Does Incomplete Unlearning Impact Medical Errors?
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Abstract

There is a patient safety problem, specifically in maintaining practitioner competency. Healthcare organizations feel the impact of regulatory, medical, and technological changes when practitioners are unable to process, retain and utilize increasing amounts of information. The rising costs associated with medical errors have increased legal and financial impacts. With the majority of healthcare safety issues related to errors, there is reason for concern. Practioners may commit medical errors due to faulty or incomplete skill updating. Training fails to account for incomplete unlearning of old competencies. There is a need to restructure technological systems and processes to reduce errors and improve patient safety.

To maintain safety, healthcare organizations must continually alter knowledge, actions, and behaviors of practitioners at a rapid pace. Unlearning requires a complete update of competencies for the most current, correctly performed methodologies. Complete unlearning is essential to maintaining competency, where incomplete unlearning may impact incidence of medical errors.

1. Introduction

Improving patient safety has been an ongoing focus for many healthcare organizations. In addition to constant change in regulations, and faced with numerous technological advances with procedural and systems changes in care delivery, organizations must also react to safely provide services. Healthcare organizations are under enormous pressure to maintain financial stability through cost reduction and productivity numbers while undergoing constant marketplace changes [1]. In many healthcare organizations, determining strategies that facilitate patient satisfaction and reduce work tasks errors is essential to organizational longevity. Healthcare organizations are challenged to keep practitioners current with advances and reduce safety risks that adds to overall costs. Medical errors "can be considered an international issue" due to the significant distribution and frequency of these errors worldwide [2]. In order to provide proper patient care, practitioners require knowledge in a fast paced, highly technical environment [3]. Developing, collaborating and sharing knowledge competencies between clinicians is essential to the medical safety in any effective primary health care practice. This focus is important because organizations need to change knowledge quickly, update knowledge to maintain customer satisfaction and safety, while decreasing operating costs and improving competitive advantage [1], [4].

To acquire these new practitioner competencies, learning strategies often include training and testing processes, pathway models, and task demonstration [5]. These organizationally driven modifications have added additional job requirements, and new processes with cross training in job functions to produce efficient practitioners.

Consider unlearning as a process of knowledge change from previous knowledge base competency. The challenge to practitioners is to continually update their knowledge quickly through the unlearning of previous competencies. Fast-paced work environments or performing several tasks simultaneously due to healthcare staffing shortages have put additional cognitive strain on healthcare practitioners. Increased demands on processing knowledge quickly also impacts task attention and use of knowledge competencies in healthcare service delivery.

The ability to maintain current practitioner competencies has proved to be a challenge as each year increasing incidence of patient safety issues are reported. During the last several years, focus on the reduction of medical errors to improve patient safety and reduce organizational costs has been targeted [6]. Preventable adverse drug reactions and other intervention errors rates vary, although the Institute of Medicine (IOM) suggests there are over 1.5 million incidences per year [7]. In terms of patient costs, errors create over 3.5 billion dollars additionally from preventable harm type errors. Overall cost from other sources estimates of errors with medical intervention has reached $282 billion in 2005 [6].

Organizations are turning to reducing the impact of workplace errors, not only to improve patient service efficiency by practitioners, but also to reduce costs.
With about 50% of all errors related to various types of medication errors there is reason for concern [6]. The rising costs associated with all types of medical errors have created legal and financial impacts for healthcare organizations. Cost estimates suggest that the figure is rising steadily from 38 million dollars annually with over 80,000 admissions to hospitals 10 years ago to over 3.5 billion dollars and 1.5 million incidences today [2], [7]. The IOM suggests that this figure represents over 26% of various preventable medical errors such as documentation writing errors [7] [8]. Organizations need to take action to reduce risk and liability by reducing the prevalence of practitioner medical errors. Correcting medical errors by solely upgrading computer systems in healthcare or adding clinical skill development programs may address only part of the problem.

2. Related Literature

The ability to acquire, refine and change competency levels from the previous learned knowledge base is a difficult process to complete quickly and efficiently for all practitioners [9], [10], [11]. Old knowledge consisting of previous knowledge base is updated through unlearning [1], [11]. In order to complete a change in knowledge base, complete unlearning is required to develop new competencies. Transmission of knowledge from the organization to practitioners is the key to maintaining this competency [5], [9]. How this knowledge change process is facilitated is an ongoing problem for healthcare practitioners [11]. Some practitioners may have difficulties in completing job functions without upset, resulting in an incomplete unlearning process. With continual emphasis on unlearning skills to update the old, the process is never-ending. Learning strategies and pathway teaching may assist to make modifications needed, but fail to focus on the difficulties of knowledge change. Practitioners involved in skill changes must be able to discard their current competencies and mental models in favor of the new knowledge [5].

Organizations need to understand all components of unlearning in order to focus on updating skill competencies and practices. Bloom’s taxonomy suggests that learning consists of three domains that relate to knowledge acquisition: the affective, the psychomotor, and the cognitive domains [12]. The affective domain consists of the way that the learner attacks and consistently responds to the learning process. The learner uses a system that controls emotional behavior and determines what knowledge to value. The development of value systems that assist the individual to develop self-reliance and independence, organizing, comparing, and prioritizing values allow the learner to adjust during the learning process.

In the psychomotor domain, the type of task that the learner performs is active and involves movement, precision, and speed [12]. The psychomotor domain suggests learners use these skills to develop competency. Learning occurs through processing of cues and translation of information into learned responses that later become habituated to proficiency.

The process of unlearning in the psychomotor domain has been previously studied [13]. The automatic activities required involve previous learning to have been completed and then knowledge changed. This may occur without conscious awareness [14]. Unlearning in the psychomotor domain showed unlearning to require factors needed to complete the knowledge change [13].

The methods by which people unlearn in the psychomotor domain are beginning to be understood, however unlearning related to the cognitive domain is not currently understood [13], [15], [16]. A new view of unlearning involving the cognitive domain may be in order. Learning of factual knowledge and abilities acquired through recall are present involve the cognitive domain. Created and acquired knowledge for later modification involves mental skill changes, unlearning.

Unlearning may be a cognitive based process whereby old information is not used and actually stored, but may reappear when the situation warrants [17]. This information can be utilized later depending on the need or purpose. The cognitive domain may be a factor that requires additional research. In healthcare practitioners, competencies are developed using cognitive skills, but unlearned when competencies are updated. Unlearning may be an additional factor to consider when the production of a medical error occurs. In patient care, when updated knowledge is incorporated into a diagnostic routine, complete or incomplete unlearning may determine the presence or absence of medical errors.

Literature on the process of unlearning was initially limited requiring tracing the concepts to its roots in the 1980’s. However, advances in the study of knowledge acquisition have developed a new interest about unlearning [18], [19]. Researchers have recently returned to unlearning due to its importance in both the organizational and individual learning processes [20], [14]. Understanding the unlearning process can facilitate the creation and alteration of knowledge [21]. Clark (2011) suggested unconscious replacement learning and unlearning occurs without awareness [14]. However, consistency in repetition, knowledge storage and retrieval systems need to be in place, for complete unlearning to occur [4].
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 automated and unconscious knowledge in favor of new learning [14].

2.1 Current concerns

The possibility of human error is prevalent whenever humans interact [23]. Solving this puzzle has remained a problem. Within healthcare organizations, practitioners have systems to allow for constant advancement in knowledge, but often errors result as the practitioner may be unfamiliar with the new process. Errors result. Errors can be of different types and may involve medication, transcription, and tacit knowledge change. Some errors can be easily solved through computer-assisted technologies. This is true for medication errors that result from incorrect dosing, medication pass, and missed interactions [24]. Healthcare systems strive to reduce the opportunities for errors to occur usually focus in two areas. It has been suggested that implementation of new systems, processes and protocols used to produce patient safety: the first being the addition of functional computer assisted systems involved in the identification and classification of the number and types of safety issues called ADE (adverse drug events) to which medication errors is a subset [6], [22], [24].

Currently, the use of computer aided systems are reducing medication errors in prescriptions and drug interaction events central to these types of ADEs [6], [22], [24]. When practitioners carry out terminologically rich activities, possibilities of error may occur. The practitioner may have not had the time needed to incorporate all of the knowledge needed to be able to completely unlearn the old system and errors result. Some actions are unable to be identified through computer technology alone, requiring human monitoring of “near miss” type incidents [2], [14], [25]. The human interaction systems involve the second area of focus in reducing medication errors. When the practitioner’s mental models have been upset through adding additional information and the updating process. The possibilities of “near- miss” incidence may increase due to the lack of complete unlearning.

The second area of focus changes are medical errors involving transcription of medical specific terms and medication pass are also additional areas of continuing concern to healthcare practitioners. Estimates suggest that these problems related to data changes are larger than expected [26]. Examples of transcription errors or inconsistent medical terminology create upset when new systems and terminologies are updated. This failure to change efficiently may be one example of incomplete unlearning in healthcare delivery [24]. Communication of healthcare information provides opportunities for errors to occur [27]. Alteration of transmitted and recently learned healthcare information may have impact on the care provided [26].

Medical errors, due to human mistakes are documented using a chart review audit of patient and practitioner interactions during care [24], [6]. It is noted that the increased frequency of errors may be due to confusions in documentation. Abbreviations, commonly used in documentation, may produce unintended confusion and comprehension in medical records resulting in medication errors [28]. “Misinterpretations of the abbreviations across the specialties pose an imminent clinical risk” [29, p. 25]. Variability in the comprehension and interpretation of abbreviations often occurs even within the physician community [8], [29].

There are numerous examples of medical errors that involve unlearning and the cognitive domain. One such example, involves giving injections. Practitioners that routinely give an injection use tacit knowledge to determine how the process should be completed [30]. Complete learning of the process to a competent level through habituated practice is the norm. The nurse must use their cognitive competency associated with successful intramuscular injections to perform the correct technique consistently. Or, when dosage calculations central to giving the correct amount of medication needed, the practitioner knows without hesitation. This becomes the tacit knowledge base worked from to complete this medication delivery task. The cognitive domain is required to use factual knowledge and motor skills acquired through recall, called knowledge base, assist in correct task performance.

Unlearning can take place as the practitioner must change injection sites or compute new dosage amounts based upon new knowledge. It is the base knowledge that provides psychomotor competency, but it is the cognitive domain that provides the tacit knowledge to complete the process. When working unfamiliar environments, the practitioner need to call upon their cognitive domain skills to make calculation changes or determine the proper dosage route, creating upset. If, in fact, the practitioner uses current tacit knowledge and
cognitive domain competencies in a new situation, errors may result. The old knowledge in this case is determined to be ineffective. The practitioner may provide an incorrect treatment creating upset due to incomplete unlearning.

In another example, for the diagnostician, the tacit knowledge base involves the “knowing” what to look for in the diagnostic process and also involves the cognitive domain. The old knowledge provides a base to work from until there is a medical advance. These change processes, when challenged by technological upset, may create a medical error. Practitioners may ignore new information that is presented maintaining the current, but outdated information. Examples of this medical error can be seen in the yearly outbreak of various influenza strains. The ability to unlearn current competencies in favor of new knowledge is challenged. With practitioners having increased demands on their attention and time, unconscious actions can be an important factor in human error. Redevelopment of new skills and practices are of paramount importance; organizations need to utilize all parts of this learning process model [12].

With speech-language pathologist practitioners, treating dysphagia patients has also undergone continual updating and has required unlearning. Once thought to be unsafe, a patient with swallow deficits, or dysphagia, was limited to a modified diet involving nectar or honey thickened liquids to reduce aspiration risks. The Frasier water Protocol allows these dysphagia patients to consume water with reduced aspiration risks [31]. Previous knowledge base requires updating through complete unlearning to avoid errors and patient safety risks. Changes in methodology initially may have also created an incomplete unlearning with technological upset due to a cognitive domain issue.

In another example, providers, such as nurses and others in the home health arena, are responsible for completely unlearning their previous procedures, going from paper documentation systems to EHRs [32]. Changes in current competencies such as these examples are ongoing. The need for unlearning knowledge base in home health nurses, therapists and social workers has been anecdotally reported to create technological upset and may be the source of errors. The process of altering their service delivery processes has created the need for complete unlearning.

As the quantity and quality of knowledge needed increases, as the stakes are higher in patient care. There is an increased possibility of errors, bodily injury or death in treatments provided. As there are changing competencies that have become more complex, there is increased difficulty unlearning completely adding to upset in the practitioner. In fast-paced critical care units, such as in an emergency department, possibilities of error may become more commonplace as care decisions involving knowledge changes occur frequently.

To develop care providers through the development of learning skills during job performance has become important to stay ahead of technological advances [8], [16]. Where skill changes remain necessary in healthcare organizations, alterations in actions, behavior and thinking require completion of the unlearning process [1], [23]. When quality of care continues to be the focus, organizations will require an understanding of complete and incomplete unlearning whenever changes are desired [1].

### 2.2 Solving the med-error problem through unlearning

With continual emphasis on learning new skills to update the old, the knowledge change process is ongoing. Unlearning continues to be an important element within organizational environments [15], [20], [33]. New actions, when learned by a practitioner, require a period of time for the old actions to be updated. The conditions that are required to enhance unlearning need to be further understood. Unlearning requires the realization that the current knowledge no longer should be used [15], [33]. Hedberg (1981), a seminal author in the field of unlearning, suggests that this process involves replacement of information, whereas Klein (1989) states that the information remains, but is no longer used until a situation that matches presents itself [14], [16], [17], [34], [35]. Clark (2010) theorizes that the possibility of unlearning occurs as a function of conscious and unconscious replacement learning [14]. Anderson acknowledges the additional strain on cognition that may account for human error in unconscious behaviors [36]. Error behavior may involve the addition of unconscious routines for automatic behavior. If these routines are repeated frequently enough, these routines can be perceived as successful [37].

Unlearning was defined by Hedberg, a seminal researcher in the field, as the process of disuse or replacement of an action, procedure, or belief in favor of a new one [34]. For the individual within the organization, additional processing, retention and modification of their knowledge base to correctly perform tasks is [38]. Undergoing knowledge change and developing competencies with that knowledge is an ongoing problem [11], [19]. The employee must make specific changes in previous knowledge base that involves implementation of the modified actions and behaviors within their job function. Unfortunately, this process may result in increased problems for the organization in terms of effort of the end-user,
possible errors and operating expenses during the change process. Updating previous behavior and old knowledge through an unlearning change process and requires further investigation [13], [16], [23].

With ever-increasing demands on the retention of information and speed of usage in the healthcare setting, whether there is time for complete unlearning to occur is in question. There remains confusion as to how this function occurs and why it can be completed and successful at one time and unsuccessful at another. This may be due to the theory that there are factors that occur during change- “technological upset” [13]. This type of the upset that occurs during the building of new competencies as the old competencies are discarded that may account for an “incomplete unlearning”. When “incomplete unlearning” occurs, practitioners resort to the familiar complete knowledge base for the correct actions [13].

One important difference points to the fact that there is an acknowledgement that the previous knowledge base has become unreliable and requires a new action or behavior to complete a task [33], [34]. However, there may be other features in knowledge change that need to be determined. The inherent complexities of unlearning are presently not well understood, supporting the need for quantitative research design [39]. Explanations of unlearning may exist, although researchers continue to be unable to accept a particular definition of unlearning [9], [38]. There is ongoing confusion between the learning process and how unlearning differs. From previous research, it was determined that unlearning was different from learning due to the existence of a prior knowledge base [13].

This behavioral repetition within a similar context accounts of approximately 45% of daily actions. When unlearning is incomplete or unsuccessful, the result may be errors in actions. During change processes where actions are already in a state of flux, such as in organizational transformation, understanding error production resulting from unlearning may prove useful [34]. Organizational mandates that create changes in routine may contribute to an increase in errors. Examples from healthcare include the low-level close approximation type errors, such as the miss-writing in medical documentation to the highest possible level errors with consequences resulting in death [27].

3. A Call for Research

The process of unlearning of the cognitive domain impact on knowledge acquisition and its relation to medical errors requires further study. In a previous study, technological upset was determined to be a factor in whether a user was able to update his knowledge base to produce a new computer action [13]. The participants reported that due to the technological upset, there was more difficulty making a change in knowledge base. With higher level functions involving the cognitive domain processes, technological upset may have an impact on unlearning in healthcare practitioners. Practitioners may be unable to process the new knowledge and assimilate it completely due to their technological upset. When challenged with the need for speed in processing, the practitioner resorts to the old knowledge.

Problems persist due to disagreement regarding the unlearning process. Additional confusion persists as to how unlearning differs from learning. Researchers may want to focus on the differentiation between the learning process and the unlearning process. The process may actually involve the degree to which knowledge is changed or incomplete unlearning. Without a specific accepted understanding of these differences between complete and incomplete unlearning process, how to successfully create knowledge change within healthcare practitioners will remain unsolved. Research can focus on establishing the link between the characteristics of knowledge change and the prevalence of medical errors.

How could incomplete unlearning be responsible for medical errors? Additional study can develop this link and provide additional understanding to what factors need to be in place to produce complete unlearning. When the practitioner is able to process and assimilate the new knowledge into the current knowledge base to update a competency, complete unlearning can be established. The indicators of incomplete unlearning could be established through quantitative methodological design.

The process of describing current characteristics of the process of unlearning, lends itself to a quantitative descriptive research design [39]. It is hypothesized that the process of incomplete unlearning, is related to the incidence of medical errors. Further qualitative study could describe and link the perceptions of incomplete unlearning to specific perceptions of error productions. Specific phenomenon may be described or demonstrated, yielding a hypothesis for further qualitative research. Statistical report survey information can also point to the prevalence of incomplete unlearning during medical errors. A meta-analysis may yield reports of additional cases of medical errors that can be attributed to incomplete unlearning. Practitioner reports can also assist in substantiating the technological-upset that may add to the process of incomplete unlearning during service delivery. Further information about whether the concept of incomplete unlearning is a factor in medical errors will be measured from collected data.
4. Summary

During transformational unlearning of a new competency, healthcare practitioners are conflicted while the stabilization of a new knowledge base are processed. A realization between old and emerging new skills must occur to allow the individual to update their current knowledge base. When practitioners attempt to update knowledge, comparison and awareness of the inconsistencies occur. The individual recognizes the gap between previous and current knowledge. Unfortunately, the individual is challenged, creating technological upset to complete unlearning rapidly. In addition, not only the amount and type of information to change within the cognitive domain, but the speed to acquire functional knowledge may also be a factor in the unlearning process. With greater understanding of complete and incomplete unlearning, and its differences from learning, new methods of knowledge acquisition, can be implemented. This research study proposal can add to the current practical understanding of the unlearning process that is not currently understood. Changing knowledge requires practitioners to alter knowledge base in favor of new competencies for patient safety and efficiency. With results from ongoing study, practitioner errors can be reduced resulting in increased patient safety during healthcare service delivery.

5. References


