



The need for a socio-technical analysis in E-health: the case of the PCEHR

Muhammad, Imran, Teoh, Say Yen and Wickramasinghe, Nilmini 2013, The need for a socio-technical analysis in E-health: the case of the PCEHR, *International journal of e-health and medical communications*, vol. 4, no. 2, pp. 65-79.

DOI: [10.4018/jehmc.2013040105](https://doi.org/10.4018/jehmc.2013040105)

©2013, IGI Global

Reproduced with permission.

Downloaded from DRO:

<http://hdl.handle.net/10536/DRO/DU:30077579>

The Need for a Socio-Technical Analysis in E-Health: The Case of the PCEHR

Imran Muhammad, Epworth Research Institute, School of Business IT and Logistics, RMIT University, Melbourne, VIC, Australia

Say Yen Teoh, Health Innovations Research Institute, School of Business IT and Logistics, RMIT University, Melbourne, VIC, Australia

Nilmini Wickramasinghe, Epworth HealthCare, Health Innovations Research Institute, School of Business IT and Logistics, RMIT University, Melbourne, VIC, Australia

ABSTRACT

Healthcare systems around the globe are facing a number of challenges. Thus increasing focus is 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 endeavours, but also have far reaching implications. Given that the implementation and adoption of these e-health solutions is so important, not to mention also requiring a substantial investment in various resources such as time and money, it is therefore essential to ensure their success. The following proffers a socio-technical analysis as an appropriate strategy to ensure more successful outcomes. An exemplar case study of the Personally Controlled Electronic Health Record (PCEHR), the chosen e-health solution by the Australian government is provided to illustrate the benefits such an analysis might provide

Keywords: E-Health, Electronic Health Record, Healthcare Delivery, Personally Controlled Electronic Health Record (PCEHR), Socio-technical System, Socio-technical system (STS)

INTRODUCTION

The aim of this study is to address a significant void in the existing literature; namely, the lack of incorporating a socio-technical analysis in healthcare contexts to ensure heightened success of ICT implementations in healthcare. An evaluation of the Personally Controlled Electronic Health Record (PCEHR) a chosen

e-health solution in Australia is provided as an exemplar case to illustrate the benefits of such an approach.

Motivation for the Study

Given current challenges in healthcare delivery most countries are currently investing heavily in ICT (Information Communication Technology)

DOI: 10.4018/jehmc.2013040105

in general and e-health solutions more specifically. Australia, like many other countries is also investing heavily in E-health initiatives. Specifically, in the federal budget (2010-11) the Australian government has allocated Au \$466.7 million over two years to develop and implement a national Personally Controlled Electronic Health Record (PCEHR) system for all Australians by 2012. This is a significant investment in the hope of transforming the healthcare delivery system in Australia. This implementation has raised many interesting questions concerning policy issues such as patient privacy, security, identification and management of consent for participation and data collection as well as technical issues concerning system complexity and user understanding of system, lack of standards and protocols, disparate health information systems and frameworks for integration as well as complex user interfaces (Currell et al., 2000; Hall, 2010; Leslie, 2011; Showell, 2011; Westbrook & Braithwaite, 2010). These issues are very important to look into for smooth and successful system implementation and sustainable adoption (Bernstein et al., 2007a; Tang, Ash, et al., 2006; Trudel, 2010; Liu et al., 2011; HFMA, 2006). These key areas of issues can be categorised as social aspects and technical aspects.

An essential aspect then becomes to provide an evaluation of such systems especially since to date no such framework exists to make substantive critiques on PCEHR; its strengths, benefits, weaknesses as well as an examination of the social and technical aspects. Moreover, no study does this from a socio-technical perspective.

Background

Healthcare is an information rich industry (Wickramasinghe & 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, one 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 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 & 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 & 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 & Schaffer, 2010). One approach advocated in the literature is the application of a socio-technical 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 socio-technical perspective is to understand the nature of the relationship and interaction between two inter-related systems; a social system and a technical system in a given environmental context (Whet-

ton & Georgiou, 2010). The emphasis is to study the multidimensional impact of technology on people, organisations and tasks as well as the impact of social or 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 socio-technical 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 Socio-technical 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 can a socio-technical perspective 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 from our case study research looking at the Personally Controlled Electronic Healthcare Record (PCEHR).

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).

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 unique patient 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 and DoHA 2011). This then 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).

The PCEHR is designed to be a person-centric system where technology is implemented in a complex clinical and organisational environment and users consist of different sets of stakeholders including healthcare service providers, healthcare managers, government bodies, healthcare pressure groups and most importantly patients (NEHTA and DoHA 2011). Further, the PCEHR is also a patient centric

Figure 1. The position of the PCEHR in the e-health solution spectrum



system and is a model for essentially engaging patients in their healthcare and empowering them in this undertaking (NEHTA and DoHA, 2011). 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 (NEHTA and DoHA, 2011). Hence, in order to assess the strengths of this solution, it also becomes important to understand the rules of interaction between users, tasks and technology, which is possible with a Socio-technical approach.

WHY A SOCIO-TECHNICAL APPROACH

Modern healthcare systems are very complex; they 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 and 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 Socio-technical 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 co-operate with clinical teams, organisational routines and individual users (Wears & Berg, 2005, Anderson & Aydin, 2005).

A socio-technical 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 socio-cultural environment where the 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 contrast, a socio-technical

approach involves a paradigm shift in the way we study the details of failures; it requires thinking beyond just the poor system design and expands the focus to include perceptions about how to perform clinical tasks (Wears & Berg, 2005; Aarts & Gorman, 2007; Aarts, Ash, & Berg, 2007). Thus, a socio-technical 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 enables us to also study if technology can or cannot exist as an independent entity.

The application of such a socio-technical perspective has been widely encouraged in healthcare settings in order to study the poor use and acceptance of information technology within such 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 work process and the infrastructure of the organisations (Sittig, 1994; Atkinson et al., 2001). One solution argued by Atkinson and his colleagues is to develop a socio-technical research and development agenda to “undertake participative, multi-stakeholder problem solving within a healthcare context” (Atkinson et al., 2001, p1). Further Coiera again emphasises 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 Socio-technical design” (Coiera 2004, p1197).

Today’s IT based healthcare solutions such as the PCEHR are not stand alone systems. On the contrary, they are purposed to work in a networked healthcare environment (Lubitz & Wickramasinghe, 2006) whence implemented in one department or section of a hospital, such systems 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 contend must be included in any important evaluation of these systems

i.e. it is important to examine both micro and macro level contexts as well as all internal and external issues.

Socio-Technical Issues Relating to the Development, Adoption, Implementation and Diffusion of (PCEHR) Technology

In Australian healthcare IT transformations, social issues also 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 as well as any individual information that is protected by law. In essence, however, the reality is that the language regarding 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 the 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 as well as the 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 a 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. Furthermore; due to the complexity of healthcare delivery systems, assimilation of information technology in healthcare needs

a deeper understanding of organisational and environmental aspects of technology adoption and use (Yusof et al., 2008; Catwell & Sheikh, 2009).

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 training, 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) and complications in patient-provider communications are some of the major concerns. At this level it is paramount that the systems are user centric and have a good fit with user values as well as existing healthcare systems.

Lastly, in regards to technology, there is a lack of infrastructure, standards and protocols which in turn results in a poor interpretability and fragmented healthcare delivery which serve only 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). Table 1 further explains the nature of these issues and factors as they relate to the adoption and implementation of e-health technologies in complex healthcare settings.

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.

RESEARCH DESIGN AND METHODOLOGY

This section presents the research design, methodology to be used and data analysis techniques to be adopted.

Research Design

This research will be divided into two stages; at the first stage we will gather multi-spectral data by conducting a comprehensive review of the literature from different fields including social sciences, information systems, health information systems and emerging technologies in health services and information management.

The purpose of this stage is to gain an in-depth background knowledge of issues and challenges facing healthcare information systems design, development and implementation. The focus will primarily be on the Australian context. In addition we will analyse any solutions presented. From the synthesis of this multi-spectral develop the initial conceptual model by

identifying the human and non-human factors for the successful PCEHR implementation and adoption. At this stage; documents and archival records of different health organisations, government agencies and private organisations involved in healthcare service delivery and PCEHR development and implementation will also be studied.

A general conceptual model is developed we will delve further to focus specifically on the PCEHR. It is important at this point to identify the factors important for its successful adoption. This will be served by answering questions such as what are the key capabilities and resources for development, adoption and diffusion of PCEHR and who are the key stakeholders in the development, adoption and diffusion of PCEHR.

At the second stage we will collect in-depth data, generate themes and develop a taxonomy. Data collection at this stage is primarily done using, open-ended and semi-structured interviews and focus group activity with the key stakeholders identified in stage 1. As noted earlier we adopt a qualitative approach using an exemplar case study (Yin, 2009). In addition, standard techniques at data analysis will be employed (Kvale, 1996). The study participants can provide retrospective and current information about their experiences with the system they are using and their expectation from the transformed system which is a key source of important data as noted by (Yin, 2009). Interviews and focused groups will be audio recorded for future transcription. Emergent themes and priori unit of analysis of different stake holders will be identified and confirmed. This stage will help us to measure the appropriateness of the use of chosen theory and model.

RESULTS

Initial Conceptual Model

For the first stage of this research; Based on a comprehensive literature review (Wickramasinghe & Schaffer, 2010; Aarts et al., 2009; Al-Azmi et al., 2009; Atkinson et al., 2001) and

Table 1. Key factors and issues and there nature

Factors and Issues	Nature of factors and Issues
Fit between Task and Technology	Socio-technical
Technical Support	Socio-technical
Different HIT Systems and their communication	Purely technical
Fragmentation	Purely technical
Fit between HIT and user skill	Socio-technical
Protocols and standards	Purely technical
Provided Security	Socio-technical
Access Rules	Socio-technical
Technology infrastructure	Purely technical
Complex user interface	Purely technical
Difficult terminologies	Purely technical
User beliefs	Purely social
User attitude	Purely social
Alignment of technology with the values of the user	Socio-technical
User Training	Socio-technical
Staffing and skills	Socio-technical
Resistance to change	Purely social
Lack of user involvement in all the stages of system life cycle.	Socio-technical
Legislative and legal issues	Purely social
Stakeholder support	Purely social
Trust	Purely social
Ethics and privacy	Purely social
Complex nature of healthcare settings	Purely social
Lack of sustainable models for E-health solutions	Socio-technical
Contextual and environmental factors	Purely social
Clarification of roles and responsibilities	Purely social
BPR	Socio-technical
Health organisation and technology fit	Socio-technical
Poor Governance of health institutions and technology	Socio-technical
Leadership	Socio-technical
High time cost	Socio-technical
Budget over runs	Socio-technical
Technology cost	Socio-technical
Business case	Purely social
Lack of incentives for service providers	Purely social

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 modal as presented in Figure 2. Further, Table 2 maps these key factors specifically to the healthcare environment.

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 modal. 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 includes both social and technical considerations (Ammenwerth et al., 2003). For instance, the nature of the integration of health information systems with the culture and business processes of healthcare organisations puts more emphasis on the evaluation methods and goes beyond the technology aspects of hardware and software, furthermore, external and internal environmental factors as well as an understanding of the diverse nature of system effects in the healthcare settings is required (Ammenwerth et al., 2003). This emphasis is on creating a better fit between human, contextual and technological factors for the successful implementation and adoption of health information systems (Dansky et al.,

Figure 2. Initial conceptual model

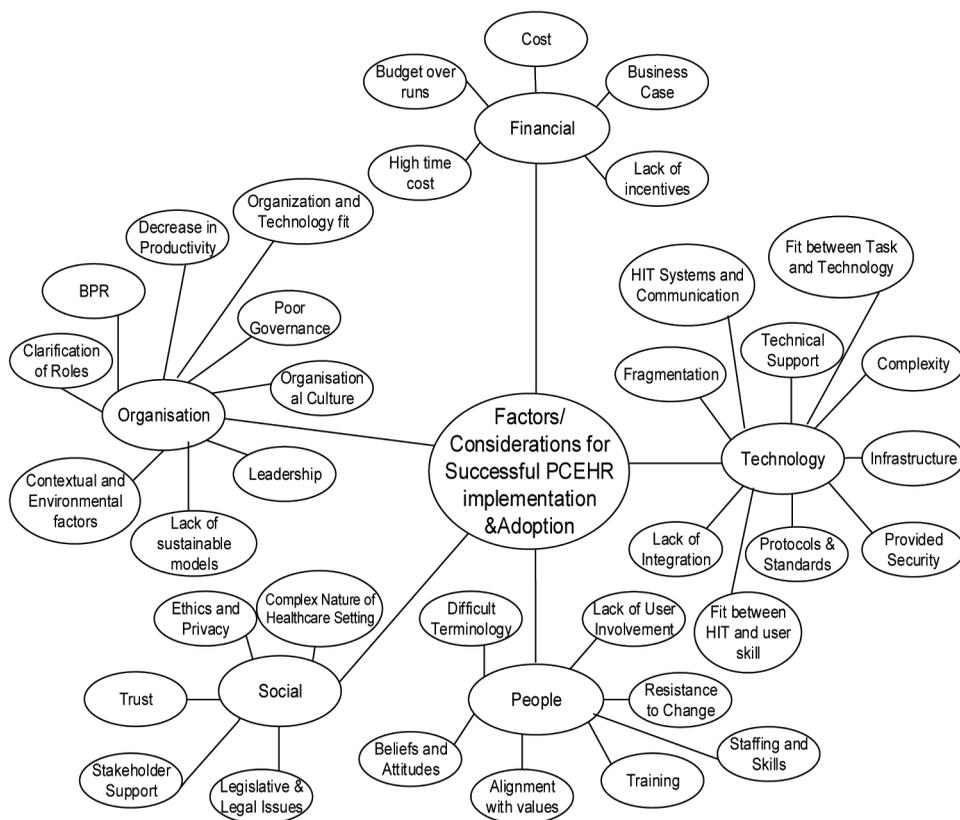


Table 2. Mapping of key factors with healthcare

Key Factors	Mapping with healthcare
Technology	PCEHR, fragmented healthcare systems such as radiology and labs.
People	Healthcare consultants, GPs, Specialists, allied healthcare service providers, clinic and hospital administrators, and healthcare insurance individuals.
Social	Health related legislation and laws, User trust, ethics and privacy rules, stakeholder support.
Organisation	Hospitals, Doctor clinics, Allied health organisations, healthcare ministries, state and federal health organisations.
Financial	Payers, funding organisations, private insurance, public insurance, healthcare direct and indirect cost, healthcare budgets, e-health costs. Doctor and other health service provider incentives.

2006; Kukafka et al., 2003; Yusof et al., 2008). To study this complex network of interactions of humans with technology in organisations and certain individual levels a Socio-technical 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 (ie 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, meso and macro levels) 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). Therefore we believe that to study this complex network of interactions of humans with technology in organisations and certain individual levels a holistic approach is a necessity. Holistic means that analysis should be done as a whole including all the interdependent parts of the system and avoid any separate or individual analysis. This approach serves to capture all issues relating to financial, organizational and social, people and technological factors during design, implementation and adoption phases of the PCEHR.

Lastly, 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 the different emergent themes within the scope of Australian healthcare system and PCEHR development and adoption. This will serve to test and then accordingly to revise the conceptual model and also uncover key issues regarding Socio-technical systems including people, process and technology issues as they relate specifically to the PCEHR.

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 (Muhammed et al., 2012). 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.

Our initial investigation into e-health solutions and their adoptions has served to indicate a great need to start focusing on social and organisational issues and shift away from the current technocentric obsession of “how the technical system can be made to work right”. The 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 (Sharma et al., 2011). 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 (Muhammed et al., 2012). Therefore the information system alone might not be the decisive factor but the social factors are likely to have much more importance in the decision making process. A socio-technical design provides us with 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). Moreover, we believe it is only by adopting a socio-technical approach that it will be possible to not only fully capture the complexities and richness of healthcare operations but also be able to analyse them effectively and appropriately and thereby assess critical issues for successful e-health solutions to ensue.

CONCLUSION

Healthcare systems are complex systems especially when as they integrate 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 unsurprisingly high, costly and have far reaching impacts. Thus, it becomes necessary and important to evaluate these interventions

with theoretically informed techniques to enable a deeper understanding which in turn can facilitate a successful implementation and adoption of health information technology. As a starting point, we believe that a socio-technical systems perspective can provide the foundation for a better understanding of these systems so that we can better evaluate and provide specific solutions to address gaps in their current 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. We set out to investigate this in the specific context of the PCEHR, in Australia. Our initial analysis and presented conceptual model for the PCEHR development in Australia to date shows that the processes underlying the PCEHR development, implementation and adoption are inherently socio-technical in nature. A socio-technical 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 socio-technical theory as (Berg, 1999) rightly indicates does have its 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. Finally, 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.

Longer term, we plan to perform a comparative analysis with other e-health solutions.

REFERENCES

- Aarts, J., Ash, J., & Berg, M. (2007). Extending the understanding of computerized physician order entry: implications for professional collaboration, workflow and quality of care. *International Journal of Medical Informatics*, 76, S4–S13. doi:10.1016/j.ijmedinf.2006.05.009 PMID:16798068.
- Aarts, J., Doorewaard, H., & Berg, M. (2004). Understanding implementation: The case of a computerized physician order entry system in a large Dutch university medical center. *Journal of the American Medical Informatics Association*, 11, 207–216. doi:10.1197/jamia.M1372 PMID:14764612.
- Aarts, J., & Gorman, P. (2007). IT in health care: Socio-technical approaches “To err is system”. [SRC – GoogleScholar.]. *International Journal of Medical Informatics*, 76(Suppl 1), 1–3. doi:10.1016/S1386-5056(07)00078-0.
- Aarts, J., & Koppel, R. (2009). Implementation of computerized physician order entry in seven countries. *Health Affairs (Project Hope)*, 28(2), 404–414. doi:10.1377/hlthaff.28.2.404 PMID:19275996.
- Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences*, 28(3), 557–582. doi:10.1111/j.1540-5915.1997.tb01322.x.
- Al-Azmi, S., Al-Enezi, N., & Chowdhury, R. (2009). Users’ attitudes to an electronic medical record system and its correlates: A multivariate analysis. *The HIM Journal*, 38(2), 33–40. PMID:19546486.
- Altman, R. B. (1997). Informatics in the care of patients: ten notable challenges. *The Western Journal of Medicine*, 166(2), 118–122. PMID:9109328.
- Ammenwerth, E., Gräber, S., Herrmann, G., Bürkle, T., & König, J. (2003). Evaluation of health information systems-problems and challenges. *International Journal of Medical Informatics*, 71(2-3), 125–135. doi:10.1016/S1386-5056(03)00131-X PMID:14519405.
- Ammenwerth, E., Iller, C., & Mahler, C. (2006). IT-adoption and the interaction of task, technology and individuals: A fit framework and a case study. *BMC Medical Informatics and Decision Making*, 6. PMID:16451720.
- Amoretti, M., et al. (2009, November). e-Inclusive videoconference services in ambient assisted living environments. In *Proceedings of the 3rd European Conference on Ambient Intelligence (AmI2009)*, Salzburg, Austria.
- Anderson, J. G., & Aydin, C. E. (2005). *Evaluating the organizational impact of health care information systems*. Springer Verlag. doi:10.1007/0-387-30329-4.
- André, B., Ringdal, G. I., Loge, J. H., Rannestad, T., Laerum, H., & Kaasa, S. (2008). Experiences with the implementation of computerized tools in health care units: A review article. *International Journal of Human-Computer Interaction*, 24(8), 753–775. doi:10.1080/10447310802205768.
- Ash, J. S., Sittig, D. F., Campbell, E., Guappone, K., & Dykstra, R. (2006). An unintended consequence of CPOE implementation: shifts in power, control, and autonomy. In *Proceedings of the AMIA Annual Symposium* (Vol. 2006, p. 11).
- Ash, J. S., Sittig, D. F., Dykstra, R., Campbell, E., & Guappone, K. (2009). The unintended consequences of computerized provider order entry: Findings from a mixed methods exploration. *International Journal of Medical Informatics*, 78, S69–S76. doi:10.1016/j.ijmedinf.2008.07.015 PMID:18786852.
- Ashish, K. (2009). Use of electronic health records in U. S. hospitals medical benefits. doi 101056NEJM-sa0900592, 25(10 SRC - GoogleScholar).
- Atkinson, C., Eldabi, T., Paul, R., & Pouloudi, A. (2001). Investigating integrated Socio-technical approaches to health informatics (p. 10–pp SRC – GoogleScholar).
- Bates, D. W. (2005). Physicians and ambulatory electronic health records. *Health Affairs*, 24, 1180–1189. doi:10.1377/hlthaff.24.5.1180 PMID:16162561.
- Bath, P. (2008). Health informatics: current issues and challenges. *Journal of Information Science*, 34(4), 501. doi:10.1177/0165551508092267.
- Berg, M. (1999). Patient care information systems and health care work: A socio-technical approach. *International Journal of Medical Informatics*, 55(2), 87–101. doi:10.1016/S1386-5056(99)00011-8 PMID:10530825.
- Berg, M. (2003). *Health information management: Integrating information technology in health care work*. Routledge. doi:10.4324/9780203563298.
- Bernstein, M. L., McCreless, T., & Côté, M. J. (2007). Five constants of information technology adoption in healthcare. *Hospital Topics*, 85(1), 17–25. doi:10.3200/HTPS.85.1.17-26 PMID:17405421.

- Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, CA: Sage Publications.
- Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: A review of the recent literature shows predominantly positive results. *Health Affairs*, 30(3), 464–471. doi:10.1377/hlthaff.2011.0178 PMID:21383365.
- Car, J., Anandan, C., Black, A., Cresswell, K., Pagliari, C., McKinstry, B., & Sheikh, A. (2008). *The impact of e-health on the quality and safety of healthcare: A systematic overview and synthesis of the literature*. NHS Connecting for Health Evaluation Programme.
- Carbonell, N. (2006). Ambient multimodality: Towards advancing computer accessibility and assisted living. *Universal Access in the Information Society*, 5(1), 96–104. doi:10.1007/s10209-006-0027-y.
- Cash, J. (2008). Technology can make or break the hospital-physician relationship. *Healthcare Financial Management: Journal of the Healthcare Financial Management Association*, 62(12), 104–109. PMID:19069330.
- Catwell, L., & Sheikh, A. (2009). Evaluating e-health Interventions: The need for continuous systemic evaluation. *PLoS Medicine*, 6(8), e1000126. doi:10.1371/journal.pmed.1000126 PMID:19688038.
- Cohn, K., Berman, J., Chaiken, B., Green, D., Green, M., Morrison, D., & Scherger, J. (2009). Engaging physicians to adopt healthcare information technology. *Journal of Healthcare Management/American College of Healthcare Executives*, 54(5), 291.
- Coiera, E. (2004). Four rules for the reinvention of health care. *British Medical Journal*, 328(7449), 1197–1199. doi:10.1136/bmj.328.7449.1197 PMID:15142933.
- Cresswell, K., Worth, A., & Sheikh, A. (2011). Implementing and adopting electronic health record systems: How actor-network theory can support evaluation. *Clinical Governance: An International Journal*, 16(4), 320–336. doi:10.1108/14777271111175369.
- Dansky, K. H., Thompson, D., & Sanner, T. (2006). A framework for evaluating eHealth research. *Evaluation and Program Planning*, 29(4), 397–404. doi:10.1016/j.evalprogplan.2006.08.009 PMID:17950868.
- Davidson, E., & Heslinga, D. (2007). Bridging the IT - Adoption gap for small physician practices: An action research study on electronic health records. *Information Systems Management*, 24(1), 15. doi:10.1080/10580530601036786.
- Demiris, G., & Hensel, B. K. (2008). Technologies for an aging society: A systematic review of “smart home” applications. Geissbuhler, A., Kulikowski, C. (Eds.), *IMIA yearbook of medical informatics 2008. Methods in Informative Medicine*, 47(Suppl 1), 33–40.
- DePhillips, H. A. (2007). Initiatives and barriers to adopting health information technology: A US perspective. *Disease Management and Health Outcomes*, 15(1). Retrieved September 27, 2011, from <http://ideas.repec.org/a/wkh/dmhout/v15y-2007i1p1-6.html>
- DesRoches, C. M., Campbell, E. G., Rao, S. R., Donelan, K., Ferris, T. G., & Jha, A. et al. (2008). Electronic health records in ambulatory care—a national survey of physicians. *The New England Journal of Medicine*, 359(1), 50–60. doi:10.1056/NEJMsa0802005 PMID:18565855.
- Devaraj, S., & Kohli, R. (2000). Information technology payoff in the health-care industry: A longitudinal study. *Journal of Management Information Systems*, 16(4), 41–67.
- Elrod, J., & Androwich, I. M. (2009). Applying human factors analysis to the design of the electronic health record. *Studies in Health Technology and Informatics*, 146, 132–136. PMID:19592822.
- Frame, J., Watson, J., & Thomson, K. (2008). Deploying a culture change programme management approach in support of information and communication technology developments in Greater Glasgow NHS Board. *Health Informatics Journal*, 14(2), 125–139. doi:10.1177/1081180X08089320 PMID:18477599.
- Georgiou, A., Westbrook, J., Braithwaite, J., & Iedema, R. (2005). Multiple perspectives on the impact of electronic ordering on hospital organisational and communication processes. *HIM J*, 34(4 SRC- GoogleScholar) (pp. 130–4).
- Georgiou, A., Westbrook, J., Braithwaite, J., Iedema, R., Ray, S., & Forsyth, R. et al. (2007). When requests become orders—a formative investigation into the impact of a computerized physician order entry system on a pathology laboratory service. *International Journal of Medical Informatics*, 76(8), 583–591. doi:10.1016/j.ijmedinf.2006.04.002 PMID:16702022.

- Goldzweig, C. L., Towfigh, A., Maglione, M., & Shekelle, P. G. (2009). Costs and benefits of health information technology: New trends from the literature. *Health Affairs*, 28(2), w282–w293. doi:10.1377/hlthaff.28.2.w282 PMID:19174390.
- Granström, A., Serrano, J. A., & Larsen, F. (2009). Mastering accountability— Integrating tools and social processes in cross-border knowledge production in the PERSONA project. In *Proceedings of the 5th International Conference on e-Social Science*. Cologne, Germany: Maternushaus.
- Greenhalgh, T., & Stones, R. (2010). Theorising big IT programmes in healthcare: Strong structuration theory meets actor-network theory. *Social Science and Medicine* (1982), 70(9), 1285-94.
- HFMA. (2006). *Overcoming barriers to electronic health record adoption: Results of survey and roundtable discussions conducted by the healthcare financial management association*. Retrieved October 4, 2011, from http://mhcc.maryland.gov/electronichealth/mhitr/EHR%20Links/overcoming_barriers_to_ehr_adoption.pdf
- Hoffinan, L. (2009). Implementing electronic medical records. *Communications of the ACM*, 18-20. doi 10.1145/15927611592770, 52(11 SRC - Google Scholar).
- Hoffinan, S., & Podguski, A. (2008). *Finding a cure: The case for regulation and oversight of electronic health record systems*.
- Kaelber, D. C., Jha, A. K., Johnston, D., Middleton, B., & Bates, D. W. (2008). A research agenda for personal health records (PHRs). *Journal of the American Medical Informatics Association: JAMIA*, 15(6), 729–736. doi:10.1197/jamia.M2547 PMID:18756002.
- Kaplan, B., & Harris-Salamone, K. D. (2009). Health IT success and failure: Recommendations from literature and an AMIA workshop. *Journal of the American Medical Informatics Association*, 16(3), 291–299. doi:10.1197/jamia.M2997 PMID:19261935.
- Kennedy, B. L. (2011). *Exploring the sustainment of health information technology: Successful practices for addressing human factors*. Northcentral University.
- Kimaro, H., & Nhamposha, J. (2007). *The challenges of sustainability of health information systems in developing countries: Comparative case studies of Mozambique and Tanzania*.
- Kralewski, J., Dowd, B. E., Zink, T., & Gans, D. N. (2010). Preparing your practice for the adoption and implementation of electronic health records. *Physician Executive*, 36(2), 30–33. PMID:20411843.
- Kukafka, R., Johnson, S. B., Linfante, A., & Allergante, J. P. (2003). Grounding a new information technology implementation framework in behavioral science: A systematic analysis of the literature on IT use. *Journal of Biomedical Informatics*, 36(3), 218–227. doi:10.1016/j.jbi.2003.09.002 PMID:14615230.
- Kvale, S. (1996). *InterViews: An introduction to qualitative research interviewing*. London, UK: Sage Publications.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network theory*. Oxford, UK: Oxford University Press.
- Leslie, H. (2011). *Australia's PCEHR challenge | archetypical*. Retrieved from <http://omowizard.wordpress.com/2011/08/30/australias-pcehr-challenge/>
- Littlejohns, P., Wyatt, J. C., & Garvican, L. (2003). Evaluating computerised health information systems: Hard lessons still to be learnt. *British Medical Journal*, 326(7394), 860. doi:10.1136/bmj.326.7394.860 PMID:12702622.
- Liu, L. S., Shih, P. C., & Hayes, G. R. (2011). Barriers to the adoption and use of personal health record systems. In *Proceedings of the 2011 iConference* (pp. 363–370).
- Lorenzi, N. et al. (2009). How to successfully select and implement electronic health records (EHR) in small ambulatory practice settings. *BMC Medical Informatics and Decision Making*, 9, 15. doi:10.1186/1472-6947-9-15 PMID:19236705.
- Lubitz, D., & Wickramasinghe, N. (2006). Healthcare and technology: The doctrine of networkcentric healthcare. *International Journal of Electronic Healthcare*, 322–344. PMID:18048253.
- Martinelli, E., et al., (2008). *Ambient assisted living from a business point of view*.
- McReavy, D., Toth, L., Tremonti, C., & Yoder, C. (2009). *The CFO's role in implementing EHR systems: The experiences of a Florida health system point to 10 actions that can help CFOs manage the revenue risks and opportunities of implementing an electronic health record*. Retrieved December 16, 2011, from http://findarticles.com/p/articles/mi_m3257/is_6_63/ai_n35529545/

- Mort, M., Finch, T., & May, C. (2009). Making and unmaking telepatients: Identity and governance in new health technologies. *Science, Technology & Human Values*, 34(1), 9–33. doi:10.1177/0162243907311274.
- Muhammed, I., Teoh, S., & Wickramasinghe, N. (2012). Why using actor network theory (ANT) can help to understand the personally controlled electronic health record (PCEHR) in Australia. *International Journal of Actor Network Theory and Technology Innovation (IJANTTI)*.
- NEHTA and DoHA (2011). Concept of operations: Relating to the introduction of a personally controlled electronic health record system. Retrieved September 26, 2011, from [http://www.yourhealth.gov.au/internet/yourhealth/publishing.nsf/Content/CA2578620005CE1DCA2578F800194110/\\$File/PCEHR%20Concept%20of%20Operations.pdf](http://www.yourhealth.gov.au/internet/yourhealth/publishing.nsf/Content/CA2578620005CE1DCA2578F800194110/$File/PCEHR%20Concept%20of%20Operations.pdf)
- NHHCRC. (2009). *A healthier future for all Australians: National health and hospitals reform commission - Final report June 2009*. Retrieved August 11, 2011, from <http://www.health.gov.au/internet/main/publishing.nsf/Content/nhhrc-report>
- Rosebaugh, D. (2004). Getting ready for the software in your future. *Home Health Care Management Practice* (pp. 228-234). doi 1011771084822303259877, 16(3 SRC - Google Scholar).
- Rosenbloom, S. T. et al. (2006). Implementing pediatric growth charts into an electronic health record system. *Journal of the American Medical Informatics Association*, 13, 302–308. doi:10.1197/jamia.M1944 PMID:16501182.
- Ross, S. E., Schilling, L. M., Fernald, D. H., Davidson, A. J., & West, D. R. (2010). Health information exchange in small-to-medium sized family medicine practices: Motivators, barriers, and potential facilitators of adoption. *International Journal of Medical Informatics*, 79(2), 123–129. doi:10.1016/j.ijmedinf.2009.12.001 PMID:20061182.
- Sharma, U., Barnett, J., & Clarke, M. (2011). Using concepts from sturcturation theory and consequence of modernity theory to understand IS deployment in health-care settings. In Y. Dwivedi, et al. (Eds.), *Information systems theory* (Vol. 2, pp. 131–143). Springer. doi:10.1007/978-1-4419-9707-4_8.
- Shekelle, P. G., Morton, S. C., & Keeler, E. B. (2006). Costs and benefits of health information technology. *Evidence Report/technology Assessment*, 1(132). PMID:17627328.
- Showell, C. M. (2011). Citizens, patients and policy: A challenge for Australia's national electronic health record. *Health Information Management Journal OnLine*, 40(2).
- Sittig, D. F. (1994). Grand challenges in medical informatics? *Journal of the American Medical Informatics Association: JAMIA*, 1(5), 412–413. doi:10.1136/jamia.1994.95153429 PMID:7850565.
- Steinbrook, R. (2008). Personally controlled online health data--the next big thing in medical care? *The New England Journal of Medicine*, 358(16), 1653–1656. doi:10.1056/NEJMp0801736 PMID:18420496.
- Tang, P. C., Ash, J. S., Bates, D. W., Overhage, J. M., & Sands, D. Z. (2006). Personal health records: definitions, benefits, and strategies for overcoming barriers to adoption. *Journal of the American Medical Informatics Association: JAMIA*, 13(2), 121–126. doi:10.1197/jamia.M2025 PMID:16357345.
- Tinker, A. (2002). The social implications of an ageing population. *Mechanisms of Ageing and Development*, 123(7), 729–735. doi:10.1016/S0047-6374(01)00418-3 PMID:11869730.
- Torda, P., Han, E. S., & Scholle, S. H. (2010). Easing the adoption and use of electronic health records in small practices. *Health Affairs (Project Hope)*, 29(4), 668–675. doi:10.1377/hlthaff.2010.0188 PMID:20368597.
- Trudel, M. C. (2010). *Challenges to personal information sharing in interorganizational settings: Learning from the Quebec Health Smart Card project*. The University of Western Ontario.
- TTeC, 51-52, Tromsø, Norway. Rubin, J., & Chisnell, D. (2008). *Handbook of usability testing: How to plan, design, and conduct effective tests*. John Wiley & Sons.
- Vitacca, M., Mazzù, M., & Scalvini, S. (2009). Socio-technical and organizational challenges to wider e-health implementation. *Chronic Respiratory Disease*, 6(2), 91–97. doi:10.1177/1479972309102805 PMID:19411570.
- Wears, R. L., & Berg, M. (2005). Computer technology and clinical work. *Journal of the American Medical Association*, 293(10), 1261. doi:10.1001/jama.293.10.1261 PMID:15755949.

- Weimar, C. (2009). Electronic health care advances, physician frustration grows. *Physician Executive*, 35(2), 8–15. PMID:19452840.
- Whetton, S. (2005). *Health informatics: A socio-technical perspective*.
- Whetton, S., & Georgiou, A. (2010). Conceptual challenges for advancing the socio-technical underpinnings of health informatics. *The Open Medical Informatics Journal*, 4, 221–224. doi:10.2174/1874431101004010221 PMID:21594009.
- Wickramasinghe, N., Bali, R. K., & Lehaney, B. (2009). *Knowledge management primer*. Taylor and Francis.
- Wickramasinghe, N., & Schaffer, J. (2010). *Realizing value driven e-health solutions*. Washington, DC: IBM Centre for the Business of Government.
- Wu, S., Chaudhry, B., Wang, J., Maglione, M., Mojica, W., & Roth, E. et al. (2006). Systematic review: Impact of health information technology on quality, efficiency, and costs of medical care. *Annals of Internal Medicine*, 144(10), 742–752. doi:10.7326/0003-4819-144-10-200605160-00125 PMID:16702590.
- Yin, R. K. (1994). *Case study research: Design and methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Yusof, M., Stergioulas, L., & Zugic, J. (2007). *Health information systems adoption: Findings from a systematic review* (Vol. 129).
- Yusof, M. M., Kuljis, J., Papazafeiropoulou, A., & Stergioulas, L. K. (2008). An evaluation framework for health information systems: Human, organization and technology-fit factors (HOT-fit). *International Journal of Medical Informatics*, 77(6), 386–398. doi:10.1016/j.ijmedinf.2007.08.011 PMID:17964851.

Imran Muhammad (Masters in Business (ERP Systems), Masters in Business Information Systems) is a PhD student at Royal Melbourne Institute of Technology (RMIT University), Australia. His primary research interests are in the area of business information systems especially in the area of healthcare information systems management and electronic health records (EHR). He has more than five years of teaching and research experience in different areas of business information systems Health informatics and management. Say Yen Teoh received the Ph.D degree in information systems from the National University of Singapore (NUS). She is currently a lecturer at the School of Business IT and Logistics and a member of the Health Innovation Research Institute (HIRi) at RMIT University, Australia. Her professional interest is to explore the effective and efficient use of medical informatics on issues relating to development, implementation and use of the system. Her research has been published in various journals such as Information Systems Frontiers, Database for Advances in Information Systems, Journal of Information Technology Management, Journal of Systems and Information Technology.

Nilmini Wickramasinghe(PhD, MBA, Grad DipMgtSt, BSc, Amusa (violin) Amusa (piano)) Epworth Chair Health Information Management, researches and teaches within the information systems domain with particular focus on developing suitable models, strategies and techniques grounded in various management disciplines to facilitate more effective design, development and implementation of IS/IT solutions to effect superior, patient centric healthcare delivery. She collaborates with leading scholars at various premier healthcare organizations throughout Australasia, US and Europe. She is well published with more than 300 referred scholarly articles, more than 10 books, numerous book chapters, an encyclopaedia and a well established funded research track record.