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Cycles of Electronic Health Records Adaptation by Physicians: How Do the Positive and Negative Experiences with the EHR System Affect Physicians' EHR Adaptation Process?

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Abstract

The integration of EHR in IT infrastructures supporting organizations enable improved access and recording of patient data, enhanced ability to make improved decisions, improved quality and reduced errors in patient care. Despite these benefits, there are mixed results as to the use of EHR. The literature suggests that the reasons for the limited use relate to policy, financial and usability considerations, but it does not provide an understanding of reasons for physicians' limited interaction and adaptation of EHR.

Following an analysis of qualitative data, collected in a case study at a hospital using interviews, this research explains how physicians interact with EHR. The key contribution of this research is in explaining how physicians interact with EHR in terms of concepts that are grounded in the real world experiences of physicians. The model of positive and negative physician work cycles is introduced and discussed. Contributions to research and practice are presented.

1. Introduction

Research has shown that the healthcare industry is plagued by rapidly increasing costs, poor quality of service, lack of integration of patient care, and lack of information access to Electronic Health Records (EHR) [1, 3, 16, 26, 30, and 41]. "Even though U.S. medical care is the world's most costly, its outcomes are mediocre compared with other industrialized nations" [9, p.2]. Medical errors are a major contributor to the decrease in the quality and to the increases the costs of the U.S. healthcare system. Medical errors result in 98,000 deaths a year and many more injuries, and as a result, patient safety has become a top priority in U.S. healthcare [18].

The use of information technology (IT) has the potential to help healthcare organizations improve quality of service while reducing costs. The California HealthCare Foundation [26] estimated that California could save more than $3.2 billion a year and reduce the number of medication-related injuries by 250,000 a year if California healthcare clinics used EHR to handle medication ordering and diagnostic tests. The Institute of Medicine (IOM)[18] reported that the U.S. healthcare system is "fundamentally broken" and called on the federal government to make a major investment in information technology in order to achieve the changes, such as the "commitment to technology to manage the knowledge bases and process of care" [18, p. 178], needed to repair the broken healthcare system.

During the past 25 years, many medical records have been converted from a handwritten record format to an EHR format, and studies [1,6,27,35,46,48] have indicated that EHR is complicated and requires a serious, sustained commitment to human resources, process re-engineering, technology, and funding. The healthcare system has been slow to take advantage of EHR and realize the benefits of computerization [29]: that is, improved access to and records of patient data, enhanced ability to make better and more-timely decisions, and improved quality of patient care and reduced medication errors.

It is commonly assumed that U.S. healthcare services organizations are approximately 10 years behind the information systems (IS) curve when compared to organizations from other industries of comparable size and complexity [29]. According to IOM (2001), "healthcare delivery has been relatively untouched by the revolution in information technology that has been transforming nearly every other aspect of society" (p. 15). This inability to take full advantage of computerization is unfortunate because EHR has the potential to improve patient care and patient safety. In 2007, however, the American Hospital Association reported that only 11% of hospitals had fully implemented EHR, and these hospitals were likely to be large, urban, and/or teaching hospitals. Vishwanath & Scamurra reported less than 10% of physicians in different practices and settings in the US use EHR, whereas more than half of the physicians in countries like Sweden, Netherlands and Australia have adopted EHR [51]. Blumenthal (2009) cites only 1.5% of US

hospitals have comprehensive EHR systems. A similar 2009 study by the American Hospital Association shows less than 2% of hospitals use comprehensive EHR and about 8% use a basic EHR in at least one care unit. These findings indicate the adoption of EHR continues to be low in US hospitals [27].

The research question investigated in this study is how do the positive and negative experiences with the EHR system affect physicians' EHR adaptation process? This question is investigated through a qualitative study that examines how physicians interact with EHR. Open coding was used to analyze the data and to develop concepts explaining these interactions in terms of the events, actions and communications carried out among the physician stakeholders. Eisenhardt's case study approach and open coding analysis grounded the results in the real world situation. As a methodological contribution, the case study of a hospital with Eisenhardt's case study approach, propositions and open coding for data analysis is an innovative combination of research methods. This is because it enables concepts and relationships to be arrived at and then assessed using the enfolding literature step from Eisenhardt and theoretical sensitivity from open coding. This combination of approaches strengthens the contributions of this study by enabling the results to be generalized to models and relationships. The research provided theoretical contributions by presenting the Physicians' Work Adaptation Cycles in Use of EHR model dealing with positive and negative work cycles of physicians. In addition, implications of this study for future research and practice are discussed.

2. Theoretical Background

Reviews of (EHR) literature show the existing challenges with the alignment of organizational design and the engineered artifact. Niazkhani et al [32, p. 546] concluded "When put in practice, the formal, predefined, stepwise, and role-based models of workflow underlying Computerized Physician Order Entry (CPOE) systems may show a fragile compatibility with the contingent, pragmatic, and co-constructive nature of workflow." Two of the findings of Greenhalgh et al [17, p. 767] were "while secondary work (audit, research, billing) may be made more efficient by the EPR (Electronic Patient Record), primary clinical work is often made less efficient" and "the EPR may support, but will not drive, changes in the social order of the workplace". In addition, Fontaine et al (2010) concluded from a systematic literature review in primary care that "The potential for HIE (Health Information Exchange) to reduce costs and improve the quality of health care in ambulatory primary care practices is well recognized but needs further empiric substantiation." IOM (2001) claimed that the healthcare system needs to join the IT revolution, and improved information systems may be a critical factor for improving the healthcare system because of the pervasive need to access, record, and share information in order to provide high-quality medical care [47]. IOM (2001) claimed that the healthcare system needs to join the IT revolution, and improved information systems may be a critical factor for improving the healthcare system because of the pervasive need to access, record, and share information in order to provide high-quality patient care [47].

Knowledge and learning play important roles in the use of IT, and researchers have developed the diffusion, adoption, and acceptance theories to explain how people adopt, accept, and use complex organizational technologies. Attewell (1992) defined complex organizational technologies as "technologies that, when first introduced, impose a substantial burden on would-be users in terms of the knowledge needed to use these technologies effectively" [11]. From an organizational learning perspective, Attewell defined technology assimilation as "a process of organizational learning in which individuals and an organization as a whole acquire the knowledge and skills necessary to effectively apply the technology" [11, p. 1345]. The burden of learning creates a knowledge barrier that inhibits the diffusion of IT. In these cases, the use of IT can be inhibited as much by the ability to adopt IT systems as the desire to adopt these systems. Consequently, IT penetration into the market from which the stakeholders could benefit is seriously affected and the benefit undermined.

According to Prensky (2001), digital natives are people who have "spent their entire lives surrounded by and using computers, video games, digital music players, video cams, cell phones and all the other toys and tools of the digital age" (p. 1). Digital natives are used to receiving information quickly, like to parallel process and multitask, prefer their graphics before their text, prefer random access, perform best when networked, and thrive on instant gratification and frequent rewards. Digital immigrants tend to adopt and use technology, but they retain their digital immigrant accent, which can be seen in such things as turning to the Internet for information second rather than first, reading the manual for computer use rather than assuming the program will teach them how to use it, or printing their email. The differences between digital natives and digital immigrant are frequently a focus of training and education efforts, and these two groups of IT users tend to favor learning

in different environments and learn effectively from different methods [34, 36].

Figure 1, Theoretical Lens, depicts the theories and influences providing the lens for this research effort. The healthcare system is a complex organization characterized by independent professionals (physicians and healthcare providers) working as knowledge workers. The ability for these knowledge workers to access data effectively and efficiently would improve the quality of work processes and patient care. However, EHR, which enable people to work effectively and efficiently access data, have been underused by U.S healthcare
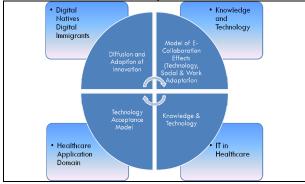

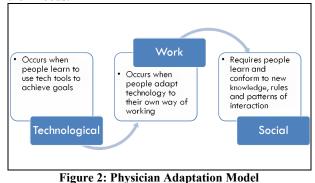**Figure 1: Theoretical Lens**

professionals, such as physicians. In order to improve the use of IT in the U.S. healthcare system, it is necessary to understand what healthcare professionals, especially physicians, think about their adaptation of EHR; therefore, this research was guided by the research question "How do the positive and negative experiences with the EHR system affect physicians' EHR adaptation process?" It examined physicians' work adaptation cycles in the use of EHR.

2.1 Physician Adaptation

The EHR has the potential to provide continuity of service to patient and could be a tool supporting collaboration for physicians and other service providers engaged in patient care. Previous technology research [37, 38, 39, 40] has investigated collaboration effects. The Model of E-Collaboration Effects provides insight to inform the Physician/EHR research in the areas of collaboration, coordination, communication and adaptation

The model of e-collaboration effects describes people's interaction with collaborative technologies. According to the model, when people use technology to work with each other, they go through technological, work, and social processes in order to adapt to new work environments [39, 40]. The adaptation of new technology in collaborative relationships occurs when members of a group learn how new technology affects

their work relationships and the work environment [38, 39, 40]. Successful collaboration requires social adaptation by team members, who must learn to conform to new knowledge, rules, and patterns of interaction.

IT affects work relationships and environments. Work adaptation occurs when people adapt the technology to their own ways of working. The work-adaptation process takes place when groups are involved in changing organizational norms and values while using collaborative technology. IT affects the work process itself and the way in which work is carried out [39, 40]. Technology adaptation occurs when people learn how to use technological tools to achieve their goals. The more flexible the technology, the easier it is for people to use the technology to meet their needs.

Figure 2: Physician Adaptation Model

Physicians using technology go through technological, work and social processes to adapt to new work environments.

3. Research Methodology

The investigation of physician interaction is complex, vague and context specific. We do not know why certain physicians use EHR and others choose not to use EHR. The qualitative methods used in this research can yield data from which process relationships and models and richer explanations about how and why processes and outcomes occur can be developed [24, 24, 49]. Qualitative methods provide researchers with the ability to discover relationships from data that is systematically gathered and analyzed [21]. Interpretivism is a type of qualitative research that allows the researcher to 'interpret' or unearth the meanings discovered in the research environment. This research is interpretivist research as defined by Klein & Myers as it assumes that a physician's knowledge of reality is gained through social constructions such a language, consciousness, shared meanings, documents, tools, and other artifacts. Interpretive methods of research in IS are "aimed at producing an understanding of the context of the information system,

and the process whereby the information system influences and is influenced by the context" [50, p. 389]. The study used an interpretivism approach to produce an understanding of physician interaction with EHR.

This study uses Eisenhardt's case study approach, interviews as the primary data collection and open coding for data analysis. The Eisenhardt method was chosen as it: 1) Generates relationships or theory with constant comparison literature; 2) Emergent theory is likely to be testable with constructs that can be readily measured; 3) High likelihood of valid relationships, models or theory because the theory building process is tied to data and other evidence.

Case studies have been used to provide description [23], generate and test theory [15, 34]. The goal of this research is to gain a rich description of physician's interactions with EHR, analyze the data and generate relationships or a theory. This study used the seven step Eisenhardt method for building theories from case study research. It is well matched to the open coding analysis selected as the case study process is "highly iterative and tightly linked to the data [10, p. 532]." Participants in the study are physicians selected from Research Medical Center.

Open coding is used to analyze the data and develop concepts as they relate to physician interaction with EHR. The qualitative method and open coding analysis enables discovery of the relationships in the real world situation. This is an innovative combination of research methods because it enables concepts and relationships to be arrived at and then assessed using the enfolding literature from Eisenhardt and theoretical sensitivity from open coding. Theoretical sensitivity allows the researcher to have insight into and to give meaning to the events and happenings in data. "Insights do not just occur haphazardly; rather, they happen to prepared minds during interplay with the data [45, p. 47]". Eisenhardt's enfolding the literature step complements the development of sensitivity. "An essential feature of theory building is the comparison of the emergent concepts, theory, or hypotheses with the extant literature [10, p. 544]". This research utilized theoretical sensitivity and enfolding the literature to develop the lens for the effort. It allowed being able to see beneath the obvious to discover the new.

Physicians have demonstrated great variation in EHR use depending on specialization [5, 7, 8, 14, 20, 22, 31] and type of practice ownership [7, 8]. Physicians have the ability to choose to directly utilize the EHR or to avoid use of the EHR. In addition, the physician has the ability to impact others in the organization by the nature of their position. Therefore, they were selected as the target interview audience. The physician selection was based on the literature

review and was designed to emphasize variety within the sample.

The examination of the relationship between IT and organizations and people broadens the field of IT; however, this type of research produces added complexity, greater imprecision, the possibility of different interpretations of the same phenomena, and the need to take these issues into account when considering an appropriate research approach [15]. The use of a case study method to discover relationships or to generate theory minimizes these risks. The Eisenhardt method was chosen as it: 1) Generates relationships or theory with constant comparison literature; 2) Emergent theory is likely to be testable with constructs that can be readily measured; 3) High likelihood of valid relationships or theory because the theory building process is tied to data and other evidence.

The qualitative study uses the Eisenhardt research method to produce in-depth descriptions of reasons for physician interaction with EHR. The research strategy focuses on understanding the dynamics present in a setting. This approach is consistent with generally accepted approaches to develop relationships or theory from cases [6, 10, 49]. Eisenhardt's method complements the open coding approach by providing the 'enfolding literature' step. The comparison of the emergent concepts, categories, and theories with conflicting concepts, categories, and theories discussed in the literature produces internal validity, and a comparison of emerging concepts, categories, and theories to similar concepts, categories, and theories discussed in the literature produces generalizability [10]. This process continually builds the researcher's theoretical sensitivity.

4. Results & Analysis

The data for this analysis was comprised of seven physician interviews from varying specialties and represented 66 pages of electronic transcripts.

Site Selection: Research Medical Center
Unit Analysis: Physician (Patton, 1987)

Physician	Specialty	Age	EHR Usage	Experience (years)	Experience at Research (years)
Barry	ER	53	96	22	15
Brian	ER	31	88	4	4
Harry	OB/GYN	45	44	15	15
Jane	Family Practice	42	62	9	9
Judith	Pediatric/ Internist	39	73	13	13
Steve	Geriatric/ Internist/VPAA	62	NA	35	11
Victor	Surgeon	38	65	8	4

Figure 3: Physician Description

This data was collected over a period of six months from October 2009 to March 2010 at Research Medical Center, a Midwestern hospital located in the United States. While analyzing the transcripts of the interviews, "labels of meaning" were identified and placed next to the relevant occurrence. Occurrences were events, happenings, actions, feelings, perspectives, actions and interactions. Categorization of the coding was done in two phases. First, the data obtained from the interviews was coded into broad categories. The interview data was analyzed using Strauss & Corbin's (1998) open coding method. Open coding was used to conceptualize raw data by naming and categorizing the phenomena through close examination of the data. During open coding, data was broken down into discrete parts, closely examined and compared for similarities and differences. The coding process yielded 833 coded quotes. The data representing events, happenings, actions and interactions that were found to be conceptually similar in nature or related in meaning were grouped under abstract concepts that best represent the phenomenon. According to Strauss and Corbin (1998), although events or happenings might be discrete elements, the fact that they share common characteristics or related meanings enables them to be grouped. Based on their ability to explain what is going on, certain concepts were grouped under more abstract higher order concepts which Strauss and Corbin (1998) term category. Categories have analytic power because they can have the potential to explain why physicians may or may not use the technology and potentially predict the effects of certain implementations on physicians' use. The 833 labels were categorized to compare codes across the interviews. The categories were derived by tabulating the number of occurrences of related concepts.

Reliability of these groupings was achieved through theoretical sensitivity, iterative coding and theoretical sampling. Strauss and Corbin (1998) suggest that theoretical sensitivity is required to enable the researcher to interpret and define data and thus develop relationships, models or theories that are grounded, conceptually dense and well integrated. Sources of theoretical sensitivity are the literature, professional and personal experiences. Additional reliability was achieved through the iterative use of open and axial coding to bring out the concepts and discover any causal relationships or patterns in the data. Strauss and Corbin [45, p.98] state that "though open and axial coding are distinct procedures, when the researcher is actually engaged in the analysis he or she alternates between the two modes". Along with the groupings of abstract concepts (open coding) and identification of causal conditions (axial coding), that lead to the occurrence or development of a phenomenon, additional coding was carried out iteratively using theoretical sampling.

Further reliability was achieved through theoretical sampling, which is the sampling of data on the basis of concepts that have proven theoretical relevance to evolving relationships, models or theories. The form of open sampling used was open sampling which is associated with open coding. Open sampling was used to select additional interview data. The 'slices of data' (Urquhart 2009) of all kinds are selected by a process of theoretical sampling, where the researcher decides on analytical grounds where to sample from next. Glaser and Straus (1967, p. 3) state that the researcher does not approach reality as a tabula rasa but must have a perspective that will help him or her abstract significant categories from the data based on the constructs identified in the literature. This data analysis produced technological, work and social adaptation categories. A further analysis of adaptation at each of the three levels revealed the level the physicians are able to use EHR to support their work practices, level of technological comfort and social interactions/connections. The categories, descriptions and number of occurrences are shown in Table 1: Physicians' Adaptation of EHR.

Table 1: Physician's Adaptation of EHR

Category	Description	Instance
Work	The physician perspective of EHR usage on physician work. Subcategories: Positive Work Impact, Negative Work Impact, Productivity.	197
Technology	The Physician perspective on implications of IT Context on EHR usage. Sub-categories: System Development, Hardware & Configuration, Training, Documentation, Desire Integrated Systems, Downtime Concern.	75
Social	The Physician perspective on implications of Social Context on EHR usage.	18
Total		285

Physician adaptation enables physicians to work within the environment of the EHR. Analysis indicates positive and negative adaptations. This research has shown that EHR have changed the work practices of physicians by forcing them to complete data entry type tasks, change the method of their assessment, and modify the flow of thought recording. It appears EHR success may hinge upon its ability to integrate data, process and thought.

4.1 Negative Cycles

The analysis suggests physicians' dissatisfaction stems from their inability to have systems support their work as demonstrated by the following instances components of negative cycle.

4.1.1 Mismatch with work processes. It appears physician work processes were not supported by the EHR. It appeared inhibited by specific functions related to specialty and lack of integration of clinical process, as indicated by the instances below:

"Now, with that being said, we have a whole generation of physicians coming up that are not as good at their clinical skills. I am not as good at my clinical skills as my elder colleagues. They can walk into a room and diagnose something because they were good clinicians. Now we look at a patient and say what do they have and then we look at the data and make the data fit what we want it to. Does the data fit what it could possibly be rather than I think it's this, what do I need data-wise to confer? And so I think with EHR we are doing a lot of it, we are spending more time trying to find out what it could be with data rather than talking to a patient". Harry.

"The major problem with technology is adoption and that most systems are not designed by people who do clinical work." Barry.

4.1.2 Mismatch with work practices. This research has shown that EHR have changed the work practices of physicians by forcing them to complete data entry type tasks, change the method of their assessment and modify the flow of thought recording. This analysis suggests a negative adaptation due to the EHR missing support for their work flow and thought processes. The following transcripts illustrate this:

"I am not there every day I have trouble navigating that particular system. Plus it is not as user friendly; it doesn't think for you, there is too much information, too many boxes of checkmark data that is not appropriate for patient care." Judith.

"And to make, and it's going to be very hard because we all have different brains and we all see things differently, I am a visual person, so when I see it on one sheet and I see all the information I need it is very easy for me to go through that. But to go through page after page after page after page and it's really only a few hours of time doesn't work for my brain."Jane.

"I think physicians are spending less time thinking about things and instead of thinking what could be causing chest pain we are trying to think about what

are the 16 dots I need to check to meet the standard to get paid and make sure that I look good ..." Brian.

"...rather than sitting down and thinking "could this be something else, what am I missing, what else could it be?" and we don't have time to that anymore, you don't have time to use our clinical skills to take care of our patient" Brian.

4.1.3 Effects on physician productivity. This cycle is amplified as physicians continue to be dissatisfied due to the negative effects on their productivity. The following transcripts illustrate this:

"What is currently happening is the clinicians are being asked to pay for it, especially the ones that are on productivity, are being asked to pay for it out of their productivity dollars and they are not going to make a return from it." Steve.

"I think that one concern is that you actually spend less face to face time with people whether it's personal family/friend time or patient care, too." Jane.

"The upgrades are almost always downgrades. We have seen a significant decrement in things like, for instance, out discharge instructions. Now I understand that as we go wider and wider in the system there will be more of them there but the problem is that our department specific guidelines now are gone and we become so generic that they become actually useless and non-customizable." Barry.

"One of the things we hear with the Computerized Physician Order Entry system we have here, CPOE, is that most providers will tell us that it costs them time." Steve.

The decline in physicians' productivity influenced the physician perspective negatively on EHR assistance with their work. This suggests that the alignment of the EHR functionality was out of sync with the responsibilities and organizational processes surrounding the work practices of the physicians.

Given these challenges, a further analysis of work adaptation investigated the level the physicians are able to use EHR to support their work practices. It appears that the work adaptation requires the majority of physician effort. The data suggests the physician productivity suffers from the EHR usage. Physicians must adapt their work and there is disparity between effort and benefit.

Physicians are challenged to adapt their work practices to incompatible systems.

Table 2: Level Physician Work Adaptation to EHR

Work Adaptation	Description	Pos (n)	Neg (n)

Category	Description		
Impact on work practices	The physician perspective of influence of EHR on physician work.	85	69
Physician Productivity	The physician perspective of influence of EHR on their productivity	(0)	(43)

This research has shown that EHR have changed the work practices of physicians by forcing them to complete data entry type tasks, change the method of their assessment, modify the flow of thought recording and enter 'clickable' fields that may or may not be relevant to their thought process. In addition the EHR were found to lack support for their specialty needs, were incompatible with their work practices and were not integrated with their 'other' work environments. This case research has shown that EHR have a negative impact on physician productivity. The physician is slowed down by the data entry requirements, search for the relevant notes and navigation through unnecessary system steps.

4.2 Positive Cycles

However, the physicians' perspective indicated positive result on the ability to access detailed data provided from other sources. The ability to integrate and access historic test results or information that was previously unavailable into their work and thought processes is beneficial. The physicians are advocates for the ability to 'access data at their fingertips'. This benefit was indicated by each physician. Positive work adaptation was revealed as demonstrated by these instances:

4.2.1 Time savings. According to physician perspective, the EHR does provide time savings related to data retrieval and decision support.

"Now true enough, the piece of technology that we use, the Electronic Health Records, saves them time for data retrieval, siphoning through old results, old dictations, old radiology reports, great for data retrieval, saves a lot of time rather than sifting piecemeal through paper charts" Judith.

"There are certain things we on our office computers have a flow sheet and I can show you an example on any obstetrical patient you can pull up .... It prints this beautiful flow sheet, it has all the information."Harry.

4.2.2 Improved access to required data. The physicians appear to find the improved access to

historical data and the tools supporting data beneficial. This is demonstrated by instances showing the benefits and expectations of future expectations.

"..The data is there to say that is true but the data isn't as strong as most of us would have hoped and particularly in light of the fact that technology hasn't replaced the traditional methods for caring for patient's by and large in terms of hands on care."Steve.

"So for retrieval of old information, retrieval of new data regarding patient care it is instantaneous, you can check information from places outside the hospital, at other physician's offices and at homes. Again, it leaves you not tied to the hospital." Judith.

"As I mentioned before I think that the data retrieval aspects are very good. You should find few physicians who disagree with that; some of the stubborn ones who just don't like the system in general will say it's not even good for that but it is. So, I like it for the data retrieval, I think the efficiency for following trends in labs, for trends in vital signs, those kinds of things are very, very good." Judith.

"Efficiency of data retrieval, getting old records. Again the longer the system is around the more efficient obtaining old records are because you continue to build your database. Whereas a new system, and we are still relatively new, we are only roughly four years into our EHR here, but the longer you get the more populated you get with the old records which is a huge benefit when it comes to taking care of patients wherever they are and wherever they go. So those are the clear advantages." Victor.

"So far it is just a fancy piece of paper. I would love to see it properly utilized as a learning tool, as a tool going forward as a way to enhance, standardized, and measure our medical care and then allow people to query, in real time, with simple English language or bool in questions, a large database of information that is being gathered by these health care organizations." Barry.

The coding analysis revealed the impact of physician perspective of administration to have an influence in physicians' adaptation of EHR.

Table 3: Organizational Processes Influencing Physician's Adaptation of EHR

Category	Description	Instance
Value Perception of Administration	The physician perspective of administration or organizational context that impacts EHR usage.	55

This category illustrates the bundles of meaning relating to how physicians perceive the support or lack of support in their adaptation of EHR. The data indicates the physicians feel the EHR decision was made without their input and buy-in. They feel they were 'mandated' to adapt to the EHR and were not considered as primary users. They felt they were left out of key decision making processes, yet were required to adjust to the EHR functions by 'becoming the highest paid user doing the lowest paid work'.

Value perception of administration is the physician perspective of the administration valuation of EHR and the physician value related to EHR. It primarily describes the lack of value associated with the increased amount of physician efforts and the perceived administrative stance of 'rosy view of EHR'. It includes sub-categories of physician communication & change management, system change methods, physician input and buy-in.

The analysis of this research suggests that there are cycles of adaptation relating to the physicians use of EHR in their work practices. A positive work cycle appears to exist, which could have beneficial work effect on physicians work practices. This positive adaptation cycle is related to the ability of physicians to use EHR to retrieve data and information to help them with their professional duties. Positive work impact can then lead physicians to become champions of 'information at their fingertips' and Decision Support (DSS). When work productivity goes down and administration does not value the work required to utilize EHR (and causes the work productivity decrease) a negative work adaptation is expected. These two cycles are illustrated in the following figure:
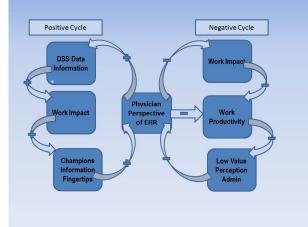

Figure 4: Physicians' Work Adaptation Cycles in EHR

The above diagram illustrates how the negative work impact, decreased physician productivity and influence of administration negatively affects work adaptation while at the same time, there appears to be a positive adaptation cycle that could be

achieved from access to data to support decisions and enhance work impact can results in physicians becoming advocates of DSS type tools and become 'champions of information at fingertips. These factors affecting adaptation by physicians appear to be influenced by other organizational processes and infrastructures.

The opportunity to influence the correlation between the negative and positive cycles provides opportunity for administration to adapt their influence to change the low value perception of the physicians and acknowledge the work impact and work productivity influences. The physician value on the ability to 'turn data to information', may be an opportunity to influence the physician perspective on the negative cycle as key to obtaining the necessary data.

Analysis indicates EHR appear to be a new technology that is considered additional work resulting in reduced productivity by the physicians required to use it. At the same time, the benefits of using these technologies have been touted by administrators and politicians. The emphasis on benefits derived from ability to turn data into information and analyze at speed of thought could be key to positive adaptation.

The development of EHR appears to have repeated a common development challenge. The physician perspective of the necessary change is reflected in a seminal Simon quote, "This is an old weakness in engineering design, not peculiar to computers: we are fascinated with our technical capabilities and design sophisticated hammers which go around looking for nails that are shaped so as to be hammerable by them (p. 135)."

4. Summary & Conclusions

The research employed a qualitative research design to discover reasons of physician interaction with EHR and to generate the Physicians' Work Adaptation Cycles in the use of EHR explaining the categories, constructs and relationships. The positive and negative work cycles describe the physician perspective relating to the EHR in this case.

It was an important area of study to provide insights for discovering physician perspective on interaction with EHR and generating and explaining the categories, constructs and relationships related to physician perspective of EHR. People use systems to meet their particular work needs, or they resist them or fail to use them. EHR can provide some major benefits in direct support of patient care: They are touted as a vast improvement over the paper record in reporting, organizing and locating clinical information. They are

touted as an improvement in physicians' decision-making by providing protocols, reminders and alert; and they can be designed to coordinate and manage patient care. Therefore, it is important to understand the physician perspective related to EHR and to understand the major components to be addressed to influence physician adaptation of EHR into their work practices and knowledge processes. This information could help practitioners develop strategies to optimize the interaction with EHR and the study could contribute to the quality of care, quality of data, effectiveness and efficiency gains and patient safety. In addition, the results of the study could guide future attempts to integrate EHR into the fabric of healthcare organizations. Ultimately, it can contribute to improved patient care and safety.

Practice can benefit from understanding Physicians' Work Adaptation Cycles in the Use of EHR and their influence in the workplace. In addition, exploring the subcategories of infrastructure and processes provides opportunity to improve these areas.

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