A Qualitative Study of the Effects of Clinical Information System Upgrades on Physicians in an Outpatient Setting

By

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A Thesis

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CERTIFICATE OF APPROVAL

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Abstract

The use of clinical information systems in healthcare is increasing as a result of its many benefits for patients, providers and administrators. Due to the growing need for improved infrastructure, functionality, security, and increased end-user expectations, some institutions that currently use clinical information systems for healthcare delivery may be preparing to introduce a whole new suite of technology to meet their needs. Re-implementation as defined in this study is the implementation of an advanced and modified version of the same system. Given the high stakes and time-sensitive nature of healthcare, reimplementation's can prove to be as complicated as first time implementations. The purpose of this preliminary qualitative study was to understand the issue of user transition during re-implementation in an outpatient setting.

The main method of data gathering was in the form of semi-structured interviews. A total of nine interviews were conducted with physicians, nurse practitioners, and administrators in the internal medicine unit of a single clinic. To protect the identity of the subjects the name and location of the study setting has been modified. Internal medicine physicians were chosen because they handle a broad range of medical therapies and they can offer insights for later studying physicians in other specialties. The *Three Phases of Change* model proposed by Bridges to understand the process of transition was used as a framework to explain how users transition from an older version of the clinical information system to a new version of the clinical information system. Interview transcripts were individually analyzed using a modified analytic induction method to identify the factors that either contributed to or hindered the user transition process. A

second aggregate analysis was conducted to refine and organize the themes and concepts identified during the individual analysis.

The themes identified in this study suggest that significant factors related to re-implementation include a systematic implementation plan, user training, support, the amount of learning required, and the transition process itself. In addition, the magnitude of change and rate of transition depends on the type of system and the integrity of the technology. For the users in this study, the step-wise implementation approach followed by implementers ensured a relatively smooth transition from the old system to the new system. Nearly all the users agreed that the new system is a big improvement when compared to the old system and is less clunky. Although there continues to be some frustration with certain features of the new system, it was currently used by all personnel at the site where this study was conducted. Those considering re-implementation in their organizations might want to consider the themes identified in this study to better inform their future plans.

Introduction

During the past decade, hospitals have faced increasing pressure to adopt the use of information systems (IS) to reduce medical errors and variability in practice. (1-3) Even though there are many benefits, the adoption of IS in healthcare has not been easy. The cause of the difficulty has many factors related to the complexity of buying, implementing and maintaining clinical information systems (CIS). Other factors that form a crucial part of the implementation strategy involve the integrity of the clinical information system, leadership, user buy-in, training, and support. These factors have been carefully considered and applied by organizations that have successfully implemented CIS.

In a desire to tightly integrate systems to better facilitate information sharing, organizations that currently have CIS are either implementing new systems or making significant new changes to their existing systems. In the field of information technology, the implementation of new features or interfaces to existing systems is referred to as re-implementation. Re-implementation as defined in this study is the implementation of an advanced and modified version of the same system. Given the high stakes and time-sensitive nature of healthcare, re-implementation can prove to be as complicated as first time implementations.

The cognitive load involved in learning to use clinical information systems is huge. (4) The use of information systems is also influenced by the background, skill set and cognitive capabilities of users. To help user's make a smooth transition, it is important to

understand and differentiate the factors that aid or hinder the user adaptation process to a new IS. (5, 6) This preliminary qualitative study attempts to understand the factors influencing the user transition process during re-implementation of a CIS. Specifically, the study attempts to understand user needs related to the amount of learning, level of training, and the implications of these factors for future re-implementation.

Background and significance

The use of information systems (IS) in healthcare has introduced a number of changes that have been both beneficial and detrimental, but mostly the former. The benefits have proven to be advantageous not only to physicians but also to patients, administrators, healthcare insurers and researchers involved in outcomes research. Although the gradual adoption of CIS in healthcare has taken place over several decades, it was not until the 1990's that there was an increased desire to develop, implement, and use clinical information systems such as electronic medical record (EMR), computerized physician order entry (CPOE) and other ancillary systems. First, the Institute of Medicine report, To Err is Human, published in September of 1999 (7) created an awareness of the consequences of medication errors and the need for increased patient safety. Second, the influential Leapfrog Group, a national consortium of Fortune 500 companies, chose computerized physician order entry (CPOE), as one of its initial three safety standards. Despite an enormous focus on CPOE, the percentage of hospitals using CPOE as of 2003 is quite low (Table 1). (8-11) Factors related to the low rate of CPOE adoption include substantial monetary commitment, technology, and the complications of using

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information systems in an industry in which function and processes are scattered across autonomous departments.

Year	Organization / Group	Results
1997	Physician Order Entry Team	**Surveyed 1000 hospitals:** 33 % have CPOE (14.8 % complete availability and 17.3 % partial availability)
2002	Physician Order Entry Team	**Surveyed 1000 hospitals:** 16.3 % had CPOE (9.6 % complete availability and 6.5 % partial availability)
2002	Dorenfest Integrated Healthcare Delivery System Database	**1,000 healthcare delivery systems and 2,500 hospitals:** 40 % considering implementation of CPOE
2003	Leapfrog Group	**Surveyed 517 hospitals:** 25 % planned to implement CPOE by 2004
2003	Leapfrog Group	**Surveyed 635 hospitals:** 4.1 % said they had CPOE; 17.2 % planned to implement CPOE by 2005.

Table 1: Percentage of CPOE use in the U.S. as identified by various surveys

Some of the significant changes introduced by CIS in healthcare delivery include accessibility to patient information anywhere within an organization (electronic medical record), reduction in medication errors (computerized physician order entry), patient access to information (online access of patient records), alerts and reminders (clinical decision support systems), and sharing of medical information for outcomes research. Although there are benefits to using CIS, relatively few healthcare organizations have been able to implement and effectively use clinical information systems for healthcare

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delivery. (12-14) It has not been an easy road to success for those organizations that currently have and use CIS for healthcare delivery. (15, 16) By using a combination of leadership, investment in technology, planned implementations, and persistence these organizations have been able to gain great benefit for healthcare delivery. It is important to understand that every organization defines success in a different way. As Stavri and Ash point out, depending on the organization's goals and objectives, there can be different interpretations of success and failure. What is considered a success at one institution might be considered as a failure in another. (17) The complex nature of healthcare delivery requires a high degree of customization to fit individual organizational needs. Despite this, factors like integrity of technology, end user training and support, and project management continue to be applicable for successful first time implementation of most CIS.

Which comes first, EMR or CPOE? The general argument has been that there is a need to have a mature EMR system before implementing a CPOE system, while others say CPOE comes before EMR. It is agreed by all that the full potential of a CPOE system cannot be realized without having an EMR to provide the necessary patient data and vice versa, and both systems need to be linked to ancillary systems (nursing, pharmacy) to come full circle. (18) Recently, industry experts have agreed that EMR and CPOE go hand in hand. While from the development point of view the focus might continue to be on stand-alone systems like CPOE, administrators will eventually need to focus on full-scale implementation of CIS. The sophisticated systems of the future will need to create linkages between clinical care, population management, finances, and systems used for

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administrative purposes. To achieve this high level of integration, organizations have to go through repeated upgrades and implementation of new software. In the field of information technology the implementation of new features or interfaces to existing systems are referred to as re-implementation. It is also defined as implementation of the same system in the event of failure of a prior implementation. Re-implementation as defined in this study is the implementation of an advanced and modified version of the same system. Given that there is considerable cognitive overload and strain for the end users during first time implementation, it is possible that the same can happen during system upgrades and re-implementations. Despite the complexity surrounding system upgrades and re-implementations, the use of IT in healthcare will continue to grow. Hence there is a need to understand the issue of re-implementation and the human resource issues surrounding technology adoption.

Problem space

What is re-implementation? In the IT world, re-implementation is a common occurrence and is relatively well understood, especially the areas of user re-training, hardware requirements, level of support, and the length of system downtime following re-implementation. But little is understood about what happens during and after re-implementation in healthcare settings. Moore's law (19) tells us that microprocessor performance doubles every eighteen months. This initiates a new cycle of hardware and software upgrades to match the increase in processor speeds. Frankel et al (20) suggest that the technical and economic development of CIS will have a three-year lifecycle. Although the lifecycle of a CIS is only slightly longer than that of a microprocessor,

constant modifications to CIS will continue to occur in the upcoming years. This suggests that most healthcare organizations will have to prepare for re-implementations in the upcoming future. Re-implementation can be either major or minor. An example of a minor upgrade would include changes to the look and feel of a dialogue box. On the other hand, a major upgrade would be on the order of moving from a CPOE system with limited capability to a CPOE system that is integrated with the EMR or a pharmacy system with decision support (in other words, moving to a full CIS). Given the code-test-implement-use-modify-code cycle most organizations employ to customize CIS to suit their needs, users will be constantly exposed to system changes that are both major and minor. Also, medicine is a highly time sensitive field with little room for error and there is a high learning curve associated with transitioning to a new system. This might result in users having significant cognitive overload, which could potentially lead to costly errors or have other consequences. Therefore, just as it is important to understand the first time implementation of CIS, it is equally important to understand the user transition process when systems are re-implemented at organizations that currently have and use CIS. It is especially vital for physicians, nurse practitioners, and others providing direct patient care. These professionals work in a high intensity environment and their ability to adopt new technology is made harder by the complexity of their work.

The *Three Phases of Change* model suggested by Bridges to explain transition is one way of understanding the user transition process. According to Bridges, transition is one of the most frequently occurring processes. Examples of transition include moving from one job to another, getting over a divorce, adapting to retirement, passing from childhood to

adolescence, and adapting to new technology. Bridges views on transition are based on the theory of personal development that views transition as a natural process of disorientation and reorientation that marks the turning point of the path of growth. (21)
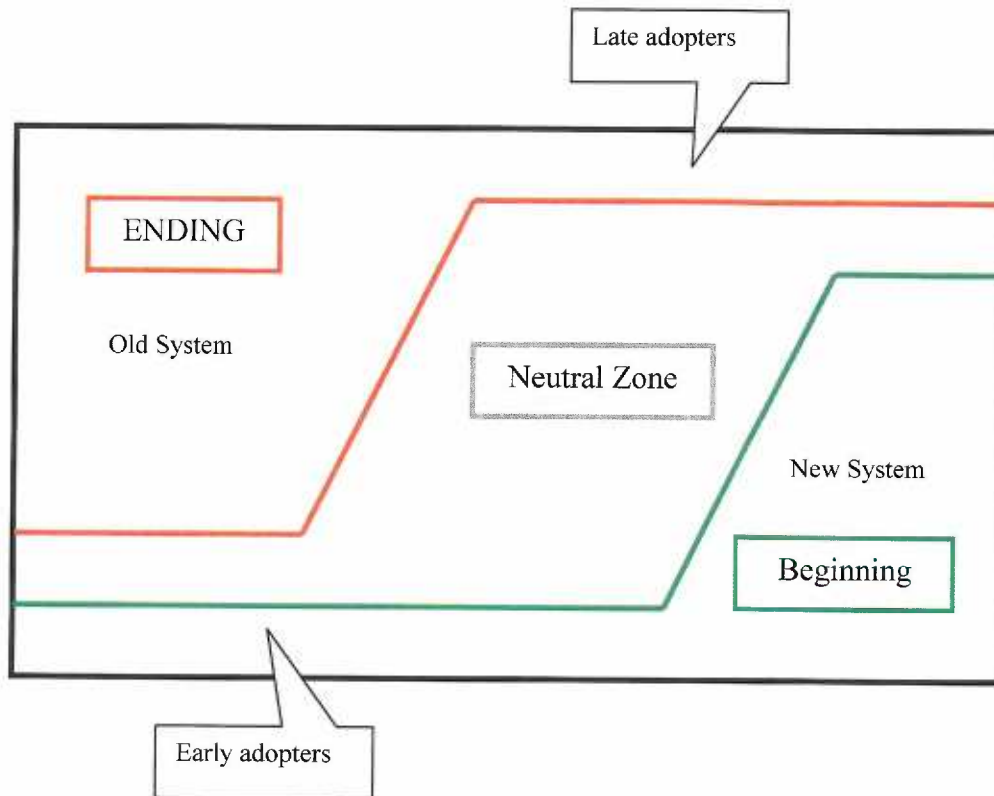
Figure 1: The Three Phases of Change
From: Bridges, W. Managing Transitions: Making the most of change, 1991

It is crucial to understand the difference between 'Change' and 'Transition' in order to understand the model proposed by Bridges. Change is external and situational like a new system, a new role, or a new job. Transition is internal and can be defined as the psychological process people go through to get used to a new situation. Multiple changes

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may take place, but unless users adapt to the intended changes there will be no difference. In other words the change is not effective unless transition takes place. (22)

Transition takes place in three stages, ending, neutral zone, and beginning (Figure 1). The first stage of transition starts with an ending: letting go of old ways of doing things. The second stage is the neutral zone, a no man's land where the old way is gone but the new way is not yet comfortable. The last stage is the new beginning, a time to get used to the new change. According to Bridges, only if users go through the first two stages successfully will they transition to the new beginning without much trauma. In addition, users need to have a clear understanding of what the change entails to transition from the neutral zone to the new beginning.

The process and time frame of transition is different for each individual. Some users accept change and adjust to new change faster, and they are often referred to as early adopters. People who adapt at a much slower pace are called late adopters. This is evident from figure 1 where the lead and lag time is built into the each of the three phases of transition to show how users progress through the transition process at their own pace. Bridges calls this the "marathon effect", and it can be applied to both individuals and groups. The process of transition as described above applies to all kinds of transition, whether learning to use a computer for the first time, or adapting to a new technology. Depending on the type of change, transition can either be big or small. When undertaking a series of small changes, such as software upgrades implemented to remove bugs or increase functionality, it is important to maintain the thread of continuity in order to

avoid chaos. This could be achieved by maintaining an institution wide goal that contributes to continuous development, much like Toyota's goal to constantly improve fuel efficiency. The organizational goal helps the users understand the purpose of the new change and acts as a guide as the users transition from the neutral to the new beginning stage. Understanding the lead and lag time is key for both large and small implementations. The transition model proposed by Bridges might help in understanding the user transition process following the re-implementation of a system.

In view of the Bridges theory, the researcher had a few basic assumptions surrounding the user transition process and they were,

- When users like the existing system and have used it for a long time they will find it harder to adapt to the new system

- Advanced or super-users will adapt to the new system faster than low and moderate level users

- The rate of adaptation will depend on the similarities between the old system and the new system put in to replace it

- The users will require the same level of training and support as they did during the first implementation

Purpose of the study

◈ To explore the process of re-implementation in a healthcare setting,

◈ To explore the process of user transition

◈ To explore the unintended consequences of re-implementation

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Research question

What are the changes that take place when a new version of an existing technology is implemented in a healthcare setting? Specifically, how does re-implementation change the following?

a) The user's view of the system

b) The learning process

c) The process of transition

d) The consequences of re-implementation

Methods section

Design

This was a qualitative study of the user transition process during re-implementation of an advanced version of a CIS. The main data collection technique used in the study was the semi-structured interview and is described below. Modified analytic induction, also discussed later in this section, was the method used to guide the data analysis process.

Setting

To protect the identity of the subjects the name and location of the study setting has been modified. United Health System (UHS) is one of the largest healthcare providers in the United States of America. UHS is divided into three main regions, the Western region, Mid-west region, and South-eastern region. This study focused on the outpatient clinics and providers in the South-Eastern region. United South-Eastern region (USER) consists of two united hospitals, and twelve outpatient medical and dental offices. USER has been

using individual information systems for healthcare delivery since 1985. In 1990, USER implemented a comprehensive outpatient patient record system (Medic One) marketed by Ambulatory Clinical Information Systems to address some of its administrative needs and to facilitate system-wide medical data access.

Implementation of Medic One at all the outpatient clinics was completed in 1997 and providers at USER have been effectively using Medic One for almost ten years. Providers at USER have been effectively using Medic One for almost tent years. During this period the information system has undergone several modifications to better suit organizational and individual needs. Medic One is so tightly integrated in to the workflow at USER that it has come to be known by several names, Medic, the system, the computer, traditional, and Medic One. Medic One is well liked and widely used at all clinics in USER.

USER had recently completed a major re-implementation of a new interface to the clinical information system called Gateway. Gateway acts as an interface to the underlying systems like the EMR, CPOE and other ancillary systems. The re-implementation was to increase the functionality (the ability to open more than a single patient record at a given time), give users more flexibility, to streamline billing, patient scheduling and other tasks associated with it. The current version of Gateway used at USER clinics is a transitional version; to allow users to adapt to Gateway. Initially users had access to both Medic One and Gateway (simultaneous use); Medic One was discontinued after four to five months as it would become harder to support both Medic One and Gateway at the same time.

Although Medic One and Gateway are products of the same company (Ambulatory Clinical Information Systems), they were quite different from each other[1]. The main differences between the two systems were the buttons, the information behind each button, the tabs, the location of the tabs, the amount of information presented on each screen, and the work routines. Also, the amount of information presented on each screen in Gateway is more than what was presented in Medic One. Overall, the new version of the clinical information system (Gateway) currently being used at USER is significantly different from the former version, so this setting is appropriate for observing the user transition process following re-implementation. Until now the issue of re-implementation in a healthcare setting has not been studied. This study is exploratory: one aim is to provide preliminary data for a larger study in the future.

Research Method

User transition to a new system can be studied by using either quantitative or qualitative methods. Quantitative methods are objective, deductive and focus on making generalizations based on the results. The researcher is usually not the instrument for data collection. Qualitative methods are subjective, inductive and focus on identifying *why* a phenomenon happens and in identifying results that are transferable to other settings. Also, the researcher is the most important data gathering "instrument".

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[1]Note: The major differences between Medic One and Gateway were identified from the interview transcripts. Additional understanding of the differences between the two systems was obtained from preliminary observations of the two systems. An in-depth study of the differences between Medic One and Gateway was not possible due to time constraints.

Surveys, which are often used in quantitative research, are one way of measuring user opinion of a new system. Surveys can either be administered a few months after implementation or administered before and after the new system has been implemented. Other quantitative methods include usability studies and task analysis. While numbers give an idea of how many people are using the new system, they do not help in answering the *why or how* questions. (23) On the other hand, qualitative methods like observations and interviews help tease out changes associated with user behavior and opinion. Berg sums up the strength of qualitative methods he states that, "qualitative methods help in understanding the real and stimulating meaning behind the phenomenon under study by teasing out the subjective elements like behavior, experiences and other external factors that might affect the natural routine or workflows of individuals and groups". (24) Given that the focus of this study was to understand how users adapt to a new system it was decided to use qualitative methods. Qualitative methods are well suited for studying the user transition process following re-implementation. There are three additional reasons for choosing to employ qualitative methods. First, re-implementation was uncharted territory and little could be found in the informatics literature about issues surrounding re-implementation. Second, the exact number of variables related to re-implementation was not known. This made it harder to identify the right variables to measure and control for bias. Third, as Taylor (25) states, human factors are too complex to control and qualitative methods provide the right tools for addressing complex issues.

There are a number of methods used for qualitative research including interviews, observations, focus groups, text analysis, conversation analysis, artifact analysis, and

action research. Given the nature of the study, it would have been optimal to use a combination of observations and interviews, but it was not possible due to the scope of this study. Since this study was conducted nearly five months after re-implementation, it seemed most appropriate to use interviews in order to maximize the amount of information gathered from the subjects and to get a snapshot of the transition process from the time of the re-implementation to the start of this study.

There are three types of interviews (26), standardized (formal or structured interviews), unstandardized (informal or non – directive) and semi-standardized (semi-structured or focused) interview. *Semi-structured interviews* (the format used in this study) are used when the interviewer has a number of questions to be asked in a specific order but needs the leeway to ask probing questions on topics that emerge during the course of the interview. This format allows the interviewer to approach the interview from the subject's perspective and use words and phrases common to the subject, and facilitate data analysis by providing the researcher with the ability to compare the subjects.

Subject consent and Institutional review board

Institutional review board (IRB) approval was sought for this project under the umbrella of the project titled "Unintended consequences of Physician Order Entry" (IRB # 7949). The subjects were consented as per the rules and regulations outlined by the OHSU and United South-eastern region Center for Health Research IRB. Before each interview the subjects were informed by the researcher about their rights, safety, and privacy. All interviews were conducted only after signatures were received on the consent form.

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Data Collection

This study used the same protocol for data collection and storage as those employed by the main study titled 'Unintended Consequences of Physician Order Entry' (OHSU IRB # 7949). Subjects were recruited for this study by referral of the co-investigators for the project. One of the co –investigators was also a working physician at the clinic where the subjects were recruited. This helped in the recruitment of users with varied experiences and opinions about Gateway. All providers recruited for this study were internists at United South Rosemary Beach Medical Center. Studying Internal Medicine physicians gave greater scope for reaching results that were transferable to other settings. The goal was to interview physicians until data saturation was reached. A detailed description of the subjects and interviews is given in the results section.

The interview format for this study was based on the research questions outlined earlier. The main objective of the interview was to identify the user's feelings about Medic One, computer skills, Gateway training, and current use of Gateway. The interview also attempted to elicit information about user adaptation to Gateway, the level of support, and the positive and negative aspects of Gateway. In addition, questions about changes in their workflow or work routine were asked to identify any modifications that might have either affected or aided the transition process. The interview guide is included in Appendix A.

Data analysis

Qualitative data analysis follows an ongoing and iterative process from the start of data collection to the final analysis. There are three types of qualitative data: audio, text and video. Each can be analyzed in several ways. The main core of qualitative analysis is coding. Coding involves the process of marking the segments of data with symbols, descriptive words or category names. Coding is followed by identification of themes, codebook or master code list building, defining the codes, identifying relationships between codes and then validating the codes with data segments or ''quotes'' (Figure 2). (27) Some of the major coding traditions are grounded theory, schema analysis, content analysis, content dictionaries, analytic induction, and ethnographic decision trees. Figure 2 gives a good overview of the various qualitative data types (blue colored boxes) and the various analysis methods (grey colored boxes). The red arrow line guides the reader to the analysis approach used by the researcher.

As mentioned earlier, analytic induction was used to guide the coding and final analysis of the data. Analytic induction is a formal, non-quantitative method for building up causal explanations of phenomena from close examination of cases. (27) Manning (28) suggests that analytic induction "is a non-experimental qualitative sociological method that employs an exhaustive examination of cases in order to prove universal, causal generalizations".
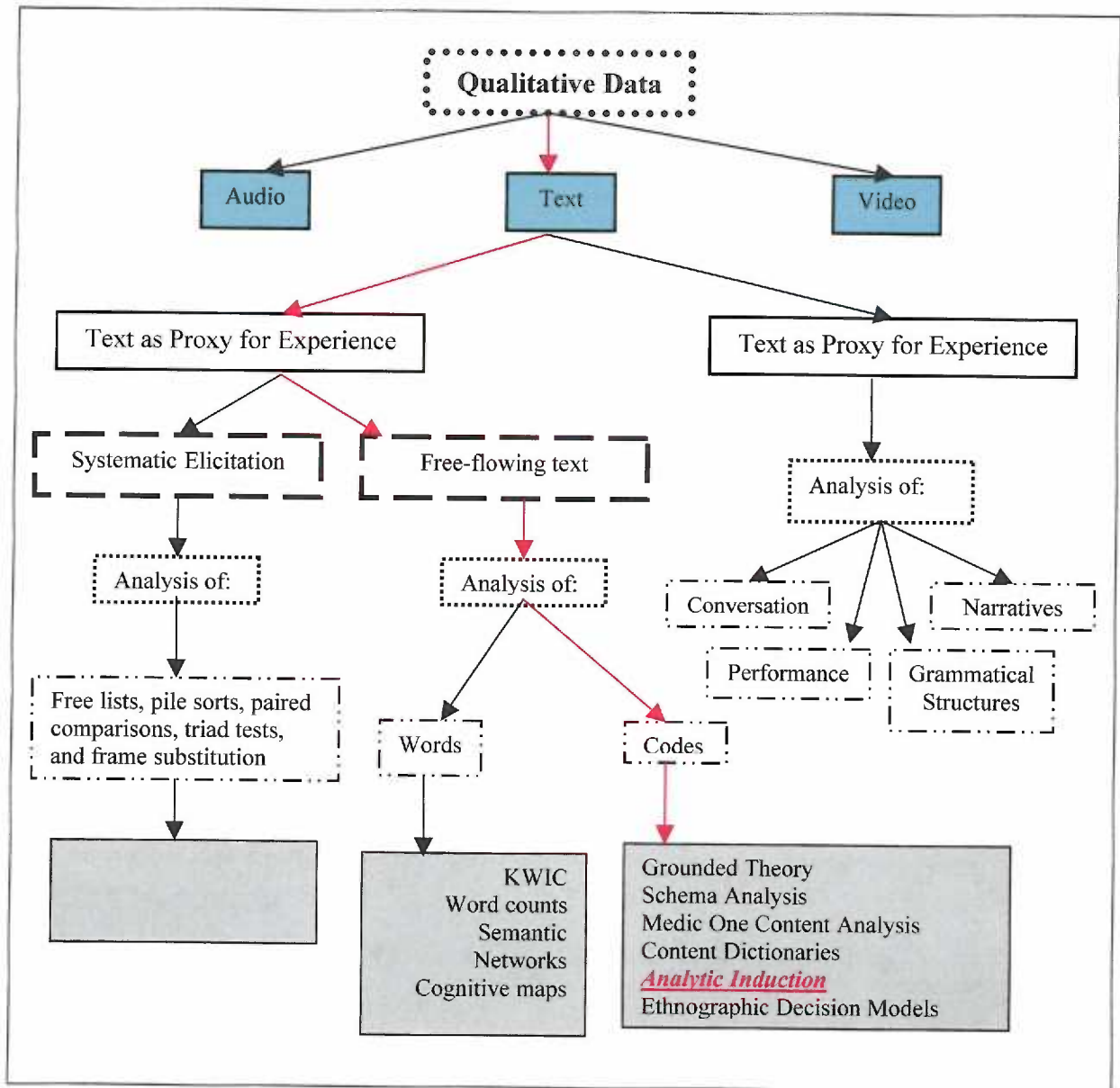
Figure 2: Qualitative data analysis typology
Patton MQ. Part 3: Analysis, Interpretation and Reporting. In: Qualitative Research & Evaluation Methods. 3rd ed. California: Sage Publications. P 431-534.

Analytic induction was first described and named by Florian Znaniecki (1934) a philosopher turned sociologist, as an alternative to statistical analysis. Znaniecki defines analytic induction as a formal negative case analysis method. It starts with a hypotheses usually based on the phenomenon under study, and a proposed explanation. Next, each

case is examined to see if the explanation fits. If it does then the next case is examined until a case is found that does not fit. Then based on the rules of analytic induction, the alternatives are to either change the explanation or change the hypotheses. The drawback of this method is that a single negative case is used to disprove the hypotheses and reformulate it. Also, it does not help in predicting the phenomenon under study. (29)

Over a period of time, analytic induction has been modified and refined to focus on the development of descriptive hypotheses that identify patterns of behaviors, interactions and perceptions. The *modified analytic induction* proposed by Bogden and Biklen in 1992 has been used primarily in sociology research. This method is employed when some specific problem, question, or issue becomes the focus of research. The method can be used in interviewing, participant observation and document analysis. (30) While analytic induction is concerned with the development of universal hypotheses, modified analytic induction involves the development of hypotheses that identifies patterns of behaviors, interactions, and perceptions. Like grounded theory, the modified analytic induction method helps in identifying emergent themes during the analysis process. Unlike grounded theory, which involves discovering new concepts and hypotheses, modified analytic induction involves a pre-selected theory or concept, usually based on literature, research or assumptions. Modified analytic induction was used in this study because it provides a framework for data analysis, and like grounded theory, allows for the inclusion of emerging theories and concepts. The basic steps of using the modified analytic induction method are as follows:

1. Early in the study or research a rough definition of the phenomenon under study is outlined along with a brief explanation.

2. A list of assumptions or concepts identified by analysis of previously published literature or studies is used to develop hypotheses, guide the data collection process and final analysis

3. The basic assumptions only serve as a guide to remind the researcher the key components to look for during analysis.

4. Concepts and ideas that emerge from the data are noted and used to solidify the original assumptions or hypotheses or ideas, and to answer the research question.

The steps outlined above represent a method of thinking about and working with data. Re-implementation is a new area of research and modified analytic induction provides a method for a step-wise approach to data collection, analysis and interpretation of results. The method aids in the development of a theory where the sample size is limited by the scope of the study. Qualitative data analysis software (QSR N6 v6.0, QSR International Pty. Ltd., Melbourne, Australia, 2002) was used to code the interview transcripts, and help in organizing, and refining the themes and concepts.

Results

No.	Subjects	Interview length (Minutes)	Interview transcript		
			Number of pages	Number of lines	Number of words
1	Subject 1	35	12	517	3797
2	Subject 2	50	15	666	5376
3	Subject 3	25	7	289	2132
4	Subject 4	30	9	371	2957
5	Subject 5	40	12	519	4814
6	Subject 6	20	5	205	1712
7	Subject 7	40	15	639	5707
8	Subject 8	25	7	292	2165
9	Subject 9	35	14	612	5263
Total	9 Subjects	300 minutes or five hours	96 pages	4,110 lines	33,923 words

Table 2: Overview of the interview and details of data set

Out of the potential list of twenty subjects who were considered for this study, seven physicians and two nurse practitioners were interviewed (participation was voluntary). Of the seven, one physician also held an administrative position. A total of six male physicians, one female physician and two female nurse practitioners were interviewed for this study. The remaining eleven chose not to participate in this study. All the subjects recruited for this study had been working at USER from four to eighteen years. They had

all used both Medic One, which was the older version of Medic One used at USER, as well as Gateway, the version currently being used at all USER clinics. This was important given that the aim of the study was to understand how users transition from one version of a system to an advanced version of the same system. As the researcher attained data saturation with nine interviews an attempt was not made to increase the number of study participants.

The data were analyzed in two iterations to understand the individual transition process and to tease out the factors that either aid or deter the transition process. First, each interview transcript was analyzed as an individual case. The individual analysis of the transcripts helped in understanding the differences in individual opinions, needs and transition stages. It also helped in developing and classifying the user type for each of the subjects and the effect this had on their individual transition processes. The researcher categorized each subject as a super-user or an average user or low-level user based on the computer skills (basic computer skills and programming), ability and initiative in customizing Gateway for personal use, and use of Gateway (Table 3). Super-users were subjects who have a programming background in addition to extensive computer skills, have the personal initiative to build macros, dot phrases and keyboard shortcuts, attempted to use Gateway with out formal training, and the ability to explore new areas in Gateway. Average and low-level users were subjects who had basic computer skills but no programming knowledge and required training to use Gateway. The main difference between the average and low-level users was that average users were capable of doing

small customizations (small macros and keyboard short cuts) by themselves. The users in this were classified as a super- user, or average users or low level user (refer to table 3).

User Type	Description	Subject
Super-user	Extensive computer skills including programming, initiative to build macros, dot phrases and keyboard shortcuts, use of Gateway without training, and the ability to explore new areas in Gateway	1, 2, 7
Average user	Basic computer skills, no programming knowledge, minimum self-exploration of Gateway, and requires training to use Gateway	6, 8, 9
Low-level user	Basic computer skills, no programming knowledge, and requires training to use Gateway	3, 4, 5

Table 3: Various user types and their descriptions

The individual case analysis also helped in understanding the terminologies that were used to describe the system (table 4). The terms listed in table 3 were common to both Medic One and Gateway. Understanding the various terms and their descriptions was advantageous to the researcher throughout the data collection and analysis stages. In addition, this gave an understanding of the user's knowledge and view of the clinical information system.

No.	Terms	Meaning
1.	ACIS	Refers to the vendor of the new interface product, i.e., Gateway
2	ACIS = Medic One = Medic One = Traditional	Refers to version of the information system that existed before Gateway.
3	Gateway	Current version of the Clinical Information System
4	RRS	Results reporting system: System used to view laboratory results
5.	Visit Navigator	Refers to the window that displays information like vitals, patient instructions, progress notes and so on.
6	Encounter	Each patient visit is termed as an Encounter. The workflow in Gateway is organized by encounter
7	Workspace	Exit a particular window or screen. E.g. Closing out of the visit navigator screen for Mr. John Doe.
8	MA	Medical assistant
9	Pre-visit summary	Refers to the structured summary patient information sheet that physicians receive before meeting their patient
10	After-visit summary	Refers to the structured summary patient information sheet that usually includes the patient instructions, labs that need to be completed before the next visit and so on. This sheet is given to the patients when they leave.

Table 4: List of commonly used terms and their description

The second iteration was the collective analysis of the themes and concepts that emerged from the data. The collective analysis made it easier to understand the main issues under study, that is, reimplementation, the user transition process, the level of training required and the amount of learning involved. It also helped in confirming or revising the assumptions the researcher had at the start of this study. To increase the validity of the

findings a physician, a clinical informatician and a qualitative researcher independently analyzed and coded all the data. The concepts and themes identified by the three independent coders were similar to those identified by the researcher. The results are organized as follows,

I. Individual case analysis

II. Themes and concepts associated with Clinical Information System transition

I. Individual case analysis

Subject 1

Subject 1 (a physician) has been with USER for nearly 15 years and has a fairly good knowledge of computers. He is adept at using computers and software programs for his work and was one of the users who attempted to use the Computer Assisted Medical Module (CAMM), one of the earlier systems used at USER. He was a long time user of Medic One having used it since its primary implementation in 1995. Overall he was very happy with Medic One and seemed to think highly of it. With Medic One he had developed numerous Macros to make his work life easier and faster. The ability to customize Medic One to suit his personal needs was a feature much appreciated by Subject 1.

It was clear from the transcript that Subject 1 was a super-user and his transition to Gateway from Medic One was relatively smooth. He seemed happy with the training

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session for Gateway and was the only clinician in this study who had started using Gateway even before the actual training. He had attended quite a few Gateway demonstrations and had been looking forward to using Gateway. This was one of the reasons he had attempted to use Gateway before his formal training. Though it looked like he had transitioned to the new system with relative ease, he continued to be frustrated with Gateway, particularly with the design, inconsistencies, and lack of specific functionalities. His opinion of Gateway can be summed up with the following quote,

Quote 1:
"Well, a lot of things have changed, they have become more straightforward. Yeah, it was a big upgrade... the upgrade was basically an ease of use, because as much as I complain about some of the features in Gateway, it is a lot less clunky than the old machine...the old system that was not good."

He explained that Gateway was still an ACIS product, and this made the transition much easier than what he had anticipated. The feel, color and design of Gateway were typical of most ACIS products. Also, the names of the various screens and modules in Gateway had not changed much. He went on to say that the transition would have been a lot harder had it not been ACIS. Early on he switched between using Medic One and Gateway. This appeared to have helped him in the early days of his transition to Gateway. He also seemed to know and use the online training extensively. This was an additional factor aiding his easy adaptation to Gateway.

He had both positive and negative things to say about Gateway. The negatives were about Gateway features that needed to be improved or changed. Though at the start of the interview he had said he was quite happy with Gateway, he later spoke about a number of

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frustrations that he had with Gateway. Some of his complaints included the inability to use the keyboard for some functions, too many clicks, inconsistent work routines, and the inability to build and use Macros. Also, the decrease in system functionality like the inability to link directly to the results reporting system was annoying to him because of the increased work involved. He was not happy with the schedule section of the inbox window. The patient's name was highlighted based on the time the patient was scheduled and not by the next patient in the exam room. This led him to open the wrong chart on more than one occasion. In his opinion Gateway could have been designed to be more user-friendly.

To summarize, Subject 1 was not affected much by his transition to Gateway. In his case, he had made the transition to Gateway earlier and more easily than most of his peers. He felt that some of his peers did not have a very high opinion of Gateway. Though it was apparent that he was frustrated with Gateway, he tried to overcome it by exploring his options. Also, he recognized the benefit of having an information system to improve patient care and this need overcame his reservations over the new system. He used the online training tools to find new features and in fact took a lot of pleasure in exploring and discovering new features. He seemed disappointed that Gateway did not live up to his expectations that were based on what he was told and saw at the various demonstrations. His one big message was that ACIS should have done additional user testing before rolling it out to the users and seemed a little disappointed with ACIS for not having done that.

Quote 2:
"They should have done a bit more testing, I think. You know, this is the first time ACIS has not come through."

Based on the comments Subject 1 made during the interview it was apparent that the transition to Gateway was not as smooth as he claimed it to be. In fact, though his transition process can be described as easy, it is still not complete because of the inconsistencies apparent in Gateway.

Subject 2

Subject 2 first came to USER as a resident and has continued working there as an internist for the past 17 years. An advanced user, he had extensive computer skills that included programming. He had used Medic One since the first time it was turned on. Although a bit apprehensive about IS, he came to recognize the value of the system so much that he became one of the super-users at USER. Like others in this study he had a high opinion of Medic One and its capabilities. In his opinion the repeated customization of Medic One had eventually fit all their (physician) needs and there was no need for a new system to replace Medic One. His opinion of Medic One and his initial transition from paper to electronic is best summed up in his own words,

Quote 3:
"Well, initially I felt that it, the fear of it being time consuming was not well founded. But subsequent to that I did realize that it did slow me down to some extent. The work was being done very effectively and was of high quality, and I feel that it is a legitimate price to pay for that. Ah… I have actually been very happy with ACIS and I think we have spent a lot of time tailoring it to the needs of the physicians, and so at the time that we made the switch I think it was about as user-friendly you could get."

Though he had not been to any of the Gateway demonstrations he had been impressed by what he had heard about the features and capabilities of Gateway. Given his own skills and prolonged use of Medic One he felt the training for Gateway had been adequate. For him the transition to Gateway had not been a hard one because the overall look and workflow processes were the same. He called the changes in Gateway as changes in 'micro routines' and so the learning was more conceptual than a complete relearning on how to use Gateway. But he mentioned that he would have found it harder to transition to a system by a different vendor. In fact he was extremely articulate about the various types of transition users might have to go through,

Quote 4:
"I believe so. I think you can come at it from three levels. One, you have never used an automated medical record before or you have to move to a drastically different system that was put together with different concepts, I think would be like… almost like starting from the beginning. But just knowing that you go from your terminal to the patient and back to the terminal that part of it is half the battle. So that part you would have to learn all over again, you know, where you physically walk from one point to another and what you do. Ah… and the third part is…which is to go to two systems put up by the same company that conceptually were not different from each other. So, we are in the third category. I think that was not an hard transition."

Subject 2 did a considerable amount of learning while completing his day-to-day patient charting and other patient care related activities. He did not have to restart his learning process with Gateway but had to learn the "micro routines" as these were significantly different from Medic One. Subject 2 used the word "micro routines" to refer to the changes in the work processes. He had found out that it was difficult to use both Medic One and Gateway simultaneously and precious time was lost in the switching process. Unlike many of his peers who used both Medic One and Gateway, he transitioned

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completely to Gateway (100 % use) after a few days as he found it cumbersome to switch back and forth between Medic One and Gateway. Again like subject 1 he felt that the current version of Gateway was a transitional version and additional testing should have been done before USER started using it.

His main complaints with Gateway were the decrease in speed and functionality (e.g., loss of the link to results reporting), changes in the micro routines that were not intuitive, small font size, loss of efficiency, and a system design that involves too many clicks. In fact, he was of the opinion that most of his peers felt that there had been a decrease in efficiency with Gateway. Subject 2's familiarity with the information system encompassed a working knowledge of its hardware and software capabilities. This gave him a unique understanding of what a change like Gateway entails.

Quote 5:
"I just know that with this version I am slower. And the end product is the same. The end product is exactly the same. So it is not living up to its advantages."

Subject 2 felt that Gateway was not doing what he was told it would do. This came as a disappointment for a computer savvy person like him as his skills had helped him adapt to the new system faster. He had hoped that by increasing the functionality, Gateway would fix some of the minor problems that existed in Medic One. Given the choice he would prefer to go back to using Medic One mainly because it was efficient to use and user friendly. Subject 2 can be described as someone whose transition has been easy but what seemed to hinder the transition process itself were the small inconsistencies that made the learning process harder.

<u>Subject 3</u>

Subject 3 was a nurse practitioner who uses the information system in almost the same way as other internal medicine physicians. She was another long time employee and had been with USER for nearly 24 years. In terms of computer skills, although she was an average user, she was quite comfortable using Medic One and other programs needed for her work. She had used Medic One for almost eight years before starting on Gateway and had a high opinion of Medic One.

She did not have any apprehensions about the Gateway implementation and was confident that she would be able to make the transition. She was happy with the training session but not with the guidebook used at the training session as it had numerous errors which made it difficult for Subject 3 to use the book as a reference for her everyday work.

Quote 6:
"Well, even the material they gave us was not correct, I would like to have had more and then the… written material was not always correct. So, the manual was not that good to refer to."

The transition to Gateway was not easy for Subject 3 and this goes beyond the general frustrations she had with the inconsistencies of the system. She was one of the users who in the early days used both Medic One and Gateway mainly because she found it harder to use the latter. In fact, she continued to use Medic One almost until it was entirely turned off. This could have been because she was used to the work routines in Medic One or because Gateway had too many bugs. She felt that even though Gateway had positive

aspects to it, the negative aspects or downsides were so aggravating that it made the whole product difficult to use. She had also heard that the current version of Gateway was a bad version and a new one was coming along soon. This seemed to help her keep a positive outlook for the future.

Quote 7:
"I hate it, ok…[laughs]. Ok, there are some things ok about it, a little bit better but there are things… that is… there are very cumbersome things about it constantly."

Some of her frustrations included,

- Gateway is not keyboard friendly

- The font is too small

- It takes numerous clicks to complete each process

- Gateway does not link into RRS

- System hangs up or locks up frequently and forces the user to restart the computer.

Subject 3 was still in the process of transitioning to Gateway and her transition process can be described as moderate. She had not started using Gateway completely until Medic One was turned off. This was the trigger that forced her to increase her efficiency with Gateway. Though she was not averse to additional training and time spent learning the system, she was frustrated with Gateway. According to her, most of her peers had an *'underlying sense of frustration'* with Gateway and did not have high opinion of it. She was pretty open about her feelings towards Gateway and went to the extent of saying she hated the system. She is hoping that the next round of upgrades will fix some of the

inconsistencies with Gateway and make it usable. Her comments below summarize her

feeling towards Gateway and her difficulties with the transition process,

Quote 8:
"Yeah, so I would just consider it my vacation time, my vacation from Gateway, and I used Medic One right up to the bloody end. I was disappointed when I could not do that anymore [laughs]. I was going back to... yeah, I was always, I had the choice here, but I figured this was 'work, work', you know. And I knew Medic One was going away, and I knew I had to increase my efficiency with Gateway."

Subject 4

Subject 4 was a nurse practitioner who had been with USER for 18 years. She was there

for the first Medic One implementation and had used Medic One for eight years.

Although not naïve in terms of computer skills she was not an advanced user. She did

have adequate skills to use Medic One efficiently and that was reflected in her good

opinion of Medic One. Medic One in her opinion was a sound and user-friendly system.

Although she had been aware that Gateway was going to be implemented, she was more

curious than disturbed by the implementation.

The transition to Gateway was not a big change for Subject 4. In her personal opinion, the

learning in Gateway had more to do with understanding the new processes, formats, and

action behind each button and tab in Gateway. In the early days after Gateway was turned

on, she used Medic One and Gateway interchangeably but later started using Gateway

more. Although she was comfortable with the amount of training she received, she was

troubled for not having learned the nuances of the system before she actually started

using it for patient care work. She was particularly troubled with the errors that were

caused due to system design and inconsistencies as they had a significant impact on patient care. She was one of the three subjects interviewed who made a point of stating that the main purpose of information systems is patient care. Her thoughts on this can be expressed via the quote given below,

Quote 9:
"And I think, you know… what I understand, for all the other things that we needed Gateway for the coding, the charging, the procedures, and all that from the point of view… that it is probably better for the organization. And I can respect that because we all need to make money and do the other things that capture the productivity of the worker. But as far as being a clinician and being very patient care centered, that is my emphasis, I just find it very easy to make mistakes. And I don't think that there is anything that makes clinicians angrier with themselves as writing a prescription on a wrong patient."

According to Subject 4 the effect of using the mouse to open features in Gateway is causing her arm and shoulder pain, and she did not have this problem with Medic One as she could use the keyboard more. She was the only one in this study who attributed her shoulder and arm pain to increased use of the mouse with Gateway. The complaints that she had about Gateway were quite similar to those outlined by other subjects. The inconsistencies with Gateway have caused her to establish a new relationship with her medical assistant (MA). For example, Subject 4 and her MA worked together to review the patients chart and instructions before anything was either put into the CIS or handed to the patient. This seemed to have helped in identifying errors and correcting them before further damage is caused. Of the nine subjects included in this study only one other subject expressed a similar relationship with his MA. The new relationship with the MA was the result of errors creeping into the after-visit summary that is handed to the patient and was a way to avoid the errors. Subject 4 had put small reminders on the

computer screen to remind her not to make certain errors and found that helped her be more vigilant.

Quote 10:
"Yeah… my MA and I have talked about it, and we are very, very careful about rechecking now, and looking everything over, and making sure we have it right. So, that's all you can do and like I said, it is happening few and far between… but it just happened last week. And … I have to say from a provider point of view it makes me very, very upset, and just like that it can ruin my entire day."

In summary, Subject 4 has had a moderate transition level to Gateway and is open to additional training to improve her efficiency. She said that she mentioned the system errors so that they can be corrected and the resulting embarrassing mistakes avoided. She went on to say that nothing made the physicians angrier than making mistakes that affected patients. Her learning process has been faster because she has been using Gateway routinely for sometime now, but has had to unlearn and relearn some of the micro routines and system alerts that tells users what has been done and what needs to be done.

Subject 5

Subject 5 had been with USER since 1996 and had used Medic One for nearly eight years. Due to time constraints it was not possible to conduct a full interview, but the insights he offered into the transition process were different from those expressed by other subjects in this study. In general, he was happy with Medic One and was willing to spend the extra time it took to input information as this had clear benefits for patient care

and information access. He knew that the Gateway implementation was to take place soon and did not remember having any uneasiness about it.

He was happy with the amount of training he had for Gateway; he felt that he had quite a bit of learning to do before he could claim to be comfortable with Gateway. He felt his transition to Gateway was easy but when compared to his colleagues he still had a number of things to learn. Throughout the interview he repeatedly stressed that he had to learn more things if he was going to use Gateway more efficiently. Gateway, training, support from USER, and increased workload were just some of the factors influencing the user transition process. He felt that the user should also play his part by learning how to use the system. As for the learning process he felt that there was a considerable amount of continuous learning (learning beyond the initial training period) involved as new features are discovered. Overall he was happy with the kind of support he received from the support team during the transition process.

He did not have strongly negative or positive opinions about Gateway. And felt that he as a user needs to learn certain things to avoid errors and improve efficiency. Due to time constraints subject 5 was unable to give the researcher specific examples of system inconsistencies or drawbacks. But he did give the following examples,

- The font is too small and is hard to read.
- There is too much information being presented on each screen

- The loss of the linkage to RRS is cumbersome, as the eight digit patient number has to be entered manually. This has led to errors and wasted time.

Quote 11
"As much as there are inconsistencies with Gateway... I still have a lot to learn. Once I learn more, maybe it will get easier."

To sum up, Subject 5's transition to Gateway was somewhere between easy and moderate. He did mention that he was still learning to use the system. This could mean he is still in the process of transition. He felt that the user also has the responsibility of learning the features and nuances of the new system. This was something not vocalized by any of the other subjects.

Subject 6

Subject 6 had worked at USER since 1985 and had reasonable amount of computer experience before coming to work at USER. Like other subjects in the study he had used Medic One since it was implementation in 1995. He could not recollect much about his training on Medic One, but did have a favorable opinion of Medic One. Overall he felt the downside of increases in work time created by Medic One were negated by the benefits like access to information, clarity of notes and better organization of data.

On the whole, Gateway was not a big change for Subject 6. Like other subjects he was happy with the training he had received. During the early days following the Gateway implementation he used both Medic One and Gateway. He used Medic One whenever he was behind schedule, or when accessing ACIS from home. In fact, he used Medic One up

until the time he started having minor problems like delayed log on time, decreased technical support, and small bugs. This was the impetus that caused Subject 6 to start using Gateway all the time. He made a point of mentioning that he was open to additional efficiency training but did not have the time to schedule a session.

Though he was not entirely happy with Gateway he acknowledged that Gateway had its upsides. He was able to tell the researcher only one upside, a new feature that helped the users add additional information to problem lists. He then went on to outline quite a few downsides or features that were bothersome. These include minute changes like the extra clicks and steps necessary to complete a process, the change in font style and size, loss of connectivity to RRS, duplication of work processes and extra steps involved in canceling orders.

Quote 12
"So there a few things that are better, it is just different. And I could accept the fact that when things are different, there is always a transition time that is... where things are a little slower, and I would say that it is overall. I can live with it."

He seemed to understand that transitions take time, but given the time constraints he felt that adaptation becomes harder because of the bugs in the system. He was very sensitive and concerned that computers are reducing the time he spends with his patients. He felt that the increase in system functionality would increase the expectations from the physicians and this would have a negative impact on patient care. This observation could also be a reflection of the time he spends in hospitals where the element of time becomes more important than in the outpatient setting. There was also the problem created by

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'canned notes' which he felt has resulted in pertinent information getting lost somewhere in the information system.

Quote 13:
"So you have this quick review function, then there is the more intense review if you want to actually get to a place where you can add to the note, make orders and send it to somebody, do something like manipulate the notes, then you have to go to a second place that requires a few more clicks. I do not know whether that is better or not. You know, I think it would have been nicer if you could go immediately... go to the place where you could edit, and send, and manipulate the note rather than having it in two places. It is a little longer if you go to the place where you could manipulate the note; it takes a little longer to get to that spot. There are those seconds again."

A big concern for Subject 6 was the increasing expectations for physicians. He felt that information systems have increased the work expected from physicians, i.e., physicians are expected to do more work in less time. This he thought might lead to potential errors during documentation or order entry. During the interview Subject 6 stated that the transition to Gateway was a minor change but his frustrations and continuing learning process point towards a transition process that was more than minor. His transition would be better described as easy to moderate. He was still learning new things about the system. And like most of the other subjects, he seemed willing to do whatever it takes to get used to the new system.

Subject 7

Subject 7 had been with USER since 2001 and had been using Medic One only for three years. Although he had not used an electronic medical record before coming to USER he had significant experience with computer programs and programming. This seemed to

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have been a factor in his getting used to Medic One with relative ease. He got most of his training for Medic One from six training CD – ROM's, that gave him the ability to learn at his own pace. He liked Medic One and was comfortable using it within three to four months. He was another super-user in this study.

Subject 7 started using Gateway with relative ease; his transition was so smooth that he was back on a full patient schedule even before his reduced schedule period ended. In the early days after implementation he used both Gateway and Medic One especially when he fell behind in his schedule. Although he felt Gateway was not better than Medic One the realization that Gateway is here to stay made him increase his efficiency by using Gateway 100 % of the time. He continues to learn new things about Gateway while completing his everyday charting. Like a number of his peers, he was disappointed that Gateway did not live up to his expectations but knew that more upgrades are on the way.

In addition to the drawbacks outlined by Subjects 1 – 6, he felt that the inbox feature in Gateway had become very cluttered resulting in a loss of efficiency. He mentioned that there was too much information being presented on each screen. This resulted in increased time in front of the computer and decreased time with the patient.

Quote 14:
"I think the inbox has become too complicated in Gateway. There are so many messages in the inbox now, patient calls, medication refills there is constantly some message in it. While one can see a lot of information on one screen, there is too much information. Valuable time is spent modifying the screen or windows to look at information. This takes time away from patient care. But I guess one could get used to it over a period of time."

Other frustrations included,

- Gateway was slower than Medic One

- Confusion between patient instructions and progress notes due to proximity and similarity in system design

- System locks up every forty-five minutes for no apparent reason resulting in a lengthy restart process (This frustration was articulated by only two of the nine subjects).

The transition to Gateway was easy for Subject 7 and although he had made the transition to Gateway he was not necessarily happy about it. His feelings are best said described by the following quote,

Quote 15:
"We were told that with Gateway we could open more than one patient chart at a time... that we could keep a number of windows open, but that does not seem to be the case [Laughs] ... you now. If Gateway was just a different way of doing the same thing, I do not understand why we needed to have a new system. The GUI is different, but all the basic components seem to be the same. Medic One satisfied all the needs; I don't see Gateway being necessarily better than Medic One."

Subject 8

Subject 8 was a physician who came to work at USER at the same time as the first Medic One implementation. She had very little experience with computers prior to her using Medic One. In spite of this she has had a very good experience with using Medic One and had only good things to say about her entire Medic One training and subsequent use of Medic One. The quote below sums up her opinion of Medic One,

Quote 16:
"I was almost dreaming about something like this. And it seems like it was put on a sliver platter and given to me. So yeah, for me it is… there are many good things about it. Of course there are a few criticisms about it, but mainly only very good things to say about Medic One.".

Even though Subject 8 had not been to the Gateway demonstrations she did not have any apprehensions about the Gateway implementation, as she was confident USER will provide the necessary training. This confidence in USER's training seemed to have come from the training she had for Medic One. In general she was not happy with the training for Gateway, even though she felt the time frame for the training was sufficient, she wanted more control and privacy to learn things on her own time.

Quote 17:
"The trainers, I did not personally… it seemed to me that… maybe they were tired at the end of the day, maybe they had been doing this all day. It seemed like they had a canned version of what they were supposed to do, and they just wanted that done and over. And maybe they had too much to do in a short time… so it seemed a little rushed, and I almost wished they had CD-ROM's."

In the early days of the transition she used both Medic One and Gateway. Once she knew Medic One was eventually going away she started using Gateway more and more to reduce her dependence on Medic One. In case of any trouble she would either ask her peers or call the help desk. Again she emphasized that without the kind of support USER had given its users it would have been harder to adapt to the new system.

Gateway did not make a big impression on Subject 8 who felt that the bugs and inconsistencies overshadowed the positive aspects of the system. She felt that the increased amount of information being presented on each screen, the small size of the

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fonts and the numerous clicks made Gateway a 'user unfriendly' system. Given this she feels that there exists potential for making errors. There are system inconsistencies like patient instruction not being included in the after-visit summary because the patient instruction window is not closed or the pharmacy fills prescriptions for orders that have been cancelled. She felt these problems had the potential to turn into malpractice suits that most physicians want to avoid. Like subject 6, she felt all the extra information is making the screen too busy and confusing for physicians to use. She went on to say that most physicians want to see only information pertinent to patient care.

Subject 8 had some complaints similar to other subjects, some of which were: Gateway is slower, her computer freezes up when using multiple applications, there is duplication of work processes and irregularity in some features requiring a single click versus others requiring a double click. The transition to Gateway has not necessarily been easy for Subject 8. In her case it would be germane to describe her transition as somewhere between easy and moderate. She felt in spite of the deficiencies, 90 % of the physicians were happy with Gateway. Even though there seemed to be continued frustration with Gateway, the faith in USER to fix the problems seemed to be the 'light at the end of a tunnel' for Subject 8.

Subject 9

Subject 9 was the only user who was both a practicing physician and an administrator. He has been with USER for the past 20 years and has been involved with Medic One right from the beginning. Being an administrative person he was no stranger to computers

but like Subject 8, he had his reservations about Medic One (older version of the CIS).

Overall he was very happy with Medic One as he felt it had been customized to suit

physician's needs. Although he has come to recognize the advantages of using CIS, he

remains cautious.

Quote 18
"By that time in my practice, I had become very efficient at… multitasking during the
visit. So I could, I could document the reasons for the encounter all the way through the
diagnosis, and then plan the face-to-face encounter with the patient, all while I was
spending time with the patient. So I realized that this would, that this system as a vision
would diminish the amount of time that I would be able to spend face-to-face with the
patients, and that was concerning to me. And it continues to be a concern"

Subject 9 had known for some time that Gateway would be implemented. In his

administrative capacity, he had been to a few of the Gateway demonstrations. Given the

experience most USER users had in using computers and the information system itself,

he felt the four-hour training for Gateway was adequate. Even though the changes

Gateway introduced were minor, he felt they were different enough to make the whole

transition quite a bit harder.

Quote 19
"No, it was a much greater change than any of the ACIS upgrades. It was probably fifty
percent of the magnitude of transition from the paper to ACIS. Something along those
lines… it was a bit of struggle."

Although he could not give me specific examples he felt Gateway was not as intuitive

and user friendly as Medic One. A user had to explore quite a bit before finding the

function behind each button. This was the case with most of the tabs, icons and buttons in

Gateway. Plus all the extraneous information presented in each window was not needed

for regular patient care. To illustrate this, Subject 9 drew an analogy between finding information in Gateway to finding news on the CNN.com website. Both, he said, took many clicks and leafing through numerous screens to find information that was not always what the user was searching for. The process not only wasted precious time but also increased the user's frustration. Given his experience in both the inpatient and outpatient setting, he was sure that the CIS would reduce the time the physician spent with the patient. Additionally mixing up key elements when he used Gateway disturbed him, for example, it was easy to confuse patient instruction box with progress note box because of the similarity between the two. He seemed to feel he should be more careful. Unlike with Medic One where moving screen to screen was intuitive and easy, with Gateway users had to be vigilant about their actions. This was hard to get used to.

The transition for Subject 9 has been more than a moderate to easy rate of transition because he is a part-time physician and also due to his administrative duties. This increased his adaptation time to Gateway and prolonged his transition process. Also his busy schedule has not permitted him to go through an efficiency training session that would have helped him understand the nuances of using Gateway. The change was made easier because there was a sense of familiarity with Gateway being an ACIS product. But like his peers he felt that a transition to a system different from Gateway would have been extremely hard.

Quote 20
"I have some knowledge of the other programs since we had six vendors come to the hospital and present their hospital information systems, ACIS being one of them. And I think it would have been extremely difficult to make that transition to a different program. I think there was... even though Gateway was so different from Medic One

ACIS I think the other systems were so completely different an approach to the documentation needs that it would have been much, much more difficult to make that transition. We actually entertained the idea of looking at… a different vendor for the hospital, and it just would have been very, very difficult. There are other reasons to go with ACIS besides that but… but… it yeah…wow!"

As mentioned earlier the individual case analysis helped understand the transition process of each subject. The researcher was also able to understand that people with differing skills have different rates of transition (figure 3). One of the assumptions that the researcher had at the start of this study was that super-users transition at a faster rate than low-level users. This assumption has been nearly validated by the data represented in figure 3 below.
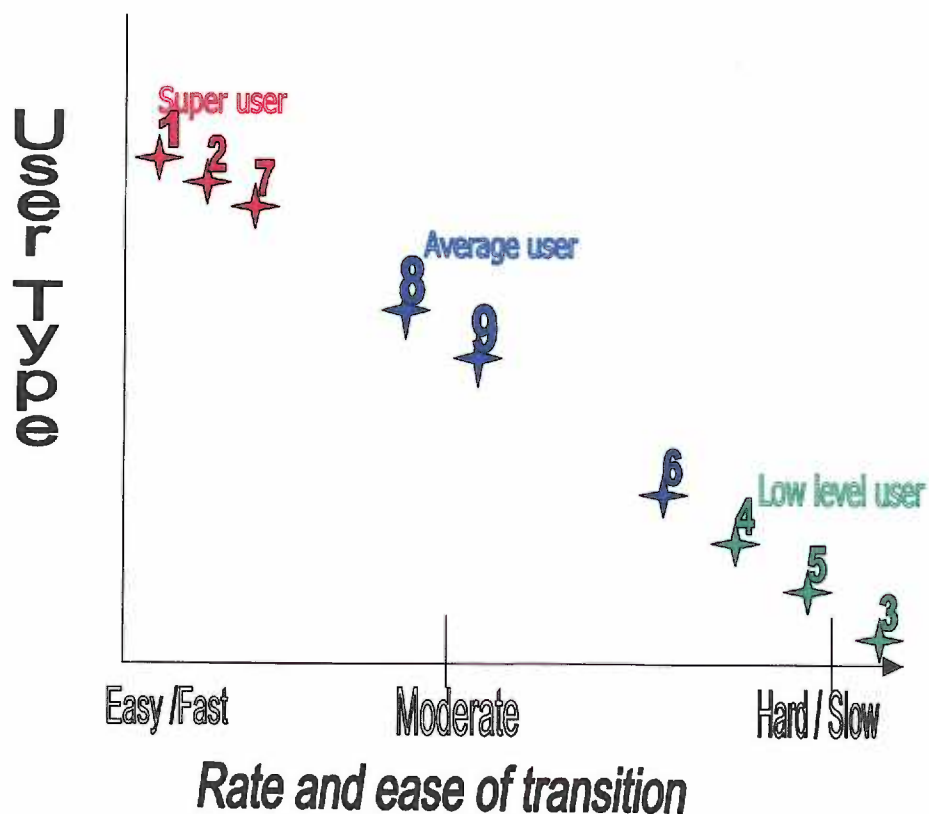

Figure 3: Individual rate of transition

In the graph the super-users are denoted in red, the average users are denoted in blue and low-level users denoted in green. All the super users (subjects 1, 2, and 7) in this study transitioned from Medic One to Gateway with relative ease and speed. The low-level users (Subjects 4, 5, and 3) had a slower rate of transition and found it harder to move to Gateway. Of the three average users, subjects 8 and 9 had a moderate rate of transition while subject 6 made a slow transition to Gateway. It is possible that there are certain external factors that might influence the rate and speed of transition. The following section outlines some of the themes associated with the transition process.

II. Themes and concepts associated with transition to Gateway

The second analysis of the interview transcripts helped in organizing and refining the themes and concepts, and gaining a deeper understanding of the user transition from Medic One to Gateway. The themes did not emerge entirely from the transcripts. They represent the main concepts that arose in relation to the research questions and the questions used in the interviews. Though the themes and concepts were not all related to the transition process itself they helped shed light on some of the other issues that might be associated with transition. The themes identified in this section are not in a structured format and do not have a specific order of importance (Table 4).

Themes	Sub-themes
Medic One vs. Gateway	Similarity and differences
	Familiarity with ACIS (What made it easy)
User background	Computer Skills
	Medic One – length of use
	Medic One – Opinion
	Exposure to system upgrades
Gradual introduction of Gateway	Knowledge about upcoming implementation
	Knowledge about Gateway use
	Reduced anxiety and apprehension
Appropriate training	Understanding the users skills and needs
	Belief and trust in the organization to provide the right training
Support	Good support structure
Simultaneous use of Medic One and Gateway	Important during transition
	Boon for medium and low level users
	Used by all users at crucial times
Transition	Easy / moderate / hard transition
	User in different stages of transition
	Mandatory use of Gateway
	Different types of transition
Magnitude of change	Major upgrade or change
	Minor upgrade or change
Learning	Ongoing process
	Learning nuances of the system takes longer
	No time to learn and share with peers
	Need for efficiency training
	Important to recognize the amount of learning users need to go through
Awareness of organization's plans	
Frustrations or system downsides	
Unintended Consequences	
New issues	Increased workload for physicians
	Decreased time with patients
	Potential role of the MA in future implementations

Table 4: Themes and concepts

<u>Medic One vs. Gateway</u>

The similarities and differences between Medic One and Gateway are discussed in this theme. Medic One and Gateway are ACIS products, so the basic look, feel, and workflow processes were still the same. By maintaining the similarity between Medic One and Gateway, ACIS and USER were able to get users over the initial hurdle of getting used to Gateway. For the users this was one of the key aspects that made the transition easier.

With Medic One, users had the option of using either the keyboard or the mouse to open a chart. All the subjects in this study appreciated this flexibility as it gave them the freedom to choose the option they were most comfortable with. Medic One was the product of eight years of customization; as a result it had very efficient work processes and numerous short cuts both of which were vital for the users. Gateway on the other hand requires the user to use the mouse instead of the keyboard. The version currently used at USER clinics was the first version released to actual users. Several of the features could not be accessed via keyboard shortcuts; users were forced to use the mouse to open a specific chart or execute a specific task. This was a sore point with all the users, as many tasks required multiple clicks and extra steps. Gateway had a few bugs and did not connect with RRS; this loss of functionality was hard for users in this study. A combination of multiple clicks, lack of connectivity with RRS, and redundancy in individual tasks were the frustrating factors for all the users. The general opinion among the subjects in this study was that ACIS and USER should have done additional user testing before rolling it out. For the users in this study the system bugs and

inconsistencies had the effect of interfering with the learning process and this in turn had the effect of slowing down the transition process to some extent.

User Background

User background such as computer skills, previous use of electronic medical records, and the influence this has on the transition process is discussed here. The users in this study had varying computer skills, with one exception, all the users had nearly eight years of experience with Medic One. During this eight-year period, there were constant upgrades to Medic One as it was tweaked to improve the functionality or reduce system bugs or to implement a new functionality. Over a period of time, the users in this study had become aware of the changes that result from the implementation of the upgrades. This includes system slow down, changes and temporary loss of functionality, training updates, and understanding the new change. The exposure to upgrades might have made them less apprehensive about the re-implementation. The prolonged exposure to using CIS for regular patient care might have been one of the reasons why the majority of the users transitioned to Gateway with relative ease.

User's experience with IS also resulted in a higher expectation of the features and capabilities of Gateway. As a result they were able to differentiate between system bugs and the general failures that were part of the new system. And even though they were frustrated with the inconsistencies in Gateway, they remained patient with USER and ACIS as they tried to fix the problems with Gateway. Another factor that seems to have influenced the transition process was the high opinion of and familiarity with Medic One.

Even though it was nearly six months since the Gateway implementation, users in this study continued to compare Gateway to Medic One. The prior experiences with computers and Medic One have made the transition process easier for some of the users, but for others the familiarity with Medic One has had the effect of prolonging the transition process and complete adaptation to Gateway.

Gradual Introduction to Gateway

This theme refers to one of the key aspects of the implementation plan, namely the gradual introduction of Gateway over a period of two to three months. From the transcripts it became obvious that the Gateway implementation was methodical (based on the description given by the users). Gateway was introduced to the users a few months before the actual implementation in the form of public announcements and demonstrations. Early demonstrations and advertisements of Gateway were used to make users aware of the impending change and increase the user's familiarity with Gateway. The users in this study either had been to a Gateway demonstration or had heard about it from their peers. The demonstrations allowed the users to observe an experienced physician using Gateway, ask questions, and talk to their peers about issues surrounding the product. The early introduction also served to reduce the anxiety about using Gateway by focusing on the benefits and advantages, like opening more than one patient chart. The gradual introduction to Gateway gave users something to look forward to and this could be one of the many reasons why the transition process became easier for the users.

<u>Appropriate Training</u>

The training of end users was another important theme that emerged from the transcripts. The users were uniform in their opinion that they trusted USER to provide them with the training they would need to adapt to Gateway. The four-hour training session for Gateway was developed based on the skill set of the users at USER. Unlike the training for Medic One that included teaching the users how to type, the training for Gateway focused only on teaching how to use Gateway. All the users were unanimous in their agreement that the training session for Gateway was adequate and it reinforced their faith in the USER training team. Two of the nine users were not happy with the errors in the training module and felt that the modules were "canned". Although they were willing to give USER trainers the benefit of doubt, they felt that the mistakes could have been avoided. They also wanted a greater degree of freedom with their training and additional instruction in how to handle the minute changes in Gateway. This feeling became stronger as system inconsistencies were identified in the course of their use of Gateway. Overall, the training session was well liked by all the subjects. In addition, dummy practice patients were made available to the users through their desktop computers if they wanted to explore new features in Gateway.

USER had provided the users with the right amount of training they would need for getting started on Gateway. Although the training sessions seemed adequate, the users were more concerned about learning the small system warnings that would help them avoid errors. For example, they need to be aware of the tiny red dot on the order entry screen that means an order has not been signed and will not be included in the after-visit

summary. Most users were open to additional training, but did not have the time to schedule it on their own.

<u>Support</u>

This theme refers to the level of support USER provided to its users during the process of transitioning from Medic One to Gateway. Support was a large issue for all the users in this study. Although users were aware that USER would give them the required support, the quality of the support was a relief to all the users, especially for the non-super-users. Even though some users felt that the site specialists were spread thin, they agreed that the support staff was always available. Users appreciated the reduced schedule they were given for the entire week following the Gateway implementation. This not only strengthened the user's belief that USER was committed to helping them but also gave them, but also gave them the time to gradually move from Medic One to Gateway. The kind of support the end user's required for Gateway was different from the support they received for Medic One. This time the user's seemed to want tips on catching errors themselves in addition to rapid correction of system inconsistencies and bugs. It was clear that support was high on the list of user requirements during the transition process and that USER had met the user's needs in this respect.

<u>Simultaneous Use of Medic One and Gateway</u>

This theme refers to the option of using Medic One during the early days after the Gateway implementation. By making Medic One available for the first few months, USER provided its user's with an alternative in times of heavy patient loads, schedule

delays or other frustrating scenarios. There was a unanimous agreement among the user's that USER had done the right thing by making Medic One available for at least a few months after introducing Gateway. In spite of the similarity between Medic One and Gateway, the availability of Medic One seemed to have helped in reducing the impact of the high learning curve associated with using Gateway. Of the nine user's in this study, four continued to use Medic One right up until the time it was turned off. Medic One was still familiar enough to be used in emergency situations and the functionality available was greater. Conversely, at least two of the users mentioned that they had become used to Gateway and would hesitate to go back to Medic One because they had forgotten how to use it!

Transition

The issues surrounding the user transition process are discussed in this theme. The organization's (USER) plan of gradually introducing Gateway before the actual implementation had helped soften the impact of the transition for the users. It is important to mention here that the users were transitioning from one ACIS product to another. The similarity between the two ACIS products (Medic One and Gateway) seemed to have contributed significantly to the ease of transition. Even though there were changes in individual work processes, the overall workflow remained the same. Most of the users in this study mentioned that their individual transitions could be described either as easy or as moderate mainly because of the similarities between Medic One and Gateway. Early on some of the users felt that the Gateway implementation was not a big change, but their comments and frustrations suggest that the change was more than minor. By being able to

use either Medic One or Gateway in the early days of the re-implementation, average users were given a comfortable alternative.

By placing the various subjects in the Bridges model, the researcher was able to understand the differences in the transition process of the subjects in this study. The users were grouped based on their prior computer skills, their length of use of Medic One, and their adaptation to Gateway. The super-users or advanced users seemed to have adapted to Gateway faster than the low level users, some of whom did not start using Gateway full time until Medic One either gave them too many problems, or until it was turned off. Of the total of nine subjects three were super-users, three were average-level users and three were low-level users.

As explained by the Bridges transition model all the subjects have gone through an initial letting go period (Ending phase). The letting go phase for USER users began with the Gateway demonstrations, the training they received, and the understanding that they had of the changes to be introduced by Gateway. In the neutral zone phase, they continued to compare Medic One to Gateway. For some users using both Medic One and Gateway simultaneously helped with their work and decreased their anxiety in using Gateway.

According to Bridges, to move from the neutral phase to the beginning phase users need a goal. All the users knew that they eventually had to start using Gateway 100 % of the time. This provided them with a goal for the next stage, that is, the new beginning. Using Gateway was mandatory for USER users; this was another factor influencing the

Users to move from the neutral phase to the beginning phase.

Old System

Late adapters:
Subjects 4, 5, 6

Late adapter:
Subjects 3

ENDING

Neutral Zone

Beginning

Early adapters:
Subjects 1, 2, 7

New System

Intermediate adapters:
Subjects 8, 9

Figure 4: Adapted from the Three Phases of change, to show the users in
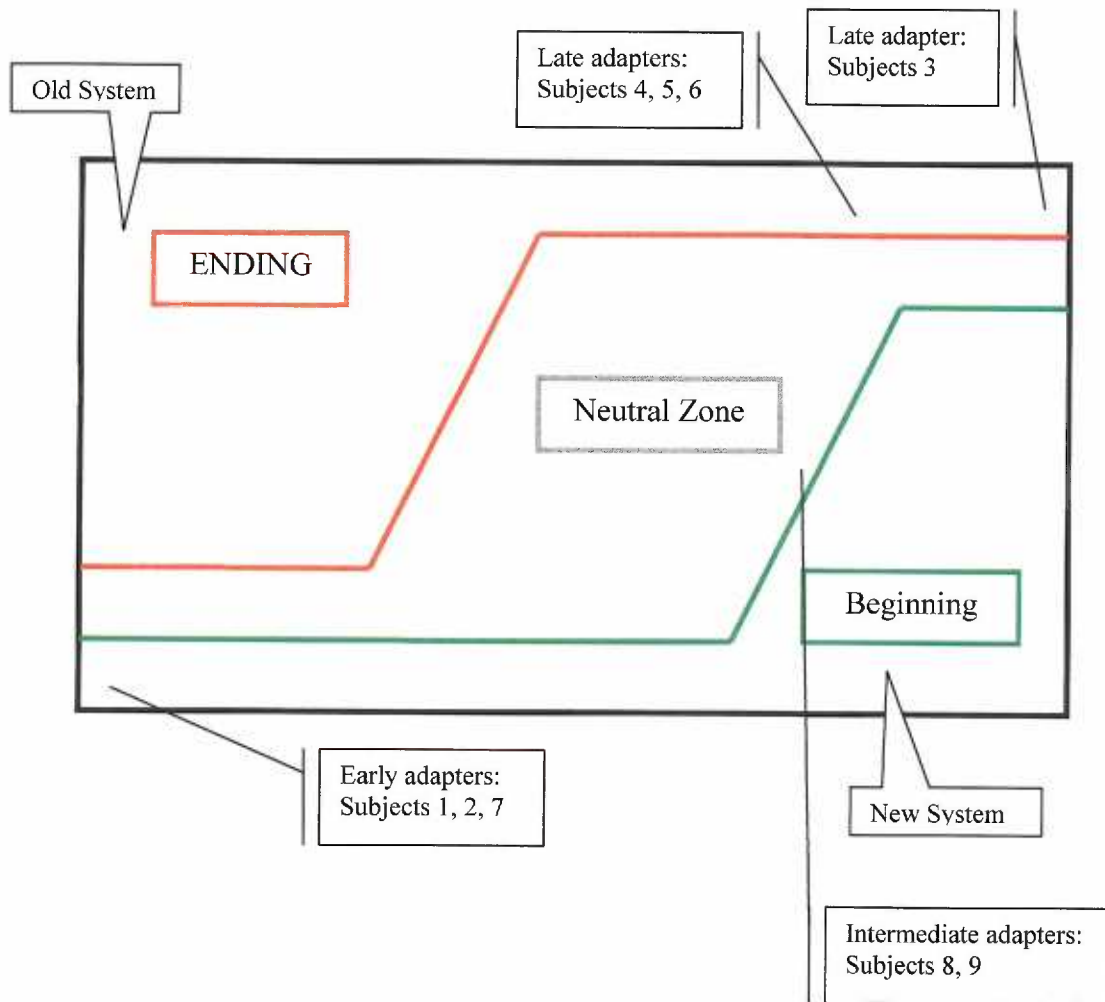various stages of transition
From: Bridges, W. Managing Transitions: Making the most of change, 1991

All the subjects included in this study had transitioned to Gateway. Subjects 1, 2 and 7

were among the early adopters and transitioned to Gateway with ease. All the three

continued to have frustrations with Gateway and were of the opinion that Medic One was

better. Even if they were offered the choice, Subjects 1 and 7 felt that they could not go back to using Medic One because they were used to Gateway. Also, they would have to relearn Medic One before they could use it. On the other hand, Subject 2 would prefer to go back to using Medic One; he felt Medic One was efficient and user-friendly and he was confident that he would remember how to use it again.

Subjects 8 and 9 were both part-time physicians and hence their transition to Gateway was longer. Even though Subject 8 was comfortable using Gateway, she would not mind going back to using Medic One. On the other hand Subject 9, like Subjects 1 and 7, felt that he could not go back to Medic One, as he would have to relearn everything. Subjects 4, 5 and 6 were still learning various aspects of Gateway. Their transition was slightly slower than the other users as they continued to use Medic One along with Gateway until the former was turned off.

Although Subject 3 had no trouble learning to use Gateway, the inconsistencies forced her to use Medic One almost until it was turned off. Her simultaneous use of Gateway and Medic One and her dislike of Gateway resulted in her having the slowest transition process. Subject 3 was clear that given the choice she would just prefer to go back to using Medic One

There was a uniform opinion among the users that it would have been extremely hard for them to transition to a non-ACIS system. They felt that the amount of learning, transition and the adaptation process would have magnified had they moved to a system where the

look and workflow was significantly different than Medic One. As outlined earlier in the individual case analysis for Subject 2, depending on the type of change there can be at least three types of transition. The first type of transition is one where users move from a paper based system to using a clinical information system. The magnitude of transition is significantly larger and harder. The second type is where the users move from a system by one company to an entirely different system by another company (for example, from Eclipsys to McKesson). The magnitude of transition could be easy or hard depending on the degree of change. The third type is where users move from one system to another system by the same company. As the change is more at a conceptual level, the transition is relatively easy compared to the other two types of transition. USER users experienced the third type of transition, and that is why the overall transition process has been easier for its users.

Magnitude of Change

The familiar "ACIS look" of Gateway seemed to have reduced the initial enormity of the transition to Gateway. A closer look at the interview transcripts showed that the changes might have been greater than what the users had expected. The changes in "micro routines" as one user referred to the changes, seemed to have taken the users longer than expected to understand and learn. Some of the users were still learning to use Gateway even though this study was conducted nearly five months after the Gateway implementation. This being a qualitative study, the magnitude of change could not be measured. The magnitude of change introduced by Gateway was inferred from the user

comments during the interview. The change is best described in the words of a subject who said that the transition to Gateway was a 50 % change from Medic One.

The Learning Curve

This main focus of this theme was the amount of re-learning required to start using Gateway. Even though the learning was more at a conceptual level, there was quite a bit of learning involved. For example, users had to learn the new work processes, learn the information behind each button and tab, interpret the error messages, and learn the cues that would help in completing a process correctly. The speed of learning seemed to have an effect on the rate of completion of the transition process, and the length of time users were dependent on Medic One. The learning curve was quite steep even though users were on a reduced schedule for an entire week.

The users did not have time to trade tips or share information with their peers. It was evident from the user comments that learning the nuances of the system would take longer and continue well after the user had started using Gateway full time. Even though the users had the option of scheduling an efficiency-training session, they did not have time. Few of the users suggested that they were open to the site specialists taking the initiative to schedule efficiency-training sessions. It was clear from the comments during the interviews that in spite of the similarities between Medic One and Gateway, a significant amount of learning was involved before users could use Gateway effectively.

Awareness of Organization's Plans

Users unanimously knew USER would attempt to fix the numerous system bugs, inconsistencies, and other issues about Gateway. Although the users in this study were not aware when the next upgrade would take place, they believed that USER was working to fix the loopholes in the new system. Since they had faith and trust in USER to correct them the users openly shared the various errors and inconsistencies in Gateway. Comments like, "will you tell them that" or "will you tell them the font is too small, I am growing old" were quite common during the interview process. Also common were comments like "we have so much to learn, maybe it will be easier" Some of the users in this study mentioned that their hope was that USER would fix some of the glaring errors in Gateway in the next upgrade. Awareness of the organization's plan seemed to reduce the user's anxiety over the deficiencies in Gateway.

Frustrations or System Downsides

During the interviews, the users expressed numerous frustrating aspects or downsides about Gateway. After using it for five months, the users in this study had a mixed opinion of Gateway. Most of the users in this study had experience in using computers and using Medic One, and were able to differentiate between errors resulting from human mistakes and those caused by faulty system design or system bugs. Even though the users in this study felt that Gateway had some good features, the general feeling was that the downsides or frustrations reduced the efficiency and usability of Gateway, and interfered with the learning process. The frustrations or downsides of Gateway could be grouped into the following categories,

- Features that were not user friendly

- Features that had errors

- Features that need to be changed

- Decrease in functionality

- Inability to build Macros and use keyboard short-cuts

- Too many tabs and buttons

- Small font size

- Too much information on each screen

Time after time the users in this study expressed their frustration with the errors and wasted time that resulted from the drawbacks or bugs in Gateway. They also realized that Gateway was still a naïve product, and that the user testing done prior to implementation was not adequate. The users gave examples of the errors so they can be corrected and not to complain about the inconsistencies in Gateway. [A full list of the inconsistencies in Gateway like system bugs and usability issues were submitted to USER. For confidentiality reasons, the list is not included in this document.]

Unintended Consequences or Unexpected Errors

The word 'Consequence' has numerous meanings some of which are, as a result of, something produced by a cause or by a set of conditions. In simple terms it is the outcome or aftermath of a cause (Merriam-Webster Online Thesaurus[1]).

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[1] Merriam-Webster online Thesaurus available at http://www.m-w.com/cgi-bin/dictionary?book=Dictionary&va=consequence

One of the aims of this study was to identify the unintended consequences of implementing the new system. Are there any unexpected consequences of moving from one version of a system to another? Some of system bugs and inconsistencies identified in the interviews seemed to have caused more than normal errors. For example, in Gateway the patient instructions and progress notes boxes were designed to facilitate ease in documenting and editing. Except for the header, the two boxes were similar in look, design, and positioned adjacent to each other. As a result most users ended up typing the patient instructions into the progress notes box and vice versa. The error here was placement of the wrong information in the patient instructions and progress notes boxes. The consequence or outcome of this error was that some patients had the progress notes included in their after-visit summary. The progress notes are meant to be the physician's notes and are not to be viewed by the patients. Users in this study were of the opinion that an error like the one described above might lead to patient complaints or lead to malpractice suits. Also, during the next office visit the physician would not be able to find the missing progress notes, as they would appear under the patient's instructions. Another example also involves the patient instruction box. The patient instruction has to be closed for the information in it to be included in the after-visit summary, and quite a few users forgot to close the boxes. The error was that the patient instructions were not included in the after-visit summary. The consequence was that the patient was not aware of the tests and medications he or she should take before their next office visit. Some of the users corrected this error by working with their MA's to make sure the correct information was included in the after-visit summary.

So a feature put in to reduce documentation issues has created new errors. The errors caused in the examples above were totally unexpected and could lead to disastrous situations.

New Issues

The researcher identified several new issues not related to transition. These include decreased time with the patient, increased workload for physicians and the potential role of the MA in future implementations.

Increased workload for physicians: the increase in workload was a big concern for some of the subjects. Although the subjects recognized the value of CIS, they continued to feel that they were highly paid data entry clerks. In addition, some users were concerned that systems with advanced capabilities would increase both the medical and non-medical work expected of physicians. For example, one of the subjects mentioned that once he was asked to look up his schedule and see if he could fit a patient in, but he felt this was beyond the requirements of his job. His primary responsibility was delivering quality patient care and that should continue to be the focus in the future. With an increase in system functionality the roles of the users should have been clearly defined.

Decreased time with the patients: due to the increase in CIS functionality, physicians are working more. As a result the time physicians spend with their patients is decreasing. Even though the information system was implemented to help with patient care, it is having the opposite effect. Another factor contributing to the decrease in time with

patients involves the errors that are caused due to poor system design. The time involved in fixing errors means time away from patients and longer working hours. Some of the users in this study felt that the decreased time with the patients was a big concern in both inpatient and outpatient settings.

Role of the MA in future implementation: some of the subjects in this study were recruiting the help of their MA's to help prevent costly errors. For example, the physicians worked with the MA to catch any errors or gaps in the after-visit summary before handing it to the patient. The MA's are already part of the workflow and it is logical that they work with the physicians to help reduce errors; this in turn might help reduce the impact of the transition process. This new relationship with the MA might prove to be beneficial to physicians. Although physicians are ultimately responsible for any errors in the after-visit summary, sharing the error checking process might help reduce the burden on physicians.

Discussion

The main objective of this study was to understand the issue of re-implementation in a healthcare setting, and the factors that affect the subsequent user transition process from Medic One to Gateway. The results show that the user transition process following re-implementation will depend on the user type, user skills, level of training, support from the organization, implementation strategy, usability of the new system, and the magnitude of change. The results are further discussed in the following three segments: the end user

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population and re-implementation; factors that contribute to the transition process, and factors that hinder the transition process.

The end user population and re-implementation

The results show that the user transition process following re-implementation will depend on the user type, user skills, level of training, support from the organization, usability of the new system, and the magnitude of change. Although the subjects in this study were all internists, they included a good mixture of super-users, average-users, and low-level users. This gave the researcher the opportunity to understand the effect of re-implementation on users with varying skills, and the differences in their transition process. The user groups differed from each other with respect to their background and skills, and this seemed to have an effect on their adaptability to the new system. This may be the reason for the faster rate of transition displayed by the super-users compared to the slightly slower rate of transition exhibited by the average and low-level users. There was only a 50 % difference (as described by the users) between Medic One and Gateway.

The learning process

Gateway was similar to Medic One in its basic design but the users had to re-learn the various micro routines, work processes, system alerts, and errors that could happen. Although the learning was at a conceptual level, there was a considerable amount of relearning involved. The user's ability to learn and speed of learning could have the effect of decreasing the rate of user transition to Gateway. People learn new things at varying rates, and implementers should consider this when outlining the transition time in

their implementation plan. In the six months following the Gateway implementation, no user (although they were open to more training) had the opportunity to schedule an efficiency training session. They also had no opportunity to interact with their peers, a time for exchanging concerns, ideas and tips on using Gateway. This might have helped the users in two ways. First, the efficiency training might have helped the users understand the nuances of the new system. Second, by tapping into the knowledge base of their peers, users might have learned tips on using Gateway efficiently. Implementers would benefit from recognizing differences in user characteristics in developing their training and support plan for future re-implementations.

The process of transition

It has taken eight years of modifying and upgrading Medic One to develop it into a sophisticated and user-friendly product, and during this time the users had become accustomed to the upheavals surrounding upgrades and system changes. Despite this exposure, and the understanding that the current Gateway version was far from perfect, the users in this study were frustrated by the various inconsistencies. Of the several inconsistencies identified by the subjects, some were system errors while others were issues related to usability. It also brings to light another issue related to transition, that is, system usability that plays a key role in learnability, efficiency and number of errors that occur. This highlights the point that there are factors other than computer skills and prolonged exposure to CIS that have an impact on the transition process. It has been suggested that usability is a key factor for monitoring CPOE systems as it can have an impact on the number of user errors and the efficient use of the system. (31)

Implementers should include user testing and de-bugging as part of their implementation plan to decrease the inconsistencies and improve the usability of the system. Gateway introduced changes in several small work routines or work processes, and the users referred to these changes as "changes in micro routines". Although this study was conducted nearly five months after the Gateway implementation, subjects were still in the process of discovering and learning new features in Gateway in the process, they are recognizing new errors and usability problems. In addition, the differences between Medic One and Gateway required the users to relearn certain work processes and features in Gateway. Kieran-Greenbush suggests that a learner (user) must master the conceptual as well as the practical aspects of technology to achieve a certain level of comfort, and that the process of learning is continuous. (32) It is possible that for some users the learning process might continue well beyond the actual transition to Gateway. Change is never easy and users in an organization tend adapt to it in different ways. Users and implementers must consider this when considering the length of time involved in the re-learning of new technology.

The factors that influenced the transition process are discussed in this section. Even though this study did not assess the Gateway implementation plan, information gleaned from the interviews helped gain an understanding of the Gateway rollout strategy and the effect this had on the transition process. The *first factor* was the gradual introduction of Gateway ahead of the actual re-implementation at the various clinics. USER has taken the lessons learned from the first time implementation of Medic One and applied it

successfully to the Gateway re-implementation. (33) The early introduction of Gateway made the users aware of the impending change and also increased familiarity with the system. The effect of this was more obvious in the super-users and champions who had either started using Gateway before any formal training or used it 100% from the day it was turned on. Except for Subjects 1, 2, and 7, the factors that acted as a trigger for subjects to start using Gateway all the time were the problems in Medic One and the day Medic One was officially turned off. Acceptance of the new system (Gateway) is one of the ways of ensuring user buy-in (34), and despite the popularity of Medic One, the early introduction of Gateway has proven to be beneficial.

The *second factor* was USER's strategy to make Medic One available along with Gateway for nearly four to five months after the Gateway implementation. All users in this study uniformly appreciated this strategy. By providing an alternative, USER seems to have avoided what could have been a major problem for the users, especially the average and lower level users. Even the super-users in this study recognized the value of having access to Medic One, and in some instances to use both the systems. Having both Medic One and Gateway helped the users maintain the continuity in their work as they progressed through the ending phase, neutral phase and finally the beginning phase of transition, and reduce the impact of the transition.

The *third factor* facilitating the transition to Gateway was the level of training and support before, during, and after the Gateway implementation. Training and support should be a key component of future re-implementation strategies both at organizations.

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This was one of the most important factors aiding the user transition process to Gateway. All the subjects agreed that given their background USER had given them the right amount of training, although some users seemed to prefer the flexibility of CD-ROM training which they could use to learn at their own pace. Developing a training program based on the skill set of its user base and establishing a rapport with its users has proven to be beneficial to both the users and USER. Kleintop et al. suggest that providing support to the users in the form of training can have positive effects on the user attitude towards technology, and on the implementation process. Although there is a significant monetary commitment involved in providing users with the ability to practice their skills and to learn to use information technologies, the investment is worthwhile in that it fosters increased use of the technology. (35) USER had provided its users with the appropriate level of training and post re-implementation support, and it has had the positive effect of enabling the users to overcome some of the hurdles associated with the transition process. This can be reflected in the willingness of the users to undergo additional training to become efficient at using Gateway.

The *fourth factor* influencing the user transition process was the awareness of the organization's pre and post implementation plans. Implementers would benefit from considering this factor in future re-implementations. The Bridges transition model stresses the importance of conveying the organization's goals and objectives to the end users. Including the users in the overall plan is important for justifying the interventions introduced to attain the final goal. Although the users seemed to understand the organization's reasons for moving to Gateway, the inconsistencies in Gateway has led

some users to speculate the real reason for moving from Medic One to Gateway. USER seems to have made a point to include the users in the detection and correction of the errors in Gateway; on their part the users felt included in the organization's plan and are more tolerant towards the inconsistencies in Gateway. Also, based on their prior experience, users were confident that USER would eventually improve the usability of Gateway. USER had successfully managed to incorporate the users into their implementation strategy, and the results are reflected in the positive opinion the users have of the organization.

The *final factor* aiding the transition process was the mandatory use of Gateway at USER. Medic One was completely turned off four months after the re-implementation and users were aware that they would not have an alternative. Even those physicians who were not happy with Gateway knew they would have to eventually to use it, and this led them to increase their learning and improve their overall efficiency. As Gateway use was mandatory at USER it was not possible to understand the impact optional Gateway use would have had on the user transition process.

Unintended Consequences of re-implementation

Inconsistencies in Gateway, system bugs, errors in system design, and information overload were identified as factors hindering the transition process. Because these factors seemed to affect the transition process of some users, they have the potential of being an impediment for future re-implementations. Based on their initial exposure to Gateway in the form of public demonstrations, the users had a certain level of expectation of the

capabilities and features. Quite a few users in this study seemed disappointed with Gateway. The general opinion among the users was that Gateway was a very naïve product and not a big improvement from Medic One. The learning and use of Gateway was affected by the inconsistencies and system bugs and had the effect of slowing the transition process. If not for the support from USER and the availability of Medic One during the transition, it would have been harder for some users to use Gateway. Many in this study felt that ACIS should have conducted additional user testing to identify and remove the various inconsistencies before introducing the product to the end users. It is important for implementers to understand the impact of system inconsistencies on user acceptance and transition, and factor this in before introducing a new product.

Gateway is designed in such a way that there is a considerable amount of information displayed on each screen. In addition to causing information overload, physicians lost valuable time in finding and gathering information for patient care. Although the users were happy with some of the features in Gateway, they were of the opinion that in many cases the information presented was unnecessary for the task at hand. Instead they would prefer to have physician specific information presented on each screen, and only access the additional information when the need arose. These findings correspond with the findings of Murff et al., who identified that "irrelevant options and information" might cause dissatisfaction and lead to inefficiency in task completion. (31) If these changes were possible and practical to implement, it would serve to reduce the cognitive load, and improve efficiency of Gateway use.

The consequences of re-implementation

The transition to Gateway has been relatively smooth for most users at USER. The study findings suggest that the majority of the unexpected consequences have resulted from usability issues rather than the transition process. In a study of 75 primary care physicians In fact Sittig et al, in a study of seventy-five primary care physicians identified that users value usability over advanced system features. (36)Implementers should be aware that usability issues might give rise to totally unexpected errors that might be detrimental to both patients and users. It has been suggested by Ash et al., that patient care information systems might not always be successful in preventing errors and could generate new errors. In addition, the errors are not usually obvious during routine analysis of patient care information systems, and only emerge when the system is embedded into the infrastructure of an organization and is used by the end users. (37) Given the scope of the study it was not possible to explore the issue of unintended consequences, but as the results suggest, it is important to consider exploring this area in the future.

Limitations

This study had several limitations that might have influenced the results. First, all the data for this study were collected in the form of interviews. As observational data could not be gathered there was no opportunity to cross reference the interview data. Second, the study was conducted nearly five months after the Gateway implementation. It is possible that user's views of Gateway had changed during those five months. The subjects in this study may have become more tolerant of downsides in Gateway. Capturing the user's opinions and feelings a few days after the re-implementation might have given a different

perspective of Gateway. It would also have given a more complete picture of the transition process. Although it was obvious that the subjects in this study had to learn quite a bit to use the system, it seems likely that the degree of learning was greater during the early days of Gateway use.

Third, this study focused on studying internal medicine physicians in one clinic. There are differences in the user population from clinic to clinic; those differences could not be identified in this study. It would be interesting to see if the same results are replicated across all specialties. Fourth, the subjects in this study focused on the limitations or frustrations of using Gateway. Given the time lag since the Gateway implementation it is possible that the users wanted to talk more about the frustrations with Gateway than they did about positive factors that played a critical part in the transition process. Finally, since it was mandatory to use Gateway it was not possible to identify changes in user reaction if Gateway use had been made optional.

Recommendations

Additional user testing could have reduced user frustration identified in the course of this study. Preferably, super-users and low level users drawn from different clinics and specialties should test the new product before rollout. Another approach is to conduct a task analysis. Task analysis is used to study the actions and the cognitive process users go through as they complete a task, and would be an excellent way of comparing two systems and identifying problems. This analysis is best done before re-implementation,

preferably in real life setting. A task analysis can help in identifying how different users will use a system, and identifying system bugs that might cause much frustration later. Major training sessions followed by a series of shorter training sessions that sequentially teach the finer aspects of the new system would help the users learn the nuances of the new system. The subjects in this study did not have the time in their schedule to plan for one-on-one efficiency training. USER could have gotten around this issue by organizing lunchtime training sessions to teach the users more effective ways of using Gateway. It would have also provided users the opportunity to interact with their peers and share information.

Summary and conclusion

The goal of this study was to understand the factors associated with re-implementation with an emphasis on the user transition process. The themes identified in this study suggest that re-implementation is important from the perspective of user training, support, and understanding the magnitude of change, all of which influence the transition process. The transition model proposed by Bridges was helpful in understanding that transitions are not automatic. The three-stage transition process is a long process because individuals have to go through all three stages as they adapt to the intended change. Understanding the time factor in transitions is important for developing a good re-implementation strategy that benefits both the individual and organization.

Although the study focused on internists at a single outpatient clinic, the results are transferable to similar re-implementations not only within USER but also at other

organizations. Factors such as gradual introduction of the new technology, appropriateness of user training, and continued support for users can be applied to other kinds of re-implementations. Further research on the subject of re-implementation in healthcare settings and the process of transition would provide valuable information for implementers and researchers.

Future directions

Future research in re-implementation should include studying users in other specialties to identify factors that might be important. A clinic-by-clinic comparison could yield results different from those identified in this study. This would provide the opportunity to generalize the study results to other clinical settings. It would also be useful to study users in a clinic before, during and after re-implementation. This would provide a way of cataloging the transition process to better outline future implementation strategies.

A combination of qualitative and quantitative methods could be used to bring out the various elements associated with re-implementation. For example, a survey could be used to quantify the number of users happy with the new system or features useful to users. Following the survey, qualitative methods like interviews and focus groups could be used to extract other subjective elements like behavior, attitude towards the new system, and emotions that might influence the transition process.

Another direction in studying re-implementation would be to study a setting where users are moving towards using a clinical information system by a different vendor (for

example, moving from a product by McKesson to a product by ACIS). This would help

in understanding the amount of learning involved in adapting to a new system.

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Appendix A

Semi-structured interview guide

Interviewee:_____Interviewer:_____

Date: Time: Setting:

About you

   Background and professional experience

   How long have you worked at USER? [Area of expertise]

   How long have you used the new version (Gateway)?

Questions for system users

   Knowledge about the new system

   - What and how much did you know about Gateway before your actual training?

   - How different it is from the older ACIS version you used a few months ago?

   Training

   - What was your Gateway training like?

   - How different was this from your Medic One training?

   - How long did it take before you were comfortable with Gateway?

Note: If the opinion ask about negative & vice versa

Opinion about other users

   - What was the opinion among your peers about Gateway right after implementation?

Effect of the new system

   - How has the new system affected your overall workflow?

   - How has this changed your work life? [Other probes: Speed and other issues]

Note: Either this or that— don not ask both the questions

   - How has it affected communication among you and others on the heath care team?

Specific questions (these are in addition to the formal questions listed above)

   - Other than the training how did you get used to the new system? [Spend personal time, etc]

   - Having used the system for a few months now what is your personal opinion about the new system?

   - Now that you have gone through one major upgrade, what do you think you will do when something like this happens again?

   - Were there any surprises with the system? [Anything unintended or unexpected?]

Note: Major vs. Minor upgrade   If given the choice, would they go back to Medic One?

Appendix B

LIST OF QUOTES (Including those in results section)

Note: All the quotes in this appendix are verbatim quotes from the interview transcripts. In some cases, an ellipsis [...] has been used to denote word(s) not captured by the tape machine or not understood by the researcher. It has also been used to denote pauses by the interviewee.

Medic One vs. Gateway

"I was almost dreaming about something like this. And it seems like it was put on a sliver platter and given to me. So yeah, for me it is... there are many good things about it. Of course there are a few criticisms about it, but mainly only very good things to say about Medic One.".

"Well, of course it is not all they said, its called Gateway because you can go anywhere within it. No, you can't. You still have to click out of this and click out of that. click here, click that, close this window, close that window and since you cannot have more than one patient open to work on, you know being easily able to move to another chart isn't there. Otherwise I think it is a whole lot straightforward than the old one."

Gradual introduction of Gateway

"That is when they started making plans on how they would rollout in this region and that we would get Gateway. And then I had seen it twice before, I was invited to an inter-regional patient safety conference that was held here and it really was inter-regional. We

had Hawaii, Georgia and everywhere. And Kasper, the guy who really knows how to use this from ACIS was there, he demonstrated it for about 20 minutes… showed how cool it was. And then I saw it one other time at Town Hall and I cannot remember why that meeting was held. I think it was for people who were interested in the system could go up and look at it. So Kasper was up here again. So I had seen it run a couple of times."

"Well… it was advertised as a newer system that actually would fix some of the drawbacks that MEDIC ONE had, which was that in MEDIC ONE you had to progressively back out from various functions to get into other functions. It was a kind of a hub and once you got into one of the branches you had to come back to the hub and go into another branch. With Gateway, you have much greater freedom of jumping from one function to another function without having to back out."

Awareness of Organizational Plans

"And I think, you know… what I understand, for all the other things that we needed Gateway for the coding, the charging, the procedures, and all that from the point of view… that it is probably better for the organization. And I can respect that because we all need to make money and do the other things that capture the productivity of the worker. But as far as being a clinician and being very patient care centered, that is my emphasis, I just find it very easy to make mistakes. And I don't think that there is anything that makes clinicians angrier with themselves as writing a prescription on a wrong patient."

Simultaneous use of Medic One and Gateway

"Oh yeah! When I work urgent care, which is one evening a week I would always, I would always go back to Medic One because I had that option. Now, I cannot do it anymore"

"You cannot use the two together. You have to log off Gateway, close everything up, and then log on to Medic One; it takes couple of minutes. So, it is not practical to go back and forth. So… because you actually loose whatever you can gain from using Medic One unless you… say you are at the end of the day, and I am just going to MEDIC ONE and not come back to Gateway then you can do that. But by going back and forth you have to completely log off the system and then go back into the other one. You loose a lot more time than what you could have saved by using Medic One."

So I would just consider it my vacation time, my vacation from Gateway and I used Medic One right up to the bloody end. I was disappointed when I could not do that anymore.

"I was going back to… yeah, I always had the choice here but I figured this was 'work, work' you know… I knew Medic One was going away, and I knew I had to increase my efficiency with Gateway.

Appropriate Training

"Much shorter, for Traditional, the training was stretched out for a week and it was like three full days and then Thursday and Friday were each mornings and patients I the afternoon and only about…at half schedule. This time around the training was much shorter, only for half-a-day. But it was appropriate given our exposure to Medic One"

"I kept hearing about Gateway for two to three months, I think… because I am only here part-time. And just like I dealt with the first situation, I... was not intimidated by computers anymore. So I thought whatever it is UHS will do a good job of training us."

"Well, even the material they gave us was not correct, I would like to have had more and then the… written material was not always correct. So, the manual was not that good to refer to."

Simultaneous use of Medic One and Gateway

Transition

"I believe so. I think you can come at it from three levels. One, you have never used an automated medical record before or you have to move to a drastically different system that was put together with different concepts, I think would be like… almost like starting from the beginning. But just knowing that you go from your terminal to the patient and

back to the terminal that part of it is half the battle. So that part you would have to learn all over again, you know, where you physically walk from one point to another and what you do. Ah… and the third part is…which is to go to two systems put up by the same company that conceptually were not different from each other. So, we are in the third category. I think that was not an hard transition."

"So there a few things that are better, it is just different. And I could accept the fact that when things are different, there is always a transition time that is… where things are a little slower, and I would say that it is overall. I can live with it."

Magnitude of change

"No, it was a much greater change than any of the MediTech upgrades. It was probably fifty percent of the magnitude of transition from the paper to MediTech. Something along those lines… it was a bit of struggle."

"Well, a lot of things have changed, they have become more straightforward. Yeah, it was a big upgrade… the upgrade was basically an ease of use because as much as I complain about some of the features in Gateway, it is a lot less clunky than the old machine…the old system that was not good."

"I have some knowledge of the other programs since we had six vendors come to the hospital and present their hospital information systems, MediTech being one of them.

And I think it would have been extremely difficult to make that transition to a different

program. I think there was… even though Gateway was so different from Medic One

MediTech I think the other systems were so completely different an approach to the

documentation needs that it would have been much, much more difficult to make that

transition. We actually entertained the idea of looking at… a different vendor for the

hospital, and it just would have been very, very difficult. There are other reasons to go

with MediTech besides that but… but… it yeah…wow!"

Learning

"We had used MEDIC ONE for 8 or 9 years. There was nothing we had to learn

conceptually.

It was just a matter to learning new buttons and the functions and all that."

"As much as there are inconsistencies with Gateway… I still have a lot to learn. Once I

learn more, maybe it will get easier."

"Well…I would then have to re-learn Medic One. I think the two… I have seen the two

as being fairly similar in being in the amount of time. But I think Gateway has a long way

to go before it can be efficient.

Frustrations or downsides

"The results reporting system no longer links with Gateway. I think they had just merged

results reporting with Medic One some time ago. So every time I want to see lab reports

or something like that, I have to manually bring up the results reporting system, type in the patient number which is usually a seven or eight digit number, and then look at reports. Again, there is an extra step involved here. And it takes time…. to enter the numbers and you have to enter them correctly. So…when I bring up the results reporting system it hides the chart review window, and I have to move the results review screen, look at the patient number and then move back to the screen and enter the number. This loss in functionality is very hard."

"I had been using Medic One regularly at home and there are times for instance when I am looking for information on patients, I'd actually rather be in Medic One because of the ability of… not to have to enter the patient's chart number to access results reporting. And that is a big thing to me. It annoys me that I have to enter those numbers again but…so I will sometimes use Medic One…when I have to go back and forth looking up information, I use Medic One."

"Yeah… my MA and I have talked about it, and we are very, very careful about rechecking now, and looking everything over, and making sure we have it right. So, that's all you can do and like I said, it is happening few and far between… but it just happened last week. And … I have to say from a provider point of view it makes me very, very upset, and just like that it can ruin my entire day."
"I think the inbox has become too complicated in Gateway. There are so many messages in the inbox now, patient calls, medication refills there is constantly some message in it.

While one can see a lot of information on one screen, there is too much information. Valuable time is spent modifying the screen or windows to look at information. This takes time away from patient care. But I guess one could get used to it over a period of time."

"We were told that with Gateway we could open more than one patient chart at a time... that we could keep a number of windows open, but that does not seem to be the case [Laughs]... you now. If Gateway was just a different way of doing the same thing, I do not understand why we needed to have a new system. The GUI is different, but all the basic components seem to be the same. Medic One satisfied all the needs; I don't see Gateway being necessarily better than Medic One."

"Now I know that it is cancelled, and the patient knows it is cancelled, the pharmacy I hope they have a system in place...where the pharmacy knows that I actually cancelled it. Yeah...this is a major problem. I mean this can potentially be malpractice, the other one I showed you can potentially be malpractice; that has happened to me more than once, like a different order getting put into the system and...that is because...I think is because of the busyness of the screen."

"Yeah... Gateway is mouse driven and Medic One was keyboard driven. In some screens, I have to point the mouse exactly over the patient name to open it. With Gateway there are more clicks to complete a task and this takes more time. "

"If you go to order entry and you have to order something, and then you pick two a day, and accept it, and then it offers you things in a somewhat different way like... "You said two a day would you rather have one pill twice a day"...and I say ok. I have to move my mouse down and click on it, and then go to another place and click accept. But sometimes I might be going fast, so I click the wrong thing and then I have to go back and do it again. Lets see... now I am going to accept the alternative... it goes to here, and then you have to click it to look at it because in this stage here, you do not see how many refills they got or did they get any refills or not; so you have click on it again to see if they got refills and so the whole process is if you want to delete it you have to cancel and delete, so it is two clicks. So if it is 5 medicines and somebody comes in and says, I need you to renew all my medicines or if it is a new patient and you have to enter all the medicines it is a frantic amount of work. I suppose if I was a better secretary I could enter the data more quickly. That's what I am... basically a very high paid data entry person."

Unintended Consequences

"So you have this quick review function, then there is the more intense review if you want to actually get to a place where you can add to the note, make orders and send it to somebody, do something like manipulate the notes, then you have to go to a second place that requires a few more clicks. I do not know whether that is better or not. You know, I think it would have been nicer if you could go immediately... go to the place where you could edit, and send, and manipulate the note rather than having it in two places. It is a

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little longer if you go to the place where you could manipulate the note; it takes a little longer to get to that spot. There are those seconds again."

"Finally the old system was integrated with it and we did not have to put the stupid number each time, now that is a big problem. I was thinking they should have a scanning option for the patient number. You know, how much time...it is clerical work... it is a waste of using a physician's brain to do clerical work. It's a total waste of time."

"Just look at this...can you imagine me trying to find stuff up here. The patient care tabs have to be emphasized visually and made more error proof both in terms of clicking, and how the order gets accepted. Now we are buried, we are lost in the trees; there are too many trees. "

"See where you write the Patient Instructions, this where you close the section ok. Now see how the screen kind of looks other than Patient Instructions this is the way the screen looks. Now you go into Progress notes, look at how the screen looks exactly like so everybody I know has written the Patient Instructions in Progress notes and put the Progress notes in the Patient Instructions so what has happened they wound up getting the note. It is terrible."

New Issues

"By that time in my practice, I had become very efficient at… multitasking during the visit. So I could, I could document the reasons for the encounter all the way through the diagnosis, and then plan the face-to-face encounter with the patient, all while I was spending time with the patient. So I realized that this would, that this system as a vision would diminish the amount of time that I would be able to spend face-to-face with the patients, and that was concerning to me. And it continues to be a concern"

Other quotes

"If they said that Gateway will never have the ability to link into results reporting, I would always have to type in the patient's number, I will go back to Medic One. If they… if it could work well you know, if they say that the new Gateway will go down less or slow down less or go faster then I'd have to stick with it. But if Medic One worked well, did not have stoppages and linked to results reporting, it is close enough that I would stick with it for that reason. "