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Does Unlearning Impact Interaction of EHR End-Users?

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Abstract: Organizations need to remain competitive in today's marketplace. Technology change impacts knowledge competencies that require alteration quickly, to reduce operating costs, and eliminate human errors. Updating computer system documentation procedures require unlearning to maintain competency. Physician end-users possess specialized competencies, or knowledge base in documentation of patient data to the degree that these operations have become automatic. To change the knowledge base of practitioners, end-users must use intellectual capital to unlearn patient care EHR documentation. This study focused on competency change, with the perceptions and influencers of unlearning of old competencies during EHR updates.

INTRODUCTION

Maintaining skill competencies while undergoing knowledge change is an ongoing problem (Nonaka, 1994). One method to develop skill competency in physician practitioners involves task repetition until errors are eliminated and learning is demonstrated (Neal, et al., 2012; Clark, 2010). Characteristics of learning have some relationship to unlearning as they both involve knowledge acquisition and change. The unlearning process involving disuse or replacement of knowledge may be related to specific types of learning or transformational change (Lewin, 1951; Hedberg, 1991).

Researchers suggest knowledge change processes are derived from learning theory, or transformational change processes, or simply part of technological advances**.** Individuals interact within organizations to update knowledge, trust, and competencies in healthcare practice (McInerney and Day, 2007). Turc and Baumgard (2007) suggest organizational knowledge management processes involve unlearning within the organization, but are uncertain how (McInerney and Day, 2007). Competency maintenance processes in organizations compare to individual knowledge change, or unlearning (Hafner, Ellis, and Hafner, 2014). In acquisition of knowledge, previous learning, considered knowledge base, can become obsolete, or consists of errors. This may be due to technological advances, or procedural changes from organizational mandates that change the knowledge base. In addition, organizations need to transfer new knowledge quickly to all end-users to maintain a competitive advantage. (Leibowitz, 2000, Duffy, 2003; Nonaka, 1994). End-users may have difficulty adjusting to numerous procedural changes and technological updates (Clark, 2010; Starbuck, 1996). Understanding change processes during competency acquisition is essential for the physician practitioner.

When environmental conditions change, knowledge and skills need updating to maintain competency (Rushmer and Davies, 2004; McInerney and Day, 2007; Starbuck, 1996). "In the global economy, knowledge is king"… "In such an environment, knowledge counts for more than capital or labor." (Starkey, Tempest and McKinlay, 2009, p. 74). For "knowledge organizations", there is a realization that there is value in knowledge. The acquisition of knowledge base and modification of this intellectual capital needs to be a new focus for healthcare end-users (Leibowitz and Beckman, 1998). The process of "unlearning" may be a critical element involved in physician practitioner end-user change (Starbuck, 1996; Nonaka, 1994).

Basic practitioner competency maintenance presents an ongoing problem for healthcare organizations (Leibowitz, 2000). Currently, researchers are uncertain how technological knowledge is updated (Low, 2011). Consider the process of unlearning. How technological knowledge and provider competency occurs may involve unlearning of previous competencies (Starkey, Tempest and McKinlay, 2000). Problems such as lost productivity, and re-work due to error production need to be avoided (Starbuck, 1996). With new methods of knowledge acquisition available

to develop effective physician competencies, leaders can implement them for successful change. The practitioner end-user that can use successful unlearning methods will acquire knowledge more effectively needed during change.

Organizations are challenged to improve practitioners' ability to acquire, and refine new skill competencies from outmoded computer system knowledge-base. The process of unlearning plays an undefined role in this knowledge change. Previously learned behavior and obsolete knowledge modified through unlearning may be the key to successful competency maintenance (Low, 2011).

THEORETICAL BACKGROUND

Unlearning has an undefined relationship to learning where skill change is needed (Hafner, Ellis, & Hafner, 2014). Both processes involve knowledge acquisition and change, however changing knowledge may involve personal experience with initial learning frameworks when acquiring new knowledge. Others suggest this process is merely change in pure form. Mezirow (1991) and Lewin (1951, 1989) both appear to believe that unlearning is oriented to transformational change stages. Unfreezing, change, and refreezing are the parts of active change according to Lewin (1951, 1989). The Three Stage Change Model utilizes a planned and controlled process directed by an organizational leader undergoing change (Lewin, 1989). Lewin's change model explains organizational level change theory, but fails to include specific individual knowledge acquisition change processes. McInerney and Day (2007) suggested that the learning process in an individual is important to the expression of knowledge and transmission of that knowledge, thus resulting in competency with other organizational individuals.

Completing needed end-user knowledge change requires innovation. To produce skill competency without errors allows for an organizational competitive advantage (Neal, et al., 2012). The development of functional, competent practitioners through new learning-change methodologies have been of interest, however, unlearning has not been the focus (Tsang and Zahara, 2008). Knowledge, skills, and competency research within the realm of learning change processes have produced discourse, but study regarding unlearning is often not included or completely understood (Akgun, Byrne, Lynn, and Keskin, 2007).

Transmission of knowledge organizationally to the end-user is the key to maintaining overall skill competency (Senge, 2006; Duffy, 2003). How this knowledge change process occurs and is facilitated is an ongoing problem (Nonaka, 1994). Unlearning, defined as the process of, disuse or replacement of an action, procedure, or belief, in favor of a new one (Hedberg, 1991). For the individual, the processing, retention and modification of their current knowledge base to correctly perform practitioner tasks is essential. The practitioner end-user must make specific changes in previous knowledge base that involves implementation of modified processes and new technologies. Unfortunately, the unlearning process may result in increased upset for the end-user; possible errors, and operating expenses. This process requires further investigation.

Take the case of a physician who provides healthcare to a new patient. The physician is responsible for evaluating the patient through collected data and determining a course of action, a plan of treatment. This action may involve, diagnostic testing, such as temperature and blood pressure, a blood draw for presence or absence of vitamins or other chemicals, or blood sugar testing. Historically, most data was collected by the practitioner and hand written. Another method of data collection included using dictation for data processing in the medical chart. Most physicians would agree that their ability to perform these routine services and document them have become automatic; these services are performed without conscious awareness. The latest innovation has changed procedures. This includes updates of data documentation procedures with the latest EHR (Electronic Health Record) system for data collection. Thus, the physician practitioner is the end-user of the EHR device for healthcare documentation.

This process has met with concern, frustration and generalized upset for many healthcare service providers, especially physicians. The physicians have had to change their knowledge and processes to work with the EHR as a tool for data documentation. When end-users are responsible for completing old tasks in new ways, it is important to understand the impact of how knowledge processes change when skills are no longer automatic. The previous strategy to "unlearn" to produce new knowledge competencies has been confused with learning (Hafner, 2015). In the learning process, the individual is exposed to new knowledge, acquires it, and processes this knowledge for

future use. This idea fails to address how knowledge is changed in end-users, such as physicians that have a previously acquired knowledge base and have made their actions automatic.

How modification and re-storage of knowledge is completed during knowledge change is under debate. Senge (2006) adds that knowledge is changed dependent on its usefulness (Senge, 2006). Newstrom believes unlearning begin with a "clean slate" before adding information (Newstrom, 1983). Hedberg (1991) posits that knowledge base is not only changed, but may also be discarded (Nonaka, 1994). This suggests that unneeded information is erased whereas, Starbuck (1996) views old knowledge is no longer used when it is incorrect (Starbuck, 1996; Hedberg, 1991). Klein (1991) suggests that knowledge is a cognitive process that may be situationally determined and also can be association-driven (Starbuck, 1996; Klein, 1989).

One method to allow for improved knowledge change is to combine informational bits for ease of use and storage. Cognitive load theory (CLT) suggests a complex relationship between the brain's ability to acquire and change knowledge (Merrienboer, and Sweller, 2010). This ability to acquire and store information for retrieval is limited. The informational units stored appears to be – seven – however the information deteriorates in as little as 20 seconds (Merrienboer, & Sweller, 2010). Automation is another method to compensate for difficulty in knowledge storage during change (Nissen, 2006; Starkey, Tempest & McKinlay, 2000). Repeated performance of an activity with enough frequency allows for automation and the individual, can perform activities without thinking. When updating knowledge, or unlearning, the automated knowledge base needs to be altered. Extension of knowledge storage capacity occurs because other activities can be focused on, such as in medical practice (Starkey, Tempest and McKinlay, 2000). Clark (2011) suggested unconscious unlearning occurs without awareness. Clark (2010) summarized unlearning by stating,

> 1) Adults may be unaware of their learning strategies they are using in general; 2) When change strategies fail, one unexamined factor is the relation of the stability of automated behaviors on new knowledge; and 3) there is limited understanding about how to unlearn automatic and unconscious knowledge in favor of new learning (Clark, 2010).

One important difference points to the fact the knowledge base has become unreliable and requires a new action or behavior to complete a task. (Hedberg; 1991; Starbuck, 1996). However, there may be other interactions in knowledge change that need to be determined. The inherent complexities of unlearning are currently not understood, supporting the need for additional research (Creswell, 2003). Explanations of unlearning are varied depending on the selected field of research (Duffy, 2003). In addition confusion remains between learning and how unlearning differs. From previous research, it was determined that unlearning was different from learning due to factors required in change and the presence of a prior knowledge base (Hafner, 2015).

Consider the increasing use of computer systems in healthcare organizations. Computer systems are responsible in a variety of automatic functions. Now computers are employed in documentation of patient data with the use of control systems prevalent in healthcare operations such as, monitoring patient data, processing drug orders, managing supply inventory, completing financial, billing and insurance transactions. In routine practice, computer systems are replaced frequently, and versions of software are changed to more closely support changing healthcare operations. As a result, EHR procedures are also updated, or replaced to correct obsolesce, thus reflecting new documentation changes.

These changes require that operations of end-users continually revise their mental models and processes to successfully use the latest EHR versions. In healthcare industries where computers are deployed to assist with work tasks, errors occur when machines are used to complete functions previously completed by humans. End-users must develop rote actions, or become automatic, in operating computing equipment no matter the frequency of changes needed (Schmorrow, Cohn, and Nicholson, 2010). With the replacement of older models with newer equipment, previously learned rote behavior may not allow for accurate operation of newer machines. The updated piece of equipment may even break due to command errors. Historically, when changing entire processes from a traditional tangible paper documentation system contained in a chart to an EHR, end users faced unlearning difficulties. These same challenges persist as end-users face technological upset attempting to make the human-computer interaction changes needed to update old processes to new.

Organizational mandates that create changes in routine may contribute to an increase in errors. Behavioral automation composed of repetitions of actions accounts of approximately 45% of daily actions (Clark, 2010). When unlearning is incomplete or unsuccessful, the result may be errors in documentation whether written or EHR generated. During change processes where actions are already in a state of flux, such as in new end-user EHR procedures, understanding error production resulting from unlearning may prove useful (Hedberg, 1991). The variety of errors may result from inaccurate use such as typing inaccuracies and other EHR errors. Additional examples of ineffective EHR use includes the low-level close approximation errors, such as the miss writing and miss typing in medical documentation to the highest possible level errors with consequences resulting in death (Walsh, and Gurwitz, 2008).

Demonstration of the automatic actions performed by end-users and commonly observed in EHR use are numerous. As the changes become more frequent, the ability to completely unlearn these automatic actions becomes more important. With the complete unlearning process in end-users defined, organizations may have the ability to acquire knowledge needed for continual updating human-computer interaction processes as often as needed. Problems such as lost productivity, re-work, and errors may be avoided (Starbuck, 1996). This then becomes the basis of new descriptive research study. With the results, consequences of incomplete unlearning during the updating of EHR knowledge change can be discovered. In addition, the results of difficulties involved with incomplete individual unlearning may establish a new link to error behavior. By determining successful unlearning methods, EHR end-users may possess the ability to change and acquire updated knowledge needed to update current competencies while maintaining productivity.

Additional benefits could lead to developing focused training in human-computer interaction systems. Unlearning of automatic actions can be facilitated by matching training materials to the end-user's knowledge change and acquisition abilities. Using knowledge about the mechanisms of unlearning may add to end-user ease of use or satisfaction.

Statement of the Problem

Skill competencies have been difficult to maintain within organizations. End-users need to keep pace with constant technological changes and industry advancements to maintain competitive advantage in today's marketplace. The amount of waste in materials, time, and human resources, not to mention the financial costs, have negatively impacted organizations who fail to understand the need for new change processes. The challenge is to develop and implement new knowledge consistently. To prepare end-users to unlearn, store and use knowledge functionally to update old outdated processes is an ongoing organizational need. Systemic change through individual unlearning is necessary solve this persistent problem. Current literature regarding the process of unlearning and its relationship to learning and has not been established or quantified. Completing the unlearning process successfully has been a challenge for end-users who modify their computer system knowledge to perform standard job functions efficiently. The confusion is that there is a difference between learning and the unlearning process when it involves practitioners that are working with updated computer processes. This study will examine unlearning to demonstrate the specific influencers that occur in the unlearning process in end-users.

There has been limited study regarding the how unlearning occurs in end-users. Although study regarding organizational unlearning has contributed to innovation processes, existing study about unlearning in human-computer interaction processes remains limited (Becker, 2010; 2004). The idea that an individual should... "eliminate preexisting knowledge or habits that would otherwise represent formidable barriers to new learning" has not been determined (Clark, 2010, p. 5). There is disagreement within current literature about what processes impact unlearning tasks involve unconscious or automatic actions (Low, 2011; Becker, 2010; 2004).

There is a gap in the existing knowledge about the process of unlearning during change in human-computer interaction processes, such as in the use EHR's. Examination of open study issues should include: 1) demonstration of unlearning in end-users during knowledge change, 2) determining influencers in the unlearning process where previous knowledge base is updated.

The research question is: How does unlearning affect end-user performance when changing to a new system interface?

RESEARCH DESIGN

Problems persist due to disagreement regarding an agreed upon definition of unlearning. Additional confusion persists as to whether unlearning is actually learning. Without a specific accepted definition and a clear delineation of the differences between the two processes, how to successfully maintain end-user competency will remain unsolved. This study focuses on demonstration of unlearning involving a change from one EHR method of collecting and using data documentation to the use of an updated EHR. These end-user physicians are familiar with patient care in the areas of assessment, diagnosis and pharmaceutical selection to the degree that their operations within patient care have become automatic. These medical practitioner end-users possess a specialized competency and currently possess a stable knowledge base in documentation completion. The description of additional components of unlearning specific to healthcare service delivery, such as diagnosis and assessment documentation in the practice of medicine are considered as current competency and previous knowledge base. In order to demonstrate the end-user difficulties in producing unlearning knowledge change requires study.

Physician end-users of an EHR device for healthcare documentation gave responses about their use of these devices during the processes of diagnostic assessment documentation and subsequent initial care to determine and measure whether unlearning has impact on documentation system change (the EHR) in service delivery. Data was collected through an electronic questionnaire comprised of two open-ended questions asking respondents about their perceptions and experiences with electronic health record technology change.

This study uses a qualitative research method to examine physician interaction with updated EHRs. It uses Yin's (1984) case study approach, open-ended survey questions as the primary data collection and open coding for data analysis. The Yin approach was chosen as it: 1) generates relationships or theory with constant comparison literature; 2) allows emergent theory that is likely to be testable with constructs that can be readily measured; 3) has a high likelihood of valid relationships, models or theory because the theory building process is tied to data and other evidence (Yin, 1984).

Open coding is used to analyze the data and develop concepts as they relate to physician interaction with EHRs. The qualitative method and open coding analysis enables discovery of the relationships in the real world situation. 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 (Yin, 1984, p. 47)." Eisenhardt's enfolding the literature step complements the development of sensitivity (Eisenhart, 1989). "An essential feature of theory building, is the comparison of the emergent concepts, theory, or hypotheses with the extant literature" (Eisenhart, 1989, p. 544). This research utilizes theoretical sensitivity and enfolding the literature to develop the lens for the effort and to strengthen the results. That is, "it is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon" (Strauss & Corbin, 1998, p. 23). This approach is consistent with generally accepted approaches to develop relationships or theory from cases (Baskerville, and Myers, 2004; Eisenhart, 1989; Urquardt, 1989; Yin, 1984).

The hospital selected for this study is an early adopter of Electronic Health Records (EHR). It has successfully integrated all of its internal units with various modules of a single EHR vendor. Data was collected over a three-month period in 2013 at an acute care county hospital located in the Midwestern United States. This hospital was chosen for its central location and importance in providing healthcare for the county. Seventy-three physicians were selected possessing a variety of specialties. The entire hospital physician population was surveyed.

Physician EHR device end-users responded about their perceptions of healthcare documentation processes changes during documentation of diagnostic assessment and testing processes, pharmaceutical selection and initial patient care. The researchers wanted to establish a link between routine processes completed with previous EHR technology documentation systems and unlearning of new EHR technology documentation. Would there be any impact in their service delivery using the new EHR system? More specifically, would unlearning be perceived using the new EHR

system? The two open-ended questions in this qualitative study were: 1) What works well related to the electronic health record system? 2) What are your concerns related to the current electronic health record system?

Twenty-nine female and forty-four male physicians completed the questionnaire. Ages of the practitioners fell into five broad groups. The groups were: 1) Eleven under 30 years; 2) Twenty in the range of 30-39 years; 3) Twenty-one in the range of 40-49 years; 4) Eleven in the range of 50-59; 5) Nine in the range of 60-69 years. One participant opted not to disclose age. Participation was voluntary, electronic, and solicited via email. There was no direct reward for participation.

The date was coded using the following definitions: 1) *Cognitive Processes*: defined as the end-user perception of time and accessibility that was needed to unlearn the old EHR documentation competencies and update to new EHR competencies, 2) *Data Integrity*: defined as the reduction or elimination of misleading and/or inconsistencies in the data to use the EHR documentation system. This also includes the privacy and ease of access in information, 3) *Proper Functionality*: Defined as the standardization of the EHR system needed to successfully use the system without upset, or disruption (Shneiderman & Shneiderman, 2003). This is an area where incomplete unlearning can breakdown the process as end-users struggle to update their current competencies, 4) *Errors*: defined as concern or fear of the production of medical errors created from incomplete unlearning when updating competencies.

RESULTS & ANALYSIS

The transcripts of the interviews were analyzed; "labels of meaning" were identified, and placed next to the relevant occurrence. Occurrences were events, happenings, actions, feelings, perspectives, perceptions, actions and interactions. Strauss & Corbin's (1998) open coding method analyzed the interview data. The authors used two phases to categorize and code the data. First, the interview data obtained were coded into broad categories. Then open coding conceptualized raw data by naming and categorizing the encountered phenomena through close examination of the data. In the second phase of the open coding process, all data were separated into discrete parts, closely examined, and compared for similarities and differences.

The coding process yielded 77 coded quotes. The data representing events, happenings, actions and interactions found to be conceptually similar in nature or related in meaning were grouped under abstract concepts that best represent the phenomenon. According to Corbin and Strauss (2008), although events or happenings might be discrete elements, the fact that they share common characteristics or related meanings enables them to be grouped (Urquhart, 1989). 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 77 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 (Urquhart, 1989). 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.

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' of all kinds, as Urquhart (1989) describes this process, are selected by a process of theoretical sampling, where the researcher decides on analytical grounds where to sample from next. In this, 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 (Strauss and Corbin, 1998). 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 EHRs to support their work practices, level

of technological comfort, and social interactions/connections. The categories, descriptions and number of occurrences are presented in Table 1.

Table 1. Physician Unlearning of EHR's

Physician Unlearning of EHR's			
Category	**Description**	**#**	**%**
Technological Upset	Any perceptions of unbalanced skills, added stress, or frustration while completing tasks using an EHR system.	77	100
COGNITIVE PROCESSES	A perception that time and accessibility are needed to unlearn the old documentation competencies and update to the new EHR competencies.	25	32
DATA INTEGRITY	The presence of misleading, inconsistent data needed to complete EHR documentation, including security, privacy and access of information. If the end-user has data that he can use; he has reduced technical upset and may be more likely to unlearn the old competency.	24	31
PROPER FUNCTIONALITY	The standardization of an EHR system needed to successfully complete a task without upset, or disruption. Incomplete unlearning can create additional struggle for the end-user as they update current competencies.	19	24
ERRORS	The concern or fear of creating an error related to inability to update a skill competency.	9	11
Others		2	2
TOTALS		**77**	**100**

Cognitive Processes

Twenty-five respondents suggested that Cognitive Processes had impact on their unlearning difficulties. *Cognitive Processes* are defined as the end-user perception of time and accessibility that are needed to unlearn the old technological documentation systems to update knowledge to the new EHR competencies. 25 participant responses were concerned with their ability to change their knowledge within time frames. An additional concern was that physician end-users had difficulty with their ability to obtain the data that they required to complete competent documentation. When inability to complete new documentation processes with needed data occurred, perceptions of decreased end-user competency and upset occurred. Additional upset and confusion was identified an unlearning influencer. Physicians expressed concerns that additional work to complete the patient documentation process was due to the EHR changes.

"Most of the notes for a specific diagnosis produced by the EHR are similar if not identical to each other" (Participant 25).

"You cannot find a good nursing assessment at all… no integration to pharmacy and current assessment of medication" (Participant 32).

Participant 37 states that,…"there is a reduction in clinical information…difficult to synthesize checkboxes".

Data Integrity

Data Integrity is defined as the reduction or elimination of misleading and/or inconsistency in the data to be able to use the EHR. This also included the privacy and access of the information. Twenty-four (24) participant responses discussed this issue. When the data possesses integrity, the end-user has reduced technical upset and may be more likely to unlearn the old competency. Unlearning the documentation competency was a concern. The end-users were concerned with the potential for additional errors in documentation of assessment and treatment due to misinformation presented within the new EHR system.

One physician commented, *"... for example, heights and weights are frequently incorrect, this in turn messes up some fields that pull the data through into calculation or dosages.... This could lead to potential med errors"* (Participant 12).

Or another physician states, *".... Approximately 20% of the drug orders require manipulation... comments don't match the order"* (Participant 8).

"Falsification of information... the templates given in the EHR system are unrealistic and way too much time to actually ask all of the question listed... the physicians assume... on behalf of the patient" (Participant 24).

Proper Functionality

With *Proper Functionality,* the end user require a system with consistency and ease of use when making the learning change. Defined as the standardization of the EHR system needed to successfully use the system without upset, or disruption, *proper functionality* was noted by 19 of the physician end-users. Several practitioners commented about the potential for upset through the lack of proper functionality. Participant 10 suggests…*"Does not seem consistent with how the drop-down menu is organized".* Upset is also apparent in another practitioner…*"Downtime procedures and negative impact of downtime on EHR.... Massive time commitment required to maintain EHR to be congruent with current practice and guidelines, on the part of the clinician and IT staff"* (Participant 4). This is an area where incomplete unlearning can breakdown the process as end-users struggle to update their current competencies. The EHR fails to support and contribute to knowledge change through a lack of standardization of the EHR for all healthcare end-users.

These unlearning influencers create additional burden on the unlearning processes. As Participant 71 states, *"When electronic medical record systems are down, patient care comes to a halt".* This comment points to the need for end-user ease in operation when healthcare documentation systems are changed.

Errors

The updating of documentation systems created enough technological upset about personal competency in service delivery that end-users were concerned. Practitioners reported observed errors or frustration. Nine practitioners reported possibility of medical errors production due to EHR documentation updates. This fear was related to the need for complete unlearning of previous competencies. When enough system change was present, end-users were uncertain of their documentation competency, creating upset. The potential for grievous errors created technological stress, to the point that the most affected end-users were willing to separate from their positions. Three examples of these upset end-user comments were:

" ... I have seen medication errors with the system" (Participant 44).

"EHR's have contributed to some errors at out hospital as well as some frustration for our doctors" (Participant 25).

"We have older employees that decide to retire primarily due to difficulty using the system" (Participant 22).

Practitioner end-users recognized the potential for problems in the unlearning process. Their inability to unlearn completely resulted in a perception of upset, a doubt their own competencies and of the data entered. The EHR system needs to support the documentation practices efficiently enough that the physician can update their documentation system knowledge to complete patient care practice procedures. When the influencers of unlearning were present, the perceptions of technological upset, and operation of the EHR became more difficult. When the upset is heightened due to frequent changes, the practitioner may take drastic steps to avoid error potential. In the model below, EHR knowledge process updating is shown to be a cyclic interaction between replacement of obsolete documentation competencies with new current documentation competencies. The practitioner end-users remain challenged to unlearn successfully to avoid upset and maintain competency.

The model in Figure 1 illustrates knowledge competency change needed to provide patient centered care. A patient centered model of technological interaction in healthcare builds upon what we know about the challenges facing the end-user practitioner. As systems change, documentation processes in the EHR need to be updated. This can create a competency knowledge gap in the end-user leading to technological upset. While it is accepted that the patient-physician relationship is at the center of healthcare-provision process, documentation of and access to needed information, assessment techniques and data collection is a vital part of this process.
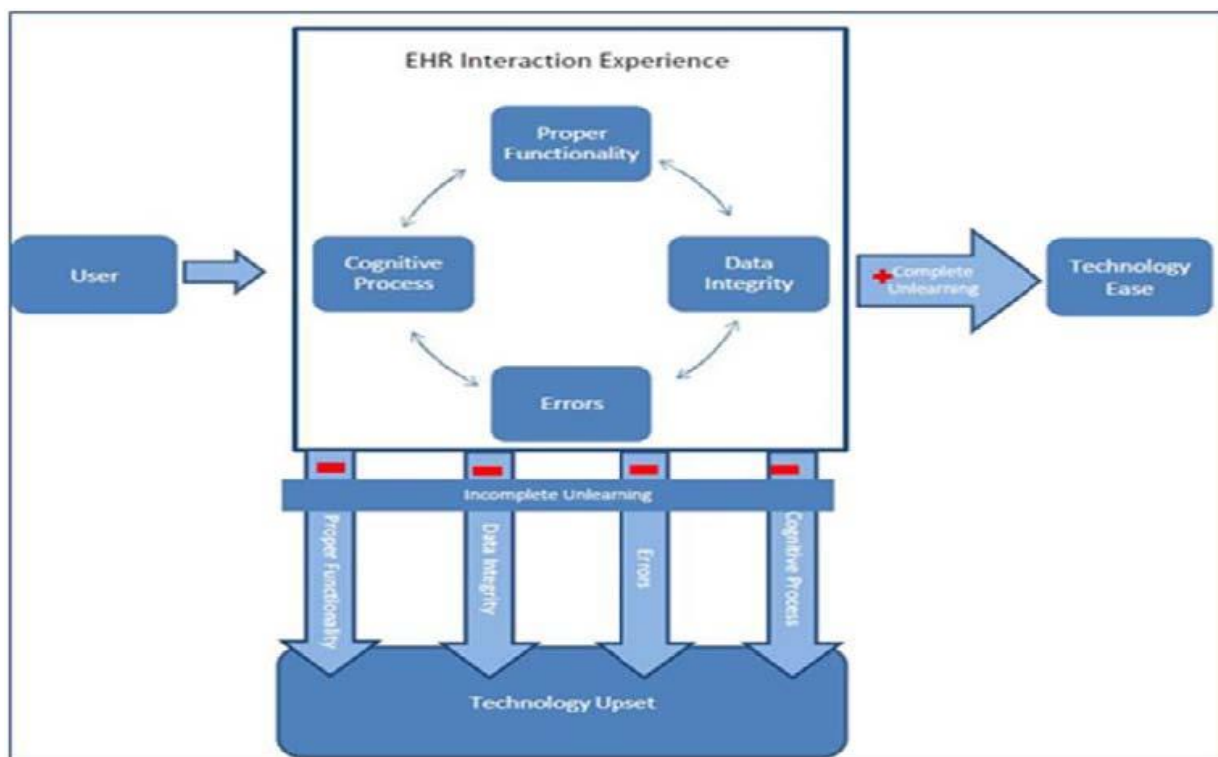

Figure 1. EHR interaction experience

Unlearning can play an important role in understanding EHR adoption processes. As new knowledge updates the obsolete, the process takes on a cyclical shape. The end-user must change competencies. This process leads to upset when the process fails to be complete. Influencers are responsible for limiting successful adoption of new EHR system changes. When there is complete unlearning of new documentation system knowledge, ease of technology use is noted by end-user practitioners. This model illustrates how integrating patient medical records with the clinical processes through EHRs with web services can enable physicians, healthcare providers and patients to

access and update current knowledge needed for "meaningful use". Adoption processes, such as the complete unlearning of new EHRs by physicians and patient end-users, can facilitate successful technology use. The opportunities for improved care through personalized medicine and tailored therapeutics by enabling all end-users to use technology and its updates is important to this process (Walsham, 1993). Understanding unlearning processes may improve quality of care as an end result of future study.

SUMMARY & CONCLUSIONS

The rising cost and decreasing quality of health care has focused the impetus of organizations towards the use of EHRs to solve these issues. The goal is to improve service delivery with the increased transparency and efficiency through the use of updated technology. However, the challenges to adoption of EHRs by physicians have tempered efforts to improve efficiency of service delivery. This study focuses on demonstration of unlearning involving knowledge change involving updated EHRs to complete patient care.

This paper has investigated: *How does unlearning affect end-user performance when changing to a new system interface?* There was a demonstration of unlearning involving a change from EHR collection and use of data in healthcare to the use of updated EHRs for the collection and recording documentation of health data. The end-users possess a specialized assessment skill and already have the ability to complete documentation in their chosen field of medicine. These end-user physicians are familiar with documentation of patient care in the areas of assessment, diagnosis and pharmaceutical selection to the degree that their EHR operations have become automatic.

Recognition of the role unlearning plays in the knowledge change process of the physician to the updated EHR is of key importance. Cognitive processes, proper functionality, and data integrity and error impact were identified as key components, or influencers, affecting physician end-user complete unlearning of the EHR system. Clearly, if one of the unlearning influencers results in negative experience, the end-user perceives 'technological upset'. As the EHR is a fluid system with frequent updates, unlearning is an essential component of the EHR interaction cycle.

Thus, continued attention to the cognitive process change, data integrity, proper device functionality, and awareness of potential errors are key to successful physician engagement with the EHR. If these four unlearning influencers result in positive experience, the practitioner is likely to achieve "technological ease" (Hafner, 2015). Technological ease enables the physician end-user to update their technological knowledge and facilitates data documentation. The ease of EHR use may lead to enhanced collaboration and support as physicians assess and verify data, solve problems, and find innovative solutions to patient conditions.

In order to achieve better quality of care, the electronic health records with web services can provide the transparency needed as physicians utilize the technology to exchange content. With improved patient interaction, patients are enabled to access their information to make better healthcare decisions. This study focuses on four influencers creating negative perceptions of unlearning of old competencies during EHR updates. Further research will need to assess complete unlearning processes to create ease of access of EHR technology.

Problems persist due to disagreement regarding how end-users can adapt quickly to changing conditions using unlearning processes. When end-users process new knowledge changes correctly, upset and inconsistencies in EHR use are reduced, creating successful knowledge updating. Without the specifics about the influencers of complete unlearning, how to successfully maintain end-user and organizational competency will remain unsolved. The process of unlearning automatic actions to produce successful human-computer interaction continues to require further study.

Changing knowledge requires organizations to alter knowledge base in favor of new competencies for organizational efficiency. Competitive advantage involves rapid knowledge acquisition and revision from current knowledge, skills and competencies through unlearning. Complete unlearning may allow end-users to adapt more quickly to changing systems and organizational processes.

This research study demonstrates the impact of the unlearning process to knowledge change. With organizations realizing change needs to occur quickly to reduce operating costs, maintain patient satisfaction and eliminate errors, factors of unlearning have become important. Computer systems, EHR systems, and documentation procedures require continual frequent updating to maintain patient care changes. Knowledge base of end-user practitioners, require change in intellectual capital to unlearn previous EHR documentation procedures and reduce technological upset. Effective EHR use by physicians can enable better healthcare documentation and service delivery. With greater understanding of unlearning, and its unique differences from learning, new methods of effective knowledge change for physician competency updating can be implemented. By addressing the end-users technological upset during unlearning, the updated requirements needed for efficient documentation and service delivery can be realized.

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