Prospectus

An Infrastructure for Intraoperative Data at the University Teaching Hospital of Kigali
(Technical Topic)

Implementation of Electronic Medical Record Systems: The Factors that Lead to Failure
(STS Topic)

By

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November 21st, 2019

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

In many fields, over recent decades, the generation and use of data has rapidly expanded and new data applications have been developed. However, there is still much room for improvement in the healthcare industry, especially in low to middle income countries (LMICs). The limited funding for medical technology, low levels of education and poor infrastructure for delivering and maintaining technology severely limit medical decision support and medical diagnostics in LMICs (Clifford, 2017).

The University of Virginia (UVA) Rwanda Human Resources for Health (HRH) is a joint initiative of the US and Rwanda to build a strong, independent health care delivery system in Rwanda (University of Virginia School of Medicine Anesthesiology Department, n.d.). While working with the University Teaching Hospital of Kigali in Rwanda, the team of anesthesiologists realized that one of the biggest challenges they are facing is the lack of electronic medical records (EMRs). All data in the operating rooms (ORs) and intensive care units (ICUs) are now hand-collected and written down on paper. Without EMRs, it is hard for them to analyze the numbers and show how their work in Rwanda is making an impact on the health-care delivery system. Not being able to show the results with numbers also makes it harder for them to apply for grants and funding.

However, while collecting medical data in digital formats can potentially lead to better quality and more efficient healthcare (Su, Win, & Chiu, 2009), it is also important to consider how designers embed ideas about users into technology they design, ideas that may not corespond to actual users. Ideas about the user - who are the caregivers at the specific hospital in this case - are just as important as the actual user (Lindsay, 2003). In designing an EMR system that benefits the hospital, one must configure the idea of doctors and nurses, and this may or may

not align with the caregivers that are recording patients' medical data. A failure to take this notion into account when developing an EMR system would result in a system that falls short of improving the efficiency of healthcare delivery.

In order to address the problem of not having digital data for analytical purposes, both technological and social factors must be considered. Below I outline a technical process for creating a digital data storage for the University Teaching Hospital of Kigali which is secure, deployable in their environment, and requires minimum maintenance. I also use the STS framework of user configuration to analyze how the designers of an EMR system implementation projected their own beliefs about engineering when configuring the caregivers as users, which led to the failure of the project.

Technical Project

Perioperative mortality rate (POMR) is defined as the number of deaths during or after surgery divided by the number of procedures performed (Ng-Kamstra et al., 2018). It can be utilized as a marker of surgical quality in a low-resource setting (Rickard, Ntakiyiruta, & Chu, 2015). POMR is also used as an important metric for hospitals when it comes to applying for grants and funding. Several intraoperative factors are believed to have high association with POMR.

At the University Teaching Hospital of Kigali in Rwanda, all data from the operating rooms (ORs) and intensive care units (ICUs) is currently collected manually and recorded on flow sheets. There are two types of flow sheets, the pre-op assessment and the intraoperative record. The pre-op assessment includes the patient's demographic information, past medical history, and allergies; while the intraoperative record keeps track of the drugs that were given to

the patient, blood pressure, body temperature, and some procedure details. Caregivers, including doctors and nurses, write down this data on the flow sheets that are by the patients' bed every time they check on the patients. These physical copies are then archived and kept in the hospital for up to 5 years. This current method makes it very hard for them to keep track of patient records and calculate the POMR. The paper-based systems are prone to errors in storage and retrieval of health information, they transmit such information slowly between different healthcare providers, and they do not readily follow with the patient when s/he moves location (Lawler, Hedge, & Pavlovic-Veselinovic, 2011). If the hospital adopts an electronic system for electronic records, there would be distinct advantages over paper records, which include: enabled access to medical records from remote locations, improved speed and ease of retrieval of records, avenues to flag abnormal results, simultaneous access to patient records by multiple users, and the ability to perform data queries to inform decision making (Akanbi et al., 2012).

There is then, a need for a system that is able to digitally store the data collected from the patients so it can later be easily retrieved and used for analytical purposes. The goal of the technical project is to design an image processing device along with a data storage system that is affordable, easy to implement, and requires minimal maintenance for the University Teaching Hospital of Kigali. The image processing device will scan in the handwritten flow sheets, which include flow charts, checkboxes, and texts, and turn the manually collected data into digital format. The data will then be transferred to and stored securely in a data store that is managed by the UVA medical system. This data will be analyzed strictly for trends and calculating performance. After analyses are performed, the data and results will be securely sent back to the hospital. Those that are registered doctors and nurses within the hospital system in Rwanda will be able to access this data to track related metrics. The focus of this project is to create an

interface that transforms the manually collected medical data into digital format and stores them securely. The analysis of the collected data is not within the scope of the project.

STS Project

Electronic medical record (EMR) systems are defined as "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization" (Agency for Healthcare Research and Quality, n.d.). Kilimanjaro Christian Medical Centre (KCMC) in Tanzania adopted an EMR system based on Care2x framework back in 2003. Care2x is an open source web based integrated healthcare environment. The system interface is customizable and usable via a tablet and mobile phone, allowing users to store patient data with a file system (Wambura, Machuve, & Nykanen, 2017). The system seemed to be successful in a few departments but failed to meet the intended objectives of implementation in the whole hospital. In 2015, the hospital replaced the previous EMR system with the HarmoniMD system. The HarmoniMD tablets used by doctors allow them to input patient data through the digital interface and access information easily. This system has been implemented in many hospitals, including some in the United States, and was expected to work well at KCMC. Despite showing great promise when it was first implemented, the hospital management has been left frustrated with the progress of the implementation. By the end of 2017, the hospital was planning to replace it with another system. A study has suggested that poor information and communication technologies (ICT) infrastructure, lack of participatory approach during the system development, lack of policies and standards, and lack of information technology (IT) directorate were amongst factors that contributed to the failure of EMR system implementations at KCMC (Mtebe & Nakaka, 2018).

However, poor ICT infrastructure and the lack of IT directorate were not the only reasons that led to the failed attempt of EMR system implementations. The implementation of EMR systems is very different when done in developed countries and developing countries. It has been suggested that health workers perceived EMR as interfering with clinical workflow, reducing productivity, and introducing disruptive changes to the workplace; further high computer anxiety in developing countries makes the situation more serious (Gamm et al., 1998). If we continue to think that poor ICT infrastructure and the lack of IT directorate are the only reasons that led to the failure of the EMR system implementation, we will not have adequate understanding of why the implementation of the EMR system at KCMC was a failure. I argue that the familiarity with computer interfaces of the health workers at KCMC is not at the same level as that of the designers of the implemented EMR system and that this disconnect is caused in part by an incomplete view of health workers' preferences and familiarity with computers and digital interfaces. My analysis of the failed attempt of EMR system implementations at KCMC draws on the STS concept of user configuration, in which designers define the identity of supposed users, which may or may not align with the actual identity of the users, and configure these user identities into the technologies they design (Oudshoorn & Pinch, 2003, p.6). In this case, the designers of the implemented EMR systems assumed that the caregivers at the hospital would want a fully-automated computer interface for their EMR system without taking into account the technology barriers and unfamiliarity with technology devices people in LMICs have.

Conclusion

Electronic medical record (EMR) systems leads to a promise of improvement in the healthcare industry, and a lot of effort has been put in to implement EMR systems in low to

middle income countries (LMICs). The technical report will deliver a new design for the University Teaching Hospital of Kigali in Rwanda that allows them to scan in manually collected data, transform it into digital format, and store them securely for analytical purposes. The system will be affordable, easy to implement, and require minimum maintenance. The science, technology, and society (STS) research paper will draw on the concept of user configuration to analyze the case of the failed implementation of EMR systems at Kilimanjaro Christian Medical Centre (KCMC) in Tanzania.

The results of the technical report will help to resolve the broad socio-technical issue of the University Teaching Hospital of Kigali not having digitized data for analytics and not being able to show the improvement of healthcare delivery through numbers. The findings from the STS paper will also give a better idea of how EMR systems should be designed to better fit the needs of LMICs.

Word Count: 1703

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