the printer, Fellow C begins a conversation with the Observer.
>
> - Observer: "So, in general, how do you feel about [the EPR]?"
> - Fellow C: "You need to learn your way around it. No system is perfect, I know. So you always need to learn it. Yeah, I've learned [the EPR] now – you know, how to get around it. I think I'm pretty good at [the EPR] now." (Observation #0331)

[23] The Health Informatics Department provides and supports the information technology infrastructure (including the hospital's EPR) for information and knowledge management which supports and enables hospital healthcare professionals to provide patient care.

APPENDIX 1: INTERVIEW PROTOCOL

Introductory Statements

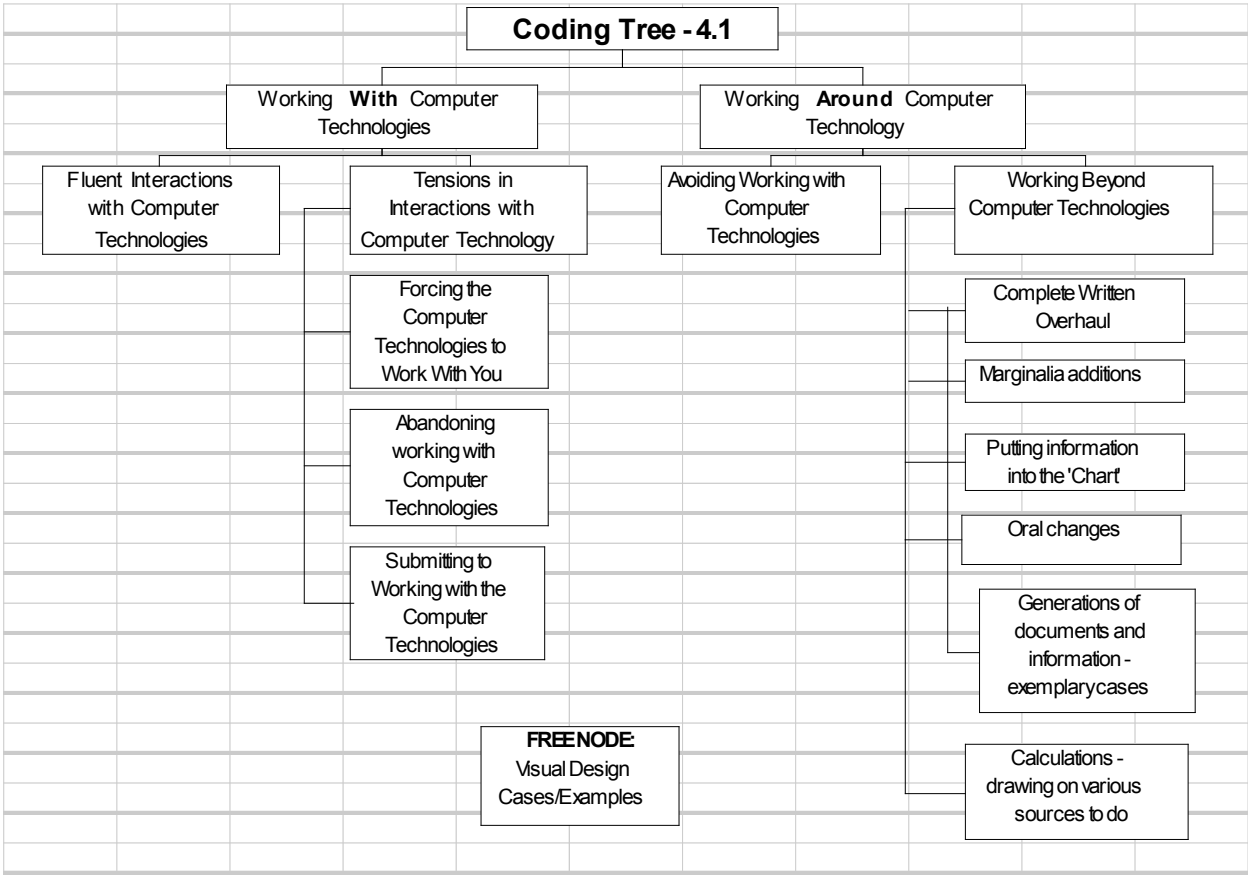
- Thanking you for making time for this interview today.
- As you know, I'm looking into Electronic Patient Records, how they are used on the ward, with other communications, in your daily work activities.
- I'm going to ask you about your communication practices on the ward and about how information gets shared and passed between different professions and between professionals within the same profession.
- So far, I've understood that information is shared in many different ways. I'm trying to understand how all these different ways of getting patient information work together.
- I can't tell you how important your thoughts are to this study, so please feel free to go into as much detail as you like. Remember, what you might think is insignificant, may be just the idea I'm looking for to start to understand how information moves around the ward.
- All answers are anonymous. Your name will never be used. I even change the gender of pronouns regularly in my transcriptions to make sure that there is no identifying information.

Interview Questions

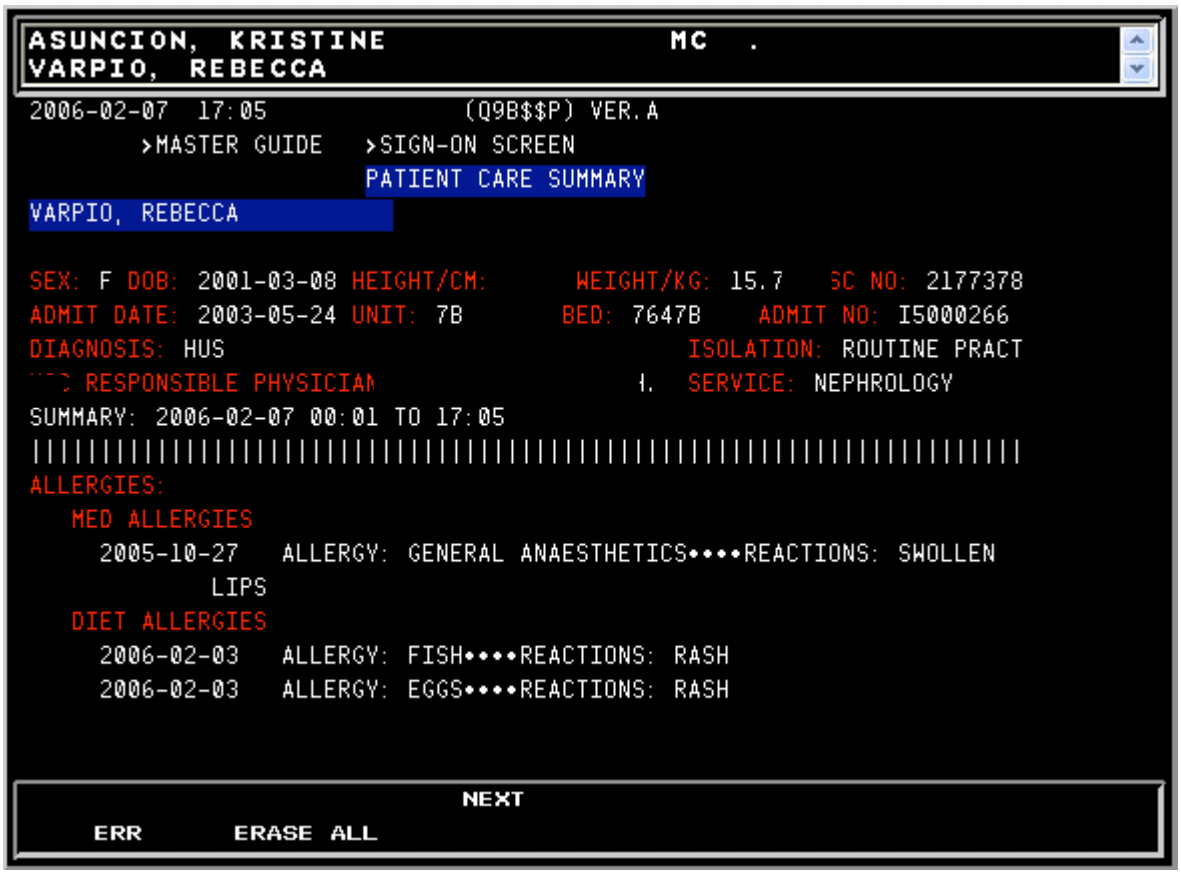
1. Could you describe for me how, on an average day on the ward, how do you get information about a patient? What sources of information do you rely on to know what is going on with your patient?
    i. Review answer (note if missed a technology: paper, oral, or [the EPR])
    ii. Review answer if not address a particular group (nurses, staff physicians, residents, nutritionists, social workers)
2. There are many different sources of information that you tap into every day. Can you tell me about what you do to organize or how you manage all these different pieces of information?
3. As you know, [the EPR] and [the Electronic Laboratory Results] are two computer systems used on the ward. Can you tell me about how much you use these technologies? When do you use them during the day and for what purposes?
4. I've noticed that often patient information is re-worked, or re-written into different kinds of documents. Some are handmade columns or charts. Some are [EPR] print outs that people write on. Do you make something like that? Can you describe that for me?
    i. Follow up: When did you learn to do that?
5. It seems that information from [the EPR] or [the Electronic Laboratory Results] are often copied by people on the ward into paper documents. Can you speculate as to why different pieces of information are re-written into different texts? Or are written in the margins of existing documents?

6. Can you give me an example of how you might get an update about a patient from a nurse/resident/nutritionist/social worker?
7. I'd like to ask you now about time and the pace of work for you on the ward. What is the impact of time constraints on your exchanges with others on the ward? Does it affect the way you share or receive information with others on the ward?
8. Can you tell me a story about a time when you've had problems or trouble getting information about a patient from someone in another profession, say from a _____or a _____?
9. With all this information, you must have to make decisions and judgements about what information to you in your daily work. So, could you tell me, generally speaking, what is:
    i. The most important source of information for your daily work?
    ii. What is the most reliable source of information?
    iii. What is the most accessible/available source of information disposable to you?
10. In your mind, what is *the* patient record?
11. If [the EPR] were available to you in a more portable format, like on a PDA, would that make a difference in the way you work?

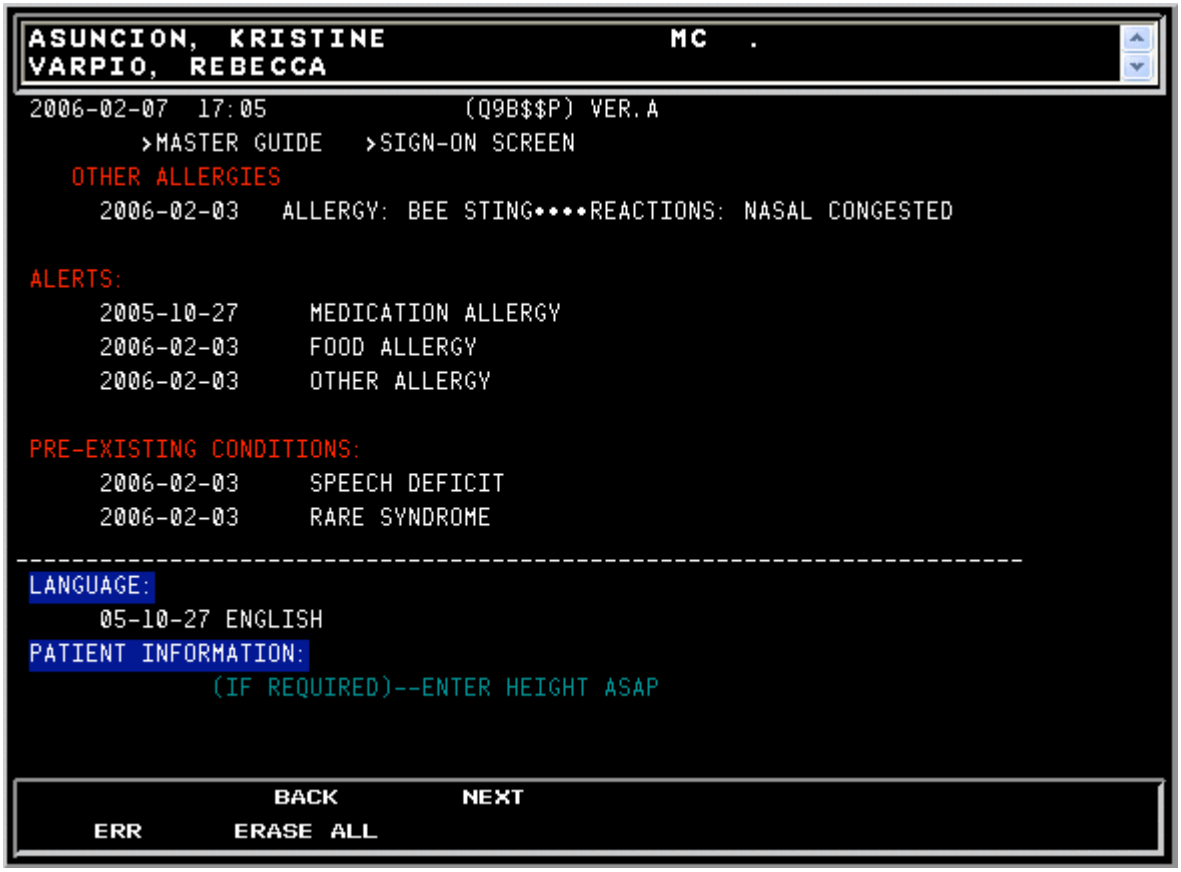
APPENDIX 2: DATA CODING STRUCTURE – FINAL VERSION



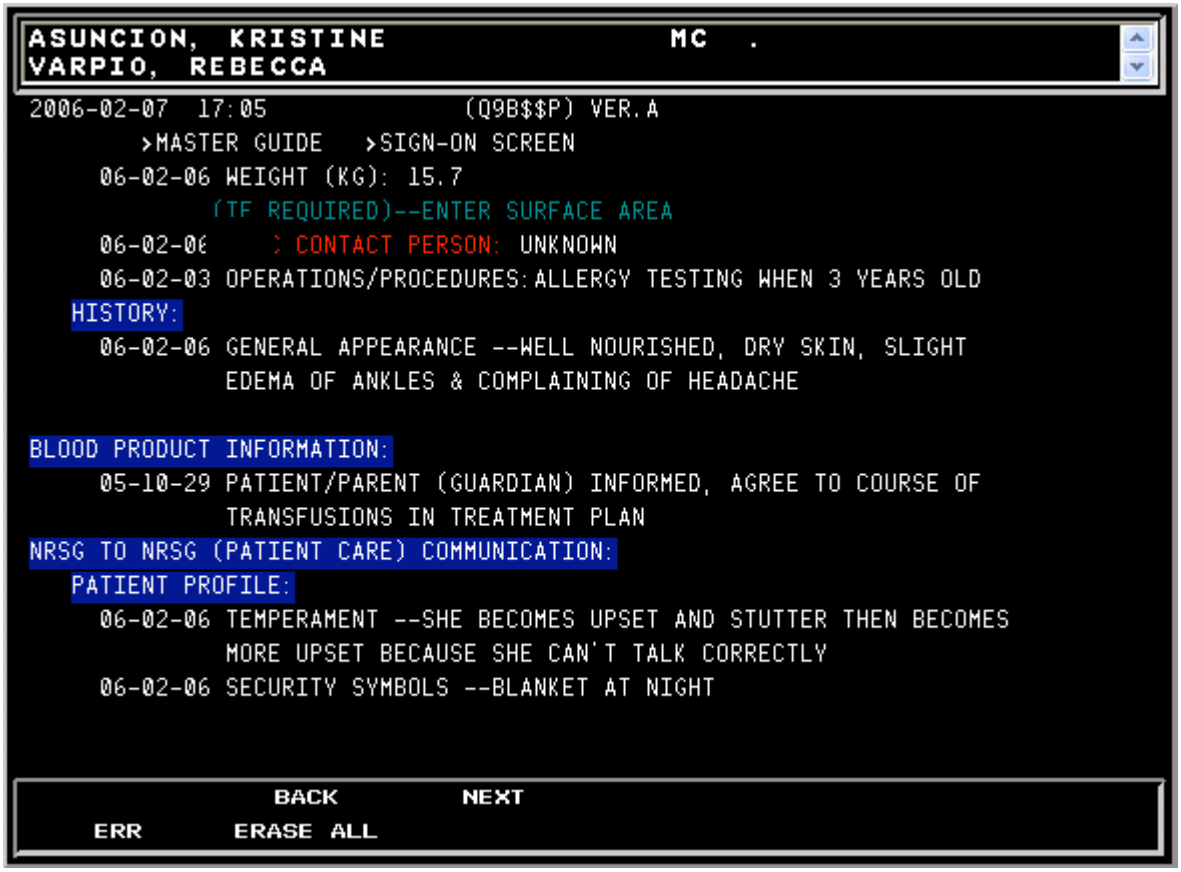
APPENDIX 3: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #1



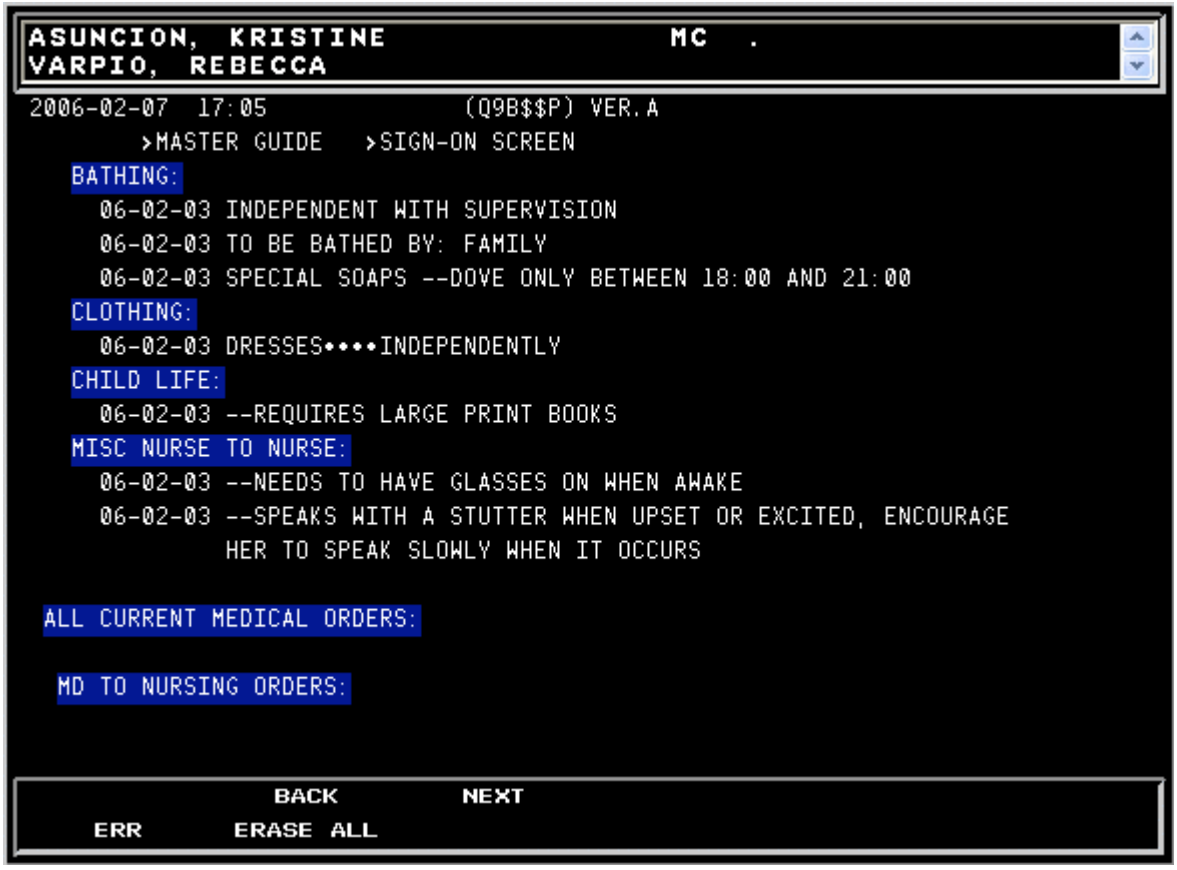
APPENDIX 4: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #2



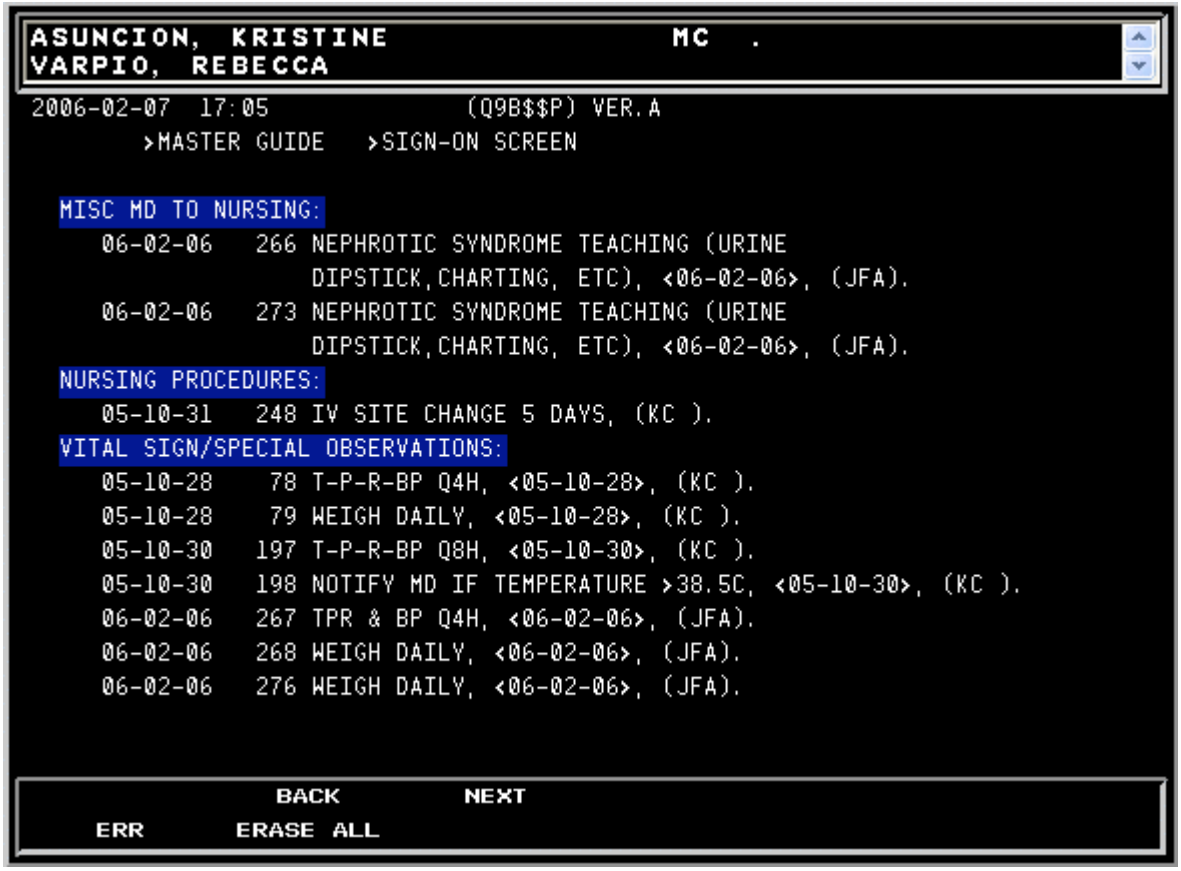
APPENDIX 5: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #3



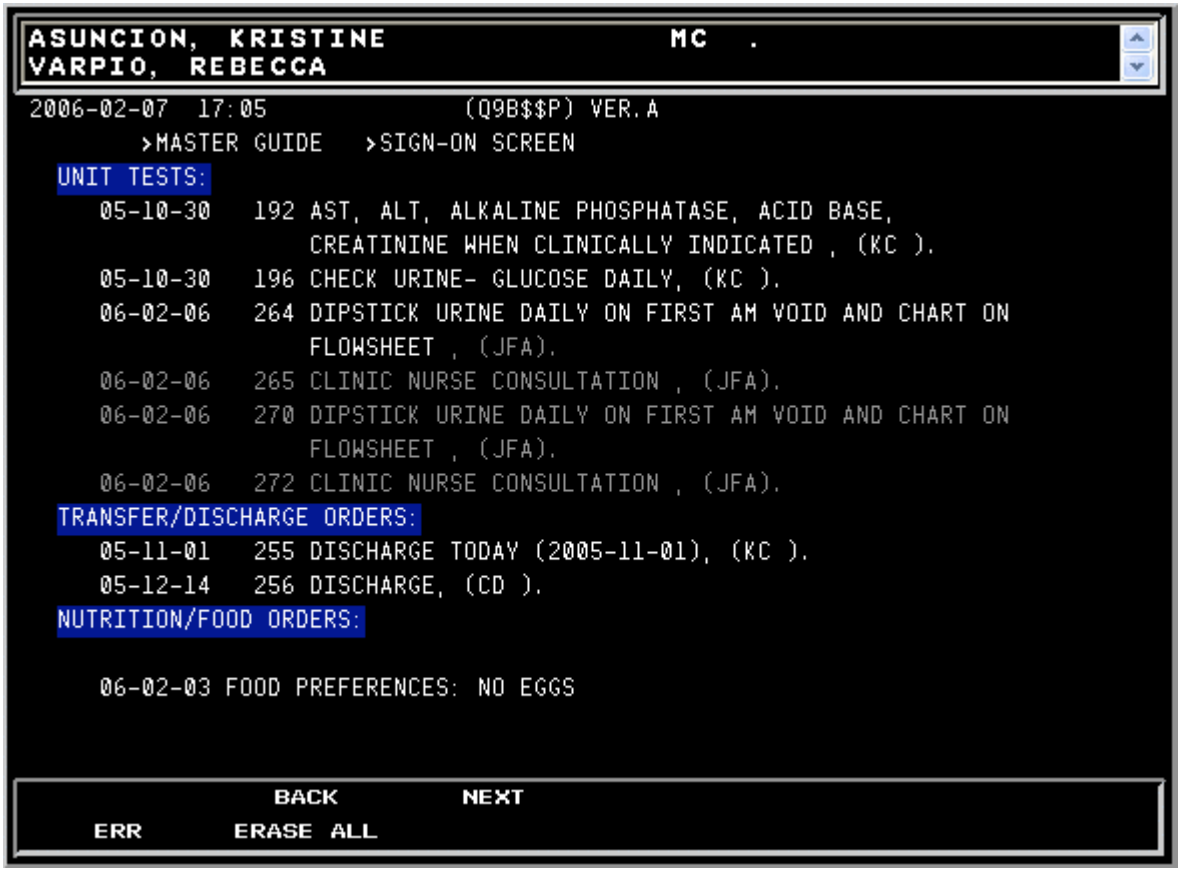
APPENDIX 6: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #4



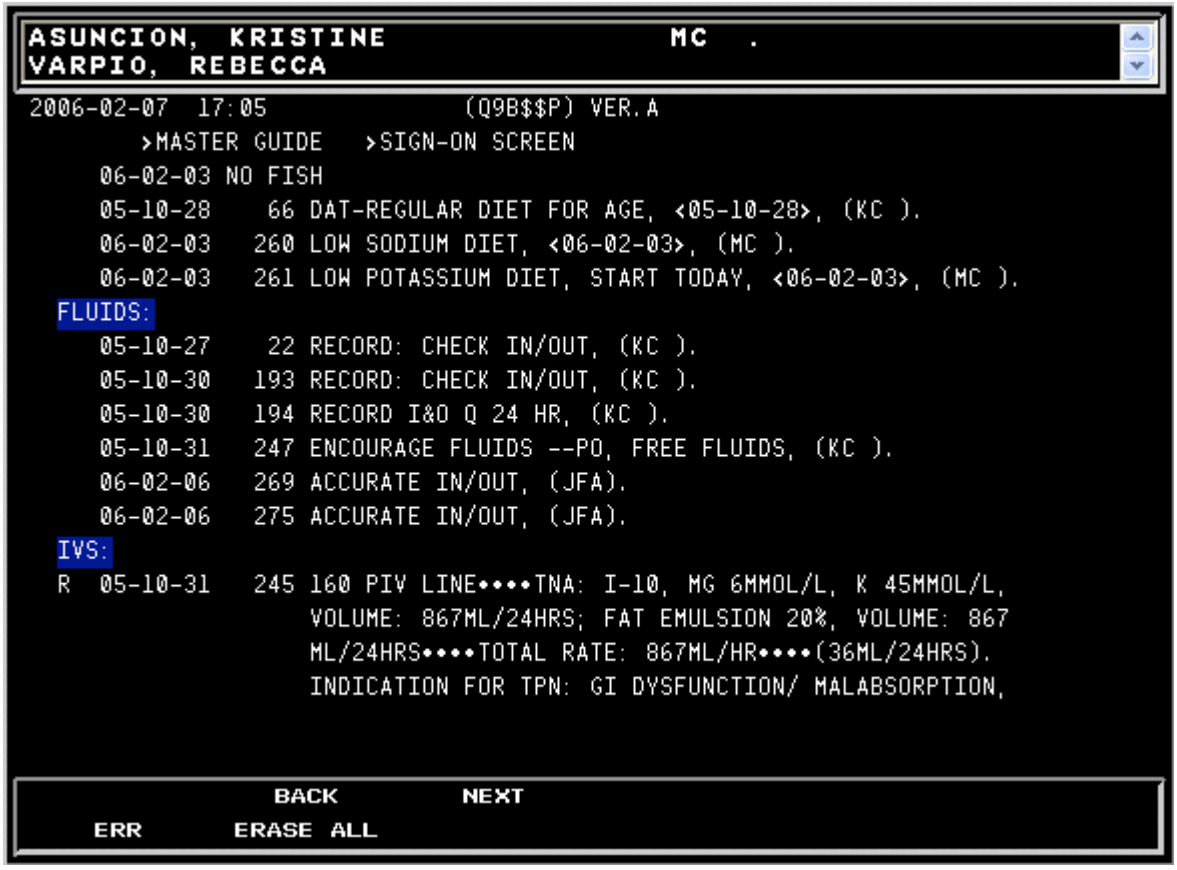
APPENDIX 7: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #5



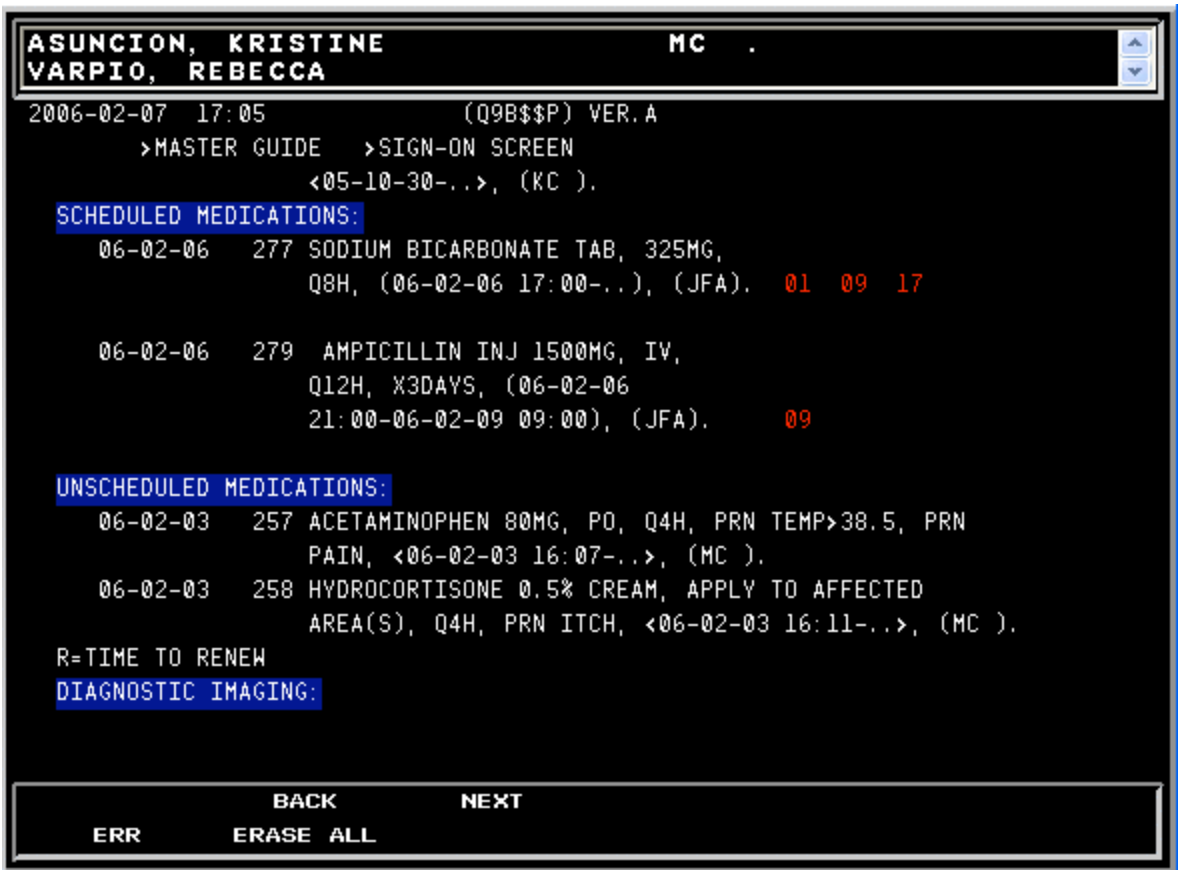
APPENDIX 8: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #6



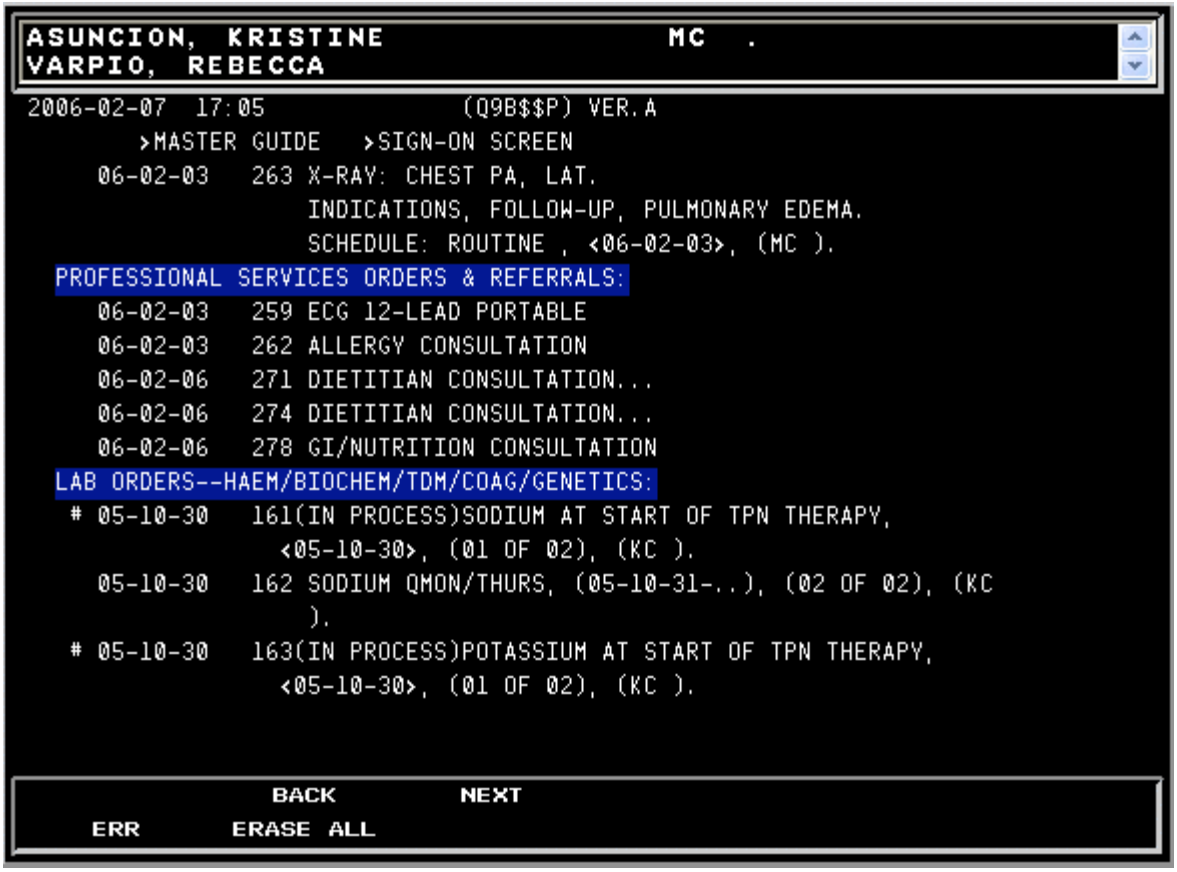
APPENDIX 9: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #7



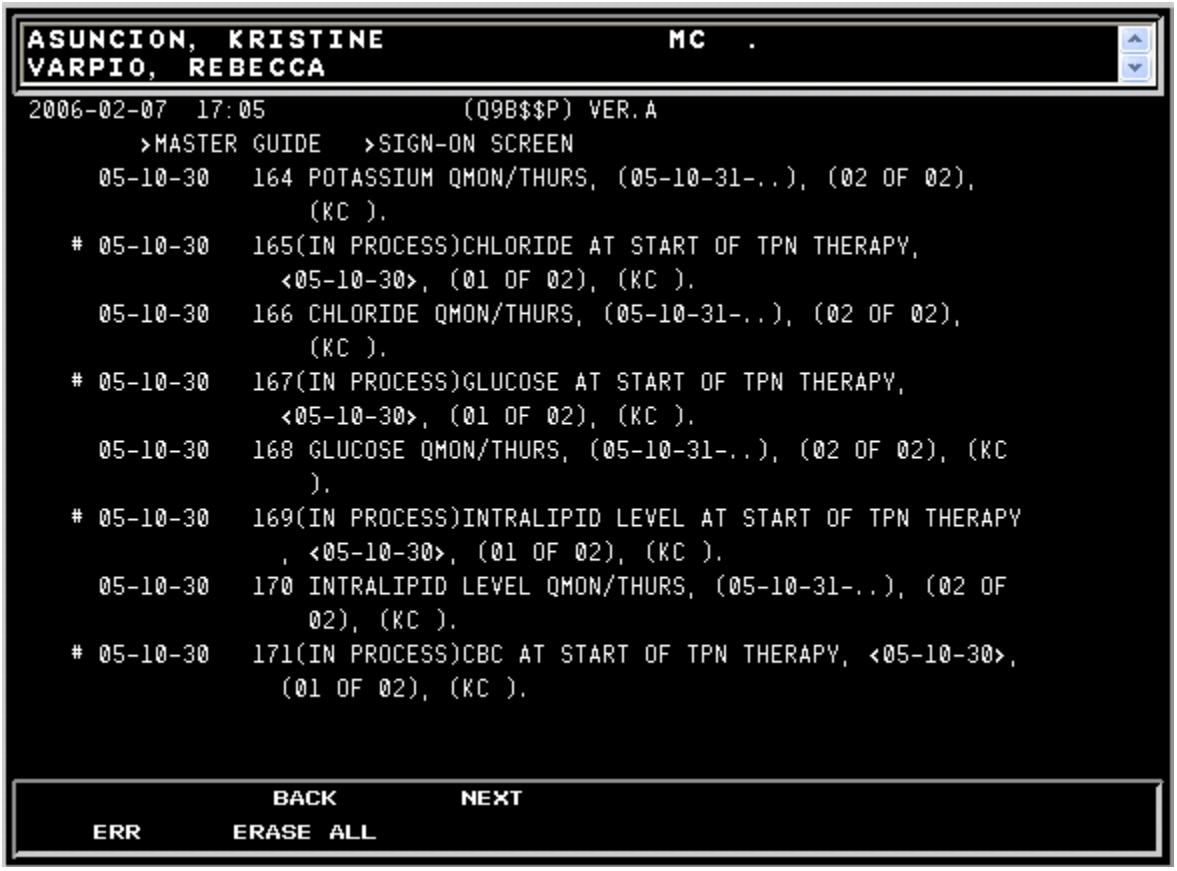
APPENDIX 10: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #8



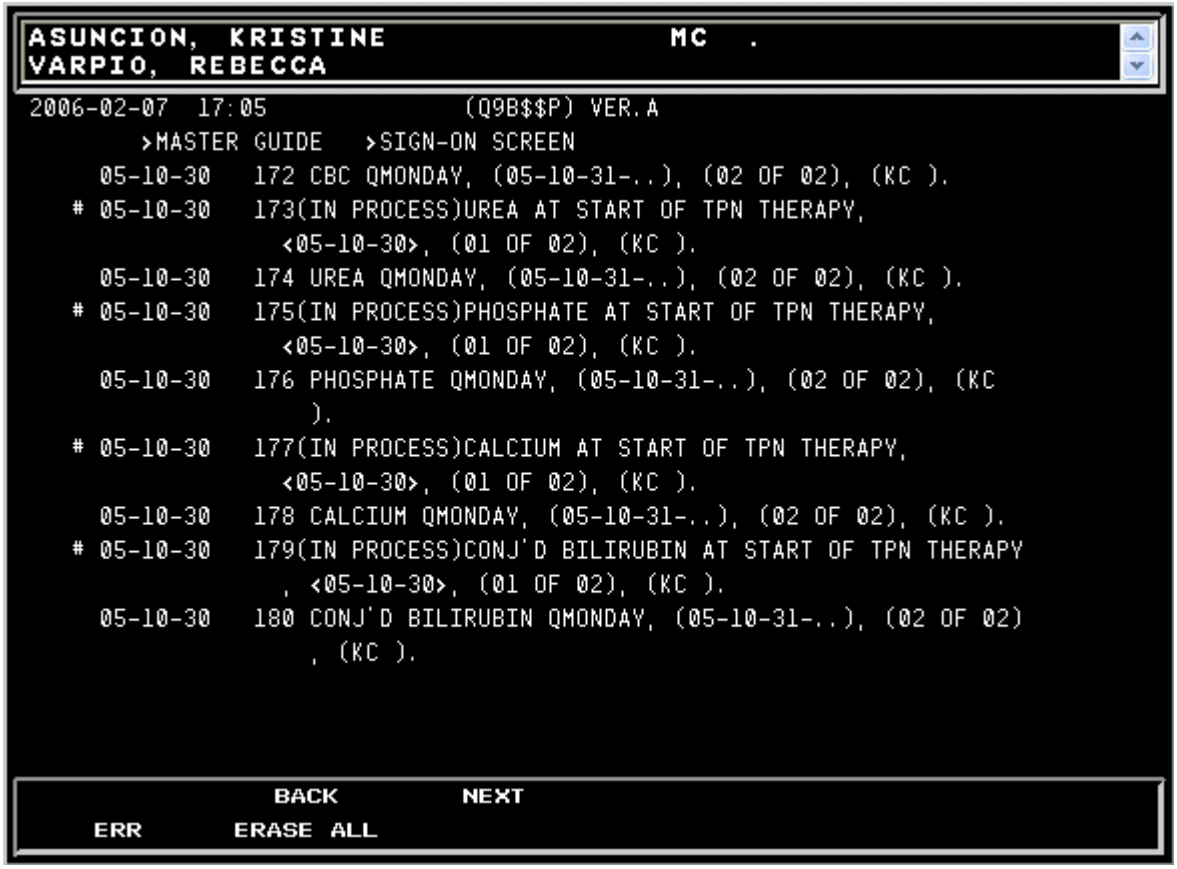
APPENDIX 11: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #9



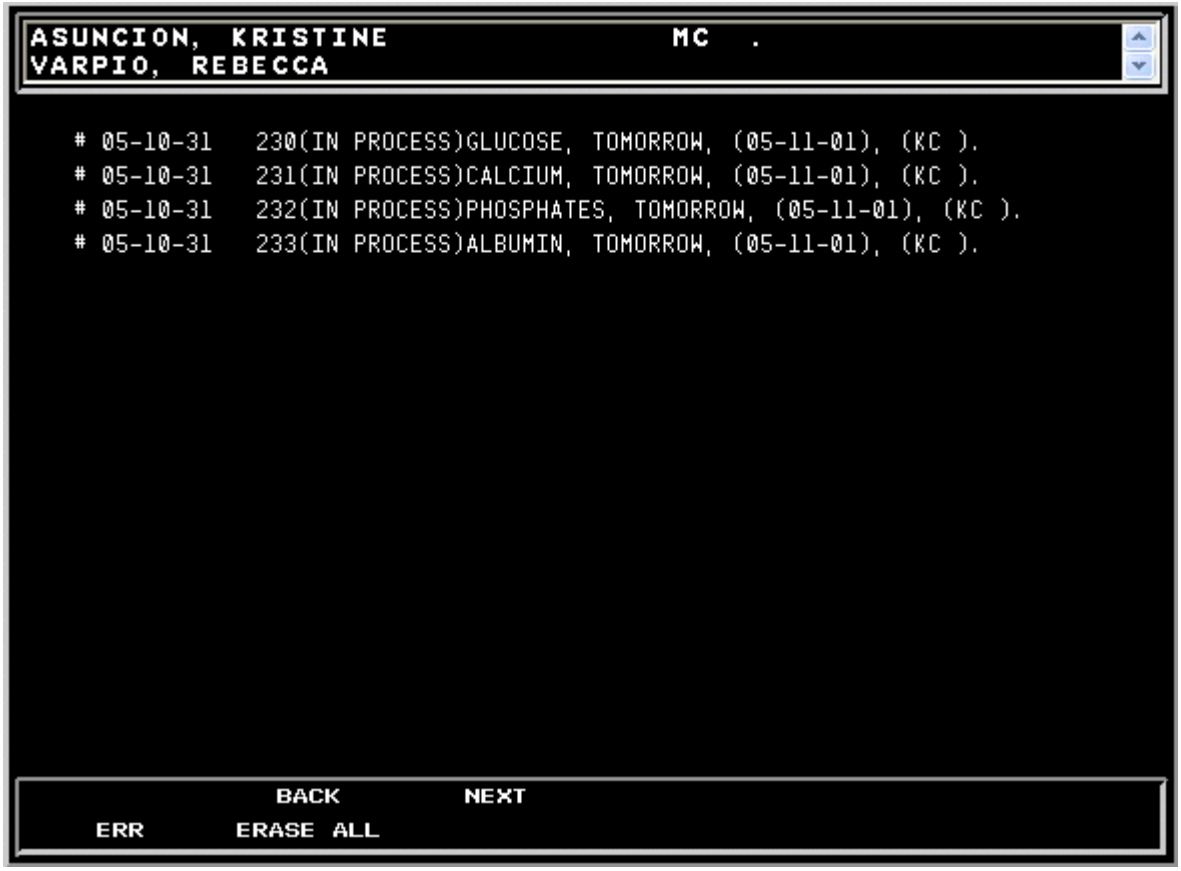
APPENDIX 12: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #10



APPENDIX 13: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #11



APPENDIX 14: EPR SCREEN SHOT OF PATIENT CARE SUMMARY SCREEN #12



APPENDIX 15: PATIENT CARE SUMMARY PAPER-BASED PRINTOUT PAGE 1

```
 7BX  -0974                                          :N - DEVLOPMENT (DEVL)
2006-02-08  08:04              (QAB$$N 010-026-NOMSS)          PAGE 001

                        PATIENT CARE SUMMARY
 VARPIO, REBECCA

 SEX: F DOB: 2001-03-08 HEIGHT/CM:      WEIGHT/KG: 15.7   SC NO: 2177378
 ADMIT DATE: 2003-05-24 UNIT: 7B       BED: 7647B    ADMIT NO: I5000266
 DIAGNOSIS: HUS                                 ISOLATION: ROUTINE PRACT
   C RESPONSIBLE PHYSICIAI                   1.  SERVICE: NEPHROLOGY
 ================================================================================
 SUMMARY: 2006-02-08 07:15 TO 19:15

 ALLERGIES:
    MED ALLERGIES
      2005-10-27   ALLERGY: GENERAL ANAESTHETICS....REACTIONS: SWOLLEN
              LIPS
    DIET ALLERGIES
      2006-02-03   ALLERGY: FISH....REACTIONS: RASH
      2006-02-03   ALLERGY: EGGS....REACTIONS: RASH
    OTHER ALLERGIES
      2006-02-03   ALLERGY: BEE STING....REACTIONS: NASAL CONGESTED

 ALERTS:
      2005-10-27     MEDICATION ALLERGY
      2006-02-03     FOOD ALLERGY
      2006-02-03     OTHER ALLERGY

 PRE-EXISTING CONDITIONS:
      2006-02-03     SPEECH DEFICIT
      2006-02-03     RARE SYNDROME

--------------------------------------------------------------------------------

 LANGUAGE:
      05-10-27 ENGLISH

 PATIENT INFORMATION:
              (IF REQUIRED)--ENTER HEIGHT ASAP
      06-02-06 WEIGHT (KG): 15.7
              (IF REQUIRED)--ENTER SURFACE AREA
      06-02-0[illegible] CONTACT PERSON: UNKNOWN
      06-02-03 OPERATIONS/PROCEDURES:ALLERGY TESTING WHEN 3 YEARS OLD
    HISTORY:
      06-02-06 GENERAL APPEARANCE --WELL NOURISHED, DRY SKIN, SLIGHT
               EDEMA OF ANKLES & COMPLAINING OF HEADACHE

 BLOOD PRODUCT INFORMATION:
      05-10-29 PATIENT/PARENT (GUARDIAN) INFORMED, AGREE TO COURSE OF
               TRANSFUSIONS IN TREATMENT PLAN

 NRSG TO NRSG (PATIENT CARE) COMMUNICATION:
    PATIENT PROFILE:
      06-02-06 TEMPERAMENT --SHE BECOMES UPSET AND STUTTER THEN BECOMES
               MORE UPSET BECAUSE SHE CAN'T TALK CORRECTLY
      06-02-06 SECURITY SYMBOLS --BLANKET AT NIGHT
    BATHING:
      06-02-03 INDEPENDENT WITH SUPERVISION

                                    CONTINUED
 ================================================================================
 VARPIO, REBECCA          2177378                PATIENT CARE SUMMARY
```

APPENDIX 16: PATIENT CARE SUMMARY PAPER-BASED PRINTOUT PAGE 2

2006-02-08 08:04 (QAB$$N 010-026-NOMSS) PAGE 002

PATIENT CARE SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15.7 **C NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
C RESPONSIBLE PHYSICIAN **SERVICE:** NEPHROLOGY

==========

SUMMARY: 2006-02-08 07:15 TO 19:15
06-02-03 TO BE BATHED BY: FAMILY
06-02-03 SPECIAL SOAPS --DOVE ONLY BETWEEN 18:00 AND 21:00

CLOTHING:
06-02-03 DRESSES....INDEPENDENTLY

CHILD LIFE:
06-02-03 --REQUIRES LARGE PRINT BOOKS

MISC NURSE TO NURSE:
06-02-03 --NEEDS TO HAVE GLASSES ON WHEN AWAKE
06-02-03 --SPEAKS WITH A STUTTER WHEN UPSET OR EXCITED, ENCOURAGE HER TO SPEAK SLOWLY WHEN IT OCCURS

ALL CURRENT MEDICAL ORDERS:

MD TO NURSING ORDERS:

MISC MD TO NURSING:
06-02-06 266 NEPHROTIC SYNDROME TEACHING (URINE DIPSTICK,CHARTING, ETC), <06-02-06>, (JFA).
06-02-06 273 NEPHROTIC SYNDROME TEACHING (URINE DIPSTICK,CHARTING, ETC), <06-02-06>, (JFA).

NURSING PROCEDURES:
05-10-31 248 IV SITE CHANGE 5 DAYS, (KC).

VITAL SIGN/SPECIAL OBSERVATIONS:
05-10-28 78 T-P-R-BP Q4H, <05-10-28>, (KC).
05-10-28 79 WEIGH DAILY, <05-10-28>, (KC).
05-10-30 197 T-P-R-BP Q8H, <05-10-30>, (KC).
05-10-30 198 NOTIFY MD IF TEMPERATURE >38.5C, <05-10-30>, (KC).
06-02-06 267 TPR & BP Q4H, <06-02-06>, (JFA).
06-02-06 268 WEIGH DAILY, <06-02-06>, (JFA).
06-02-06 276 WEIGH DAILY, <06-02-06>, (JFA).

UNIT TESTS:
05-10-30 192 AST, ALT, ALKALINE PHOSPHATASE, ACID BASE, CREATININE WHEN CLINICALLY INDICATED , (KC).
05-10-30 196 CHECK URINE- GLUCOSE DAILY, (KC).
06-02-06 264 DIPSTICK URINE DAILY ON FIRST AM VOID AND CHART ON FLOWSHEET, (JFA).
06-02-06 265 CLINIC NURSE CONSULTATION, (JFA).
06-02-06 270 DIPSTICK URINE DAILY ON FIRST AM VOID AND CHART ON FLOWSHEET, (JFA).
06-02-06 272 CLINIC NURSE CONSULTATION, (JFA).

TRANSFER/DISCHARGE/OTHER MISC ORDERS:
05-11-01 255 DISCHARGE TODAY (2005-11-01), (KC).
05-12-14 256 DISCHARGE, (CD).

CONTINUED

==========

2006-02-08 08:04 (QAB$$N 010-026-NOMSS) PAGE 003

PATIENT CARE SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15. **SC NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
C RESPONSIBLE PHYSICIA **SERVICE:** NEPHROLOGY

SUMMARY: 2006-02-08 07:15 TO 19:15

NUTRITION/FOOD ORDERS:

06-02-03 FOOD PREFERENCES: NO EGGS
06-02-03 NO FISH
05-10-28 66 DAT-REGULAR DIET FOR AGE, <05-10-28>, (KC).
06-02-03 260 LOW SODIUM DIET, <06-02-03>, (MC).
06-02-03 261 LOW POTASSIUM DIET, START TODAY, <06-02-03>, (MC).

FLUIDS:

05-10-27 22 RECORD: CHECK IN/OUT, (KC).
05-10-30 193 RECORD: CHECK IN/OUT, (KC).
05-10-30 194 RECORD I&O Q 24 HR, (KC).
05-10-31 247 ENCOURAGE FLUIDS --PO, FREE FLUIDS, (KC).
06-02-06 269 ACCURATE IN/OUT, (JFA).
06-02-06 275 ACCURATE IN/OUT, (JFA).

IVS:

R 05-10-31 245 160 PIV LINE....TNA: I-10, MG 6MMOL/L, K 45MMOL/L, VOLUME: 867ML/24HRS; FAT EMULSION 20%, VOLUME: 867 ML/24HRS....TOTAL RATE: 867ML/HR....(36ML/24HRS). INDICATION FOR TPN: GI DYSFUNCTION/ MALABSORPTION, <05-10-30-..>, (KC).

SCHEDULED MEDICATIONS:

06-02-06 277 SODIUM BICARBONATE TAB, 325MG, Q8H, (06-02-06 17:00-..), (JFA). **09 17**

06-02-06 279 AMPICILLIN INJ 1500MG, IV, Q12H, X3DAYS, (06-02-06 21:00-06-02-09 09:00), (JFA). **09**

UNSCHEDULED MEDICATIONS:

06-02-03 257 ACETAMINOPHEN 80MG, PO, Q4H, PRN TEMP>38.5, PRN PAIN, <06-02-03 16:07-..>, (MC).
06-02-03 258 HYDROCORTISONE 0.5% CREAM, APPLY TO AFFECTED AREA(S), Q4H, PRN ITCH, <06-02-03 16:11-..>, (MC).

R=TIME TO RENEW

DIAGNOSTIC IMAGING:

06-02-03 263 X-RAY: CHEST PA, LAT. INDICATIONS, FOLLOW-UP, PULMONARY EDEMA. SCHEDULE: ROUTINE , <06-02-03>, (MC).

CONTINUED

APPENDIX 18: PATIENT CARE SUMMARY PAPER-BASED PRINTOUT PAGE 4

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15.7 **NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
C RESPONSIBLE PHYSICIAN: . **SERVICE:** NEPHROLOGY

SUMMARY: 2006-02-08 07:15 TO 19:15

PROFESSIONAL SERVICES ORDERS & REFERRALS:

06-02-03	259	ECG 12-LEAD PORTABLE
06-02-03	262	ALLERGY CONSULTATION
06-02-06	271	DIETITIAN CONSULTATION...
06-02-06	274	DIETITIAN CONSULTATION...
06-02-06	278	GI/NUTRITION CONSULTATION

LAB ORDERS--HAEM/BIOCHEM/TDM/COAG/GENETICS:

# 05-10-30	161	(IN PROCESS)SODIUM AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	162	SODIUM QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	163	(IN PROCESS)POTASSIUM AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	164	POTASSIUM QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	165	(IN PROCESS)CHLORIDE AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	166	CHLORIDE QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	167	(IN PROCESS)GLUCOSE AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	168	GLUCOSE QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	169	(IN PROCESS)INTRALIPID LEVEL AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	170	INTRALIPID LEVEL QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	171	(IN PROCESS)CBC AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	172	CBC QMONDAY, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	173	(IN PROCESS)UREA AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	174	UREA QMONDAY, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	175	(IN PROCESS)PHOSPHATE AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	176	PHOSPHATE QMONDAY, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	177	(IN PROCESS)CALCIUM AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	178	CALCIUM QMONDAY, (05-10-31-..), (02 OF 02), (KC).
# 05-10-30	179	(IN PROCESS)CONJ'D BILIRUBIN AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
05-10-30	180	CONJ'D BILIRUBIN QMONDAY, (05-10-31-..), (02 OF 02), (KC).

CONTINUED

APPENDIX 19: PATIENT CARE SUMMARY PAPER-BASED PRINTOUT PAGE 5

2006-02-08 08:04 (QAB$$N 010-026-NOMSS) PAGE 005

PATIENT CARE SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15. **C NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
C RESPONSIBLE PHYSICIA H. **SERVICE:** NEPHROLOGY

SUMMARY: 2006-02-08 07:15 TO 19:15

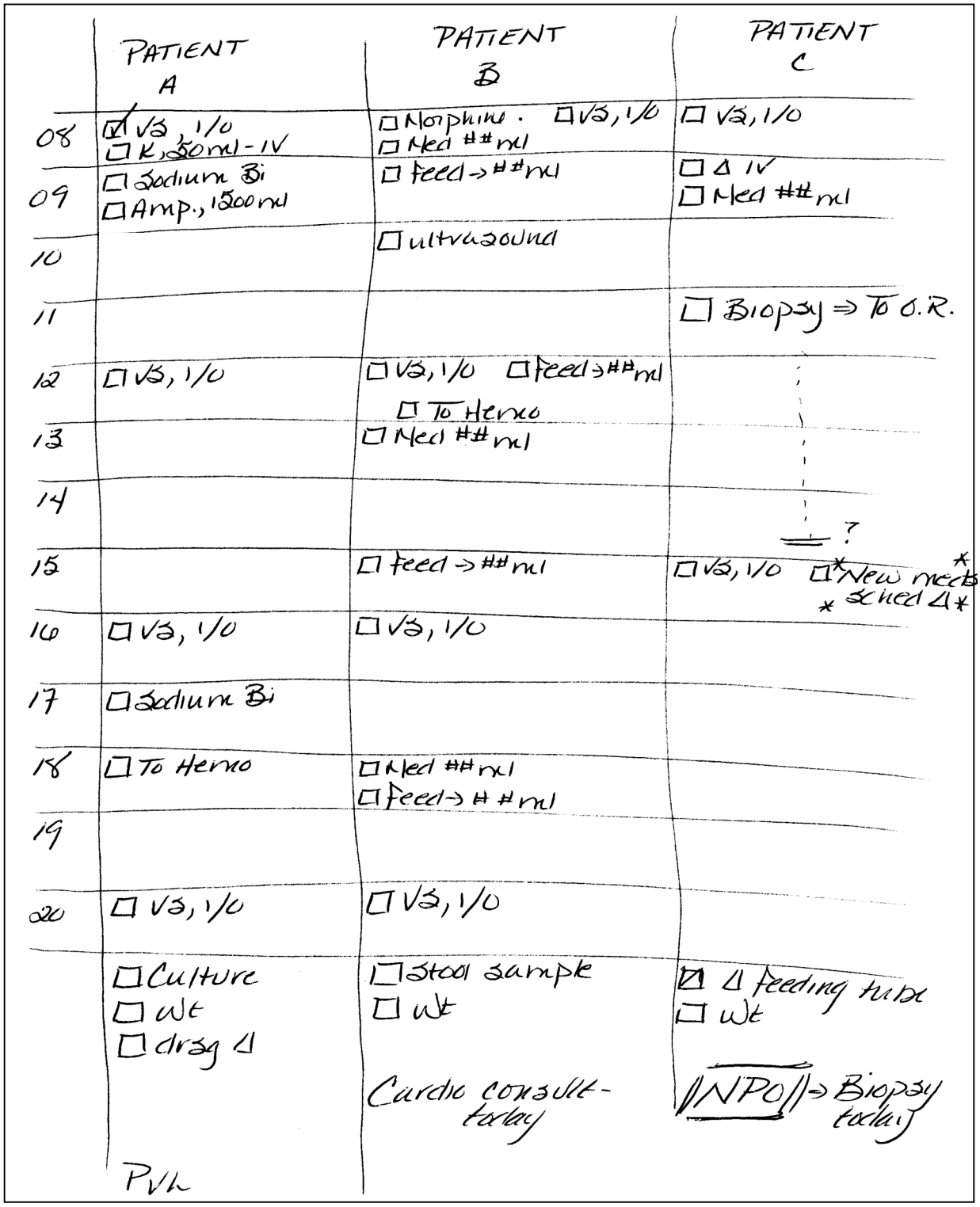
#	05-10-30	181	(IN PROCESS)UNCONJ'D BILIRUBIN AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	05-10-30	182	UNCONJ'D BILIRUBIN QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	05-10-30	183	(IN PROCESS)ALBUMIN AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	05-10-30	184	ALBUMIN QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	05-10-30	185	(IN PROCESS)MAGNESIUM: AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	05-10-30	186	MAGNESIUM: QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	05-10-30	187	(IN PROCESS)AST AT START OF TPN THERAPY, <05-10-30>, (KC).
#	05-10-30	188	(IN PROCESS)ALT AT START OF TPN THERAPY, <05-10-30>, (KC).
#	05-10-30	189	(IN PROCESS)ALKALINE PHOSPHATASE AT START OF TPN THERAPY, <05-10-30>, (KC).
#	05-10-30	190	(IN PROCESS)ACID BASE AT START OF TPN THERAPY, <05-10-30>, (KC).
#	05-10-30	191	(IN PROCESS)CREATININE AT START OF TPN THERAPY, <05-10-30>, (KC).
#	05-10-31	222	(IN PROCESS)CBC, TOMORROW, (05-11-01), (KC).
#	05-10-31	223	(IN PROCESS)DIFF, TOMORROW, (05-11-01), (KC).
#	05-10-31	224	(IN PROCESS)BLOOD FILM, TOMORROW, (05-11-01), (KC).
#	05-10-31	225	(IN PROCESS)SODIUM, TOMORROW, (05-11-01), (KC).
#	05-10-31	226	(IN PROCESS)POTASSIUM, TOMORROW, (05-11-01), (KC).
#	05-10-31	227	(IN PROCESS)CHLORIDE, TOMORROW, (05-11-01), (KC).
#	05-10-31	228	(IN PROCESS)UREA, TOMORROW, (05-11-01), (KC).
#	05-10-31	229	(IN PROCESS)CREATININE, TOMORROW, (05-11-01), (KC).
#	05-10-31	230	(IN PROCESS)GLUCOSE, TOMORROW, (05-11-01), (KC).
#	05-10-31	231	(IN PROCESS)CALCIUM, TOMORROW, (05-11-01), (KC).
#	05-10-31	232	(IN PROCESS)PHOSPHATES, TOMORROW, (05-11-01), (KC).
#	05-10-31	233	(IN PROCESS)ALBUMIN, TOMORROW, (05-11-01), (KC).
	05-10-31	234	MAGNESIUM, DAILY, UNTIL DC'D, <05-10-31-..>, (KC).

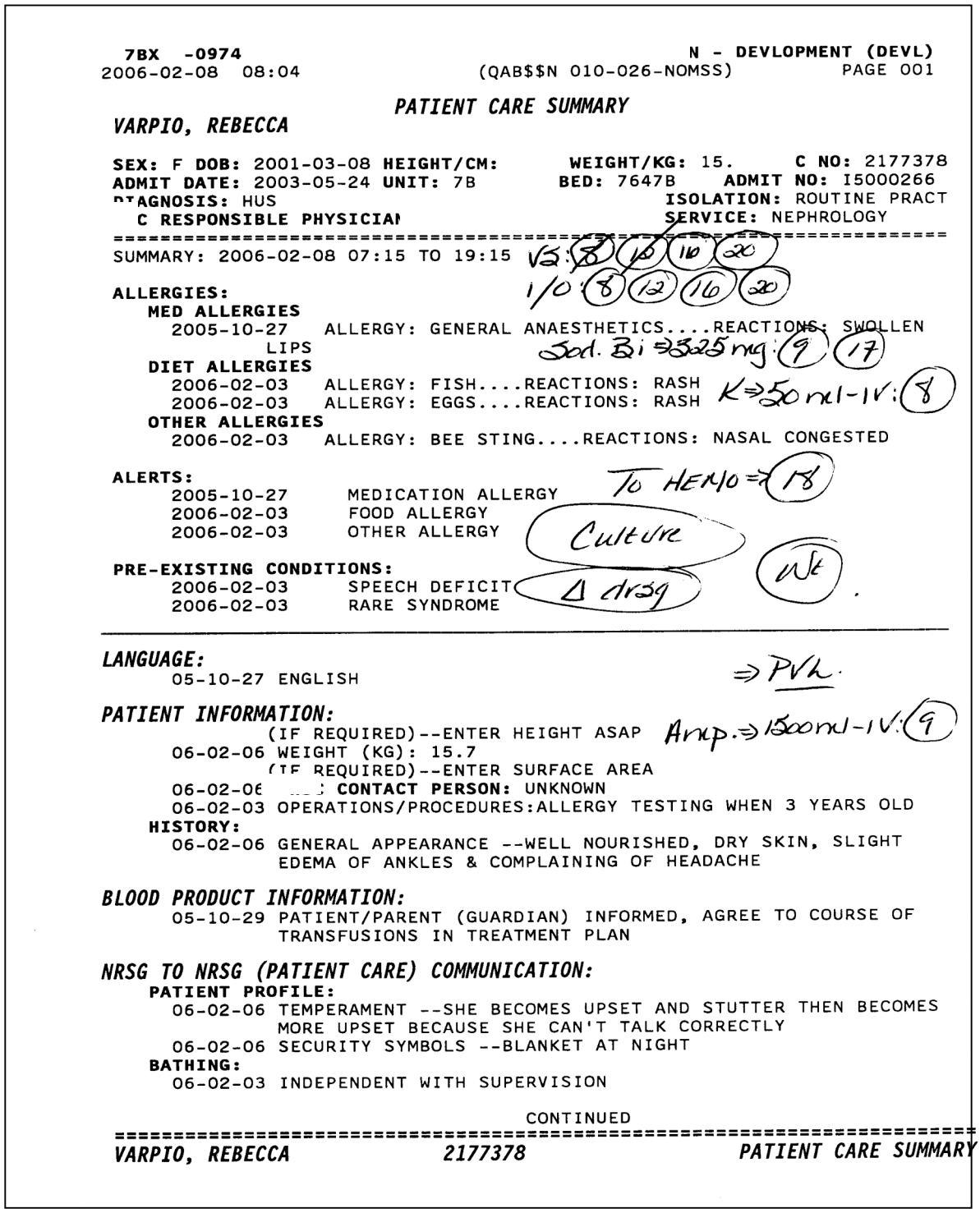
LAST PAGE

VARPIO, REBECCA ***2177378*** ***PATIENT CARE SUMMARY***

-*-

APPENDIX 20: NURSING TRANSFORMATION COMPLETE WRITTEN OVERHAUL





7BX -0974 N - DEVLOPMENT (DEVL)
2006-02-08 08:04 (QAB$$N 010-026-NOMSS) PAGE 001

PATIENT CARE SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15. **C NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
C RESPONSIBLE PHYSICIAN **SERVICE:** NEPHROLOGY

SUMMARY: 2006-02-08 07:15 TO 19:15

ALLERGIES:
MED ALLERGIES
2005-10-27 ALLERGY: GENERAL ANAESTHETICS....REACTIONS: SWOLLEN LIPS
DIET ALLERGIES
2006-02-03 ALLERGY: FISH....REACTIONS: RASH
2006-02-03 ALLERGY: EGGS....REACTIONS: RASH
OTHER ALLERGIES
2006-02-03 ALLERGY: BEE STING....REACTIONS: NASAL CONGESTED

ALERTS:
2005-10-27 MEDICATION ALLERGY
2006-02-03 FOOD ALLERGY
2006-02-03 OTHER ALLERGY

PRE-EXISTING CONDITIONS:
2006-02-03 SPEECH DEFICIT
2006-02-03 RARE SYNDROME

LANGUAGE:
05-10-27 ENGLISH

PATIENT INFORMATION:
(IF REQUIRED)--ENTER HEIGHT ASAP
06-02-06 WEIGHT (KG): 15.7
(IF REQUIRED)--ENTER SURFACE AREA
06-02-06 **CONTACT PERSON:** UNKNOWN
06-02-03 OPERATIONS/PROCEDURES:ALLERGY TESTING WHEN 3 YEARS OLD
HISTORY:
06-02-06 GENERAL APPEARANCE --WELL NOURISHED, DRY SKIN, SLIGHT EDEMA OF ANKLES & COMPLAINING OF HEADACHE

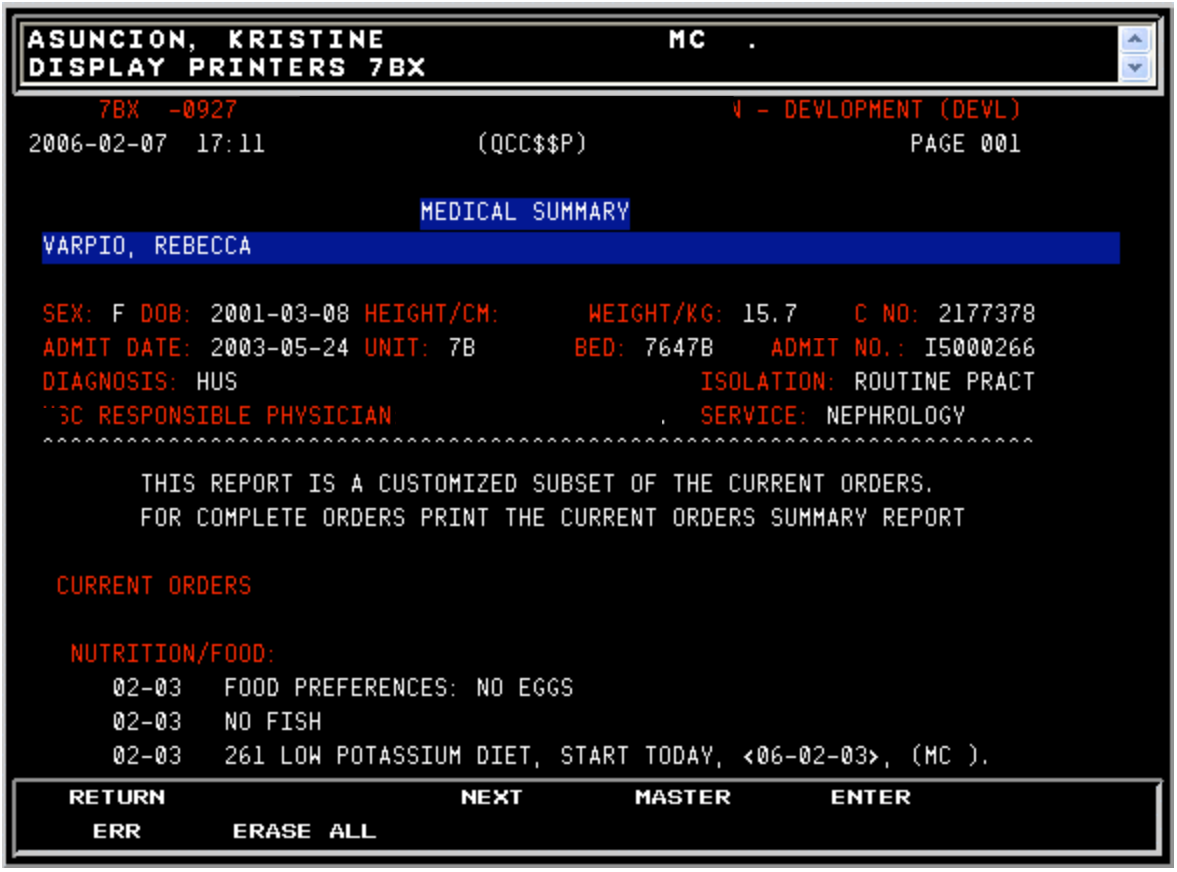
BLOOD PRODUCT INFORMATION:
05-10-29 PATIENT/PARENT (GUARDIAN) INFORMED, AGREE TO COURSE OF TRANSFUSIONS IN TREATMENT PLAN

NRSG TO NRSG (PATIENT CARE) COMMUNICATION:
PATIENT PROFILE:
06-02-06 TEMPERAMENT --SHE BECOMES UPSET AND STUTTER THEN BECOMES MORE UPSET BECAUSE SHE CAN'T TALK CORRECTLY
06-02-06 SECURITY SYMBOLS --BLANKET AT NIGHT
BATHING:
06-02-03 INDEPENDENT WITH SUPERVISION

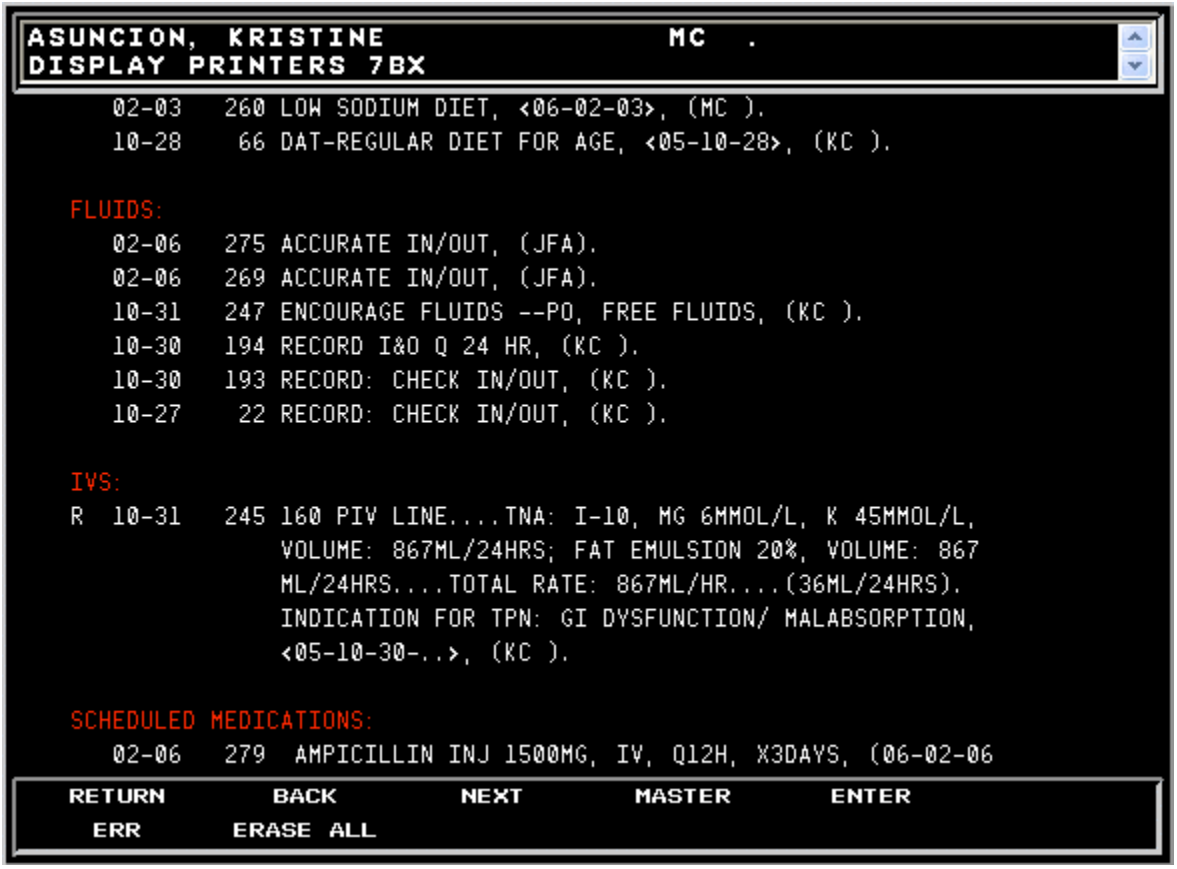
CONTINUED

VARPIO, REBECCA ***2177378*** ***PATIENT CARE SUMMARY***

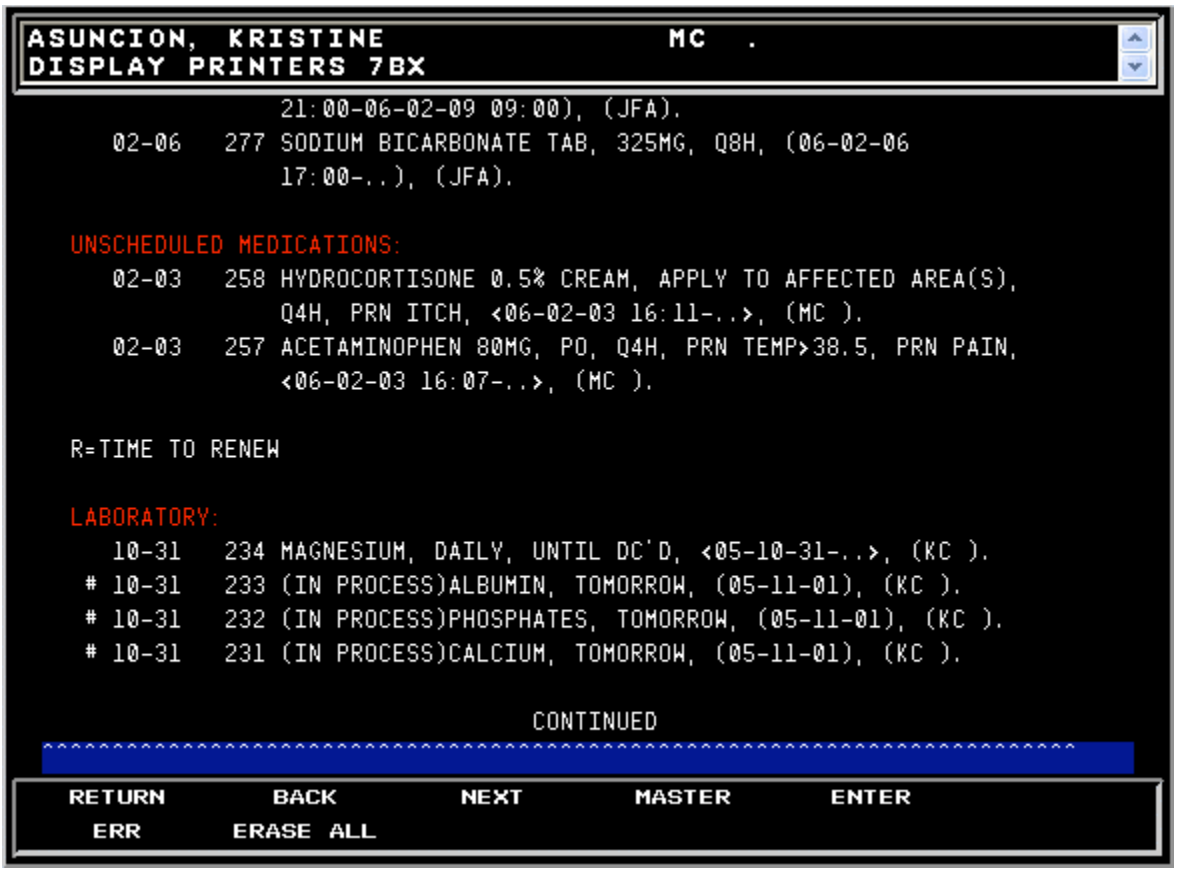
APPENDIX 22: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #1



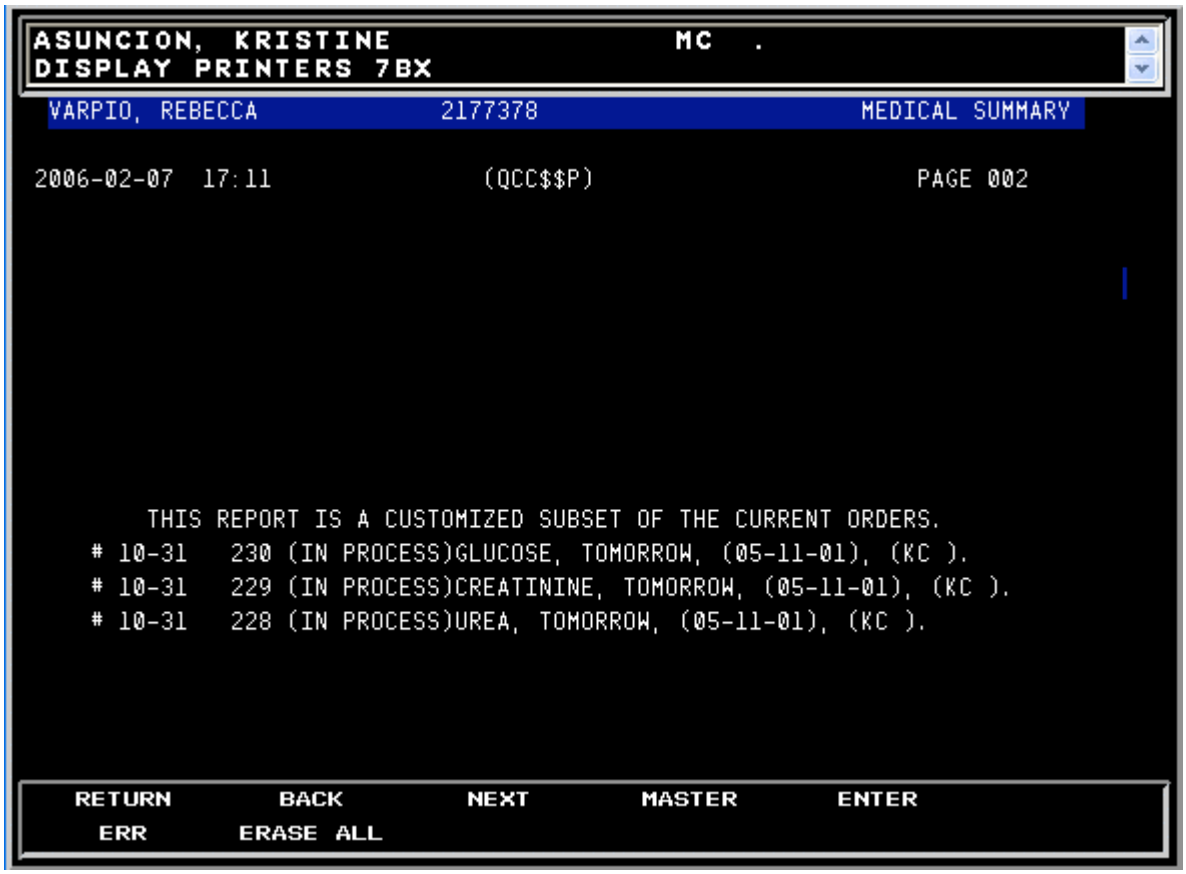
APPENDIX 23: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #2



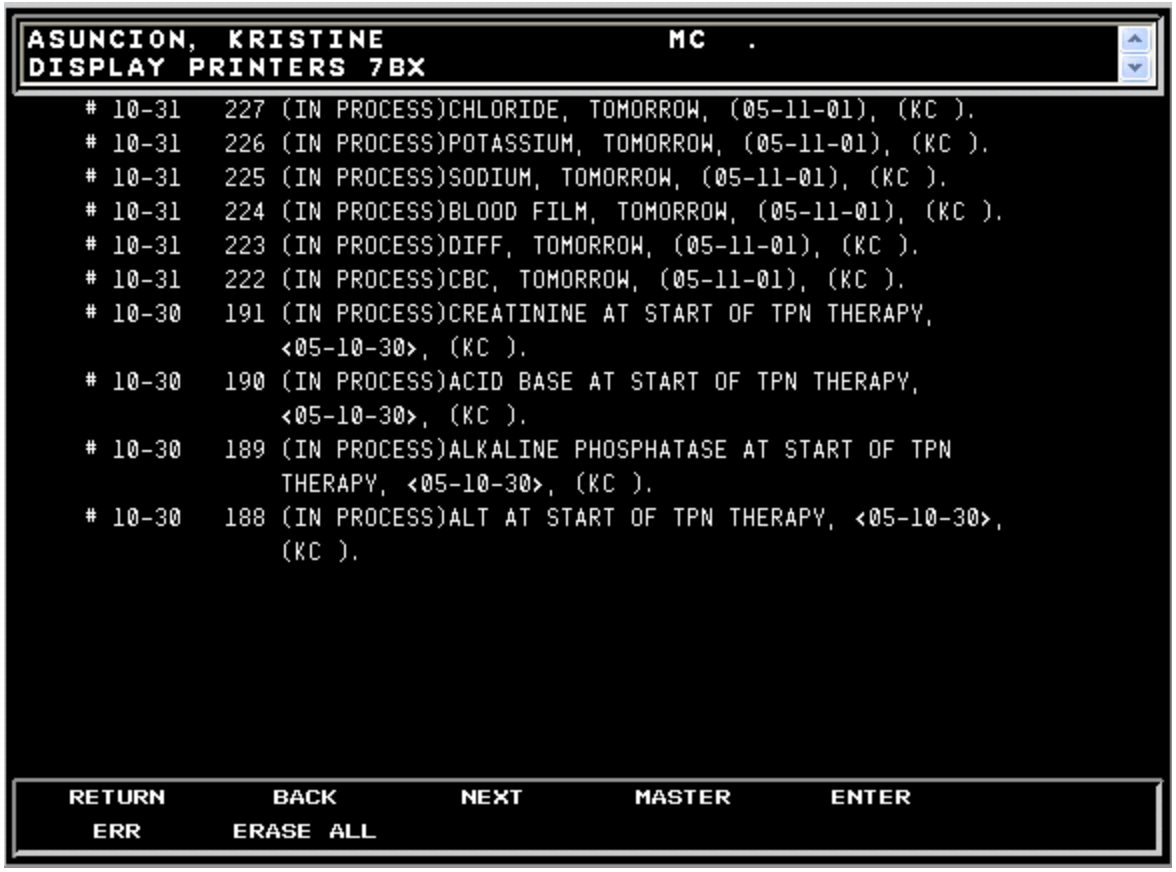
APPENDIX 24: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #3



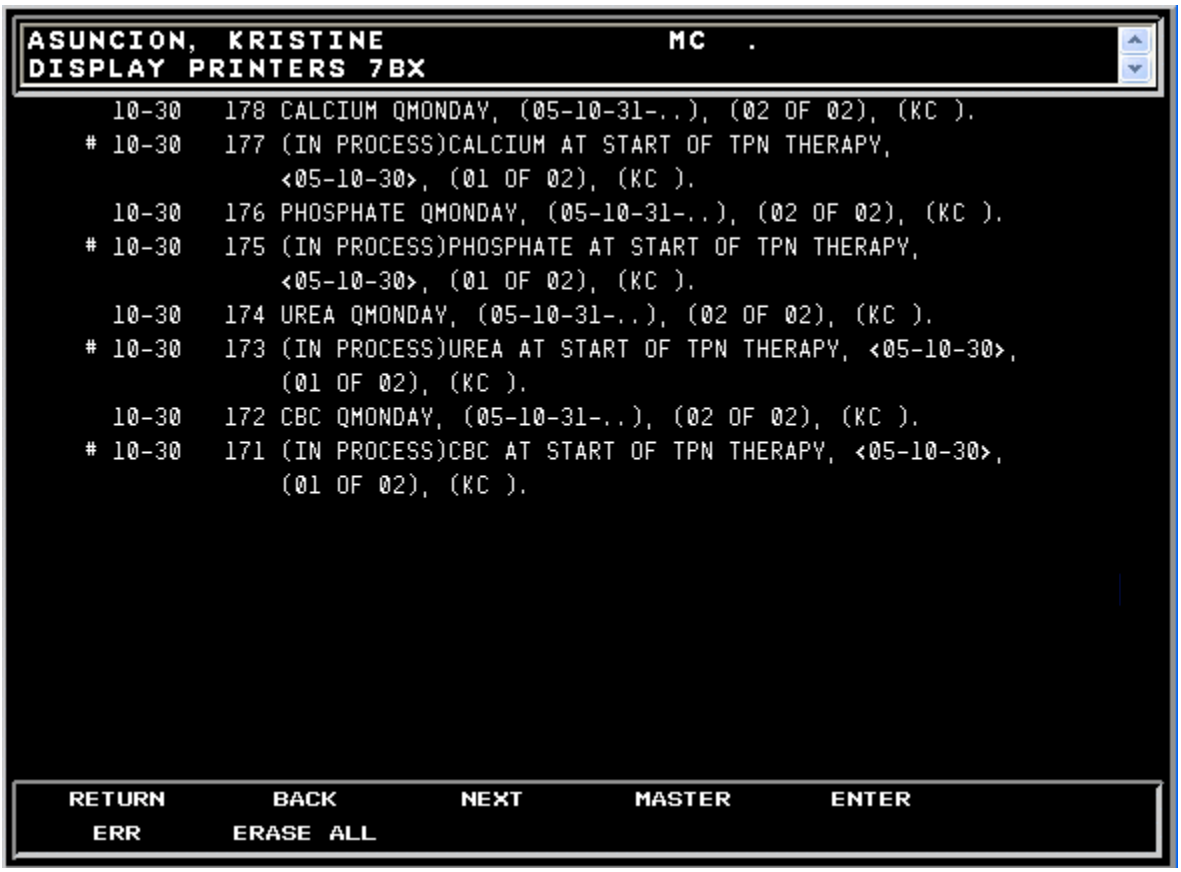
APPENDIX 25. EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #4



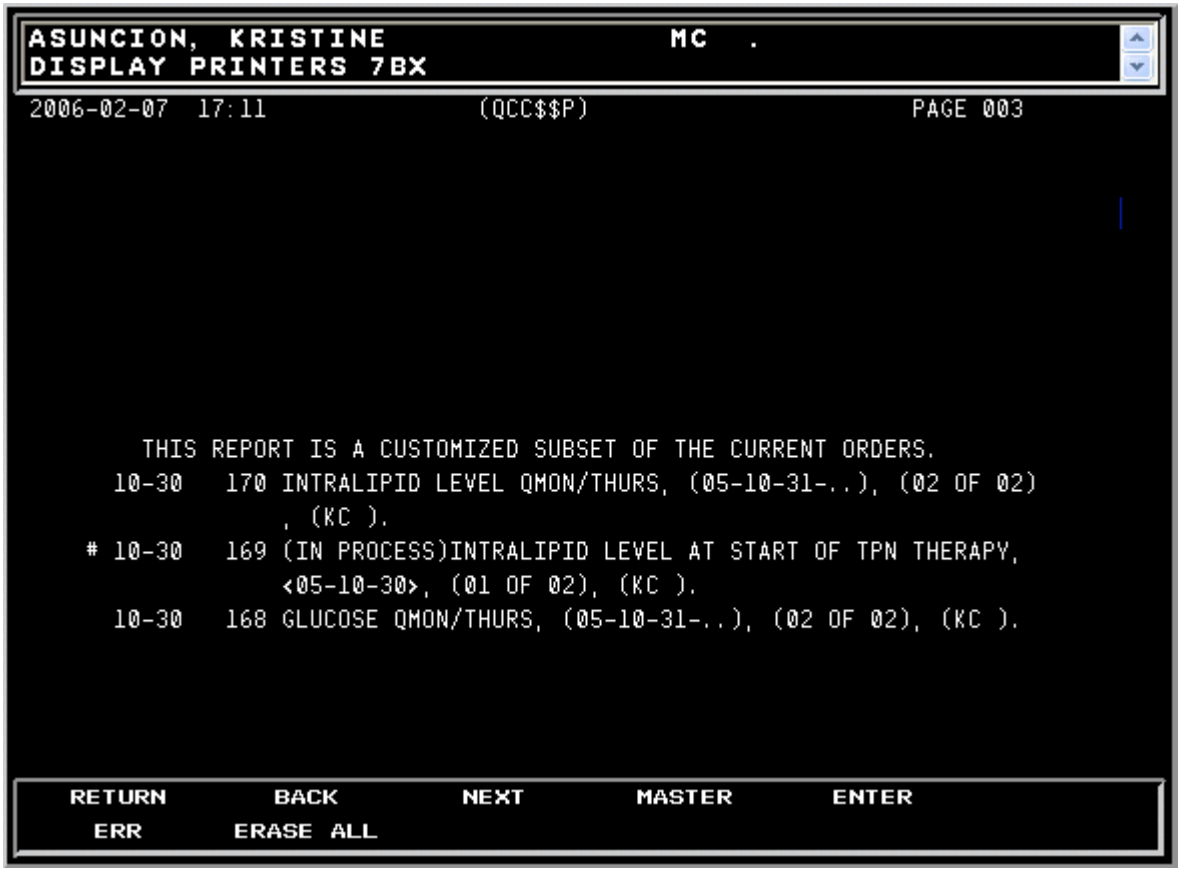
APPENDIX 26: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #5



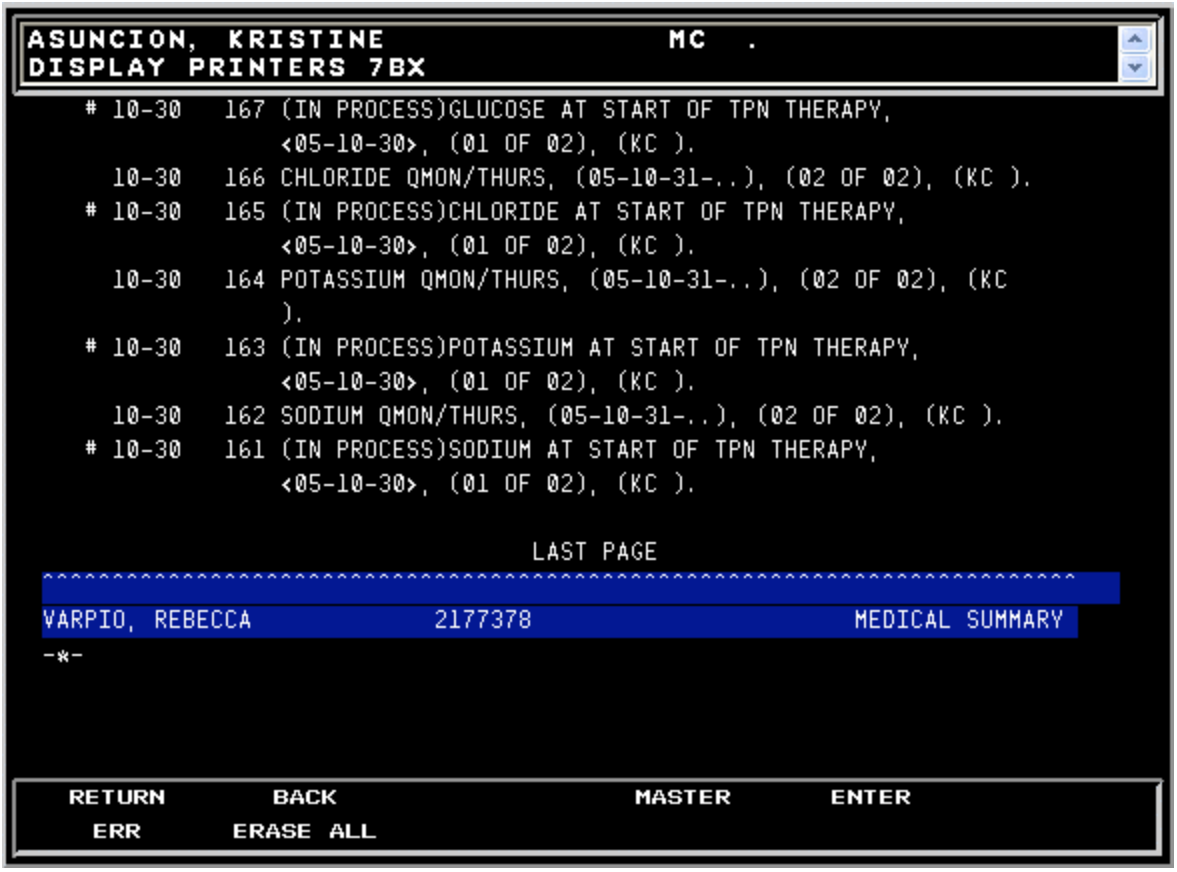
APPENDIX 27: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #6



APPENDIX 28: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #7



APPENDIX 29: EPR SCREEN SHOT OF MEDICAL SUMMARY SCREEN #8



APPENDIX 30: MEDICAL SUMMARY PAPER-BASED PRINTOUT PAGE 1

```
 7BX  -0975                                          I - DEVLOPMENT (DEVL)
2006-02-08  08:05                                                PAGE 001

                          MEDICAL SUMMARY
VARPIO, REBECCA

SEX: F DOB: 2001-03-08 HEIGHT/CM:      WEIGHT/KG: 15.:     C NO: 2177378
ADMIT DATE: 2003-05-24 UNIT: 7B       BED: 7647B    ADMIT NO.: I5000266
DIAGNOSIS: HUS                                   ISOLATION: ROUTINE PRACT
 SC RESPONSIBLE PHYSICIAN                    .   SERVICE: NEPHROLOGY
================================================================================
       THIS REPORT IS A CUSTOMIZED SUBSET OF THE CURRENT ORDERS.
       FOR COMPLETE ORDERS PRINT THE CURRENT ORDERS SUMMARY REPORT

 CURRENT ORDERS

  NUTRITION/FOOD:
     02-03    FOOD PREFERENCES: NO EGGS
     02-03    NO FISH
     02-03    261 LOW POTASSIUM DIET, START TODAY, <06-02-03>, (MC ).
     02-03    260 LOW SODIUM DIET, <06-02-03>, (MC ).
     10-28     66 DAT-REGULAR DIET FOR AGE, <05-10-28>, (KC ).

  FLUIDS:
     02-06    275 ACCURATE IN/OUT, (JFA).
     02-06    269 ACCURATE IN/OUT, (JFA).
     10-31    247 ENCOURAGE FLUIDS --PO, FREE FLUIDS, (KC ).
     10-30    194 RECORD I&O Q 24 HR, (KC ).
     10-30    193 RECORD: CHECK IN/OUT, (KC ).
     10-27     22 RECORD: CHECK IN/OUT, (KC ).

  IVS:
  R  10-31    245 160 PIV LINE....TNA: I-10, MG 6MMOL/L, K 45MMOL/L,
                  VOLUME: 867ML/24HRS; FAT EMULSION 20%, VOLUME: 867
                  ML/24HRS....TOTAL RATE: 867ML/HR....(36ML/24HRS).
                  INDICATION FOR TPN: GI DYSFUNCTION/ MALABSORPTION,
                  <05-10-30-..>, (KC ).

  SCHEDULED MEDICATIONS:
     02-06    279  AMPICILLIN INJ 1500MG, IV, Q12H, X3DAYS, (06-02-06
                  21:00-06-02-09 09:00), (JFA).
     02-06    277 SODIUM BICARBONATE TAB, 325MG, Q8H, (06-02-06
                  17:00-..), (JFA).

  UNSCHEDULED MEDICATIONS:
     02-03    258 HYDROCORTISONE 0.5% CREAM, APPLY TO AFFECTED AREA(S),
                  Q4H, PRN ITCH, <06-02-03 16:11-..>, (MC ).
     02-03    257 ACETAMINOPHEN 80MG, PO, Q4H, PRN TEMP>38.5, PRN PAIN,
                  <06-02-03 16:07-..>, (MC ).

  R=TIME TO RENEW

  LABORATORY:
     10-31    234 MAGNESIUM, DAILY, UNTIL DC'D, <05-10-31-..>, (KC ).
   # 10-31    233 (IN PROCESS)ALBUMIN, TOMORROW, (05-11-01), (KC ).
   # 10-31    232 (IN PROCESS)PHOSPHATES, TOMORROW, (05-11-01), (KC ).
   # 10-31    231 (IN PROCESS)CALCIUM, TOMORROW, (05-11-01), (KC ).

                                    CONTINUED
================================================================================
VARPIO, REBECCA              2177378                        MEDICAL SUMMARY
```

APPENDIX 31: MEDICAL SUMMARY PAPER-BASED PRINTOUT PAGE 2

2006-02-08 08:05 PAGE 002

MEDICAL SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15. **C NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO.:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
RESPONSIBLE PHYSICIAN **SERVICE:** NEPHROLOGY

THIS REPORT IS A CUSTOMIZED SUBSET OF THE CURRENT ORDERS.

#	10-31	230 (IN PROCESS)GLUCOSE, TOMORROW, (05-11-01), (KC).
#	10-31	229 (IN PROCESS)CREATININE, TOMORROW, (05-11-01), (KC).
#	10-31	228 (IN PROCESS)UREA, TOMORROW, (05-11-01), (KC).
#	10-31	227 (IN PROCESS)CHLORIDE, TOMORROW, (05-11-01), (KC).
#	10-31	226 (IN PROCESS)POTASSIUM, TOMORROW, (05-11-01), (KC).
#	10-31	225 (IN PROCESS)SODIUM, TOMORROW, (05-11-01), (KC).
#	10-31	224 (IN PROCESS)BLOOD FILM, TOMORROW, (05-11-01), (KC).
#	10-31	223 (IN PROCESS)DIFF, TOMORROW, (05-11-01), (KC).
#	10-31	222 (IN PROCESS)CBC, TOMORROW, (05-11-01), (KC).
#	10-30	191 (IN PROCESS)CREATININE AT START OF TPN THERAPY, <05-10-30>, (KC).
#	10-30	190 (IN PROCESS)ACID BASE AT START OF TPN THERAPY, <05-10-30>, (KC).
#	10-30	189 (IN PROCESS)ALKALINE PHOSPHATASE AT START OF TPN THERAPY, <05-10-30>, (KC).
#	10-30	188 (IN PROCESS)ALT AT START OF TPN THERAPY, <05-10-30>, (KC).
#	10-30	187 (IN PROCESS)AST AT START OF TPN THERAPY, <05-10-30>, (KC).
	10-30	186 MAGNESIUM: QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	185 (IN PROCESS)MAGNESIUM: AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	184 ALBUMIN QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	183 (IN PROCESS)ALBUMIN AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	182 UNCONJ'D BILIRUBIN QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	181 (IN PROCESS)UNCONJ'D BILIRUBIN AT START OF TPN THERAPY , <05-10-30>, (01 OF 02), (KC).
	10-30	180 CONJ'D BILIRUBIN QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	179 (IN PROCESS)CONJ'D BILIRUBIN AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	178 CALCIUM QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	177 (IN PROCESS)CALCIUM AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	176 PHOSPHATE QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	175 (IN PROCESS)PHOSPHATE AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	174 UREA QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	173 (IN PROCESS)UREA AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	172 CBC QMONDAY, (05-10-31-..), (02 OF 02), (KC).
#	10-30	171 (IN PROCESS)CBC AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).

CONTINUED

APPENDIX 32: MEDICAL SUMMARY PAPER-BASED PRINTOUT PAGE 3

2006-02-08 08:05 PAGE 003

MEDICAL SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15. **C NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO.:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
RESPONSIBLE PHYSICIAN **SERVICE:** NEPHROLOGY

THIS REPORT IS A CUSTOMIZED SUBSET OF THE CURRENT ORDERS.

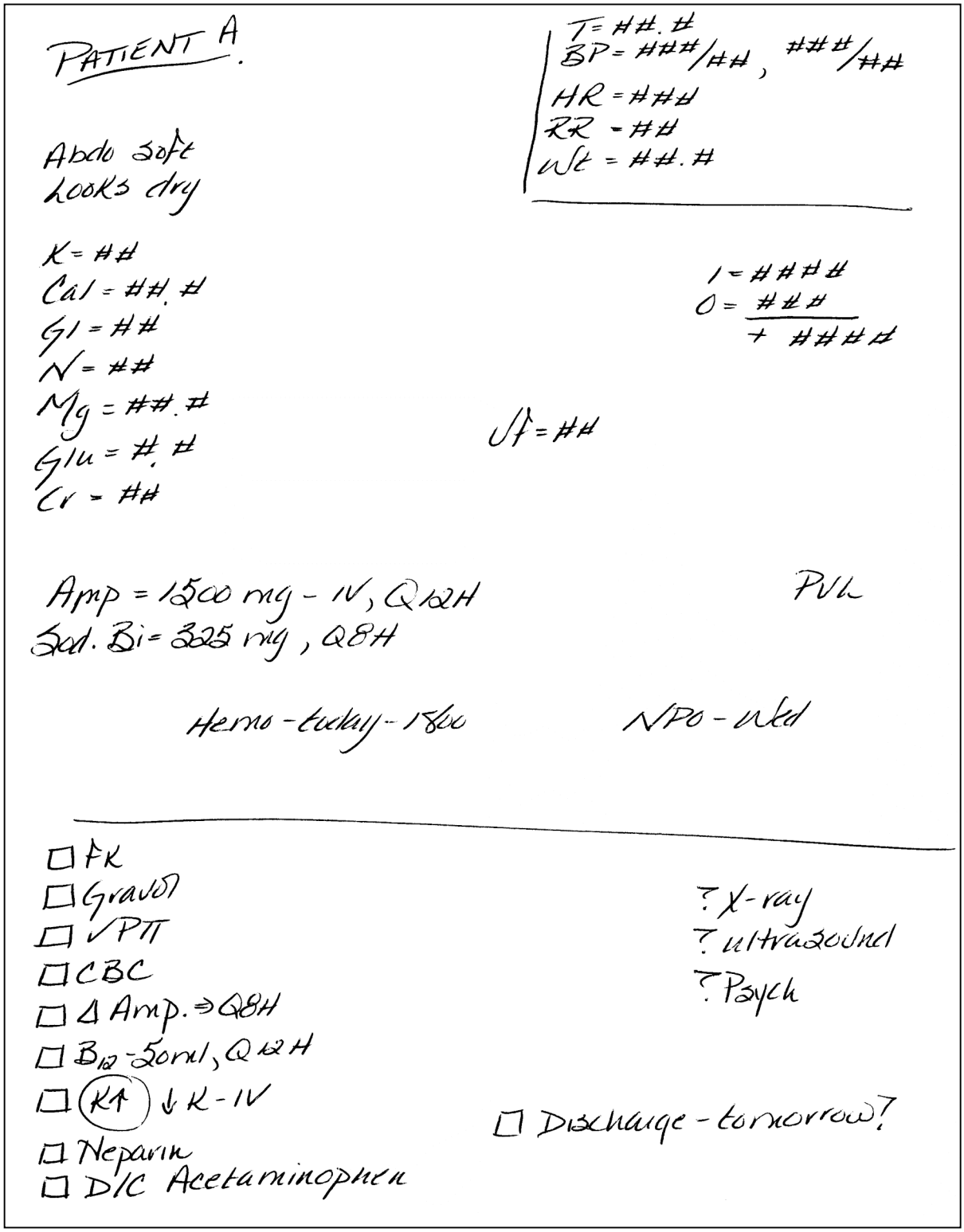
	10-30	170	INTRALIPID LEVEL QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
#	10-30	169	(IN PROCESS)INTRALIPID LEVEL AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	168	GLUCOSE QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
#	10-30	167	(IN PROCESS)GLUCOSE AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	166	CHLORIDE QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
#	10-30	165	(IN PROCESS)CHLORIDE AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	164	POTASSIUM QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
#	10-30	163	(IN PROCESS)POTASSIUM AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).
	10-30	162	SODIUM QMON/THURS, (05-10-31-..), (02 OF 02), (KC).
#	10-30	161	(IN PROCESS)SODIUM AT START OF TPN THERAPY, <05-10-30>, (01 OF 02), (KC).

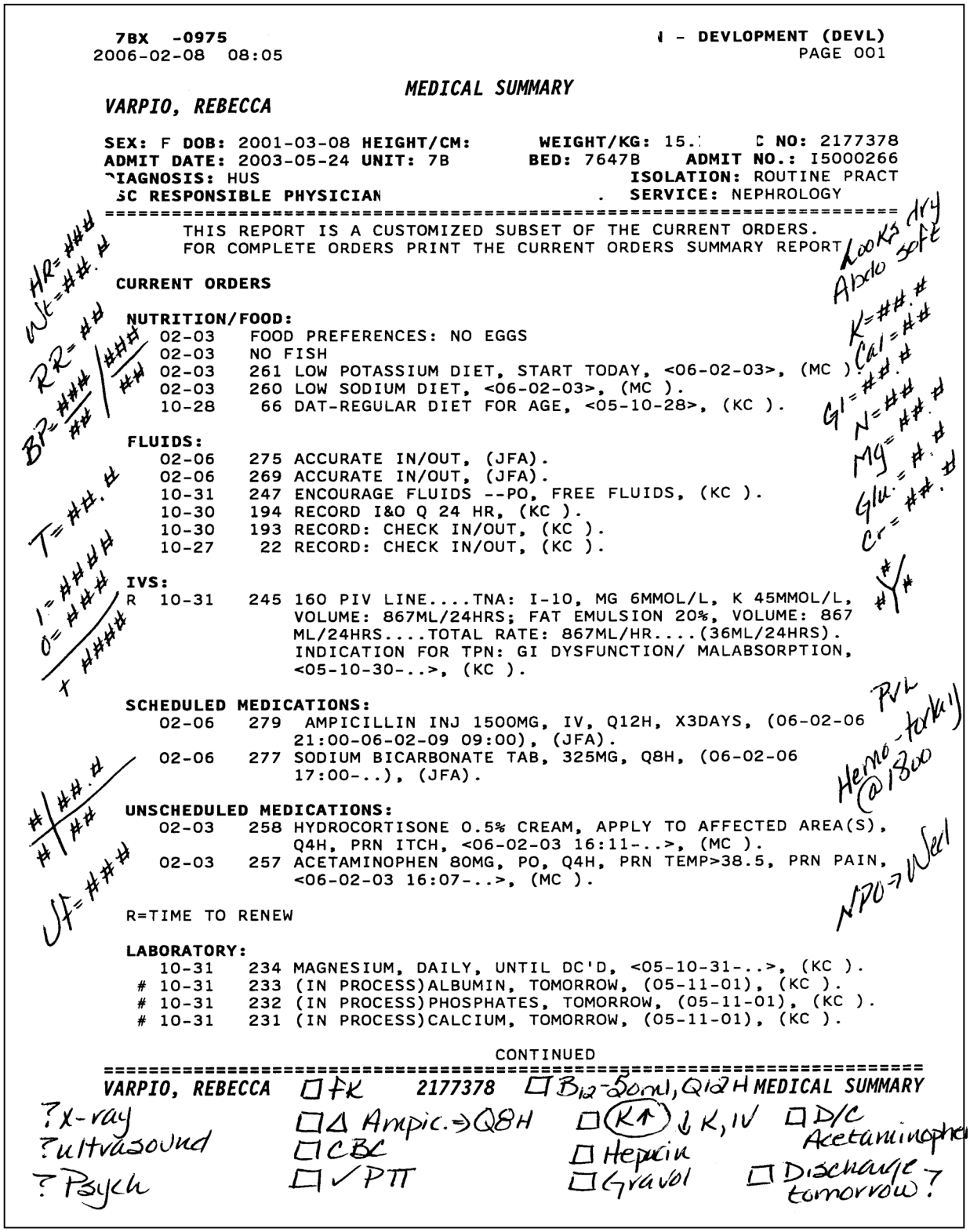
LAST PAGE

VARPIO, REBECCA ***2177378*** ***MEDICAL SUMMARY***

-*-

APPENDIX 33: PHYSICIAN TRANSFORMATION COMPLETE WRITTEN OVERHAUL





7BX -0975 — DEVLOPMENT (DEVL)
2006-02-08 08:05 — PAGE 001

MEDICAL SUMMARY

VARPIO, REBECCA

SEX: F **DOB:** 2001-03-08 **HEIGHT/CM:** **WEIGHT/KG:** 15.[illegible] **C NO:** 2177378
ADMIT DATE: 2003-05-24 **UNIT:** 7B **BED:** 7647B **ADMIT NO.:** I5000266
DIAGNOSIS: HUS **ISOLATION:** ROUTINE PRACT
RESPONSIBLE PHYSICIAN . **SERVICE:** NEPHROLOGY

THIS REPORT IS A CUSTOMIZED SUBSET OF THE CURRENT ORDERS.
FOR COMPLETE ORDERS PRINT THE CURRENT ORDERS SUMMARY REPORT

CURRENT ORDERS

NUTRITION/FOOD:
02-03 FOOD PREFERENCES: NO EGGS
02-03 NO FISH
02-03 261 LOW POTASSIUM DIET, START TODAY, <06-02-03>, (MC).
02-03 260 LOW SODIUM DIET, <06-02-03>, (MC).
10-28 66 DAT-REGULAR DIET FOR AGE, <05-10-28>, (KC).

FLUIDS:
02-06 275 ACCURATE IN/OUT, (JFA).
02-06 269 ACCURATE IN/OUT, (JFA).
10-31 247 ENCOURAGE FLUIDS --PO, FREE FLUIDS, (KC).
10-30 194 RECORD I&O Q 24 HR, (KC).
10-30 193 RECORD: CHECK IN/OUT, (KC).
10-27 22 RECORD: CHECK IN/OUT, (KC).

IVS:
R 10-31 245 160 PIV LINE....TNA: I-10, MG 6MMOL/L, K 45MMOL/L, VOLUME: 867ML/24HRS; FAT EMULSION 20%, VOLUME: 867 ML/24HRS....TOTAL RATE: 867ML/HR....(36ML/24HRS). INDICATION FOR TPN: GI DYSFUNCTION/ MALABSORPTION, <05-10-30-..>, (KC).

SCHEDULED MEDICATIONS:
02-06 279 AMPICILLIN INJ 1500MG, IV, Q12H, X3DAYS, (06-02-06 21:00-06-02-09 09:00), (JFA).
02-06 277 SODIUM BICARBONATE TAB, 325MG, Q8H, (06-02-06 17:00-..), (JFA).

UNSCHEDULED MEDICATIONS:
02-03 258 HYDROCORTISONE 0.5% CREAM, APPLY TO AFFECTED AREA(S), Q4H, PRN ITCH, <06-02-03 16:11-..>, (MC).
02-03 257 ACETAMINOPHEN 80MG, PO, Q4H, PRN TEMP>38.5, PRN PAIN, <06-02-03 16:07-..>, (MC).

R=TIME TO RENEW

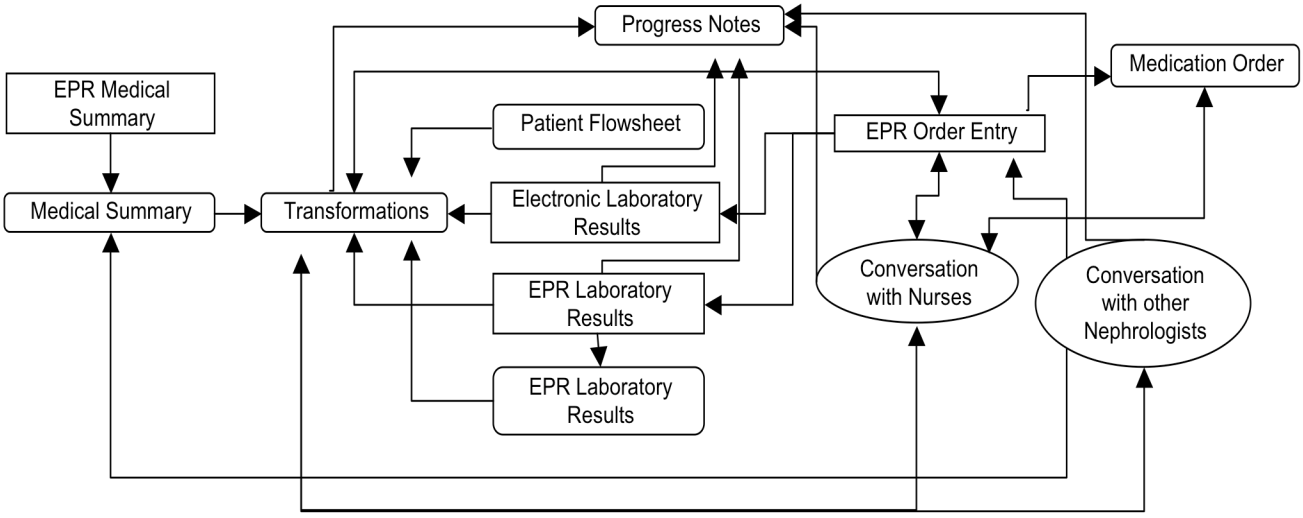
LABORATORY:
10-31 234 MAGNESIUM, DAILY, UNTIL DC'D, <05-10-31-..>, (KC).
10-31 233 (IN PROCESS)ALBUMIN, TOMORROW, (05-11-01), (KC).
10-31 232 (IN PROCESS)PHOSPHATES, TOMORROW, (05-11-01), (KC).
10-31 231 (IN PROCESS)CALCIUM, TOMORROW, (05-11-01), (KC).

CONTINUED

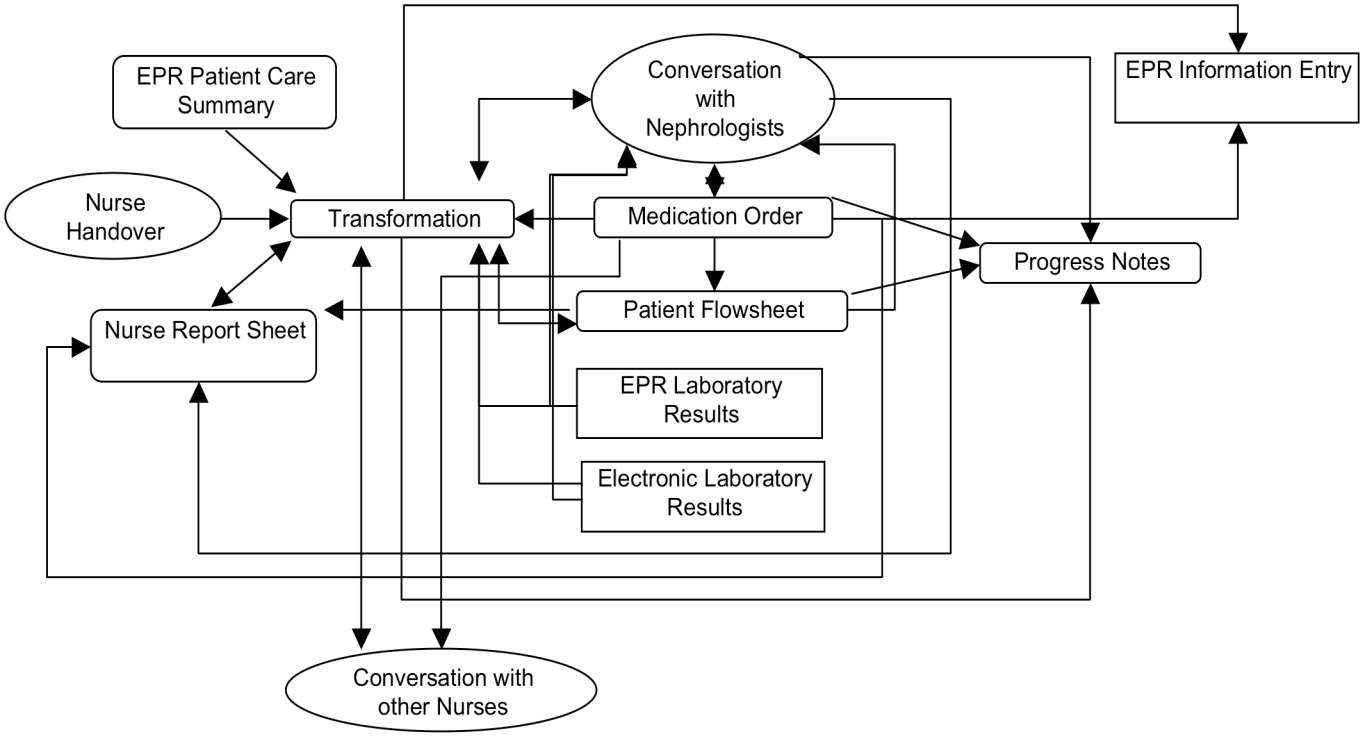
VARPIO, REBECCA ☐FK **2177378** ☐B12-50mL, Q12H **MEDICAL SUMMARY**
?X-ray ☐Δ Ampic.→Q8H ☐(K↑) ↓K, IV ☐D/C Acetaminophen
?ultrasound ☐CBC ☐Heparin
?Psych ☐✓PTT ☐Gravol ☐Discharge tomorrow?

HR=### Wt=##.# RR=## BP=###/## T=##.# I=#### O=#### + #### UF=### #/##.#/## Looks dry Abdo soft K=##.# Cal=## GI=##.# N=### Mg=##.# Glu=#.# Cr=##.# #/# PVL Hemo-forky @1800 NPO→Wed

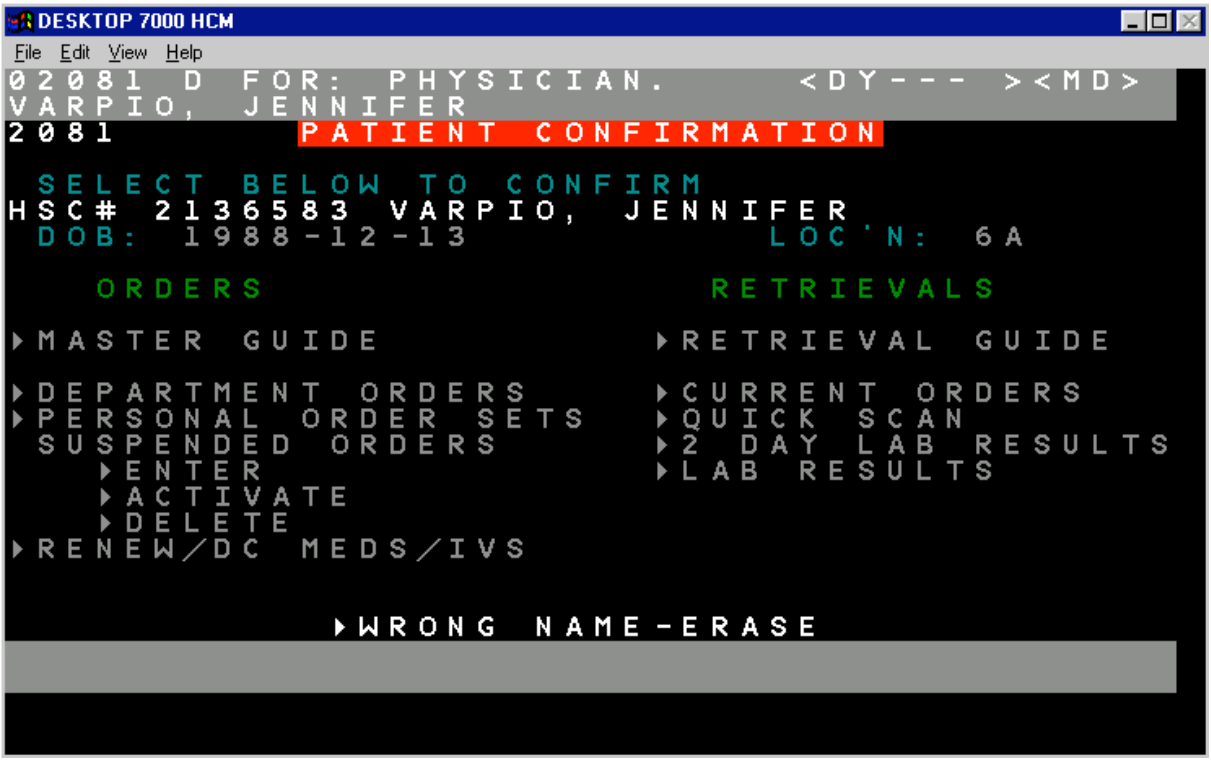
APPENDIX 35: PHYSICIAN GENRE ECOLOGY



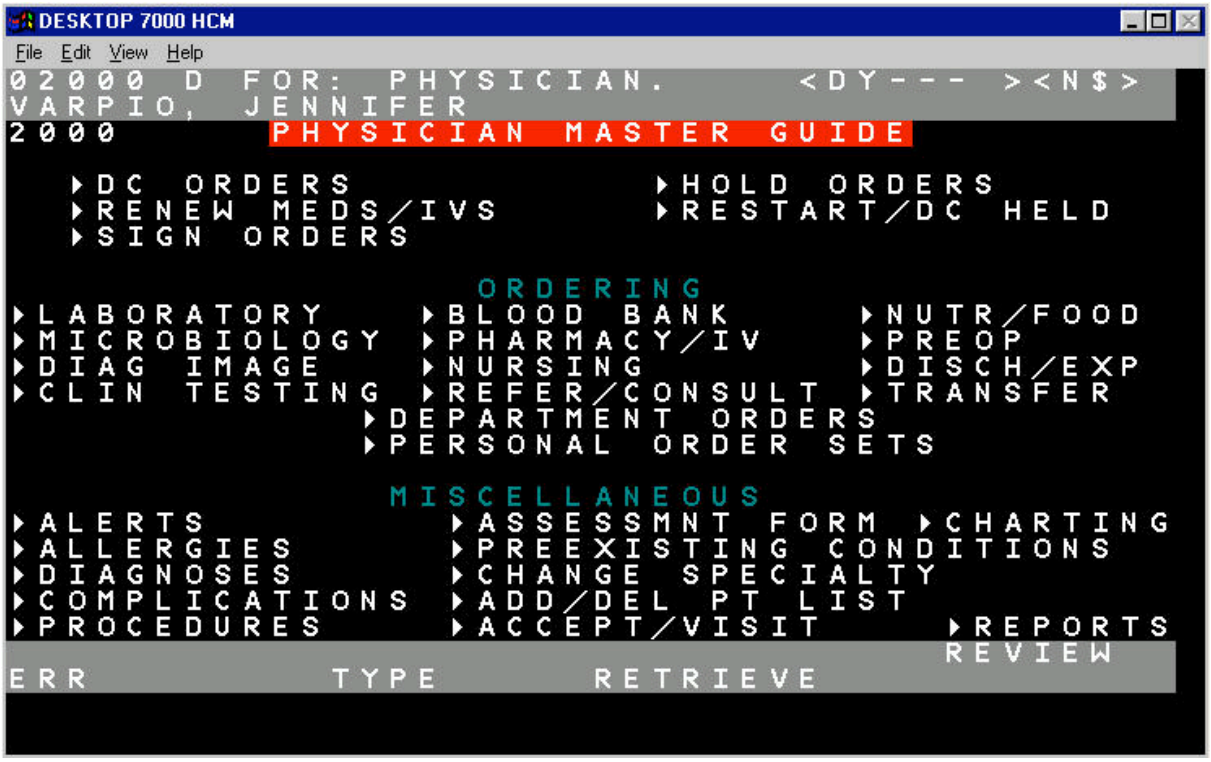
APPENDIX 36: NURSING GENRE ECOLOGY



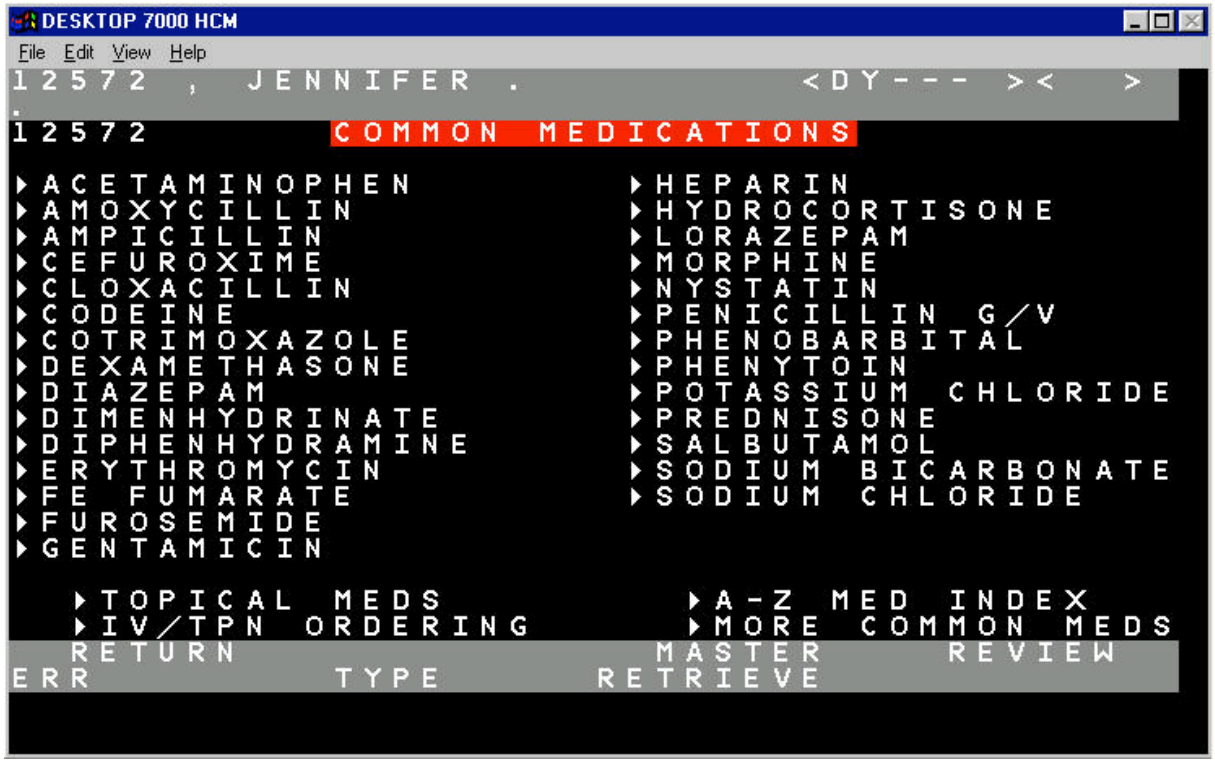
APPENDIX 37: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #1



APPENDIX 38: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #2

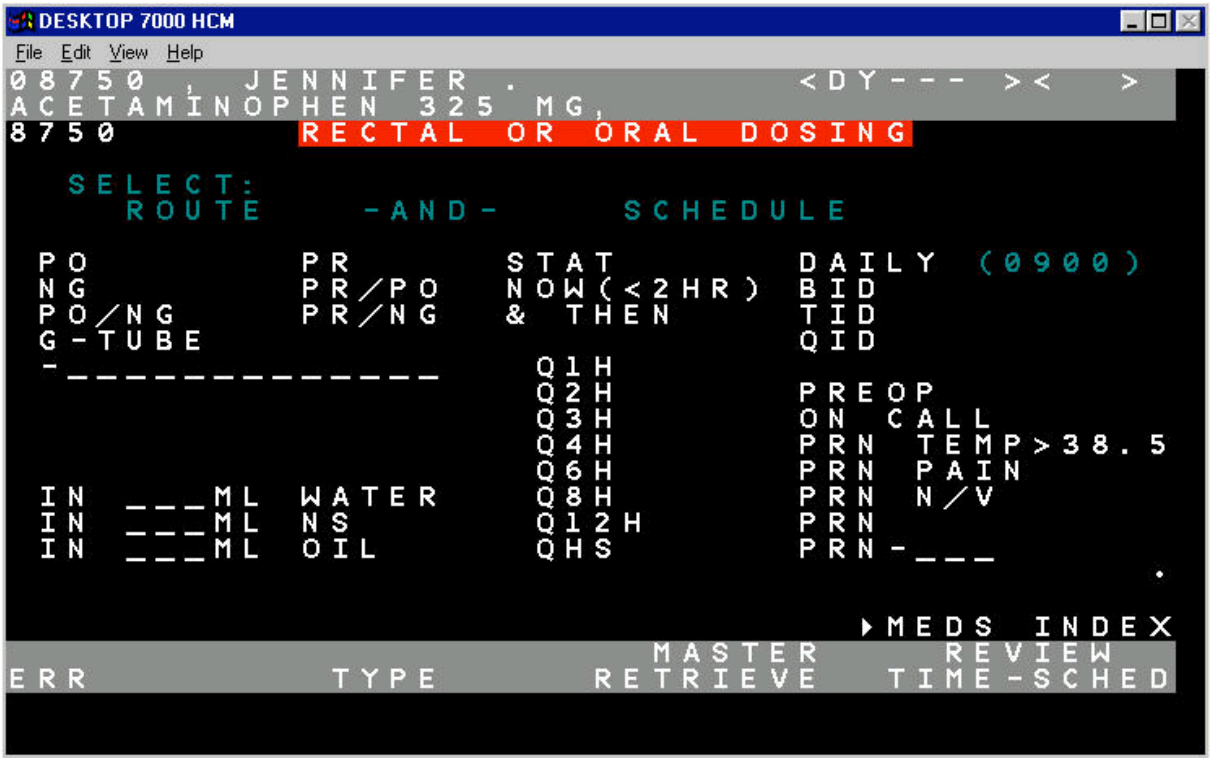


APPENDIX 39: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #3

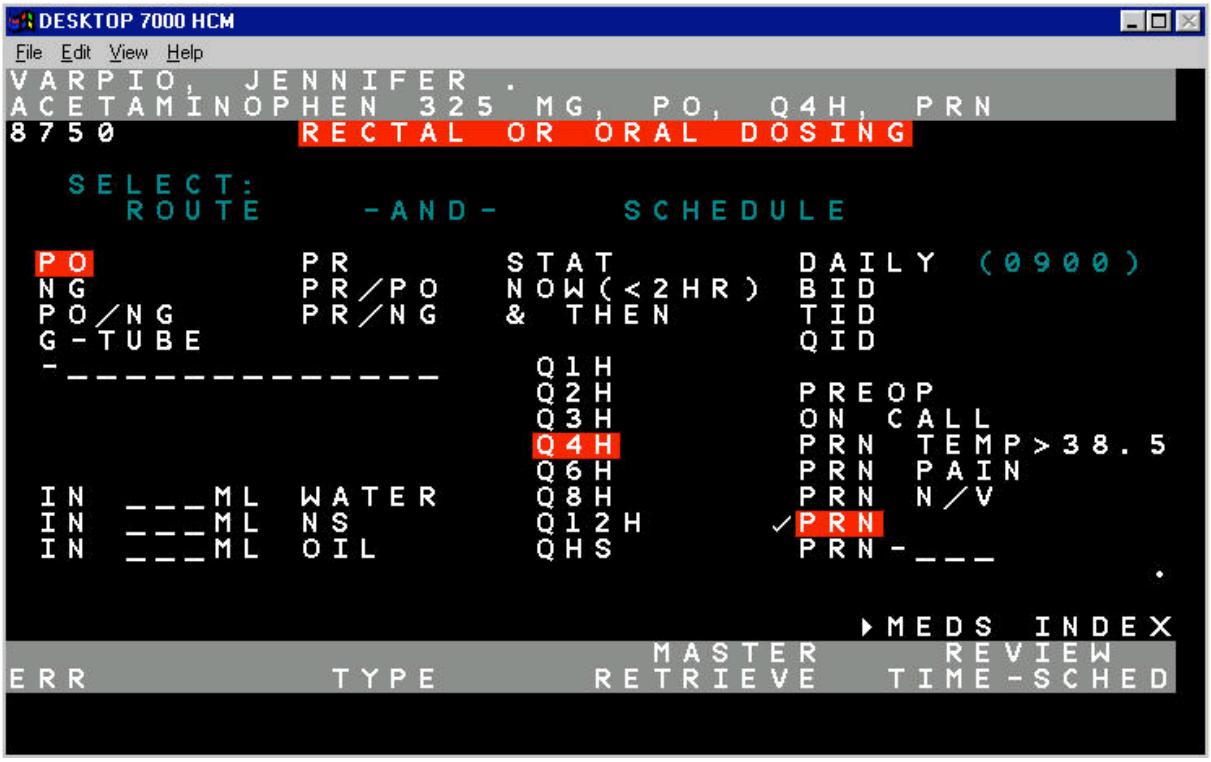


APPENDIX 40: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #4

APPENDIX 41: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #5

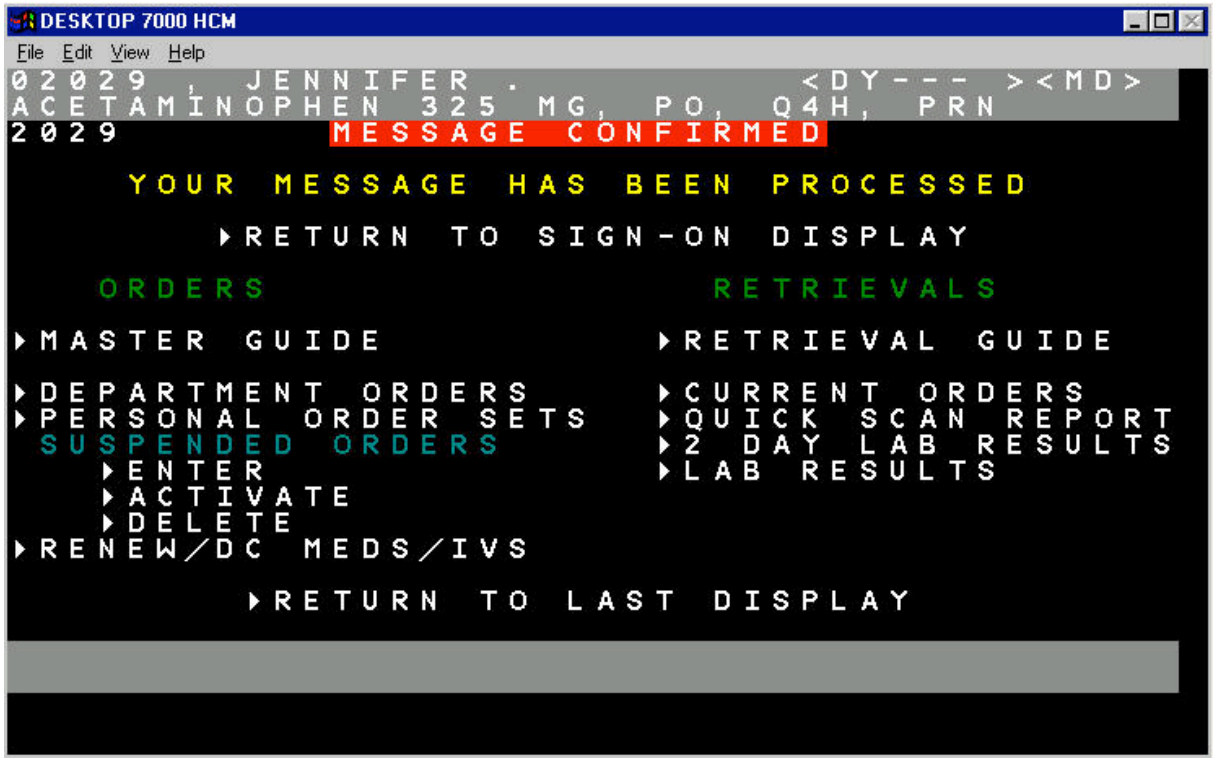


APPENDIX 42: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #6



APPENDIX 43: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #7

APPENDIX 44: EPR ORDER ENTRY FOR ACETAMINOPHEN SCREEN #8



APPENDIX 45: FLUENT INTERACTIONS WITH COMPUTER TECHNOLOGIES

In this study, fluent interactions with computer technologies were defined as instances in observation data were users interacted with a computer technology and accomplished their goals transparently. Transparency is defined here as an act of using a computer system being cognitively unnoticed by the user. In this way, fluent user interactions were completed without delay and without observable notice of having to negotiate with the system itself.

It should be noted that one set of fluent interactions were not included in this discussion. The following discussion omits interactions where users accessed the EPR at the beginning of their shift to print out Medical Summaries or Patient Care Summaries. While these interactions meet with the definition of 'fluent' used here, these interactions were addressed in-depth in chapter 4. Consequently, these interactions will not be addressed here.

Physicians' Fluent Interactions

Of the 93 fluent interactions noted during the study's observations, 72 were completed by physician-users. This clear majority of fluent interactions (77%) being physician based was an expected result since observations consistently showed physicians spending more time at computer terminals than any other profession on the ward. And, although there was evidence of physicians occasionally using the computers for accessing e-mail, searching the world wide web, or other activities, these activities were the exception, and not the rule, of physician-computer interactions. When physicians were using ward computers, they were normally using either the hospital's EPR or the Electronic Laboratory Results system.

The 72 fluent interactions completed by physicians can be grouped into two separate activities. First, 35 fluent interactions were observed when physicians were viewing lab results in either the EPR or the Electronic Laboratory Results system. The other 37 fluent interactions occurred while physicians used the EPR to do order entry.

Physicians experienced fluent interactions with computer technologies when they were viewing lab results through the EPR and the Electronic Laboratory Results system. This lab viewing activity regularly occurred either when residents/fellows discussed patients with a staff physician during rounding activities, or when physicians worked alone and then transcribed the lab results onto their Transformation documents. An example of a fluent use of the Electronic Laboratory Results system during a discussion between a novice physician and a staff physician occurred during observation session #0420, when Fellow B and Staff physician F were working on computer stations at the back of the nursing station desk. The fellow and staff were working individually, each using a computer for their own tasks, when Fellow B initiated the following conversation. Note that Fellow B was already viewing patient lab results within the Electronic Laboratory Results system when the conversation was initiated:

- Fellow B: (looking at computer screen of the Electronic Laboratory Results system for a patient's values) "It's 11.7. His [test name]."
- Staff F uses her computer to access the Electronic Laboratory Results system and loads the patient's values. She then responds: "His white count is ##. His differential is ###."
- Fellow B: "Today's?"

- Staff F: “Yeah. I’ll look back and see what it was before that” (scrolls through values on Electronic Laboratory Results screen) “And his FK is ###.”
- Fellow B: “Yes. I saw that. It’s going down.”
- Staff F: “It was ## yesterday, ## before that, ## before that.”
- Fellow B: “Yes. So it’s getting better.”
- Staff F: “Definitely.

As this example illustrate, the act of working with this computer system was transparent for both physician users since the interactions were completed without delay and without observable negotiations with the system itself.

Similarly fluent interactions were also evident when physicians worked individually with the Electronic Laboratory Results viewing system. During these fluent viewing interactions, most physicians transcribed values from the computer system onto a paper-based document. These transcribed values were usually written into the physician’s Transformation or directly into the patient’s Progress Note. In the following example, from observations session #0301, a fellow was working at a computer station with the hospital’s EPR. The physician had just finished creating new medication orders for a patient when she opened a new window in the computer and accessed the Electronic Laboratory Results system:

- Fellow A accesses Electronic Laboratory Results values for the patient. With the patient’s values on the screen, Fellow A begins to transfer values from the Electronic Laboratory Results system to the Progress Note she is writing in the patient’s active paper chart.

The fellow is not observably aware of having to negotiate or interact with the Electronic Laboratory Results system. The physician is interacting with the data within the system, and not the system itself.

Physicians also had fluent interactions with the computer technologies on the ward when conducting order entry activities. All patient orders had to be electronically entered through the hospital’s EPR in order for them to be acknowledged and activated. It should be noted here that while some order entry activities were fluent, other order entry activities were not. However, since some order entry activities were fluent, those interactions will be addressed here. Of the 37 fluent order entry interactions, physicians were observed ordering medications, blood testing (i.e. CBC panels), other laboratory testing (i.e. stool sample testing), consultations from other services (i.e. transplant), imaging (i.e. x-rays), and the discontinuation of medications. An example of a fluent order entry was observed during observation session #0519 when Fellow C was observed interacting with the EPR to order insulin for a patient on the ward. The following excerpt from the observation session describes her computer activity and includes a brief informal interview with the Fellow regarding that interaction:

- Fellow C is at a computer terminal behind the central nursing station desk, has accessed EPR, and is accessing the medication order screens. Fellow C selects insulin order screen, and gains access to the order screen. She enters an insulin order (complete with time for order to be given to patient, and dosage) and selects ‘Enter’ function. She is then at the review screen, but does not enter this order into the system. Instead, she accesses the order entry screens again. Fellow C makes another insulin order, enters it, and is given review screen. There are now two insulin orders on the review screen, but she does not enter the orders. She repeats the process and enters a third insulin order.
- Observer addresses Fellow C: “Are you entering the same order again?”

- Fellow C: "No. Here, I'll show you. I have to order insulin again for ever time I need it [Note: Fellow C is at the EPR review screen and is using the cursor on screen to circle each entry as she addresses them in turn from top/first order to bottom/third]. This one is for lunch. Then I'll make another one, this one, for dinner. This one is for bedtime. Now I'll make one more for breakfast tomorrow because I may not be here in time for breakfast orders."
- Fellow C accesses the insulin order screens a fourth time, and enters another insulin order. At the review screen there are now four insulin orders. Fellow C enters these orders into the system.

As this excerpt exemplifies, physician order entry can be classified as fluent. In this example, multiple orders for the same patient and for the same medication were ordered in succession. The clarification question establishes that these multiple orders weren't errors, but were intentional creations that were easily created by the physician.

It is worth noting that of the 37 fluent order entry interactions, 11 of those orders (30% of the orders) were for discontinuing medications. The fluency of this frequently created order is noteworthy since discontinuing a medication is an order entry activity that requires very little interaction with the EPR. To discontinue an order, a physician entered a patient's 'Discontinue Current Orders' screen within the EPR and selected as many orders as he/she choose from the list of active medications provided. Once the medications were selected and entered, the EPR review screen was displayed and accepted as discontinuations upon review by the physician. Discontinuing an order was an activity that was often transparent for the user. This transparency was evident in the following example of a fellow discontinuing an order, taken from observation session #0217:

- Fellow B comes onto the ward and goes to a computer terminal behind the central nursing station desk Fellow B accesses the EPR and enters into a patient's file information. Fellow selects the 'DC [DC=discontinue] current orders' function, enters the first screen of 'DC current orders' and begins to scroll through the patient medications listed there.
- Fellow B uses the phone sitting on the desk to call for a consult for the patient for whom she is discontinuing orders. After the conversation, Fellow B hangs-up.
- Fellow B then returns to the EPR and continues to go through the DC orders screens. The patient is on many medications. Fellow is going through many screens (hits 'Next' function 12 times in total to find the order to be discontinued). She selects a specific medication, enters that selection, reviews the selection at the review screen, and then enters the order.

Here, even though the fellow places a request for a consultation call during the discontinuation activity and despite the fact that there are 12 screens of orders to be screened before she can find the order to be discontinued, this activity is completed very quickly (within a 5 minute time frame of the observation notes), and without being observed as expressly interacting with the EPR system.

Nurses' Fluent Interactions

The remaining 21 fluent interactions observed during the study were completed by nurse-users. Again, these fluent interactions can be grouped around two separate activities. Twelve of these

fluent interactions involved nurses signing off medications with the EPR system, while 7 interactions found nurses viewing lab results within the Electronic Laboratory Results system. The two extraneous interactions will not be addressed in this discussion.

The majority of fluent nursing interactions (57%) involved the signing off of patient medications. All medication orders were maintained within the hospital's EPR, and so the activity of signing off those medications had to be completed through the EPR. Medications did not need to be signed off immediately after they had been given to the patient. Instead, the EPR was designed to allow nurses to sign off medications when it was most convenient. However, as the following example illustrates (from observation session #1124), the nurses did not require much time to sign off medications:

- Nurse H comes to the central nursing station desk and sits at a computer terminal there. He accesses a patient file within the EPR, goes to the medication orders screen, selects a medication order. He gets visual confirmation of the selection via red highlighting that appears around that order and a white checkmark on the left hand side of the order. He enters the time when the order was given, reviews the information at the review screen, and then uses the 'Enter' function to enter the medication as having been given.
- Timing: the signing off is done in less than 30 seconds.

This nursing interaction is fluent, going unnoticed by the user, and is an activity that nurses completed repeatedly throughout their day.

The second grouping of fluent nursing interactions centers around the viewing of lab results within the EPR or the Electronic Laboratory Results system. Like the physicians, most nurses transcribed lab values from the computer system onto a paper-based document. In the following example, taken from observations session #0118, Nurse EE (a novice nurse on the ward with only a few weeks of experience) was being mentored by Nurse E. Nurse E was teaching Nurse EE how to find patient lab results. They were both sitting at one computer terminal and Nurse E was orally and visually explaining certain parts of the EPR to Nurse EE:

- Nurse E is giving Nurse EE guidance about where to go/click on the EPR screen – they have already picked a patient name and have accessed the Master Guide screen for the patient and have gone to video access [viewable only, not printable access] lab results within the EPR
- Nurse E: "This is where you get lab results but its usually not as updated as [the Electronic Laboratory Results system]. So, here, go to [the Electronic Laboratory Results system]
- Nurse E helps Nurse EE access the Electronic Laboratory Results system. They wait for results to load into the system and to display.
- Nurse E: "Usually, they show your values here [points to far left hand side of the screen] which is nice."
- Results come up in display.
- Nurse E: (quoting the text in the Electronic Laboratory Results system) "'Pending, pending, pending.' So we're waiting on those. When they come in, we'll write it in our Flowsheet."

In this example, the mentoring nurse was teaching the novice nurse how to access the screens, but there was no observably evident moment of the mentoring nurse having to negotiate or interact with the computer technologies themselves. Instead, this example illustrates the simplicity of the task for the mentoring nurse and how her focus is on finding the information, not interacting with the system itself.

REFERENCES

Angrosino, M. V. & Mays de Pérez, K. A. (2000). The interview: From structured questions to negotiated text. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed) (pp. 645-672). Thousand Oaks, CA: SAGE Publications.

Arnheim, R. (1969). *Visual thinking*. Cambridge: Cambridge U Press.

Artemeva, N. (1994). Key concepts in rhetorical genre studies: An overview. *Technostyle, 20* (1), 3-38.

Artemeva, N., & Freedman, A. (2001). "Just the boys playing on computers": An activity theory analysis of differences in the cultures of two engineering firms. *Journal of Business and Technical Communication, 15*(2), 164-194.

Ball, M. J., & Collen, M. F. (Eds.). (1992). *Aspects of the computer-based patient record*. Berlin: Springer.

Barry, A.M. (1997). *Visual intelligence: Perception, image, and manipulation in visual communication*. Albany: SUNY Press.

Barthes, R. (1977). *Image-music-text.* London: Fontana.

Bates, D. W., Leape, L. L., Cullen, D. J., Laird, N., Petersen, L. A., Teich, J. M., et al. (1998). Effect of a computerized physician order entry and a team intervention on prevention of serious medication errors. *Journal of the American Medical Association. 280*(15). 1311-1316.

Bazerman, C. (1988). *Shaping written knowledge: The genre and activity of the experimental article in science.* Madison: University of Wisconsin Press.

Bazerman, C. (1994). Systems of genres and the enactment of social interactions. In A. Freedman & P. Medway (Eds.), *Genre and the new rhetoric*, (pp. 79-101). London: Taylor & Francis.

Bell, H. D., Walsh, K. A. & Katz, S. B. (2000). "Aristotle's pharmacy": The medical rhetoric of a clinical protocol in the drug development process. *Technical Communication Quarterly, 9,* 249-269.

Berg, M. (1997). *Rationalizing medical work: Decision-support technology and medical practices.* Cambridge, MA: The MIT Press.

Berg, M. (2004). *Health information management: Integrating information technology in health care work.* New York, NY: Routledge.

Berkenkotter, C. (2001). Genre systems at work: *DSM-IV* and rhetorical recontextualization in psychotherapy paperwork. *Written Communication, 18,* 326-349.

Beuscart-Zéphir, M. C., Anceaux, F., Crinquette, V., & Renard, J. M. (2001). Integrating users' activity modeling in the design and assessment of hospital electronic patient records: The example of anesthesia. *International Journal of Medical Informatics. 64.* 157-171.

Bijker, W., & Law, J. (Eds.). (1992). *Shaping technology-building society: Studies in sociotechnical change.* Cambridge, MA: MIT Press.

Bogdewie, S. (1999). Participant observation. In B. F. Crabtree & W. L. Miller (Eds.), *Doing qualitative research* (pp.47-70). Thousand Oaks, CA: Sage.

Bourdieu, P. & Passeron, J.-C. (1990). *Reproduction in education, society and culture.* Thousand Oaks, CA: Sage.

Britten, N. (1995). Qualitative interviews in medical research. *BMJ. 311,* 251-253.
Callon, M. (1987). Society in the making: The study of technology as a tool for sociological analysis. In W. E. Bijker, T. P. Hughes, & T. J. Pinch (Eds.), *The social construction of technological systems: New directions in the sociology and history of technology* (pp. 83-103). Cambridge, MA: MIT Press.
Callon, M. (1991). Techno-economic networks and irreversibility. In J. Law (Ed.), *A sociology of monsters: Essays on power, technology and domination* (pp. 132-161). New York, NY: Routledge.
Callon, M. (1999). Actor-network theory – the market test. In J. Law & J. Hassard (Eds.), *Actor network theory and after* (pp.181-195). Oxford, UK: Blackwell Publishers.
Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed) (pp. 509-535). Thousand Oaks, CA: SAGE Publications.
Connor, J. (1994). Self-help medical literature in 19th century Canada and the rhetorical conversation of plain language. *Journal of Technical Writing and Communication, 24,* 265-283.
Coe, R. M. (1987). An apology for Form; or, Who took the form out of the process?. *College English, 49* (1), 13-28.
Coe, R. M., Lingard, L. & Teslenko, T. (2002). Genre as action, strategy, and *difference*: An introduction. In. R. M. Coe, L. Lingard & T. Teslenko (Eds.), *The rhetoric and ideology of genre* (pp. 1-12). Cresskill, NJ: Hampton Press, Inc..
Cole, M., & Engeström, Y. (1993). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 1-46). Cambridge, UK: Cambridge University Press.
Cole, M., & Scribner, S. (1978). Introduction. In. L. S. Vygotsky, L. S. *Mind in society: The development of higher psychological processes* (A. R. Luria, M. Lopez-Morillas, & M. Cole, Trans.; M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.
Cooper, A. (1995). *About face: The essentials of user interface design*. Seattle: Microsoft Press.
Covvey, D. (2006). *In pursuit of the EHR holy grail: A critical situational review*. Paper presented at the Waterloo Institute for Health Informatics Research. Retrieved July 29, 2006, from http://webcast.csg.uwaterloo.ca/archives/2006_Feb22/defaultWM.aspx?archiveID=10
Crosson, J. C., Stroebel, C., Scott, J. C., Stello, B., & Crabtree, B. F. (2005). Implementing an electronic medical record in family medicine practice: Communication, decision making, and conflict. *Annals of Family Medicine. 3*(4). 307-311.
Dautermann, J. (1997). *Writing at good hope: A study of negotiated composition in a community of nurses*. Greenwich, CT: Ablex.
Denzin, N. K. & Lincoln, Y.S. (2000). Introduction: The discipline and practice of qualitative research. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed) (pp. 1-28). Thousand Oaks, CA: SAGE Publications.

Devitt, A. J. (1991). Intertextuality in tax accounting: Generic, referential, and functional. In C. Bazerman & J. Paradis (Eds.), *Textual dynamics of the professions* (pp. 336-357). Madison, WI: University of Wisconsin Press.

Devitt, A. J. (2000). Integrating rhetorical and literary theories of genre. *College English, 62* (6), 696-717.

Dick, R. S., & Steen, E. B. (Eds.). (1991). *The computer-based patient record: An essential technology for health care*. Washington: National Academy Press.

Dunmire, P. (2000). Genre as temporally situated social action. *Written Communication, 17,* 93-138.

Durst, R. K. (1984). The development of Analytic Writing. In A. N. Applebee (Ed.), *Contexts for learning to write: Studies of secondary school instruction* (pp. 79-102). Norwook, NJ: ABLEX.

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research.* Helsinki, Finland: Orienta-Konsultit.

Engeström, Y. (1999). Expansive visibilization of work: An activity-theoretical perspective. *Computer Supported Cooperative Work, 8*, 63-93.

Engeström, Y. (2000). Activity theory as a framework for analyzing and redesigning work. *Ergonomics, 43*(7), 960-974.

Engeström, Y., Engeström, R., & Vähäaho, T. (1999). In S. Chaiklin, M. Hedegaard, & U. J. Jensen (Eds.), *Activity theory and social practice* (pp.345-374). Aarhus, DK: Aarhus University Press.

Engeström, Y., & Miettinen, R., (1999). Introduction. In Y. Engeström, R. Miettinen & R.-L. Punamäki (Eds.), *Perspectives on activity theory* (pp.1-16). Cambridge, UK: Cambridge University Press.

Erickson, T. D. (1990). Working with interface metaphors. In B. Laurel and S. J. Mountford (Eds.), *The art of human-computer interface design* (pp. 65-74). Reading, MA: Addison-Wesley.

Freedman, A. & Medway, P. Locating genre studies: Actecedents and prospects. In A. Freedman & P. Medway (Eds.), *Genre and the new rhetoric* (pp. 1-20). London: Taylor and Francis.

Fujimura, J. H. (1995), Ecologies of action: Recombining genes, molecularizing cancer, and transforming biology. In S. L. Star (Ed.), *Ecologies of knowledge: Work and politics in science and technology* (pp.302-346). Albany, NY: State University of New York Press.

Gasser, L. (1986). The integration of computing and routine work. *ACM Transactions on Office Information Systems, 4*, 257-270.

Giddens, A. (1984). *The constitution of society: Outline of a theory of structuration*. Cambridge, MA: Polity Press; Berkeley, CA: University of California Press.

Glaser, B., & Strauss,A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Haas, C. (2005). Research in activity: An analysis of speed bumps as mediational means. *Written Communication, 22*(2), 127-165.

Haber, R. J. & Lingard, L. (2001). Learning oral presentation skills: a rhetorical analysis with pedagogical and professional implications. *Journal of General Internal Medicine, 16*, 308-314.

Hackos, J. T., & Redish, J. C. (1998). *User and task analysis for interface design.* New

York.
Hammersly, M. & Atkinson, P. (1995). *Ethnography: Principles in Practice*. London: Routledge NY: Wiley.
Hayles, K. N. (1999). *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics.* Chicago, IL: University of Chicago Press.
Heard, S. R., Roberts, C., Furrows, S. J., Kelsey, M., & Southgate, L. (2003). Corridor consultations and the medical microbiological record: Is patient safety at risk?. *Journal of Clinical Pathology. 56.* 43-47.
Heilker, P. (1996). *The essay: Theory and pedagogy for an active form.* Urbana, Illinois: NCTE.
Hodder, I. (2000) The interpretation of documents and material culture. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed.). (pp. 703-716). Thousand Oaks, CA: SAGE Publications.
Hodge, R. & Kress, G. (1993). *Social semiotics.* Ithaca, NY: Cornell University Press.
Holtorf, C. (2003, April 25). *Actant-networks.* Retrieved June 20, 2006, from http://tspace.library.utoronto.ca/citd/holtorf/3.11.html
Hunter, K. M. (1991). *Doctors' stories: The narrative structure of medical knowledge.* Princeton: Princeton University Press.
Jackson, P. W. (1968). *Life in classrooms*. New York, NY: Holt, Rinehart & Winston.
Janesick, V. J. (2000). The choreography of qualitative research design: Minuets, improvisations, and crystalization. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed) (pp. 379-400). Thousand Oaks, CA: SAGE Publications.
Johnson, C. M., Johnson, T. R., & Zhang, J. (2005). A user-centered framework for redesigning health care interfaces. *Journal of Biomedical Informatics. 38*. 75-87.
Johnson, M. (1987). *The body in the mind.* Chicago, IL: University of Chicago Press.
Kelle, U., Prein, G., & Bird, K. (1995). *Computer-aided qualitative data analysis: Theory, methods, and practice.* Thousand Oaks, CA: Sage Publications.
Kennedy, T. J. & Lingard, L. A. (2006). Making sense of grounded theory in medical education. *Medical Education, 40*. 101-108.
Kostelnick, C. (1994). From pen to print: The new visual landscape of professional communication. *Journal of Business and Technical Communication, 8,* 91-117.
Kostelnick, C. & Roberts, D. D. (1998). *Designing visual language: Strategies for professional communicators*. Needham Heights, MA: Allyn & Bacon.
Kress, G., & van Leeuwen, T. (1996). *Reading images: The grammar of visual design*. London: Routledge.
Kushniruk, A. W. (2001). Analysis of complex decision-making processes in health care: Cognitive approaches to health informatics. *Journal of Biomedical Informatics. 34*, 365-376.
Kushniruk, A. W., Patel, V. L., & Cimino, J. J. (1997). Usability testing in medical informatics: Cognitive approaches to evaluation of information systems and user interfaces. *Proceedings of a conference of the American Medical Informatics Association annual fall symposium.* 218-222.
Kutti, K. (1999). Activity theory, transformation of work, and information systems design. In Y. Engeström, R. Miettinen & R.-L. Punamäki (Eds.), *Perspectives on activity theory* (pp.360-375). Cambridge, UK: Cambridge University Press.

Kuzel, A. (1999). Sampling in qualitative inquiry. In B. F. Crabtree & W. L. Miller (Eds.), *Doing qualitative research* (pp. 33-45). Thousand Oaks, CA: Sage.
Lane, J.F. (2000). *Pierre Bourdieu: A critical introduction.* Sterling, VA: Pluto Press.
Latour, B. (1987). *Science in action: How to follow scientists and engineers through society.* Cambridge, MA: Harvard University Press.
Latour, B. (1988). *The pasteurization of France*. Cambridge, MA: Harvard University Press.
Latour, B. (1991). Technology is society made durable. In J. Law (Ed.), *A sociology of monsters: Essays on power, technology and domination.* New York, NY: Routledge.
Latour, B. (1999). *Pandora's Hope: Essays on the reality of science studies.* Cambridge, MA: Harvard University Press.
Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory.* New York, NY: Oxford University Press.
Law, J. (1992). *Notes on the theory of the actor network: Ordering, strategy and heterogeneity.* Retrieved June 20, 2006, from Lancaster University, Centre for Science Studies Web site: http://www.comp.lancs.ac.uk/sociology/papers/Law-Notes-on-ANT.pdf
Lay, M. (2000). The legal status of direct-entry midwives in the United States: Balancing tradition with modern medicine. In M. Lay, L. Gurak, C. Gravon, & C. Myntti (Eds.), *Body talk: Rhetoric, technology, reproduction* (pp. 226-243). Madison: University of Wisconsin Press.
Leont'ev, A. N. (1981). *Problems of the development of mind.* Moscow: Progress.
Lingard, L., Garwood, K., Schryer, C. F., & Spafford, M. (2003). A certain art of uncertainty: Case presentations and the development of professional identity. *Social Science and Medicine*, *56*, 603-616.
Lingard, L., Schryer, C. F., Spafford, M., & Garwood, K. (2003). Talking the talk: School and workplace genre tension in clerkship case presentations. *Medical Education, 37*, 612-620.
Mann, R. & Williams, J. (2003). Standards in medical record keeping. *Clinical Medicine, 3*(4), 329-332.
McCarthy, L. P. (1991). A psychiatrist using DSM-III: The influence of a charter document in psychiatry. In C. Bazerman & J. Paradis (Eds.), *Textual dynamics of the professions: Historical and contemporary studies of writing in professional communities* (pp. 358-378). Madison: University of Wisconsin Press.
Miller, C. (1984). Genre as social action. *Quarterly Journal of Speech*. *70,* 151-167.
Nardi, B. A. (Ed.). (1996). *Context and consciousness: Activity theory and human-computer interaction.* Cambridge, MA: MIT Press.
Paré, A, & Smart, G. (1994). Observing genres in action: Towards a research methodology. In A. Freedman & P. Medway (Eds.), *Genre and the new rhetoric* (pp. 146-155). London: Taylor and Francis.
Patel, V., Arocha, J., & Kushniruk, A. (2002). Patients' and physicians' understanding of health and biomedical concepts: Relationship to the design of EMR systems. *Journal of Biomedical Informatics*. *35*, 8-16.
Patel, V., Kushniruk, W., Yang, S., & Yale, J.-F. (2000). Impact of a computer-based

patient record on data collection, knowledge organization, and reasoning. *Journal of the American Medical Informatics Association*. *7*(6), 569-585.
Pollock, N. (2005). When is a work-around?: Conflict and negotiation in computer systems development. *Science, Technology, & Human Values, 30*(4), 496-515.
Poissant, L., Pereira, J., Tamblyn, R., & Kawasumi, Y. (2005). The impact of electronic health records on time efficiency of physicians and nurses: A systematic review. *Journal of the American Medical Informatics Association. 12*(5), 505-516.
Prout, A. (1996). Actor-network theory, technology and medial sociology: An illustrative analysis of the metered dose inhaler. *Sociology of Health & Illness, 18*(2), 198-219.
Reither, J. (1985). Writing and knowing: Redefining the writing process. *College English, 47* (6), 620-628.
Rodriguez, N. J., Murillo, V., Borges, J. A., Oritz, J., & Sands, D. Z. (2002). A usability study of physicians interaction with a paper-based patient record system and a graphical-based electronic patient record system. *Proceedings of a conference of the American Medical Informatics Association annual symposium.* 667-671.
Romanow, R. J. (2002). *Building on values: The future of health care in Canada* (Commission on the Future of Health Care in Canada Cat No. CP32-85/2002E IN). Ottawa, ON: National Library of Canada.
Rose, A. F., Schnipper, J. L., Park, E. R., Poon, E. G., Li, Q., & Middleton, B. (2005). Using qualitative studies to improve the usability of an EMR. *Journal of Biomedical informatics. 38*, 51-60.
Rosner, M. (2001). Theories of visual rhetoric: Looking at the human genome. *Journal of Technical Writing and Communication, 31*(4), 391-413.
Russell, D. R. (1997). Rethinking genre in school and society: An activity theory analysis. *Written Communication, 14*(4), 504-554.
Salager-Meyer, F. (1994). Reading medical abstracts: A genre study of the interaction between structural variables and the reader's linguistico-conceptual competence. *Journal of Research in Reading, 17.* 120-146.
Sarangi, S., & Roberts, C. (1999). The dynamics of interactional and institutional orders in work-related settings. In S. Sarangi & C Roberts (Eds.), *Talk, work and institutional order: Discourse in medical, mediation and management settings* (pp. 1-57). The Hague, the Netherlands: Mouton de Gruyter.
Schryer, C. F. (1993). Records as genres. *Written Communication, 10*, 200-234.
Schryer, C. F. (1994). The lab vs. the clinic: Sites of competing genres. In A. Freedman & P. Medway (Eds.), *Genre and the new rhetoric*. (pp. 105-124). London: Taylor and Francis.
Schryer, C. F. (2000). Walking a fine line: Writing negative news letters in an insurance company. *Journal of Business and Technical Communication, 14*, 445-497.
Schryer, C. F. (2002). Genre and power: A chronotopic analysis. In R. M. Coe, L. Lingard, & T. Teslenko (Eds.), *The rhetoric and ideology of genre: Strategies for stability and change* (pp.73-102). Cresskill, NJ: Hampton.
Schryer, C.F., Campbell, S., Spafford, M.M., & Lingard, L. (in press). You are how you cite: Citing patient information in healthcare settings. In A. Freedman & N. Artemeva (Eds.), *Rhetorical Genre Studies and Beyond*. Inkshed press.
Schryer, C.F., Lingard, L., & Spafford, M. M. (2005). Techne or artful science and the

genre of case presentations in healthcare settings. *Communication Monographs, 72* (2), 234-260.

Schryer, C.F., Lingard, L., Spafford, M.M., & Garwood, K. (2003). Structure and agency in medical case presentations. In C. Bazerman & D. Russell (Eds.), *Writing selves/Writing societies.* Retrieved May 23, 2006, from http://wac.colostate.edu/books/selves_societies/

Schryer, C. F., & Spoel, P. (2005). Genre theory, health-care discourse, and professional identity formation. *Journal of Business and Technical Communication. 19*(3). 249-278.

Segal, J. Z. (2000). What is a rhetoric of death? End-of-life decision-making at a psychiatric hospital. *Technostyle, 16,* 67-86.

Shneiderman, B. (1998). *Designing the user interface: Strategies for effective human-computer interaction* (3rd ed.). Don Mills, ON: Addison Wesely.

Sicotte, C., Denis, J.L., Lehoux, P., & Champagne, F. (1998). The computer-based patient record: Challenges towards timeless and spaceless medical practice. *Journal of Medical Systems*. *22*(4), 237-256.

Spafford, M. M., Lingard, L., Schryer, C. F., & Hrynchak, P. K. (2004). Tensions in the field: Teaching standards of practice in optometry case presentations. *Optometry & Vision Science, 81*, 800-806.

Spinuzzi, C. (2001). "Green light doesn't mean hydrology!": Towards a visual-rhetorical framework for interface design. *Computers and Composition, 18,* 39-53.

Spinuzzi, C. (2003a). Compound mediation in software development: Using genre ecologies to study textual artifacts. In C. Bazerman & D. Russell (Eds.), *Writing selves/Writing societies.* Retrieved May 23, 2006, from http://wac.colostate.edu/books/selves_societies/

Spinuzzi, C. (2003b). *Tracing genres through organizations: A sociological approach to information design.* Cambridge, MA: The MIT Press.

Spinuzzi, C, Hart-Davidson, W., & Zachry, M. (2004). *Modeling knowledge work* (White paper series: #040505-1). Retrieved July 29, 2006, from University of Texas at Austin, Computer Writing and Research Lab Web site: http://www.cwrl.utexas.edu/?q=node/159

Spinuzzi, C., & Zachry, M. (2000). Genre ecologies: An open-system approach to understanding and constructing documentation. *Journal of Computer Documentation, 24*(3), 169-181.

Spoel, P. & James, S. (2003). The textual standardization of midwives' professional relationships. *Technostyle, 18* (2), 3-29.

Stalder, F. (1997, September). *Actor-network theory and communication networks: Toward convergence* (Introduction). Retrieved June 20, 2006, from http://felix.openflows.org/html/Network_Theory.htm.

Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage.

Stake, R. E. (2000). Case studies. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed) (pp. 435-454). Thousand Oaks, CA: SAGE Publications.

Strauss, A. & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks: Sage Publications.

Tebeaux, E. (1991). Ramus, visual rhetoric, and the emergence of page design in medical writing of the English Renaissance: Tracking the evolution of readable documents. *Written Communications, 8,* 411-445.

Thompson, J. B. (1991). Editor's introduction. In P. Bourdieu (Ed.), *Language and symbolic power* (pp.1-34). Cambridge, MA: Harvard University Press.

Tufte, E. R. (1990) *Envisioning information.* Cheshire, CT: Graphics Press.

University of Helsinki, Finland, Center for Activity Theory and Development Work Research. (n.d.). *Cultural-historical activity theory.* Retrieved April 7, 2006, from the University of Helsinki Web site: http://www.edu.helsinki.fi/activity/pages/chatanddwr/chat/

University of Toronto, ON, Wilson Centre for Research in Education (n.d.). *Vision, Mission and Objectives*. Retrieved June 7, 2006, from the University of Toronto Web site: http://cre.med.utoronto.ca/vision.php

University of Waterloo, ON, Waterloo Institute of Health Informatics Research (n.d.). *What is health informatics (HI)?*. Retrieved June 7, 2006, from the University of Waterloo Web site: http://hi.uwaterloo.ca/hi/HIinfo.htm

Vidich, A. J. & Stanford, M. L. (2000). Qualitative methods: Their history in sociology and anthropology. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed) (pp. 37-84). Thousand Oaks, CA: SAGE Publications.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (A. R. Luria, M. Lopez-Morillas, & M. Cole, Trans.; M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.

Whatis?com. (2006, Jan. 20). Chaos theory. In Whatis?com: The leading IT encyclopedia and learning centre. Retrieved July 11, 2006, from http://whatis.techtarget.com/definition/0,,sid9_gci759332,00.html

Yates, J., & Orlikowski, W. (2002). Genre systems: Structuring interaction through communicative norms. *Journal of Business Communication, 39*, 13-35.