

## Longitudinal Analysis and Coping Model of User Adaptation

Nancy Tobler<sup>a</sup>, Janet Colvin<sup>a</sup>, and Neil W. Rawlins<sup>b</sup>

<sup>a</sup>Utah Valley University, Orem, UT, USA; <sup>b</sup>Kadlec Clinics, Richland, WA, USA

### ABSTRACT

Understanding how technology influences how individuals, groups, and organizations work continues to be an important organizational communication and technology process. Changes to healthcare technology continue to be advocated in order to increase both efficiency and effectiveness of healthcare. Influences on the successful implementation range from organization to group to individual attitudes. Prior research in healthcare and technology has called for longitudinal study of implementations. This study focuses on one influencer, the individual coping strategies, by using the coping model user adaptation applied to a two-year study of implementation of a new electronic health record in a medium-sized physician group. Results indicate that attitudes and coping strategies vary between clinicians and staff and vary across time.

### KEYWORDS

Process theory; multi-method; organizational unit; implementation; coping

### Introduction

Research on advanced technologies and their influence on organizational processes continues as an important area of study. Researchers continue to debate the best explanation for the complex process of organizational change and technology [1, 11, 18, 22, 26, 27, 28, 30, 35, 38, 39, 42]. The same technology in similar organizations can succeed or fail. As technology implementation occurs, the change can increase workloads, create conflicts, increase energy expenditure, and may even interfere with accomplishing work. One challenge remains to clarify factors associated with implementation success and failure, especially over time.

Healthcare organizations continue to require and implement information technologies. The United States healthcare industry continues to struggle with the need to understand and implement new technology. United States national reports state that medical errors are at crisis levels [2, 16, 34, 41]. Electronic Health Records (EHR) continue to be recommended in order to (a) disseminate evidence-based protocols, (b) reduce medical errors, (c) save money, and (d) enhance disease detection. However, EHRs have not been widely implemented, and when implemented, use is low. EHRs adoption exists between 17 and 55 percent in ambulatory care facilities [6, 12, 13, 14, 32]. Of those with EHRs, only a small percent use the robust features that will change healthcare [14, 23, 40]. The low adoption and use results are likely the reason EHRs have not shown consistent positive change in medical care effectiveness [1, 20, 44] or in the efficiency of healthcare processes [29, 24, 31]. Because EHRs have the potential to improve the quality of human lives and reduce the costs of healthcare, the implementation of EHRs is an important organizational process to understand.

One theory that helps explain attitude complexity during technology implementation is the coping model of user

adaptation (CMUA). The following research study explains CMUA, prior research that uses the CMUA model, and the need to study over time and within time. After the theoretical explanation, a two and half-year study of 18 clinicians implementing a new EHR is described and the results reported.

### Theoretical foundation

Beaudry and Pinsonneault [5] combine previous studies through the use of an integrative model, the coping model of user adaption (CMUA). They note,

By defining user adaptation as coping, we can study a wide range of user responses including how users restore emotional stability, modify their tasks, reinvent and adapt the technology, or even resist it. We can also understand the antecedents and effects of these user behaviors. Considering user adaptation as coping also allows us to study user behaviors that occur before, during, and after the implementation of a new technology (p. 494).

In the CMUA model (see Figure 1), Beaudry and Pinsonneault [5] present four adaptation strategies: benefit maximizing, benefits satisficing, disturbance handling, and self-preservation. Benefits maximizing occurs when an IT event occurs, and users see it both as an opportunity and as something that they can control. When this happens, users increase in efficiency and effectiveness. When users feel that the IT event is an opportunity, however, one over which they have little control, benefits satisficing occurs. Benefits satisficing produces limited effects on efficiency and effectiveness. In a situation where users feel that they have some control over the IT event, but it has perceived negative consequences—what Beaudry and Pinsonneault term disturbance handling—they try to find ways to successfully adapt and minimize such perceived negative consequences. This may ultimately lead to an increase in individual efficiency and effectiveness as well.

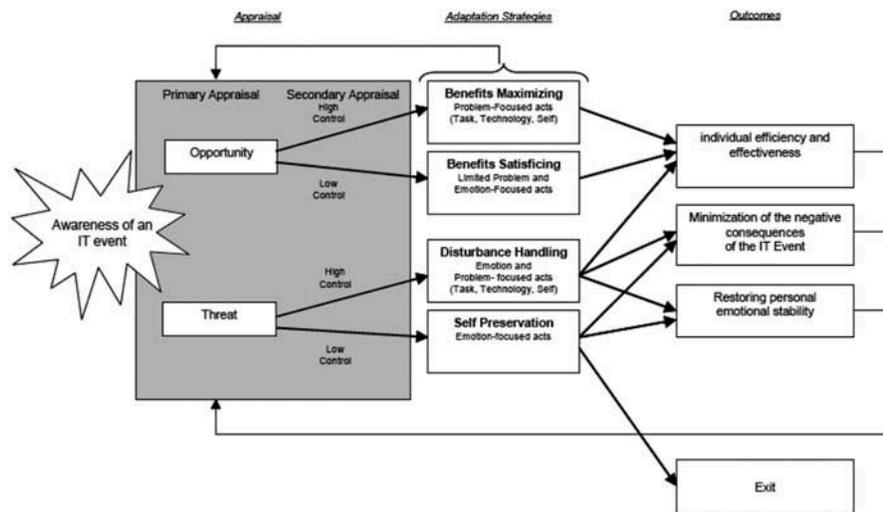


Figure 1. Coping model of user adaptation [5].

Finally, if users feel threatened by an IT event and have only limited control they engage in activities geared toward self-preservation. This can either lead to minimization of the perceived negative consequences or to becoming emotionally disengaged or leaving the situation all together (see Figure 1 for explanation of process).

Coping model research falls into two main categories: perception processes that occur prior to the “appraisal” phase [9, 10, 15, 17, 19] and coping processes during the implementation of a new technology [5, 7]. Research on prior to the CMUA model center on individual user perceptions and technology purposes such as virtuous or malicious. In a study of a new electronic medical system being implemented in a large public university campus health department, Fadel and Brown [10] suggest that prior to the appraisal process by current technology users provides insight into how prior adoption-related attitudes influence use of the technology. They seek to understand what attitudes specifically influence the appraisal process. Technology implementation exists within a larger context of technology and nontechnology organizational and personal processes. Users approach technology from both a self-interested “how will this technology help me” and from an empowerment frame of “what change can I make to the system” [10]. Results indicate that prior attitudes about technology do influence a user’s approach to the appraisal process [9, 10]. Both of the Fadel studies look at a one-time assessment (1 year out from implementation) and suggest that research on technology implementation should look at adaptation over time [2, 3, 4]. In addition, the Fadel studies 65 participants, 85% were female and it is unclear how many were physicians. The level of power and prestige of the user may influence how technology is adapted and used [37].

Other prior to the appraisal process research states that the type of software being implemented or considered and a bias toward the current system must be explained. Liang and Xue [19] suggest that users’ approach and avoidance of a technology constitute different processes. When trying to avoid malicious software such as a virus, users’ risk tolerance, and

ability to avoid problems create a different coping model. They find a curvilinear relationship between “perceived threat and avoidance motivation” [19, p. 85] and a moderating role of perceived threat and avoidance motivation. In addition, Kim and Kankanhalli [15] propose that a “status quo bias” exists. Many users feel that the current system provides both the efficiency and effectiveness goals. Kim and Kankanhalli propose that user’s attitudes include switching benefits and costs and that norms (individual, colleague, and organization) influence the technology use outcomes. Certainly the status quo bias may exist in any technology implementation. In prior research on EHR and physician attitudes, in general, physicians believe they are already efficient and effective and do not need software to “fix” those [37]. An overtime research approach may help to identify how or if the “status quo” bias changes or continues to influence the use of the new technology. Kwahk and Oh [17] explain that the expectations of the users will also influence the coping that is needed.

In the second group of CMUA research that occurs during the implementation of a new technology, the research provides support for the model as well as expands the model in such areas as user emotion and peer support. In an experimental research study, Elie-Dit-Cosaque and Straub [8] found strong support for the model in their examination of threats and opportunities embedded in IT events. They suggest that individuals’ interaction over time and at various stages of IT implementation are dynamic and continue to evolve.

In addition to the support for the existing model of coping during initial IT implementation, Beaudry and Pinsonneault [5] identify how emotions play a role in the coping process. They find, especially in early implementation, that emotions play an important part in acceptance and usage of IT. In another study on the influence of emotion, Fadel [9] notes that this model can help understand how individuals adapt more successfully to IT changes if they focus on problems rather than on the emotions that they are feeling.

Most of the research using CMUA to explain the complex process of IT implementation used a one-time attitude assessment and perception of outcomes measure. Other IT

researchers have called for a process and longitudinal approach to understand initial perceptions and use and expand that understanding over time [2, 3, 7, 27]. Interaction over time with peers [36] and the technology changes how technology is used and the usefulness of robust technology such as EHRs [37].

In addition, the following study recognizes that the users' level of power may also influence use and peer use [37]. In the case of EHRs, the major change of technology use falls on physicians. Typically, when a new technology is implemented into a business organization, those with the most power in the organization are not the ones "forced" to use it. Physicians can and do walk away from a practice and start somewhere else. In the case of EHR implementation, the key processes of the organization are at stake. How a record is kept influence how and what can be billed to insurance and provide essential information for effective care of patients, such as access to lab information and prior notes on a patient. In the EHR case, the research must take into account the power of physicians, the group nature of medical work, and the need to understand the process over time. One of the first researchers in medical technology was Barley [3, 4] and the implementation of CAT machine. Barley explains the need for process research.

Change occurs over time. Barley [3, 4] stated three levels of comparison are needed (a) synchronic, (b) diachronic, and (c) parallel [7]. Synchronic analysis focuses within an organizational departments over the same time period. For example, Barley's work on CAT scan technology compared different departments within the same hospital. Barley identified changes in how work moved through the radiology department as the technology was used. By comparing different departments, Barley was able to identify individual and group levels of change.

In a diachronic analysis, research examines change over time by comparing old and new technologies. At each observation, each process across the organization is documented and compared to past patterns. For example, Orlikowski and Gash [28] incorporated a three-time-period observation, (a) prior, (b) during, and (c) after implementation. In their research study on Notes software implemented into a software company help group, they identified continuous change as group members began to share solutions to problems. The analysis over time allowed for comparison of how humans and technology changed during the implementation process.

Parallel analysis utilizes comparison across sites. Without a comparison to other technologies in use, it is difficult to establish a credible claim. For example, Barley [3] compared two installations of CAT scan technology. His parallel analysis demonstrated that power did not stay with the radiologist, rather power shifted based on who learned and used the technology more. In one hospital, the radiologist maintained power over the use of the new technology because the physicians were the ones who knew how to read the CAT scans. In the other hospital, technicians developed more power because they were trained to run the CAT scanner and to read the scans.

In order to understand attitudes and coping strategies over time and across clinician groups, the following study

examines a medium-sized clinician practice with 56 clinicians and mid-levels as well as staff at 12 locations with a total of 14 specialties in order to determine what types of user adaptability strategies are present and how those compare to the attitudes of the clinician or clinician's assistant in charge of a particular practice. This study seeks to extend the use of the CMUA model to a clinician group implementing a new EHR system, understand the influence of clinician attitude on medical support staff.

RQ1: How do clinicians and staff view a new EHR implementation over time?

RQ2: Does the clinician impact clinician and medical support staff attitude toward a new EHR implementation and if so how?

RQ3: Over time, what types of user adaptation strategies are employed by clinicians and staff?

## Methods

This study utilizes a mix-method design with both a quasi-experimental and a qualitative-observational component. No patient-identifiable data were collected during the observations and interviews. Data are aggregated for this report. Data were collected on clinicians who had volunteered to be observed and timed. Thirteen clinicians were observed at least once. Ten clinicians were observed before and after at three different points in time. Comparison data were analyzed by individual clinicians, by specialty and overall completion rates for the clinician organization.

## Site

One ambulatory, multispecialty group was selected based on changing from one EHR to a new EHR. From 1995 to 2007, the group was primarily an obstetrics and gynecology (OB/GYN) practice with seven clinicians, five mid-level practitioners, 25 clinical staff, and 15 administrative staff. Using Rogers' categorization system [33], the clinicians at the initial OB/GYN practice are considered innovators and early adopters of EHR technology. The group adopted the first EHR in 1996 and used that system until 2001. One of the clinicians was part of a company that developed an EHR from 1996 to 2001. Between 2001 and 2002, the group attempted to integrate two EHRs. Both implementations failed. At the end of 2002, the fifth and current EHR programs were implemented. At six months, the group nearly disbanded the implementation. With a change in clinician lead implementer, the EHR was adapted and used until August 2011. In 2007, the OB/GYN group started a multispecialty clinic in conjunction with the local hospital to create an integrated healthcare system. The former system had been adapted and modified to meet clinicians' workflow. A new EHR was purchased so that the ambulatory group and the hospital group would have the same EHR. Both the ambulatory group and the hospital group had to move from an existing system to the new

ERH. In fall of 2011, the group shifted to a new EHR to help make integration with the local hospital seamless.

### Participants

The multispecialty practice has 56 clinicians and mid-levels at 12 locations with a total of 14 specialties. This multispecialty group provides a unique opportunity to understand a medium-sized, nonacademic ambulatory setting with a wide range of technology expertise as they adapt a new EHR. In order to answer how workflow was adapted, clinicians were observed at four different times over two and half years. Fifteen clinicians volunteered to be observed prior and three times after implementation to the new EHR. Institutional review was completed at Utah Valley University. Eight of the observed were clinicians and seven were mid-level clinicians. Nine were obstetrics/gynecology specialty. Six were family practice, internal medicine, or pediatric specialties. All clinicians and medical assistants that were observed signed a consent form. All observed patients signed a consent form to be observed.

### Procedure

The research compares one month prior to change in EHR to post change in EHR at 2 months, 10 months, and 2 years. Each clinician was followed up by one of the researchers. The researchers used a time notation computer program to note when the clinician entered the examination room and left the examination room at the end of the visit. The patient examination provided a stable observation time because it is rarely interrupted by colleagues. Observational notes were taken on the use of the EHR. Interviews were conducted with clinicians and available medical staff. The overall workflow pattern was noted at each observation. Change in workflow was noted.

### Coding

Following data collection, observation notes and interviews were coded for attitude (positive, negative, or neutral) comments or observations, for theme (efficiency, useful to healthcare, other), overall attitude toward the EHR implementation (positive, negative, neutral), as well as for the type of user adaptation strategy being employed.

Beaudry and Pinsonneault [5] developed their CMUA model using two North American banks as case studies. In this study using clinician groups, the model was adapted slightly. User adaptation strategies were coded in the following ways. Comments were coded as a Benefits maximizing strategy if they indicated that IT (clinicians/clinician's assistants and staff) users felt that they were not only in control of

the situation but also saw the change from a previous EHR as one that was beneficial and had potential for increasing the clinician's effectiveness. Benefits satisfying strategy codes occurred when EHR users saw the EHR implementation as an opportunity but one in which they had little control – either in its initial implementation or in how they adapted to and used the EHR. Any statement that was positive about the new implementation but not something the user was changing or adapting was coded as benefits satisfying. Disturbance handling codes were used when EHR users felt as if they had some control over the situation and how they were using the EHR but felt confused or unsettled by the implementation. Finally, self-preservation strategies were used when IT users felt they had limited control, felt frustrated, and felt like they weren't getting any help from technology specialists in solving their problems. Beaudry and Pinsonneault [5] indicate that in this strategy if users feel overwhelmed and unable to cope, they will leave the situation all together. In this study, none of the observed clinicians left as a result of the EHR implementation. One clinician who was not observed was reported to have left because of the shift to the EHR.

### Results

The unit of analysis used was individual thought units. The entire coding process yielded a total of 1,460 coded quotes and observations from 18 clinicians as well as from 7 of their medical assistants and/or office staff. These were coded for valence, theme, overall attitude toward the EHR implementation, and type of user adaptation strategy being employed.

Research Question one asks how clinicians view the new EHR implementation over time. This question is answered by examining the attitude, theme, and overall feelings about the implementation from 2011 to 2013. Across all categories, the number of comments made about the EHR dropped over time. Clinicians, MA, and staff differ in how the comments change over time. In general, clinicians seem to say less on all aspects of the EHR as they get used to the system. Valence was assessed through coding each comment as being positive, negative, or neutral toward the new EHR. Table 1 shows the overall numbers for valence. Clinicians' positive statements in 2011 were 56% (n = 128), and steadily decreased to 33.5% (n = 40) in 2012, and 21% (n = 3) in 2013. Negative statements started at 21% (n = 48) in 2011, increased to 33.5% (n = 40) in 2012, and decreased to 0 in 2013. Neutral comments steadily increased from 23% (n = 53) in 2011 to 33% (n = 39) in 2012 and, finally, 79% (n = 11) in 2013. Medical assistants and staff did not mirror these percentages, however. Positive statements began at 62% (n = 71) in 2011, dropped to 20% (n = 12) in

**Table 1.** Comment valence.

	Clinicians			Medical assistants and staff		
	October 2011	May 2012	October 2013	October 2011	May 2012	October 2013
Positive	n = 128, 56%	n = 40, 33.5%	n = 3, 21%	n = 71, 62%	n = 12, 20%	n = 40, 24%
Negative	n = 48, 21%	n = 40, 33.5%	n = 0, 0%	n = 37, 32%	n = 39, 65%	n = 61, 36%
Neutral	n = 53, 23%	n = 39, 33%	n = 11, 79%	n = 7, 6%	n = 9, 15%	n = 68, 40%
Total	N = 229	N = 119	N = 14	N = 115	N = 60	N = 169

2012, and rose slightly to 24% (n = 40) in 2013. Negative comments in 2011 were 32% (n = 37), rose to 65% (n = 39) in 2012, and dropped to 36% (n = 61) in 2013. Finally, neutral statements in 2011 were 6% (n = 7) and steadily increased to 15% (n = 9) in 2012, and 40% (n = 68) in 2013.

The majority of the clinicians viewed the new implementation positively as did their assistants and staff. Though they complained about having to change the way they were using the EHR in their daily work, they were generally positive about what had happened and what they hoped to have happen in the future. By 2012, clinicians were evenly split between positive, negative, and neutral comments and by 2013 the majority of comments were neutral. Medical assistants and staff began viewing the implementation positively; however, by 2011 the comments were mostly negative and finally by 2013 they were slightly more neutral than negative.

Table 2 breaks down comments into themes about the EHR. With few exceptions, comments focused on either how efficient clinicians and staff were with using the new EHR or how effective the system was in overall healthcare. Efficiency comments included both statements about faster, slower, and staying the same. In 2011, clinicians were mainly concerned about efficiency (n = 180, 79%) and by 2013 100% of the comments (n = 14) were focused on efficiency. Medical assistants and staff were concerned about efficiency (n = 54, 47%) and a variety of other topics (n = 60, 52%). The “other” category rose in 2012 to 57% (n = 34) and efficiency dropped slightly to 43% (n = 26). By 2013, 86% (n = 143) were centered on efficiency. Comments about efficiency included the following: *“I can’t find the report in this new EHR,” “It takes forever to find my previous notes,” and “I’m going to like this new EHR because I can enter rounds right at the hospital.”* Comments on improving health care centered around working with the patients: *“He doesn’t have as much eye contact with the patients when he has to enter the information in the*

*computer while he’s in the room,” “He puts in all the medications and orders while the patient is right there,” and “I couldn’t find the information I wanted to give the patient.”* Overall, clinicians were focused on using the technology quickly and in such a manner that they could see more patients and also increase the quality of the health care they were providing.

Research Question two asks, “Does a clinician champion impact clinician and medical support staff attitude toward a new EHR implementation, and if so, how?” This is answered through comparison of clinician’s with their staff’s overall feelings about the new implementation and whether it is a gain, loss, or no change from the previous EHR. Table 3 shows this comparison between clinicians and staff where data were collected from both 2011 and 2013.

When comparing physician to staff attitude in 2011, 62% were the same by 2013, 71% were the same. Perhaps even more telling is that at the beginning of the implementation in 2011, cases where the physicians were positive, all but one of their staffs was as well. When the clinician’s attitude was negative or neutral, almost all of their staff attitudes were negative. There was only one case where the physician was positive and the staff was negative. Elie-Dit-Cosaque and Straub [8] found that individuals can follow their own strategies of adaption; however, these findings suggest those in power can follow their own strategies better than those of less power and that those in power can influence subordinates. This finding supports Lorenzi and colleagues [21] when they suggest physician champions provide the value put on an EHR and direction for the overall project. Zazzali and colleagues [43] suggest that clinicians are more satisfied when they are in a culture that “values autonomy over how they do their work, freedom from external control, and voice in how the organizations they work in are managed” (p. 1156). Typically, technology implementations influence the workers at the entry or lower levels of power in an organization. In the

Table 2. Theme.

	Clinicians			Medical assistant and staff		
	October 2011	May 2012	October 2013	October 2011	May 2012	October 2013
Efficiency, faster, slower, same	n = 180, 79%	n = 81, 68%	n = 14, 100%	n = 54, 47%	n = 26, 43%	n = 143, 86%
Effectiveness (increase, decrease, same)	n = 17, 7%	n = 8, 7%	n = 0, 0%	n = 1, 1%	n = 0, 0%	n = 23, 14%
Other	n = 32, 14%	n = 30, 25%	n = 0, 0%	n = 60, 52%	n = 34, 57%	n = 0, 0%
Total	N = 229	N = 119	N = 14	N = 115	N = 60	N = 166

Table 3. Clinician impact.

	Clinician overall attitude 2011	Staff overall attitude 2011	Comparison 2011	Clinician overall attitude 2013	Staff overall attitude 2013	Comparison 2013
Practice 1	Negative	Negative	Same	Negative	Negative	Same
Practice 2	Negative	Positive	Different	Positive	Negative	Different
Practice 3	Negative	Negative	Same	NA	NA	NA
Practice 4	Neutral	Negative	Different	Neutral	Negative	Different
Practice 5	Positive	Positive	Same	Positive	Positive	Same
Practice 6	Negative	Negative	Same	NA	NA	NA
Practice 7	Neutral	Negative	Different	Neutral	Neutral	Same
Practice 8	Positive	Positive	Same	NA	NA	NA
Practice 9	Neutral	Negative	Different	Neutral	Neutral	Same
Practice 10	Positive	Positive	Same	Neutral	NA	NA
Practice 11	Negative	Negative	Same	Neutral	Neutral	Same
Practice 12	Positive	Positive	Same	Neutral	NA	NA
Practice 13	Positive	Negative	Different	Neutral	NA	NA

**Table 4.** Clinician user adaptation strategy.

Clinicians	October 2011	May 2012	October 2013	Totals
Disturbance Handling	n = 133, 58%	n = 44, 37%	n = 0, 0%	n = 177, 50%
Benefits Satisficing	n = 69, 30%	n = 36, 30%	n = 1, 33%	n = 106, 30%
Benefits Maximizing	n = 16, 7%	n = 32, 27%	n = 2, 67%	n = 50, 14%
Self-Preservation	n = 11, 5%	n = 7, 6%	n = 0, 0%	n = 18, 5%
Totals	N = 229	N = 119	N = 3	N = 351

**Table 5.** Medical assistants and staff user adaptation strategy.

Medical assistants and staff	October 2011	May 2012	October 2013	Totals
Disturbance Handling	n = 60, 52%	n = 40, 67%	n = 39, 39%	n = 139, 50%
Benefits Satisficing	n = 42, 37%	n = 13, 22%	n = 23, 23%	n = 28, 30%
Benefits Maximizing	n = 6, 5%	n = 0, 0%	n = 22, 22%	n = 28, 10%
Self-Preservation	n = 7, 6%	n = 7, 11%	n = 16, 16%	n = 30, 10%
Totals	N = 115	N = 60	N = 100	N = 275

case of EHR implementations, clinicians may be the most impacted by the change [29].

Research Question three asks what type of user adaptation strategies are employed by clinicians and staff. To answer this question, comments were coded according to Beaudry and Pinsonneault's [5] CMUA model. Tables 4 and 5 show the overall totals for each strategy by clinician and medical assistants and staff.

Both clinicians and staff comments fell into the Disturbance Handling category most frequently in 2011. Disturbance handling occurs when an IT event occurs, everyone has not only perceived negative consequences but also feel like they are able to have some sort of control over the final outcome. Comments in this category included the following: "Front desk and screens in back are different. [We] have to transfer things up front and that is one more step for patients to lose patience" and one clinician who kept mumbling over and over "It will get better. It will get better." As Beaudry and Pinsonneault suggest, neither of these comments indicate the speaker is quitting nor not trying to work on the issues, rather as they work these problems out, they will possibly become more efficient and effective though they are currently frustrated with the new implementation. At this point, most of the comments are emotion-based and not project-based. Staff were continuing to work through Disturbance Handling issues through 2013. Clinicians, however, dropped to 0% by 2013 and the highest percentage of comments by then were in the Benefits Maximizing category and project-based demonstrating that they had worked through implementation issues and were now able to see the benefits of the new EHR.

The second highest category in the CMUA model in 2011 for clinicians and staff was Benefits Satisficing. Benefits Satisficing occurs when users don't feel they have a whole lot of input into the process or control over how it is ultimately implemented, but generally still see the new technology as a positive thing. Comments in this category typically focused on project-based things the new technology could do and that were seen as positive but not something the user could change or adapt to. One clinician said, "[the new technology] seems very user friendly." Another said, "I like that I can print off the patient summary now." Beaudry and Pinsonneault [5] suggest this positive acceptance of an IT event does not necessarily encourage users to change the

system or use it in different ways and thus produces limited effects on effectiveness and efficiency.

By 2013, physicians had increased slightly in the Benefits Satisficing category, while staff had dropped. Clinicians had learned how to use particular aspects of the EHR and said things such as "I've got my smart sets all worked out now." Staff, on the other hand, decreased in the Benefits Satisficing category as they worked through implementation.

While the previous two strategies may be seen as more moderate responses, the last two strategies tend to be the positive and negative extremes. Benefits Maximizing was third in total of coded responses in 2011. In this strategy, clinicians and staff saw the new implementation as something they had a say in, could adapt, were project-based and ultimately would be an opportunity to improve their effectiveness and patient care. One clinician commented, "occasionally things pop up and I have to learn how to do it but after a few times, you learn how to make it faster." Another felt she navigated the [new] screen quite well and adapted the screen to meet her needs. Typically, users in this category viewed the new EHR as an opportunity to learn about and maximize for their own benefit.

By 2013, both clinicians and staff had increased in the numbers of comments coded as Benefits Maximizing. Clinicians increased by 60% as they adapted the EHR to their own workflow and made it work in a variety of ways. Staff also increased by 17%, demonstrating their ability as well to adapt to and improve ways of using the new EHR.

Finally, if users feel threatened by an IT event and have only limited control, they engage in activities geared toward self-preservation. Beaudry and Pinsonneault [5] note this can either lead to minimization of the perceived negative consequences and becoming emotionally disengaged or leaving the situation all together. In this study, one clinician left the practice because of the new EHR implementation. Most however who felt threatened responded in ways that indicated extreme frustration and the inability to do anything to alleviate that frustration. Comments tended to be emotion based and included the following: "We have questions and get backed up and (the company) does not have the answers" and this observation: "[the clinician] went to office to find ultrasound but did not find anything until after patient left. She was

very, very frustrated.” By 2013, clinician’s comments in this category dropped to 0, while staff’s increased 10%.

## Discussion

The results demonstrate that (a) attitudes and coping strategies change over time, (b) clinicians and staff attitudes and coping strategies change differently over time, and (c) important changes occur throughout a two-year time period. On research question one, over time, clinician attitudes change, which is similar to findings from Barley [4]. The number of times clinicians make comments decreases over time. An overall sense of moving toward acceptance or neutrality can be seen. However, medical and administrative staff attitudes stabilize on positive percent of statement and negative statements increase and then decrease as well as neutral statements increase. Understanding how attitudes shift over time and how those in power (clinician’s) may accept some changes is an important finding.

The concern over efficiency continues to be important. Tobler [37] also found that efficiency was stated more often than effectiveness. Clinicians appear to believe that they are effective at providing healthcare, and that technology will not improve effectiveness. If they do believe that technology will improve healthcare, they do not make statements about healthcare while being observed or interviewed. The chief concern appears to be efficiency. The concern over efficiency occurs over the two years of observation. Certainly, over time analysis helps researchers understand that the complex nature of change does change in some areas (valence) and remains stable over time in other areas (efficiency)

Research question two findings suggest that clinician’s group of medical staff attitudes develop in a similar manner as the clinician. This finding is similar to Tobler’s [37] findings, comparison of clinician or clinician assistant attitudes with staff attitudes. These results also demonstrate the influence of the medical practice culture, which is described as clinicians needing autonomy and control [43].

Finally, the biggest contribution of this research to the CMUA model is that ongoing appraisals of IT implementation over time demonstrate the viability of this model and that strategies change with time as people became adapted to new technology. Such findings extend knowledge about the user adaptation model and add to Fadel’s [9] research that suggests new implementation should focus on problem-focused adaptation. Key changes indicate that people in power adapt the most quickly and usually focus on a problem and adapt the technology to their own workflow and not vice versa. Getting the clinician on board with the implementation can encourage the entire process of adaptation. Even more important is the finding that expands the focus of previous CMUA literature by highlighting the role of a clinician champion who is part of the clinical community and has technological expertise. This study found that IT power users may not be the best influencer for change; such users are seen as suspect and not knowledgeable about what clinicians really need. Clinician champions adapt technology and have the credibility to facilitate implementation from within the community.

In implementing new technologies into practice, unsuccessful patterns need to be identified early. For example, when implementing an EHR, the time it takes for clinicians to chart needs to be addressed early on in the training. Trainers should monitor the patterns to check for work-arounds or refusals before the pattern becomes established and difficult to change and users may give up on the EHR. Another key finding was that when IT tried to conduct training, they focused on how the EHR should work. These trainings were not successful and clinicians and staff continued to complain and ignore specific training directives. When a fellow clinician who was not only a champion for the implementation but also understood the technology conducted the training, he focused on how the EHR could be adapted to the clinicians, there were much fewer complaints.

One of the key findings is that the EHR must be adapted to the local practice. When a patient does not fit the standardized path, it needs to be easy for the clinician to change the EHR to facilitate a unique care path for an individual. Flexibility is so important to successful implementation that small practices may need additional resources to meet the flexibility need. In the case of small practices, it may be difficult to find the human technology resources to help clinicians meet their needs. In the United States, 80% of ambulatory care is provided by clinicians in small practices with less than 9 clinicians [6]. This means that EHR vendors may need to add adaptation as part of the sale of an EHR and have someone from within the practice conduct training and adapt it to the specific practice needs could be more successful than having IT specialists conduct the training.

## Conclusion

This research supports theories that view technology implementation as a mutually influencing process, humans adapt to technology and technology adapts to humans. This research demonstrates the need for clinicians to be able to adapt the technology in ways that are consistent with their medical practice. Successful implementers appeared to find ways to adapt the technology to do more. Others need to have resources to help them better adapt to the technology. Adaptation and use of resources lead clinicians to be more or less successful over time in adopting the same software.

At the national level, calls have been made for transformational changes that would result in the patient and clinician working more proactively to prevent disease and to maintain health. There is a long way to go if a transformation is to happen. Robust EHR technology has the potential to change how clinicians and patients approach care. The ability to be more proactive with health maintenance and chronic conditions can be facilitated by technology. For example, contacting patients to remind them of recommended health maintenance and to keep up with needed medication checks could reduce the consequences of avoiding or forgetting to take care of themselves. However, clinicians have to be able to use those parts of the EHR for the changes to occur. Additional resources may be needed prior, during, and after implementation so that continual adaptations can be made.

### Limitations and future research

This research was conducted at four points during the adoption process rather than continuously. The detailed method employed made thorough reporting difficult. However, much can be gained from this study. Continued research should look at multiple levels of change within organizations and make comparisons to both similar and different organizations facing similar implementations. More longitudinal studies are needed so that phases of participant and technology can be identified [31]. Future implementation research should take advantage of the technology trail of acts that are automatically recorded in order to capture the acts of both participants and technology and look for patterns of use that may not be possible to capture by observation. Additionally, the role of clinician champions needs to be studied in more depth to determine what constitutes credibility and if there are any universal behaviors that can be implemented to increase effectiveness.

### References

- [1] Ash JS, Sittig DF, Poon EG, Guappone K, Campbell E, Dykstra RH. 2007. The extent and importance of unintended consequences related to computerized provider order entry. *J Am Med Inf Assoc.* 14(4):415–423.
- [2] Aspden P, Corrigan JM, Wolcott J, Erickson SM. (Eds.). 2004. *Patient safety: Achieving a new standard for care.* Institute of medicine of the National Academies. Washington, DC: The National Academies Press.
- [3] Barley SR. 1986. Technology as an occasion for structuring. Evidence from observations of CT scanners and the social order of radiology departments. *Administrative Sci Q.* 31(1):78–103.
- [4] Barley SR. 1990. Images of imaging: Notes on doing longitudinal field work. *Organiz Sci.* 1(3):220–247.
- [5] Beaudry A, Pinsonneault A. 2010. The other side of acceptance: Studying the direct and indirect effects of emotions on information technology use. *MIS Q.* 34(4):689–710.
- [6] Burt CW, Sisk JE. 2005. Which clinicians and practices are using electronic medical records?. *Health Affairs* 25(5):1334–1343.
- [7] DeSanctis G, Poole MS. 1994. Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organiz Sci.* 5(2):121–147.
- [8] Elie-Dit-Cosaque CM, Straub DW. 2010. Opening the black box of system usage: User adaptation to disruptive IT. *Eur J Inf Syst.* 20(5):589–607.
- [9] Fadel KJ. 2012. User adaptation and infusion of information systems. *J Comput Inf Syst.* 52(3):1–10.
- [10] Fadel KJ, Brown SA. 2010. Information systems appraisal and coping: The role of user perceptions. *Commun Assoc Inf Syst.* 26(6):107–126.
- [11] Greenhalgh T, Stones R. 2010. Theorising big IT programmes in healthcare: Strong structuration theory meets actor-network theory. *Social Sci. Med.* 70(9):1285–1294.
- [12] Health Information Technology in the United States: Where We Stand, 2008. [cited 2009 Feb 4] Available from: <http://www.rwjf.org/files/publications/other/EHRReport0609.pdf>.
- [13] Jamoom E, Beatty P, Bercovitz A, Woodwell D, Palso K, Rechtsteiner E. 2012. *Physician Adoption of Electronic Health Record Systems: United States, 2011 NCHS data brief.* Hyattsville, MD: National Center for Health Statistics.
- [14] Jha AK, Ferris TG, Donelan K, DesRoches C, Shields A, Rosenbaum S, Blumenthal D. 2006. How common are electronic health records in the United States?: A summary of the evidence. *Health Affairs* 25(6):496–507.
- [15] Kim J, Kankanhalli A. 2009. Investigating user resistance to information systems implementation: A status quo bias perspective. *MIS Q.* 33(3):567–582.
- [16] Kohn LT, Corrigan JM, Donaldson MS. (Eds.). 1999. *To err is human: Building a safer health system.* Washington, DC: National Academy Press.
- [17] Kwahk K-Y, Oh S-W. Examining the effect of user expectations on system use activity, *European Conference on Information Systems, ECIS.* 2009.
- [18] Leavitt HJ, Whisler TL. 1958. Management in the 1980's. *Harv Bus Rev.* 36(6):44–48.
- [19] Liang J, Xue Y. 2009. Avoidance of information technology threats: A theoretical perspective. *MIS Q.* 33(1):71–90.
- [20] Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. 2007. Electronic health record use and the quality of ambulatory care in the United States. *Arch Internal Med.* 167(13):1400–1405.
- [21] Lorenzi NM, Kouroubali A, Detmer DE, Bloomrosen M. 2009. How to successfully select and implement electronic health records (HER) in small ambulatory practice settings. *BMC Med Inf Decis Making* 9(15).
- [22] Markus ML, Robey D. 1988. Information technology and organizational change: Causal structure in theory and research. *Manage Sci.* 34(5):583–589.
- [23] Menachemi N, Ford EW, Beitsch LM, Brooks RG. 2007. “Incomplete EHR adoption: Late uptake of patient safety and cost control functions. *Am J Med Qual.* 22(5):319–326.
- [24] Miller RH, West C, Brown TM, Sim I, Ganchoff C. 2005. The value of electronic health records in solo or small group practices. *Health Affairs* 24(5):1127–1137.
- [25] Miranda D, Fields W, Lund K. 2001. Lessons learned during 15 Years of clinical information system experience. *Comput Nurs.* 19(4):147–151.
- [26] Orlikowski WJ. 1996. Improvising organizational transformation over time: A situated change perspective. *Inf Syst Res.* 7(1):63–92.
- [27] Orlikowski WJ. 2007. Sociomaterial practices: Exploring technology at work. *Organiz Stud.* 28(9):1435–1448.
- [28] Orlikowski WJ, Gash DC. 1994. Technological frames: Making sense of information technology in organizations. *ACM Trans Inf Syst.* 12(2):174–207.
- [29] Poissant L, Pereira J, Tamblyn R, Kawasumi Y. 2005. The impact of electronic health records on time efficiency of clinicians and nurses: A systematic review. *J Am Med Inf Assoc.* 12(5):505–515.
- [30] Poole MS. 2009. Collaboration, integration, and transformation: Directions for research on communication and information technologies. *J Comput-Mediated Commun.* 14(3):758–763.
- [31] Poole MS, Van de Ven AH, Dooley K, Holmes ME. 2000. *Organizational change and innovation processes: Theory and methods for research.* New York, New York: Oxford Press.
- [32] Poon EG, Jha AK, Christino M, Honour MM, Fernandopulle R, Middleton B, Newhouse J, Leappe L, Bates DW, Blumenthal D, Kaushal R. 2006. Assessing the level of healthcare information technology adoption in the United States: A snapshot. *BMC Med Inf Decis Making* 6(1):1–9.
- [33] Rogers EM. 2003. *Diffusions of Innovations* 5th ed. New York: Free Press.
- [34] Sarata AK. 2009. Measuring health care quality: Measure development, endorsement and implementation. *Congressional Res Serv.* 7-5700, R40749.
- [35] Scott T, Mannion R, Davies H, Marshall M. 2003. Quantitative measurement of organizational culture in healthcare: A review of available instruments. *Health Serv Res.* 38(3):923–945.

- [36] Sykes TA, Venkatesh V, Gosain S. 2009. Model of acceptance with peer support: A social network perspective to understand employees' system use. *MIS Q.* 33(2):371–393.
- [37] Tobler N. 2008. Technology, organizational change and the non-human agent: Exploratory analysis of electronic health record implementation in a small practice ambulatory care. Dissertation, Salt Lake City, Utah: University of Utah.
- [38] Tyre MJ, Orlikowski WJ. 1994. Windows of opportunity: Temporal patterns of technological adaptation in organizations. *Organiz Sci.* 5(1):98–118.
- [39] Unertl KM, Novak LL, Johnson KB, Lorenzi NM. 2010. Traversing the many paths of workflow research: Developing a conceptual framework of workflow terminology through a systematic literature review. *J Am Med Inf JAMIA* 17 (3):265–273.
- [40] Wilcox A, Bowes WA, Thornton SN, Narus SP. 2008. Clinician use of outpatient electronic health records to improve care. *AMIA Symposium Proceedings*, pp. 809–813.
- [41] Van Den Bos J, Rustagi K, Gray T, Halford M, Ziemkiewicz E, Shreve J. 2011. The \$17.1 billion problem: The annual cost of measurable medical errors. *Health Affairs* 30(4):596–603.
- [42] Venkatesh V, Morris MG, Davis GB, Davis FD. 2003. User acceptance of information technology: Toward a unified view. *MIS Q.* 27(3):425–478.
- [43] Zazzali JL, Alexander JA, Shortell SM, Burns LR. 2007. Organizational culture and physician satisfaction with dimension of group practice. *Health Serv Res.* 42(3):1150–1176.
- [44] Zhou L, Soran CS, Jenter CA, Volk LA, Orav EJ, Bates DW, Simon SR. 2009. The relationship between electronic health record use and quality of care over time. *J Am Med Inf Assoc.* 16(4):457–464.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.