When Healthcare Industry Faces IT Innovation

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This literature review provides an insight into trends within academic research in the field of IT adoption in the healthcare sector. There are two main debates regarding IT adoption in healthcare sectors whether to adopt or not to adopt. Each of them has its own justifications regarding its applicability. This paper reviews recent research regarding IT in healthcare and classifies the research along three different dimensions – "Organizational Vs Individual", "Benefits Vs Barriers" and "Pre–Vs Post-adoption". This review of the existing literature provides a comprehensive understanding from both an academic and empirical perspective of the current situation, and identifies gaps towards which future research can be directed.

1. Introduction

The healthcare industry is arguably the world's largest information intensive industry. Although the need for information in healthcare is universally accepted, surveys show that the progress in integrating IT innovation into healthcare has been slow in comparison to other fast-moving industries like the finance industry (Ford, Menachemi et al. 2006; Ash and Bates, 2005). Adoption seems to be a significant problem with respect to embedding IT innovation in the healthcare industry. Here, the term adoption is defined as "the acquisition of an IT application" (Davidson and Heslinga, 2007), which indicates the transfer from the traditional information-sharing methods to the emerging technology-based information network.

Relevant literature covers a wide range of IT applications, such as Electronic Health Records (EHRs), Electronic Medical Records (EMRs), Computer Physician Order Entry (CPOE) and the use of handheld computers like the PDA. Regardless of the type of the healthcare-related application, there is a growing body of relevant literature to measure the current adoption as well as to guide future prospects for IT innovation. The studies use different frameworks, models and theories to study both adopters and non-adopters. There are debates regarding the validity of applicable models based on data analysis using different theories.

2. Approaches to classify the literature

The goal of this review is to analyze this area of research against three comparable macro angles which correspond to scope, economic perspective and phase. In terms of scope, this paper discusses the organizational level versus the individual level of IT acceptance, comparing IT adoption by organizations such as hospitals and primary practices to technology acceptance by individuals such as physicians and patients. Along the economic dimension, a benefit-barrier perspective demonstrates how authors' emphasis on either benefits or barriers will result in different conclusions regarding adoption measurement. With respect to phases, focusing on different time stages in adoption (e.g. pre-adoption versus post-adoption) can lead authors to different conclusions. The following will more fully describe these three dimensions. However, they are not completely separable, and may overlap.

2.1 Organizational Versus Individual

A discrepancy in the approach taken in research on adopters and non-adopters has sometimes resulted in studies reaching quite opposite conclusions. A substantial amount of research focuses on healthcare technology acceptance at the individual level (Davis 1989; Chau and Hu 2001; Wilson and Lankton, 2004), while other research pays attention to organizational and environmental determinants, e.g. in looking at adoption in hospitals, conceptualized as the organizational level (Kazley and Ozcan, 2007; Hu, et al. 2002).
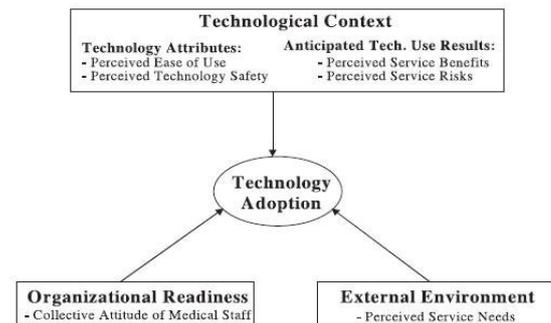

Figure 1-1(Hu, et al., 2002)

At the organizational level, Hu, et al. (2002) suggest a framework (Figure 1-1) that incorporates those factors pertaining to the technological context, organizational readiness and external environment which influence an organization's telemedicine technology adoption. Similarly, Kazley and Ozcan (2007) propose a model (Figure 1-2) using a Resource Dependence Theoretical Perspective, where organizational and environmental factors are examined to determine the national EMR adoption in acute-care hospitals.
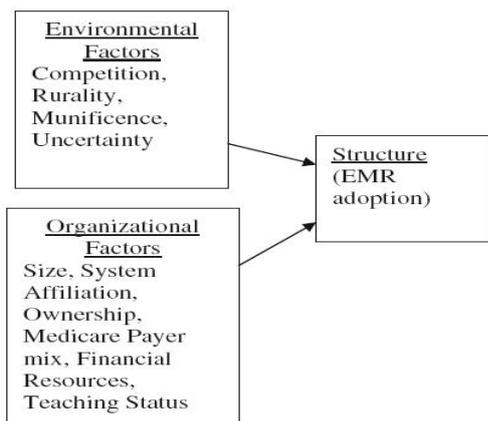
Figure 1-2 (Kazley and Ozcan, 2007)

Hu, et al. (2002) developed a framework to classify adopters and non-adopters. In their opinion, those organizations that have committed funding to a telemedicine technology or have already implemented the technology and are actually using it are regarded as adopters, while organizations that have not yet made a commitment to the use of technology are considered as non-adopters. According to them, the three most important factors that have a significant effect on IT adoption are perceived service risks, perceived ease of use and collective attitude of medical staff. Understandably, organizations are more likely to make the decision to use new technology when they exercise predominant control over their internal conditions. Within this context, Kazley and Ozcan (2007) emphasize that a large scale, affiliated system and urban location are three significant predictors for hospital use of EMRs. These factors supporting adoption are derived from environmental and organizational theories.

In additional, several empirical studies indicate that the adoption of IT in healthcare to some extent depends on the level of IT sophistication in organizational performance (Pare and Sicotte, 2001). Pare and Sicotte (2001) introduce their framework to of IT sophistication along three dimensions of sophistication: functional sophistication, technological sophistication and integration sophistication. According to their analysis of data, integration sophistication tends to rank at the lowest level. This means that the communication between clinical and administrative applications needs more attention. Acknowledging the status quo of IT sophistication within the organization, hospitals could situate their position among the healthcare industry in terms of IT adoption and use of information technologies. In return, IT adoption might be promoted by analyzing IT sophistication level (Pare and Sicotte, 2007).

In contrast, numerous studies shed light on user acceptance of technology, which puts emphasis on acceptance at an individual level. A leading model to measure user acceptance conceptualized by Davis (1989) is the Technology Acceptance Model (TAM). This demonstrates two theoretical determinants, perceived usefulness (PU) and perceived ease of use (PEOU) which contribute to behavioural intention (BI). Based on TAM, different researchers frame their own integrated models to examine the user acceptance particularly in the healthcare industry. Wilson and Lankton (2004) cite the model (Figure 2-1), incorporating TAM as well as the motivational model defined by Venkatesh, et al. (2002) to meas-

ure patients' acceptance of provider-delivered e-health. The motivational model suggests intrinsic motivation (IM) and extrinsic motivation (EM) as two prominent factors (Davis, et al. 1992), and Venkatesh, et al. (2002) propose their integrated model using IM, PEOU and unitary PU-EU to predict BI. Chau and Hu (2001) advance their integrated model (Figure 2-2) using the Theory of Planned Behavior (TPB), which contains three original constructs in parallel: attitude, subjective norms and perceived behavioural control (Ajzen, 1991). In relation to the study on healthcare, Chau and Hu (2002) assume that compatibility is an essential factor for BI, and thereby 'a decomposed TPB model' is conceptualized. Keeping Chau and Hu's (2001) views about compatibility in mind as a convincing background to integrated models, Wu, et al. (2007) propose their structural equation model (Figure 2-3) incorporating TAM and Innovation Diffusion Theory (IDT) (Roger, 2005). To be more specific about the study in healthcare, they assert two other constructs that supplement the structure, namely, self-efficacy and technical support and training. Healthcare providers use their own various models to measure user acceptance, which complicates matters.

Patients are more likely to accept e-health when they are satisfied with the current medical care situation, are willing to seek more information about healthcare and have easy access to the internet (Wilson and Lankton, 2004). On the other hand, professionals, including physicians and clinicians, tend to be pragmatic with their technology acceptance decisions. PU appears to be the most significant factor in data analysis. That is, professionals are likely to accept new technology like telemedicine if it is perceived as a tool to improve their workflow (Chau and Hu, 2002). Chau and Hu (2001) also articulate why PEOU is insignificant to BI in the model by identifying the high general competence, mental capacity and quick-learning skills of physicians, which may make them subtly different from other groups in the studies.
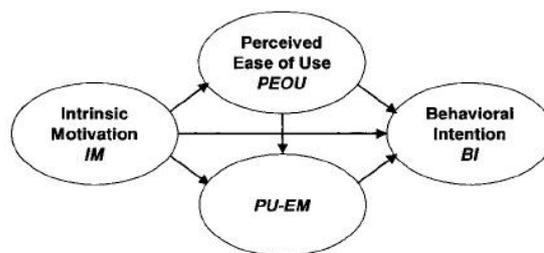
Integrated Model

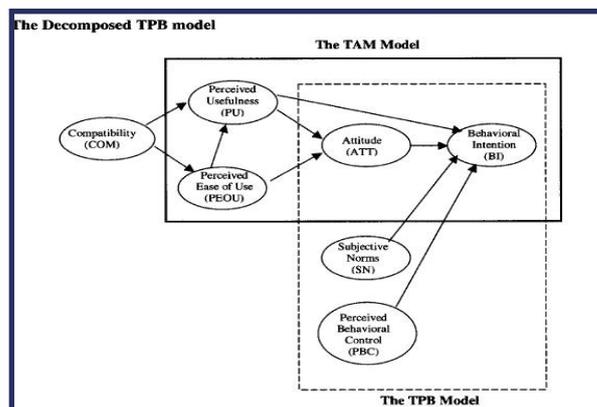Figure 2-1(Wilson and Lankton, 2004)
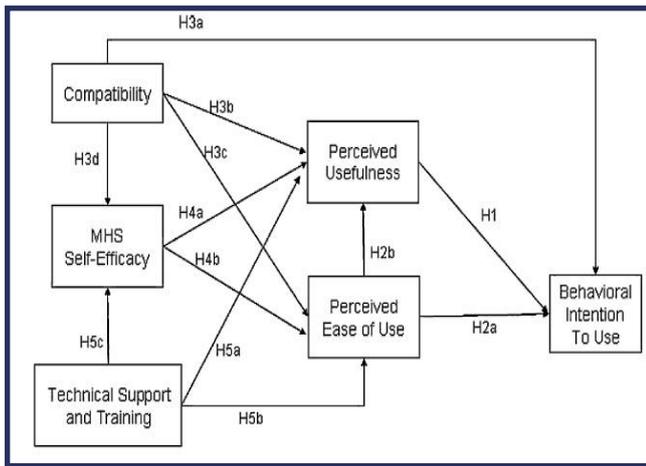

Figure 2-2(Chau and Hu, 2001)

Figure 2-3(Wu, et al., 2007)

Research at the organizational level and the individual level needs a significant amount of correlation to fill in the gap between the two different approaches. Once the organization such as a hospital decides to adopt a new technology, it is important for the users inside the organization to adopt it as well. It is this gap that will result in failures where the organization is willing to accept the technology without measuring and understanding the perception of users. Most research focuses either on the individual level or organizational level adoption of IT in healthcare. However, McAlearney, et al. (2005) considers this gap between organizations and individuals such as physicians. They advise that if physicians are willing to make better use of handheld computers (IT technology), it is important to upgrade the usability and usefulness of the device as well as to promote its use and support it with substantial training and servicing support facilities.

2.2 Benefit Versus Barrier

The question whether to adopt a new technology in the healthcare industry may not have a clear answer. Numerous research efforts assess the benefits and barriers in terms of functionality, financial return, organizational properties and social concerns.

It is widely accepted that introducing information technology techniques such as Electronic Medical Records (EMRs) or Computerized Physician Order Entry (CPOE) could reduce rates of medication errors, and also improve healthcare quality by moving the paper-based industry into e-health (Ford, et al. 2006; Hillestad, et al. 2005; Lu, et al. 2005; Cutler, et al. 2005; Anderson and Balas 2006). Historically, the traditional paper-based record-keeping is popular because of its simplicity and low cost. Nevertheless, computerization and the emerging information technology have significant benefits for healthcare sectors in various aspects such as ease of access to remote data, utility of large volume of data and computerized ordering (Bates, et al. 2003). Hillestad, et al. (2005) also state that EMRs might transform healthcare, enumerating benefits such as efficiency savings, safety benefits and productivity, Therefore, Bates, et al.(2003) argue that a high standard healthcare service qualification could only be met with the introduction of EMRs.

There is a widespread belief that the use of handheld com-

puters could benefit the healthcare industry in areas of documentation, medical reference, and information access to patient data. This supports the continued adoption of IT (Lu, Xiao et al. 2005). Cutler, Feldman et al. (2005) also speculate that the diffusion of information about the benefit of CPOE within teaching hospitals contributes to the large ownership of CPOE there. This notion of benefits thus is paramount to an even wider spread of CPOE in other healthcare organizations.

Meanwhile, numerous researchers talk about barriers and reveal deep concerns about both the technology and its adoption (Anderson and Balas 2006; Davidson and Heslinga 2007; Anderson, 2007; Cutler, et al. 2005). Anderson (2007) asserts that most physicians believe that lack of financial support for IT applications would be the most significant barrier to adoption. Since implementing IT facilities involves a high initial cost and a level of uncertainty in payoffs, there is a risk in the initial IT decision. In this respect hospitals will make the investment only if the implementation leads to a success so that they can recover most of their investment (Ash and Bates, 2005). Inadequate vendors and competing providers for IT applications are viewed as another barrier. The uncertainty of recovery of the initial investment and concerns about whether providers and vendors will remain in business to support their products increase the uncertainty about selecting a suitable vendor (Davidson and Heslinga, 2007). Bates, et al. (2003) argue that parties who pay for the IT application need not obtain maximum financial gain. The interests of those who invest in EMRs, third-party payers and purchasers of healthcare should be aligned, and they should receive proportional return on their investment. Otherwise, it can hamper the successful adoption of IT.

Davidson (2007) articulates his views based on an action research (AR) project to investigate the barriers in adopting Electronic Health Records (EHRs) in small physician practices. He concludes that it is mainly features of the organization that determine differences in adoption within the healthcare industry in United States. The gap between small and larger practices influences the adoption among physicians, due to more resources being available in larger practices for up-front investment and on-going support. Moreover, it is not only the size of the practices but also their organizational knowledge management that promotes the use of IT. Two major theoretical studies relevant to this analysis are Orlikowski, et al. (1995) regarding technology use mediation (TUM) and Duguid (2005) regarding communities of practice (CoP).

Other barriers to adoption of information technologies are based on social aspects. The complexity of EMRs and clinical IT applications impedes the wide use of information technology among physicians. That is, there is a gap between the expressed belief in the value of EMRs and the actual intention to use it (Ash and Bates 2005; Anderson, 2007). As suggested by Lu, Xiao et al. (2005) and Ash and Bates (2005) physicians are reluctant to use new technologies such as PDA or EMR if they do not fit their current workflow seamlessly. Anderson (2007) states that although on one hand IT promotes patient safety, on the other hand there are concerns about privacy, hindering the implementation of IT. In addition, identifying a unique patient when implementing IT can give rise to privacy issues, and thus legal barriers (Ash and

Bates, 2005).

Here we speculate that there are several arguments both in favour as well as against adoption of IT in terms of benefits and barriers. It is however important that the benefits and barriers are examined from multiple perspectives. Most of the literature articulates benefits from more technical viewpoints such as effectiveness and efficiency, whereas others identify barriers mostly from social perspectives such as privacy and legality. The key factor that influences the IT adoption is whether IT has profound benefits that overweigh barriers to overcome (Anderson and Balas, 2006).

2.3 Pre-Adoption Versus Post– Adoption

Pre-adoption refers to the period starting with the initial decision to adopt information technology to the time of initial implementation, whereas Post-adoption refers to the period starting when the new technology goes into use even if merely in the early stage.

The initial theory of pre-adoption and post-adoption beliefs was put forward by Karahanna, Straub et al. (1999) at a time when few empirical studies had looked into this time or phase issue. Karahanna, et al. propose a framework which combines innovation diffusion theory and attitude theories to examine differences between pre-adoption and post-adoption beliefs. Social norms alone dominate pre-adoption mainly because of the absence of concrete knowledge about the technology prior to adoption. In the post-adoption period, concrete knowledge and experience generate perceptions of usefulness and image. However, it is undoubtedly the case that studies on pre– and post-adoptions are limited, suggesting the need for further research.

Studies made at different times relative to adoption may reach inconsistent conclusions on the same question about adoption. When EMRs in small physician practices and telemedicine in Hongkong are studied at early stages of implementation, quite limited adoption is measured, according to Davidson (2007) and Chau and Hu (2005). As to individual level adoption, physicians' resistance to use of EMRs is primarily due to lack of the availability of time. Data entry application may take time to learn, but time is the most precious things to physicians. Physicians who are in the advanced post-adoption stage (that is, familiar with the technology) prefer to use EMRs whereas novices do not, since for experienced users it will take little time out of the regular time made available for patients (Bates, et al. 2003).

Hu, et al. (2002) develop the notion of a continuum of organizational technology adoption, conceptualized as seven logical and distinct phases. These range from the definition as "Already adopted telemedicine technology and used it for clinical purposes" to "Thought about potential adoption but decided not to pursue at present time", including almost all possible variables. By means of the described continuum, it is clear that an organization that has already allocated resources to new technology is more likely to adopt IT than one that informally realizes the potential benefits of telemedicine and has made the decision to adopt but has not yet allocated any resources.

When Anderson and Balas (2006) made their study on computerization of primary care in the United States, the survey they designed contains patterns of questions to locate physicians' stage for each IT application. Whether he or she "had

implemented", "planned to implement within one year", "had no plans to implement but was interested in learning more", or "had no interest" were taken into consideration as a prominent factor with respect to time scale to adoption. As a result, physicians in different stages will have different response to the same question on the web-based survey.

3. Discussion and Conclusion

The three issues discussed in this paper provide a comparison of the different approaches used in studies of IT adoption in the healthcare industry. It is evident that practitioners must understand the potential benefits of information technology in the long term perspective and thus hospitals and primary practices would like to take steps forward to invest and embrace emerging technologies. Barriers need to be identified and addressed at the earliest opportunity, since it is only where IT has profound benefits which outweigh barriers that institutions will adopt the new technologies (Anderson and Balas, 2006). Moreover, the likelihood of adopting future and emerging technology among the organizations will increase as organizations advance along the phases on the continuum described by Hu, et al. (2002).

IT innovation in healthcare as a research topic is quite new because of the relative short history of technology adoption in healthcare in comparison with other industries. Consequently, it has latent research opportunities not only from an "IT enabler/constraint" perspective, but also from other perspectives which theorize the technological and organizational issues regarding IT innovation, such as actor-network theory (ANT). ANT represents an attempt to analyze the complex socio-technical world in which we live as comprising hybrids of human and non-human elements, at the same time contesting the boundaries between the technical and the social, human capabilities and machine functions. An increasing number of IS researchers are making explicit use of the theory in their work, including in IS research regarding the healthcare industry (Walsham 1997). Bloomfield, Coombs et al. (1992) articulate how ANT approach does not privilege either the social side or technology by discussing an interesting case study of the development of a particular set of resource management information systems in the UK National Health Service. They argue that social structures and technology are interwoven within the actors who persuade others to align with their interests. Monteiro and Hanseth (1995) use ANT to study the innovation diffusion of IT in general practice in Norway and conclude that ANT is a powerful tool to understand how organizational behaviour is influenced by technical aspects and adoption of IT in healthcare. They also hold the opinion that structurational analysis along with ANT would give a better perspective of the overall scenario. This further fortifies the need of more than a technological perspective while analyzing the prospects of IT adoption in healthcare, and hence these additional perspectives should be borne in mind when academics conduct future research in this area.

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