Rigorous Analytical UX Research Proposal – a Quantitative and Qualitative study

The research question:

"Technology adoption: assessing the efficiency of biometric authentication technologies in the EHR log-on procedure."

The intervention, rationale and hypothesis:

Earlier, I conducted an informal observation at the New York Presbyterian Hospital of the user experience with the EHR systems. One of the major inefficiencies I noticed in the observation was the amount of time and number of steps taken for the physicians to log onto the EHR (Allscripts). In this informal observation, one physician was noted to have spent a total of 6-7 minutes from unlocking the desktop to successfully launch a patient profile. He was taken through three different log-in interfaces that required him to insert his credentials for three times; the loading time between each interface was also consuming. In response to this observation, I propose an intervention that introduces biometric authentication technology (BAT) to the EHR in its log-on procedure, in an effort to reduce the time taken for providers to log on. I seek to test the hypothesis that BAT, in the form of fingerprint recognition technology, result in reduced time among healthcare providers to complete their log-on procedure.

The entire study will last for 9 months– first a quantitative research (6 months) followed by a qualitative research (3 months)

Quantitative study methods

The intervention study will be carried out at two different hospitals that also utilize the Allscripts EHR software, with one being controlled and the other being the intervention group. The intervention will last for 6 months. The study population will be the EHR users in the Emergency Department only. I choose to study this population because they represent the most urgent and time-pressing cohort to the EHR system, requiring the swiftest processing and retrieval of patient records. The independent variable in this study will be the presence and absence of the BAT, and the dependent variable will be the time required for the study population to successfully log onto Allscripts. All the desktops in the emergency department of the intervention hospital will be equipped with the fingerprint recognition technology, along with a built-in timer that times the log-on time. The timer will start timing as soon as the computer detects any interaction initiated by a user (i.e. a slight movement on the mouse or a tap on the keyboard) and will stop when the homepage of the EHR is successfully and completely launched. There will still be an option for the intervention group participants to log-on manually (using username and password), in case of technical errors of the BOT or strong

preference over manual log-on methods. However, neither will it be the primary method displayed on the log-in page nor encouraged among the group. If more than 5% of the log-ons were done manually by a participant in the intervention group, they will not qualify for the study. Changes to the computer server and network, upgrades to software packages, as well as the number of times a user is required to authenticate their identity in the log-on procedure will all be controlled; the only workflow being intervened in will be the method of logging on.

The mean of log-on time in the intervention group will be compared with the control hospital that has no intervention. The G Power statistical software, with alpha = 0.05 and 1-beta = 0.8, will be used to compute the sample size in this two-tail parallel-group trial with 1:1 allocation and a continuous outcome. The delta value will be set at 0.4, assuming that a 40% target difference in log-on time with the BAT implementation between the two independent samples will be considered statistically significant. All participants who met the inclusion criteria will be included in this primary analysis on the basis of their randomized intervention assignment.

Assuming that the mean of the log-on time follow a normal distribution, I will perform a t-test with 5% level of significance for the hypothesis H0: $\mu1=\mu2$ vs H1: $\mu1\neq\mu2$, where μ is the mean of the log-on time, to determine whether the presence or absence of BAT significantly influence the time taken to complete the EHR log-on procedure. Bivariate correlation and linear regression analyses will be run to assess the relationship between background characteristics and extent of EHR use.

Qualitative study methods

A qualitative research will be conducted post-intervention (after the 6-month period) among the intervention group to understand their views and experience with the BAT. The goal of the qualitative study is to gain greater understanding of the findings of the prior quantitative study.

Interviewees will be selected using purposive sampling method based on the level of improvements in time logging onto the EHR system by a user with the implementation. The subjects with the shortest average log-on time (first quartile) as well as the subjects who had the longest average log-on time (third quartile) in the intervention group will be included in the interview sample. 10 participants from each of the group will be sampled, totaling 20 for the sample size. The reason for this is to ensure the study include the skeptic in addition to those who are known to have benefited from the technology. Hence there is not a complete list of interviewees for now– it will depend on the quantitative research data.

The interview will take the form of semi-structured, meaning the interviewer will follow a guideline but will follow topical trajectories in the conversation that may stray from the script when deemed appropriate. Open-ended questions will be used to elicit the

interviewee's thoughts on and experience with the fingerprint technology in their EHR log-on procedure– positive and negative. Although a set of questions will be planned and created prior to all the semi-structured interviews, the interviewers will have the flexibility in the topics they would like to discuss. They can adjust the question list based on the response of the interviewee to avoid any interruptions to the continuity of the interviewee's thought.

The interviewer will also seek the interviewee's consent to tape record the interview conversations. The purpose for this is to allow the interviewer to not focus on taking detailed notes and be more engaged with the interviewee throughout the process. The recordings will also assist the research in the data analysis.

Grounded theory (Corbin and Strauss, 1988) will be employed to come up with new theory inductively on the basis of the qualitative data, not guided by any existing theory or framework. The researcher will first tag transcripts with codes to identify interesting common ideas. Then they will group similar codes into concepts or themes. Finally, they will identify relationships between the concepts to create theory that serve as explanations for the prior quantitative findings.

Research limitations

Age is a potential confounding variable in this study as it may influence both the dependent and independent variables. On the one hand, Modi et al. (2007) found that aging results in loss of collagen; compared to younger skin, aging skin is loose and dry, and decreased skin firmness directly affects the quality of fingerprints acquired by sensors; thus, affecting the outcomes. On the other hand, age may influence the performance of and access to the BAT, because older people are likely to be less tech-savvy than their younger counterpart– they may not know where on the sensor to position their finger, or what is the appropriate amount of pressure to apply. They may also opt out of using BAT to log-on and resort to the traditional manual methods.

For history effects, the event that may change the conditions or affect the outcomes of the study include wounds and cuts. If participants in the intervention group had an accident which cut their fingers, the sensor may take a longer time to scan their fingerprint or it may not be able to detect at all; the final outcomes may then be affected.

The purpose to log onto the EHR may be an effect modifier and affect the outcomes of the study. Given the various types of work being carried out in the emergency department by different actors every day– ranging from the administrative tasks performed by a clinical clerk, such as updating and keeping records, to the critical tasks performed by a physician upon the arrival of a ill patient in extremis, such as retrieving their medication history– the urge of the users to log onto the EHR as quickly as possible may also differ. It may be likely that tasks involved less emergency allow

the EHR user to “take their time” between log-in interfaces, resulting in an overall longer time.

In terms of generalizability, considering this intervention is only implemented in hospitals that use Allscripts as a vendor, it will not be generalizable to hospitals who use a different software vendor such as Epic or Cerner. Besides, even within hospitals that use Allscripts as their EHR system, the results of this study will only be applicable to the emergency department but not any other departments. It is also worth noting that because this is a multimethod study, only the quantitative findings can potentially be generalized; the qualitative research is not statistically generalizable.

How the two studies relate to or inform each other

The quantitative study will have to be completed prior to the qualitative study. This is because the sampling frame will depend upon the participants who fall within each of the quartile of the dataset. The list of interview questions will only be created when the primary data analysis is complete, as the questions will take different shapes based on the findings. For example, if the primary analysis identified that the implementation of BAT did not reduce EHR log-on time at all, the interview questions would focus on discerning the barriers to and difficulties with the technology and exploring the reasons behind the failure of the implementation.

Additionally, if were any extreme outliers in the primary datasets (users who had a noticeably short log-on time vs users who had a significantly long log-on time), it would be important to explore the variables that have contributed to such outcomes, and whether there were any effect modifiers unaccounted for.

Conclusion

This study endeavors to address the long time the EHR takes for its users to log on. Even though this study is specifically designed for Allscripts EHR system within the emergency department setting, the findings can be used as a reference for other similar situations, such as in the patient departments, nursing home, or dental clinics that are experiencing a long EHR log-on time and are interested in the implementation of BAT to solve the inefficiency.

References

Corbin J, Strauss A. (1988) Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage Publications.; current edition is the 4th

Modi, S., Elliott, S., Whetsone, J. and Kim, H. (2007). Impact of Age Groups on Fingerprint Recognition Performance. IEEE Workshop on Automatic Identification Advanced Technologies, pp.19-23.