

Implementation of Electronic Medical Record Systems: The Factors that Lead to Failure

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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

Since 2003, the Kilimanjaro Christian Medical Centre (KCMC) in Tanzania has adopted two electronic medical record (EMR) systems, based on the Care2x framework and HarmoniMD system respectively. The systems were expected to make retrieving patient data easier for doctors and to make the medical care process faster and smoother, but both systems failed eventually. Researchers suggested that lack of a participatory approach during the system development, policies and standards, information technology (IT) directorate, and poor information and communications technologies (ICT) were amongst the factors that contributed to the failure of the implementations (Mtebe & Nakaka, 2018).

However, the researchers had limited understanding of other issues, such as how parts of the technology were not properly designed for the KCMC healthcare providers. Continuing to ignore these aspects will result in an incomplete understanding for the failure of EMR systems implemented at KCMC. Further, if EMR systems are not properly configured for users, healthcare providers will not use the system or functionality it provides, resulting in inefficiency and a waste of money.

I argue that the designers of the EMR systems failed to take an actual user-centered approach when creating the software, which is why the systems did not ultimately succeed. My analysis on the EMR systems implemented at KCMC will draw on the science, technology, and society (STS) concept of User Configuration. Specifically, I will focus on the disconnection between the users imagined by designers of the EMR systems and the actual users, and how they failed to account for the technology barriers and unfamiliarity with technological devices people in low- to middle-income countries (LMICs) have.

Literature Review

As more hospitals and medical centers start to implement electronic medical record (EMR) systems to help healthcare providers work more efficiently and improve patients' experience, various study groups have examined the implementation and effectiveness of these systems. Many studies have found that even when these EMR systems work effectively in developed countries, they fail to reach the expected goals when being implemented in low- to middle-income countries (LMICs). Further, researchers tend to blame the failure on the poor information and communication technologies (ICT) infrastructure and the lack of information technology (IT) directorate. As a result, they call for more investment in improving the Internet connectivity and communication infrastructures. While these improvements are important for LMICs and may certainly make a difference, putting the blame solely on the lack of technology does not consider the entire picture. Researchers do not address the root of the problem, namely that designers and developers of these systems fail to acknowledge the gap between the users that they configured and the actual users.

Various studies have been conducted on the challenges LMICs face when implementing EMR systems, as well as case studies on specific hospitals. In *Challenges to E-healthcare Adoption in Developing Countries: A Case Study of Tanzania*, Omary et al. (2009) pointed out the challenges of implementing EMR systems in developing countries. Factors that led to failures of implementation included the lack of funds, healthcare policies, and manpower, as well as the low rate of internet penetration and bandwidth. The research suggested that LMICs should use free and open source software to overcome the lack of funding, improve their ICT infrastructures, and establish healthcare-related regulations. However, the research did not look

into the design process of the EMR systems, and thus whether the systems were designed properly for the actual users was not a factor that was taken into consideration.

Rather than studying the implementation of EMR systems in Tanzania as a whole, Mtebe and Nakaka looked at a specific use case. In *Assessing Electronic Medical Record System Implementation at Kilimanjaro Christian Medical Center, Tanzania* (2018), they examined how the two EMR systems implemented at the Kilimanjaro Christian Medical Center (KCMC), based on the Care2x framework and HarmoniMD system respectively, turned out to be a failure. They found that several ICT firms were given contracts in the past for the hospital's local area network (LAN), and every firm designed the network without taking into consideration existing networks. Besides the poor ICT infrastructure, the implemented EMR systems were also not integrated with other existing systems at the hospital, limiting its extensive usage (Mtebe & Nakaka, 2018). The study also showed that communications between the design team and KCMC were inefficient. For each request sent out, it would take the team more than a month to respond, without providing any solutions. The researchers recommended that the hospital redesign the network, including replacing old devices such as routers and improving the cabling structure. The hospital should also formulate policies and standards to govern the implementation of EMR and other related infrastructure in order to create an environment for the smooth implementation of systems and planning how future designs should integrate with existing systems. However, these recommendations put the blame on the lack of ICT infrastructure and policies, and ignore areas in which the software was not properly designed for the healthcare providers at KCMC, who are the real users of the systems.

Researchers often blame system failure on lack of technological infrastructure, but this leaves out analysis of how the design and development of systems does not take users and their

familiarity with technology into account. I will analyze how failing to address users' preferences and familiarity with the adoption of technology is a major component of why the implemented EMR systems at KCMC eventually failed by utilizing the STS framework of User Configuration to understand where designers and developers fell short in properly designing products for healthcare providers at KCMC.

Conceptual Framework

The science, technology, and society (STS) concept of user configuration is a helpful framework for understanding why the implementation of electronic medical record (EMR) systems at Kilimanjaro Christian Medical Centre (KCMC) failed. The implementation of the system should depend on the users' needs and abilities being met by the technologies. The concept of User Configuration accounts for the process of developing the identities of users, how technologies attempt to define user actions, and how ideas about users are built into technologies' designs. It accounts for the relationship between user and system, and how users come to use the technology. In what follows, I elaborate on Steve Woolgar's concept of User Configuration and explain how it helps frame my analysis of the failure of EMR systems implemented at KCMC.

It is common for engineers to design for themselves, considering themselves to be representatives of the future users (Bardini and Horvath, 1995). According to Lindsay (2003), it is not just the actual, real-life users who matter. Ideas about the user—or user representations—are just as important in the relationships between users and technology. Woolgar (1991) also pointed out that the act of configuration involves defining the identity of putative users and setting constraints upon their likely future actions through the functional design of the physical artifact.

The concept of User Configuration is helpful in understanding why the design and implementation of EMR systems at KCMC ultimately failed, and why healthcare providers did not fully utilize the technology. The failure is mainly due to designers and developers not properly configuring users and not orienting the technology towards real users. In the analysis that follows, I will use the concept of configured users to examine how these configurations constrained certain users because the users that designers envisioned did not reflect the identities and needs of actual users. I will analyze how the developers designed for the users that they envisioned and where there were disconnections between the envisioned and actual users of the systems.

Analysis

The electronic medical records (EMR) systems implemented at Kilimanjaro Christian Medical Centre (KCMC), based on the Care2x framework and HarmoniMD system respectively, have been proven successful in use cases in developed countries. However, the adoption at KCMC turned out to not meet performance expectations, and were eventually abandoned. The designers and developers of the implemented EMR systems at KCMC failed to take an actual user-centered approach when designing the systems, resulting in the systems not being used at their full potential. While some healthcare providers in the hospital appreciated the systems' functionalities, many did not. Designers did not fully understand the healthcare providers' familiarity with and preference for computers and digital interfaces, which resulted in the failure of these systems.

Actual Users - Values, Needs, Abilities, and Demographics

The process of implementing EMR systems is complex because it involves both medical professionals and non-medical professionals, with both having high levels of expertise, power, and autonomy. Moreover, these professionals have multiple objectives, such as curing and caring for patients, in addition to educating new physicians and nurses; they both need to be involved in the implementation process (Mtebe & Nakaka, 2018).

Accounting for users' values is extremely important when considering how to properly design technologies. When implementing the EMR system at KCMC, understanding healthcare providers' perception about data use and technology in the hospital is vital for creating a successful system. These technologies have drastically changed healthcare providers' work, and it is important to take into account how they feel about these changes. As noted earlier, some users have had a positive experience with the implemented EMR systems, but the majority of users did not feel like the systems made a positive impact on their everyday work.

Focus group discussions have revealed that there was a lack of involvement of users throughout the design and implementation of the project, and that this had an impact on the outcome of the implemented EMR systems at KCMC (Mtebe & Nakaka, 2018). The systems were acquired in a top down approach with few users being involved, only individuals in top management positions were involved in the initiation, negotiation and procurement of the information systems (Mtebe & Nakaka, 2018). However, the healthcare providers who work directly with patients are the ones who will actually use the system. Being a referral hospital for more than 15 million people in Northern Tanzania, KCMC is a hospital that not only provides patient service, but also values training and research as per the hospital's mission (Kilimanjaro Christian Medical Centre, n.d.). By communicating with the top management, the designers and

developers of the system were able to understand the goals that these stakeholders wanted the systems to achieve: implementing the systems at an affordable price, and bringing profit to the hospital (Mtebe & Nakaka, 2018). However, the values that the actual users were hoping to get out of the systems were to improve the efficiency of their everyday work, make sure patients were cured, and ensure a positive experience for each patient's visit. Had designers and developers learned what type of functionalities the healthcare providers would have preferred to have and what data they would have found valuable, the systems would likely have brought more satisfaction to the users. Many of the healthcare providers in KCMC stopped using the implemented systems very quickly because they did not feel like they were improving their work efficiency or helping them get a better grasp of how each patient was doing. Varying expectations from different users can lead to systems that create a disparity between those who benefit from the system and those who have to do additional work to support it, which often leads to system failure (Scholl, Syed-Abdul, & Ahmed, 2011). While the improvement on ICT infrastructure and related policies that researchers are calling for might help smoothen the users' experience, it will not change what these users view as more valuable.

Designing for actual users' needs is a key aspect of creating successful technologies. Converting from a paper-based system to an EMR system is complex and difficult because it represents a paradigm shift for the work of physicians and other staff (Williams & Boren, 2008). If not designed properly, the implementation of EMR systems at KCMC may actually take longer for healthcare providers to record patient data, thus making their work more inefficient. As mentioned earlier, the top managers were the only ones involved in the acquisition process (Mtebe & Nakaka, 2018). The top managers and the actual users—the healthcare givers at KCMC, have different perspectives, thus the needs are not the same. Not understanding the

difference between the needs of these two groups has resulted in the systems being designed to meet the needs of the top management instead of the actual users, and eventually failing to meet expectations. It is important to take into consideration the healthcare providers' preference of the technology and the interfaces they are more familiar with when designing and implementing these EMR systems at KCMC.

Another significant feature of properly configuring actual users is understanding their abilities. With EMR systems, issues such as a lack of computing skills among staff may complicate the adoption process (Scholl, Syed-Abdul, & Ahmed, 2011). Solutions for developing countries often require a different approach than what was done in developed countries. A study has shown that EMR adoption is highly correlated with users' level of comfort with computers (Looms et al., 2002). Healthcare providers in low- to middle-income countries (LMICs) usually have less experience with technological devices compared to those in developed countries, and this is a main factor as to why the systems based on the Care2x framework and HarmoniMD system were successfully implemented in developed countries but failed when deployed at KCMC.

Besides values, needs, and abilities, the demographic of users is a factor that is often overlooked. The experience people have with technology can vary between Tanzanian people from different demographic groups. Some factors that may contribute to the difference include their age, if they are from a rural or urban area, or if they came from a wealthy family or not. For example, a study has shown that among the world-wide population, younger people with ages between 18 and 34 years old are more likely to use the internet and own a smartphone compared to people with ages of 35 and older (Poushter, 2018). A study by Mothobi and Moshi (2017) reported that when Internet access is compared between rural and urban areas, 86% of rural

dwellers remain unconnected to the Internet, compared to 44.6% in urban areas. Besides the gap between people in rural and urban areas, those with a wealthier background may be more familiar with the use of technological devices. Even as technology becomes more affordable and Internet access seems increasingly ubiquitous, a “digital divide” between rich and poor still remains, with the rich and educated being more likely than others to have good access to digital resources (Soltan, n.d.) The difference between individual users is something important to take into consideration when designing and implementing an EMR system at KCMC.

According to the study done by Mtebe and Nakaka (2018), some healthcare providers liked the deployed EMR systems, were able to understand how they work, and used them to meet their needs. However, those healthcare providers are too few and far between. Healthcare providers represent a wide array of backgrounds, and it is important to understand the differences between individuals when creating a system for healthcare providers. Based on the research mentioned previously, it is shown that designers did not properly configure users and ignored important aspects of real users. Specifically, they did not account for the difference in values, needs, abilities, and demographics of the real users.

Ideal, Configured Users

The designers of the EMR systems at KCMC configured the users to be individuals that had their main focus on the financial impacts the implementation could bring to the hospital. In an interview done by Mtebe and Nakaka (2018), the executive director said that,

We have no problem spending money for the EMR system, the most important thing is to ensure we get the system that will be working at an affordable price. We are losing a lot

of revenues for conducting our business manually. We need to make use of the technology now.

The emphasis on “affordable price” shows that the executive director’s main focus was on the financial aspect. By mentioning how the hospital is losing a lot of revenues also conveys the idea that money is what the top managers care about the most. This interview indicates that the main focus of the executive director was on the financial aspects, instead of solely the quality of care for patients.

Studies have shown that the implementations of EMR systems can result in a positive financial return on investment to the healthcare organization (Wang et al., 2003), and it is reasonable for KCMC to see the implementation of the EMR system as an opportunity to increase their profit. However, only focusing on the financial aspect is very problematic for many healthcare providers. Too much of the design process was focused on the financial aspects, leaving healthcare providers to struggle with getting themselves familiar with the systems and using it to improve the quality of healthcare service they give to patients at KCMC. The EMR systems implemented at KCMC have not made the workflow more efficient or satisfying for healthcare givers. The design and implementation of the EMR systems were not directed at healthcare givers—the people who will be actually using the systems. Their ideal users are the ones who are enthusiastic about increasing the hospital’s profit and bringing data applications into the healthcare industry. Many healthcare givers do not meet this description. The implementation of the EMR systems at KCMC underscored the disconnections between the ideal users that designers configured and the actual users who use the systems in their everyday lives.

Rather than targeting the healthcare providers, the EMR systems implemented at KCMC targeted the top executives of the hospital who ultimately decide if the hospital should invest in

these systems. As shown in the aforementioned interview, these high-level managers were eager to embrace the idea of digitizing the medical record system, as long as doing so brings more profit to the hospital. It is widely believed that broad adoption of EMR systems will lead to major healthcare savings, reduced medical errors, and improved healthcare (Hillestad et al., 2005). However, those who believe in the promising future of EMR systems are mostly researchers and hospital managers—none of whom use the systems in real hospital settings with real patients present. These recognitions of the benefits of EMR systems come from groups of people who value technology and data use in the healthcare industry - people who meet the description of the designers' and developers' ideal users. Based on the implementation process of the EMR systems at KCMC, it seems that the systems were configured to these kinds of users, and notions about these ideal users were used to build the product. Because of the huge differences between the ideal configured users and actual users, the EMR systems at KCMC were not used to their fullest potential and were eventually abandoned.

I have shown that the difference between the actual users and the configured users is what led to the failure of the EMR systems implemented at KCMC. However, some may argue that improving the ICT infrastructure and integrating new and existing systems will solve the issues of healthcare providers struggling with the use of these newly implemented systems. This, in fact, is what the researchers in the field have been calling for. They claim that lack of technological foundation is what led to confusion and problems navigating the systems. This does play a role in the failure of the implemented EMR systems at KCMC; for example, without a regular power supply (RTERadio1, 2016) and stable internet connectivity (Trbovic, 2019), the situation does make it harder for the implemented EMR systems at KCMC to be a success. While there is room for the technology infrastructures to improve, this does not mean that the

designers and engineers were not at fault. There were fundamental flaws with the design and implementation process of the EMR systems at KCMC that led to the healthcare givers' frustration. Studies have shown that an efficient training procedure for converting to EMR is a key factor to long-term success for these systems (Henry Schein, n.d.). Technology experts might have thought that the systems were easy to use, but actual users did not. The EMR systems implemented at KCMC were not properly designed for the healthcare givers' familiarity with technology, and thus did not bring enough positive impacts to their everyday work.

Conclusion

Electronic medical record (EMR) systems have many benefits. They improve the legibility of clinical notes and provide decision support for drug ordering, while also helping support program monitoring (Kalogiropoulos et al., 2009). Healthcare providers at Kilimanjaro Christian Medical Centre (KCMC) were charged with the task of familiarizing themselves with the new electronic systems and using them to help improve the hospital's efficiency. While the implemented EMR systems at KCMC were supposed to help the hospital make its transition into the digital era, they are failing to live up to their potential. A huge number of healthcare providers did not utilize the functionalities provided. According to a study, many physicians continue to resist the new technology, as they prefer the standard method of record keeping (Kalogiropoulos et al., 2009).

As the case of the design and implementation of EMR systems at KCMC shows, there were many areas in which the designers and developers failed to meet the healthcare providers' needs and fully understand the real users. The general consensus from scholars is that there is a need for better information and communication technologies (ICT) infrastructure and integration

of new and existing systems. While the notion of improving the ICT infrastructure and better integrating new and existing systems will increase the performance of the new EMR systems and help them meet the intended objectives, this is a very narrow viewpoint. It fails to acknowledge the real users and their needs. Designers and developers of the EMR systems implemented at KCMC did not properly configure users and take an actual user-centered approach when designing and implementing the product, which the concept of User Configuration helps make clear. Failing to understand the healthcare givers' needs and familiarity with technology will result in lack of system use, which is ineffective and a waste for hospitals to invest in. My argument highlights the importance of understanding the actual users' values, needs, abilities, and demographics in order to properly configure the user.

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