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THE APPLICATION OF A SOCIOTECHNICAL ANALYSIS FOR THE PERSONALLY CONTROLLED ELECTRONIC HEALTH RECORD

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Abstract

Healthcare systems around the globe are facing a number of challenges. Increasing focus is thus being placed on constructing appropriate healthcare reforms which are attempting to address how to tackle these challenges. A critical enabler in these reforms is the adoption of an e-health solution. Such e-health solutions are not only expensive and complex endeavors, but also have far reaching implications. Given that the implementation and adoption of these e-health solutions is so important; it is also vital to have an extensive evaluation and analysis of these systems with a theoretically informed lens. This then will serve to maximize and sustain the benefits of the proposed solution and realise its full potential for achieving superior healthcare delivery. To date the literature is voids of such evaluations. Hence, this paper proffers the use of a sociotechnical systems (STS) analysis. The exemplar case study under consideration is that of the Personally Controlled Electronic Health Record (PCEHR), the chosen e-health solution by the Australian government.

Keywords: Healthcare; Healthcare Delivery; Healthcare Operations; Healthcare Management; Personally Controlled Electronic Health Records; PCEHR; E-Health; Electronic Health Record; EHR; Sociotechnical system; STS
1 INTRODUCTION

Healthcare is an information rich industry (Wickramasinghe and Schaffer, 2010). In addition, today all OECD countries are facing major challenges in trying to deliver quality healthcare services (Wickramasinghe et al., 2009). This confluence of factors makes the need for a comprehensive system, that can not only handle multispectral data and disparate information but also can improve the flow of this information between key stakeholders (for example: service providers, consumers, government agencies and healthcare managers) to improve health outcomes and quality of care (Mort et al. 2009), a competitive necessity. Health information systems in general and e-health solutions more especially have the potential to do this; and hence we see the key role for e-health solutions on all healthcare reform agendas today (Wickramasinghe and Schaffer, 2010; Mort et al. 2009; Car et al., 2008). It is for these reasons that in Australia, the government has chosen to adopt a personally controlled electronic health record (PCEHR).

Although there are many benefits of health information technology (Buntin et al. 2011; Devaraj & Kohli, 2000; Goldzweig et al., 2009; Shekelle, Morton, & Keeler, 2006; Tang et al., 2006; Wu et al., 2006) the transformation is difficult and the level of adoption and usage of such systems is generally low (Kaelber et al. 2008; Steinbrook, 2008). Issues relating to the adoption and usage of such systems in healthcare environments are not just technical in nature but are multidimensional and include organisational, cultural, legal and social considerations as well (Ammenwerth et al., 2006; Catwell and Sheikh, 2009; Cresswell et al. 2011; Lorenzi et al., 2009; DesRoches et al. 2008; André et al. 2008).

To fully explore all issues pertaining to successful adoption and usage of e-health solutions and technology in general in healthcare, researchers have rightly argued that IT based interventions in healthcare settings should be evaluated with theoretically informed techniques (Wickramasinghe and Schaffer, 2010). One approach advocated in the literature is the application of a sociotechnical perspective based evaluation of complex healthcare systems and IT based interventions. (Wickramasinghe, Bali, & Lehaney, 2009; Yusof et al., 2007; Aarts et al., 2004).

The main focus of a sociotechnical perspective is to understand the nature of the relationship and interaction between two interrelated systems; a social system and a technical system in a given environmental context (Whetton & Georgiou, 2010). The emphasis is to study the multidimensional impact of technology on people, organisations and tasks as well as the impact of sociol and people issues on technology design, adoption and use (Cresswell et al. 2011). For this reason, it is also important to understand the inter-relationship and interactions of the two between each other (Coiera, 2004). Thus, in order to develop a true assessment of the key barriers and facilitators of the PCEHR implementation and adoption, it is important to analyse this project through a sociotechnical lens which will serve to facilitate the capture of all key issues – technical and non-technical.

Hence, this paper proffers the merits of taking a Sociotechnical system (STS) approach to evaluate the Personally Controlled Electronic Health Record (PCEHR) in the Australian context in an attempt to provide a rich analysis of all key issues and critical success factors necessary for its successful deployment. In so doing, this research in progress will also demonstrate the merits of a STS approach. Specifically, we will answer the research question how a socio technical perspective can facilitate a better understanding of the critical issues regarding e-health solutions development and successful deployment. To answer this question we will use an exploratory qualitative case study approach. We choose the exemplar case of the PCEHR in Australia and as noted by Yin (1994) the use of an exemplar case is appropriate when investigating a novel, new phenomenon (Yin, 1994). We subscribe to recognised qualitative data collection and analysis techniques including thematic analysis as discussed by Kvale (1996) and Boyatzis(1998). The following presents interim results of our research in progress study.
2 THE PERSONALLY CONTROLLED ELECTRONIC HEALTH RECORD (PCEHR)

The terminology adopted in Australia for electronic record keeping and its e-health solution is known as the Personally Controlled Electronic Health Record (PCEHR) which sits between individually-controlled health records and healthcare provider health records (NEHTA and DoHA 2011; figure 1). Thus, the PCEHR has a shared use and mixed governance model (NEHTA and DoHA 2011; figure 1).

![Figure 1. The position of the PCEHR in the e-health solution spectrum](image)

Specifically, the PCEHR is a person-centric secure repository of electronic health and medical records of individual’s medical history that would act as a hub for linking hospital, medical and pharmaceutical systems using a patient unique identifier (NHHRC, 2009:134). One of its key features is that it captures information from different systems and presents this information in a single view to consumers and authorised service providers for better decision making about health and service delivery (NEHTA & DoHA 2011). This is a hybrid health information system that integrates web based personal health records with a clinical electronic health record system and allows shared access to both consumers and healthcare providers based on a shared responsibilities and mixed governance model. (Leslie 2011).

As we can see from the overview the PCEHR is a person-centric system where technology is going to be implemented in a complex clinical and organisational environment and users are going to be different set of stockholders including healthcare service providers, healthcare managers, government bodies, healthcare pressure groups and most importantly patients.

Further, the PCEHR is a patient centric system and is a model for essentially engaging patients in their healthcare and empowering them in this undertaking. The PCEHR utilises advances in technology most notably that of web 2.0 which makes it possible to engage users by providing them interactive user interfaces. Hence, it also becomes important to understand the rules of interaction between users, tasks and technology, which is possible with a Sociotechnical approach.

3 WHY SOCIOTECHNICAL APPROACH

Modern healthcare systems are very complex; consist of many social and technical organs that are very deeply rooted, interrelated and interdependent (Wickramasinghe et al., 2009). The change in one aspect of the system can affect another aspect and can further increase the complexity of healthcare services (Wears & Berg, 2005). The introduction of new technology would have implications in clinical roles, work processes and may enforce cultural changes (Coiera 2004; Ash et al. 2006; Ash et al. 2009) despite the fact that the user attitude and the use of technology is socially shaped (Coiera, 2004). A Sociotechnical approach views IT (information technology) systems and software as an active member of the organisation or an important factor in the social network of healthcare settings that continuously interact and cooperate with clinical teams, organisational routines and individual users (Wears & Berg, 2005, Anderson & Aydin, 2005).
A sociotechnical approach attempts to describe the characteristic or manner of an interaction or behaviour of competing systems, it further tries to explain the dynamics of the interaction between technology and the sociocultural environment where technology is going to be used (Whetton, 2005). Purely techno-centric evaluations have been widely criticised because of their limitations (Whetton, 2005; Berg, 2003; Littlejohns, Wyatt, & Garvican, 2003). In addition, the sociotechnical approach involves a paradigm shift in the way we study the details of failures; it requires now to think beyond the poor system design and the perceptions about how to perform clinical tasks (Wears & Berg, 2005; Aarts & Gorman, 2007; Aarts, Ash, & Berg, 2007). Thus, a sociotechnical approach emphasises an understanding that the very existence of technology is a part of social system and mediated by organisation considerations. In the case of the PCEHR, this approach would enable us to study also if technology can or cannot exist as an independent entity.

The application of such a sociotechnical perspective has been widely encouraged in healthcare settings to study the poor use and acceptance of information technology within healthcare settings (Coiera, 2004; Whetton, 2005; Berg, 1999). The major challenge organisations are facing at the moment is to find ways to successfully incorporate health information systems into the work process and infrastructure of the organisations (Sittig, 1994; Atkinson et al. 2001). One solution argued by Atkinson and his colleagues is to develop a sociotechnical research and development agenda to “undertake participative, multi-stakeholder problem solving within a healthcare context” (Atkinson et al. 2001, p1). Further Coiera again emphasised this by arguing that “if health care is to evolve at a pace that will meet the needs of society it will need to embrace this science of Sociotechnical design” (Coiera 2004, p1197).

Today’s IT based healthcare solutions such as the PCEHR are not stand alone systems. On the contrary, they are purposely to work in a networked healthcare environment (Lubitz & Wickramasinghe, 2006) whence implemented in one department or section of a hospital would not only be impacted by the other departments or sections (Georgiou et al., 2005; Georgiou et al., 2007) but may also be affected by external environmental factors such as health organisations, government and private funding bodies and regulators. This then becomes a complex healthcare environment and one in which we suggest that it is important to evaluate these systems at both micro and macro level to cover all internal and external issues.

3.1 Sociotechnical Issues Relating To The Development, Adoption, Implementation And Diffusion Of (PCEHR) Technology

In Australian healthcare IT transformation, social issues have huge significance. Topics relating to individual privacy, health information security, ethics and legal issues have been extensively debated in different reports (Showell, 2011). The breach of privacy and security of health information is a common concern among Australian consumers and health privacy advocates despite the fact that the draft (Personally Controlled Electronic health Record Act 2011) emphasises the security and privacy of an electronic health record of individuals as well as any information that is protected by law. But in essence, the hard fact is that the language about the placement of the requirements and standards is vague and serves to add to the confusion and also raise many more concerns among users (Hoffinan & Podguski 2008). Furthermore, there are many policy issues involving development of standards to set security and access rules of the system (Hoffinan & Podguski 2008). In addition, a comprehensive process of consultation between PCEHR system users and system developers and implementation team is urgently need and should be emphasised as key policy issues (Showell 2011).

Along with these privacy and policy issues, organisational issues e.g poor governance, organisational culture and poor management of the change process have also been reported. These issues can have damaging effect on e-health adoption and implementation (Hoffinan 2009; Greenhalgh & Stones 2010; Kennedy 2011; Bernstein et al. 2007). Further, these issues can aggravate the resistance to the change process and also complicate the diffusion of the PCEHR technology.
At the micro level, user acceptance (Frame et al. 2008; Agarwal & Prasad 1997), perceived ease of use (Al-Azmi et al. 2009), lack of knowledge about the system (Bath 2008; Elrod & Androwich 2009; Kaplan & Harris-Salamone 2009; André et al. 2008; Liu et al. 2011), lack of stakeholder consultation (Showell 2011), lack of willingness to assimilate the technology into daily routines and processes (Cash 2008; Ross et al. 2010; Davidson & Heslinga 2007; Kaplan & Harris-Salamone 2009), conflict between system and user embedded values (Cash 2008; Kaplan & Harris-Salamone 2009), complex and complicated user interfaces (Yusof et al. 2007), conflict between physician activities and training schedules (André et al. 2008; Yusof et al. 2007; Kaplan & Harris-Salamone 2009) are some major concerns.

Lastly, in regards to technology, the lack of infrastructure, standards and protocols which in turn results in lack of interpretability and fragmented healthcare information systems which serve to further complicate a very complex situation (Davidson & Heslinga 2007; Hoffinan & Podguski 2008; Kralewski et al. 2010; Vitacca et al. 2009; HFMA 2006; Kennedy 2011; Trudel 2010). Pre-implementation and post-implementation vendor support is yet another key concern for organisations (Kralewski et al. 2010; Cohn et al. 2009; Kennedy 2011; Liu et al. 2011; Trudel 2010; Tang et al. 2006). Lack of financial resources to buy very expensive health information systems hardware and software for start-up and later on upgrades is also identified as a complex issue (Aarts & Koppel 2009; Ashish 2009; Bates 2005; Bath 2008; Weimar 2009; Kaplan & Harris-Salamone 2009). Lack of technical resources and experience with information technology implementation within healthcare settings is another problem faced by many (Torda et al. 2010; Trudel 2010; Liu et al. 2011; Kennedy 2011; André et al. 2008; Bath 2008; DePhillips 2007; Davidson & Heslinga 2007; McReavy et al. 2009). The accuracy of data obtained through the information system and its ability of sorting, querying and validating data in some cases is very poor and is considered as a big barrier for HIT (healthcare IT) adoption (Rosenbloom et al. 2006; Rosebaugh 2004; Kimaro & Nhampossa 2007).

Given the complex nature of the healthcare system, coupled with the challenges and barriers described above relating to the adoption and implementation of IT into healthcare contexts; the importance of conceptualising and framing the critical factors for evaluating the proposed PCEHR system cannot be over emphasised. Hence, the next section presents our initial conceptual model that attempts to capture all the key considerations as discussed above for further analysis.

4 RESULTS – INITIAL CONCEPTUAL MODEL

Based on a comprehensive literature review (Wickramasinghe & Schaffer., 2010; Aarts et al., 2009; Al-Azmi et al., 2009; Atkinson et al., 2001) and synthesis, five key considerations and factors were identified for the successful implementation and adoption of e-health solutions in general; namely financial, organisational, social, people and technological. These have facilitated the development of the proposed conceptual model as presented in figure 2. Specifically as the PCEHR has many similar aspects to e-health solutions implementation, it is logical to use these factors as the basis of our model. Naturally the specific study will test the validity of the proposed conceptual model. This initial conceptual model serves to capture the important aspects of the barriers and facilitators for the prediction of the successful adoption and implementation of the PCEHR. The proposed model identifies a network of different actors interconnected to each other. It further illustrates, that a central issue with the evaluation of IT based healthcare interventions with the complexity of the evaluation objects (Ammenwerth et al., 2003). For instance, the nature of the integration of health information systems with the culture and business process of healthcare organisations puts more emphasis on the evaluation methods and goes beyond the technology aspects of hardware and software that captures external and internal environmental factors as well as to understand the diverse nature of system effects in the healthcare settings (Ammenwerth et al., 2003). To study this complex network of interactions of humans with technology in organisations and certain individual levels a Sociotechnical System (STS) perspective is indeed prudent (Cresswell et al. 2011).
We note that in the conceptual model (fig 2) it is possible to view these factors at different levels. In particular micro level issues (ie issues related to the individual user level), meso level issues (i.e., issues related to the organisational level) and macro level issues (i.e., issues related to the government level) dealing with policy regarding funding and privacy aspects; however, it is important to remember that the actual factors are relevant at all levels (micro, maso, macro) and together form a heterogeneous network as per Actor-Network Theory (Latour, 2005), and thus it is important at least initially to view them at the same level much like the way Actants are all treated equally in ANT (Latour, 2005)

It is important to note that the initial conceptual model is based on the first part of our study which consisted of a comprehensive literature review and document archival analysis. For the second part of our study, we will go forward with the qualitative data collection and thematic analysis of different emergent themes within the scope of Australian healthcare system and PCEHR development and adoption. This will serve the purpose test and then accordingly to revise the conceptual model and also uncover key issues regarding Sociotechnical systems including people, process and technology issues as they relate to the PCEHR.

![Initial Conceptual Model](image)

**Figure 2. Initial Conceptual Model**

## 5 DISCUSSION

IT based interventions to reform healthcare services for the improvement of health outcomes are increasing. However, the success rates with these interventions are not encouraging. Evaluations of failed systems have emphasised the need to use appropriate tools and techniques that can capture and explain the complex nature of healthcare service deliveries and their interactions with the new proposed technologies. Further, it is also important to evaluate these technologies with theoretically informed techniques that are sufficiently rich and robust in order to understand the barriers and facilitators that are critical for more successful outcomes.

An initial investigation into e-health solutions and their adoptions have indicated a need that developers and implementation teams should start focusing on social and organisational issues and
shift away from the technocentric obsession of “how the technical system can be made to work right”. This has been identified with our initial analysis of the health information systems literature. Literature clearly outlines that the failure is not just because of a poor understanding of technological issues but also and more importantly about a lack of understanding and interest in organisational, cultural and social issues; i.e., a good user friendly interface and easy to learn system would not be adopted if the privacy and security concerns of the users could not be addressed at the same time poorly designed and complex information systems in healthcare settings where users have insufficient IT training would face real challenges of adoption. Further, ignoring the existing organisational workflows and social interactions in redesigning the organisational process may hinder the implementation and adoption process which could have adverse effects on healthcare service outcomes. Therefore the information system alone might not be the decisive factor but the social factors might have much more importance in the decision making process. Given this; the main focus of the development and implementation teams should be on organisational work practises, teamwork and communication, organisational cultural issues, leadership role, user attitudes, perceptions, reactions and satisfactions, government role and governance, stakeholder consultation at all stages of system development and adoption including policy formation, different kind of financial issues, ethics and privacy issues. For the research purpose the inherent complexities of the healthcare environment such as its organisational culture and social aspects and their interaction with newly introduced technology requires some kind of techniques and tools that can properly explain and explore the issues. Sociotechnical design is a well-thought-out approach to acknowledge the complexities of the healthcare environment and explain the interaction between a social system and a technology (Altman, 1997; Atkinson et al, 2001; Coiera, 2004). To further explore this topic, we intend to extend this study with the qualitative data collection phase. We will identify key stakeholders in the PCEHR development, implementation and adoption and from this we will begin with identifying key informants and follow up will interviews to understand and validate the key factors and considerations for successful PCEHR implementations and adoptions as identified from the literature and presented in the above initial conceptual model.

It is important to note that the PCEHR has both similarities and differences to other e-health solutions noted in the literature. We have at times extrapolated findings, barriers, facilitators and key points from the literature, which were not specific to the PCEHR per se. we believe this to be appropriate since the other solutions were all consistent with IS/IT in healthcare contexts. However our next phase, namely the testing of the proposed conceptual model will serve to confirm if this has been an appropriate approach.

6 CONCLUSION

Healthcare systems are complex systems especially when it integrates with information technology. The challenge of this study is further complicated by the interaction of different human and nonhuman actors that mainly lead to failed technology based healthcare interventions and implementations. As a result, failure rates are surprisingly high, costly and have far reaching impacts. Thus, it would be interesting and important to evaluate these interventions with theoretically informed techniques to enable a deeper understanding which could facilitate the successful implementations and adoptions of health information technology. As a starting point, we believe that a sociotechnical systems perspective can provide foundation for a better understanding of these systems so that we could better evaluate and provide solution for the PCEHR development, implementation and adoption. Furthermore, it can also enhance our understanding by providing a mechanism to study the relationships between technology organisation, people, and social and finance factors that influence the success of e-health implementation and adoption. We believe that a viable healthcare system can only be achieved if all of these considerations are jointly optimised. Our initial analysis and presented conceptual model for the PCEHR development in Australia to date shows that the process underlying the PCEHR development, implementation and adoption are inherently sociotechnical in nature. A sociotechnical approach of study therefore will allow more flexibility in system design and adoption. We are confident that this approach will be of benefit to both practitioners, for better design and
implementations and researchers, for better evaluation. We do however; acknowledge that sociotechnical theory does have shortcomings and suggest that to overcome these one should combine such an analysis with other theories such as actor network theory and/or structuration theory. We conclude this study by calling for more confirmatory follow up research in this vital area.

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