# BARRIERS TO HEALTH CARE INFORMATION TECHNOLOGY: A REVIEW

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## ABSTRACT

Driven by incentives or by penalties, large-scale capital investments for healthcare information technology (HIT) has taken place over the past decade, paving way to significant amount of research in managing HIT. In this study, we cover different perspectives from diverse set of disciplines, classify and categorize contextual factors that prove to be a barrier for implementation, integration and use stage of HIT in healthcare. We use 37 articles from 23 medical, business and information system journals to identify six contextual factors that could impede the implementation, integration and use of HIT. The six contextual factors are actors/user pre-participation and buy in, risk assessment and safety, member centrality and hierarchy, physician resistance, training, attitude and interoperability.

Keywords: Healthcare information technology; literature review; barriers.

## INTRODUCTION

Driven by the incentives and penalties associated with the implementation or non-implementation of healthcare information technology (HIT) under the HITECH Act of 2009, healthcare organizations have pooled resources to effectively design, develop and deliver a working healthcare information technology systems. However, as Shawney (2013) points out that the missing link is not the implementation of a flexibility but the *use* of it. Although healthcare organizations are implementing HIT and eagerly looking forward to the positive performance outcomes such as quality improvement and cost reduction, Buntin, Burke, Hoaglin and Blumenthal (2011), point out that the key issue in implementing HIT is to identify and document the challenges faced while implementing HIT. When 95% of medicare and Medicaid electronic health record (EHR) incentive program has achieved meaningful use of certified health IT, it is imperative to identify critical barriers that exist in its continued integration and use of HIT in health systems. In this paper, we present a review of the literature and identify critical factors that impact the project implementation, integration and use of any healthcare information technology in healthcare sector.

In recent past, different academic disciplines has studied the varying views on implementation, integration and use of HIT in health systems and how they impact performance. As early as the 1990s, the positive outcomes of health system integration were shown (Shortell and Hull, 1996; Kumar and Motwani, 1999). Shortell and Hull (1996) found that increased physician-system integration led to high inpatient productivity and higher clinical integration. While higher perceived clinical integration led to greater system net revenue and also inpatient productivity. Special issues in Decision Support System Journal (2013), Information Systems Research (2011) and European Journal of Information System (2007) has pushed the envelope for further study and theory building using implementation-integration- usage stages for HIT systems. However, these literatures have failed to explain the overarching framework for HIT implementation, integration and usage and unified framework to identify barriers at each stage. Our

objective for this paper is to understand the relationships between different schools of literature in building a long-term strategic framework which involves HIT implementation stage, assimilation and integration stage and finally use stage as seem in practice and to further identify appropriate contextual factors that may hinder the positive performance outcomes for HIT.

## LITERATURE REVIEW

Chiasson & Davidson (2004) established four categories to organize published healthcare information system studies based on the influence of information system (IS) theory in healthcare context. 1) IS-Only papers focus on generalizable IS theory without specific consideration of the healthcare context. The papers do not explore how the healthcare context might influence theoretical constructs or assumptions. 2) Healthcare-Only papers focus on describing the design, development, implementation, and use of information-intensive technologies in healthcare without significant application of IS theories. 3) IS-Healthcare papers primarily focus on developing or testing IS theories with secondary consideration given to interactions with the healthcare context. 4) Healthcare-IS papers more systematically consider the influence of context by applying IS theory to analyze health care issues. Romanow, Cho and Straub (2012) reiterated the importance of generating health care and IS research as categorized by Chiasson and Davidson (2004) but pointed out that the number of citations has waned over a period of time. We find that our study focuses on an integrative review to create a framework with different stages in HIT fits well with the much required Healthcare-IS set of papers.

Furthermore, Agarwal, Gao, DesRoches, and Jha (2010) in their review of healthcare-IS papers identified three broad areas for future research. It included design, implementation and meaningful use; measurement and quantification of HIT payoff; and extending the traditional realm of HIT. Under the HIT Design, Implementation, Meaningful Use area proposed by Agarwal et al (2010), we find that there is an interrelated sequence of stages from HIT implementation to systems integration to continuous improvement. Our research shows that in each of these three distinct stages - implementation, integration, usage - one or more contextual factors pose significant challenge for successful completion of the HIT phases. Our research question for this study is *what are the contextual factors under each stage of HIT management that impacts its performance in healthcare setting?*

## METHODOLOGY

For our research in this study, in order to characterize the viewpoints among different schools of thought we searched peer-reviewed articles from 1999 to 2014 in the journals related to medical, business, and information system fields in premier academic database such as Proquest and Ebsco. Our keyword search was limited to the term ‘health care (healthcare) *information* technology’. In this study, we do not include any physical healthcare or medical technologies but only articles that pertain to information technology in healthcare setting. Although healthcare information system (HIS) is a basic foundation on which healthcare information technology (HIT) is built, for the purpose of this study we focused on information technology and excluded articles pertaining to healthcare information system. Articles that studied health care information system under the umbrella of health care information technology are included for our review. Using the above mentioned search criteria we obtained abstract for 163 articles. Since the focus of our study is to find a framework with implementation-integration- usage stages of HIT and to identify contextual factors for each, we eliminated articles that lacked research rigor such as opinion pieces and anecdotal evidences. We screened the 163 articles for qualitative and quantitative research rigor and our final list resulted in 37 papers including 5 review papers. These were collected

from 23 medical, business, information system journals (see Figure 1). Our review and analysis, we did not show any research article that discusses the long-term, strategic perspective for managing HIT. Building on existing theory that focuses on specific issues of HIT implementation, we create a framework for HIT implementation, integration and use stages that includes three chronologically related phases of implementation, integration and usage along with a feedback loop. Based on the analysis of the articles we categorized the articles into major contextual factors under each stage of the HIT management.

Figure 1: List of journals included by discipline:

| ***Decision Sciences / Management*** | ***Information System*** | ***Medical*** |
|---|---|---|
| *Production and operations management*<br>*Decision sciences*<br>*Journal of healthcare management*<br>*IEEE transaction –Engineering management*<br>*Healthcare management science*<br>*Journal of management and marketing in health care*<br>*Journal of industrial ergonomics*<br>*Healthcare management review*<br>*Work* | *Information system research*<br>*Information system journal*<br>*Information and organization*<br>*Decision support systems*<br>*European journal of information system*<br>*MIS Quarterly*<br>*Information system frontier* | *New England journal of medicine*<br>*Health affairs*<br>*Annals of internal medicine*<br>*JAMA*<br>*International journal of medical informatics*<br>*Academic medicine*<br>*Hospital topics* |

## ANALYSIS

An early literature review conducted between 2004-2007 by Goldzweig, Towfigh, Maglione and Shekelle (2009) find a prolific use of patient-focused applications and independent IT systems instead of integrated and interoperable technologies. They find that there are limited information about the contextual factors and process changes that are critical to success of a broad-scale implementation of health IT systems.

As a result of our analysis, we find that for successful management of HIT and its processes, hospital administrators have to consider the entire process of HIT design, development, implementation, integration, and continuous improvement. We categorize these stages HIT implementation, system integration and continuous usage/improvement in addition to a feedback loop needed to upgrade or change existing HIT on an on-going basis (Refer Figure 1). The three stages are chronologically related and are affected my major contextual factors of its own in each stag as described below.

### Implementation Stage

Jha, DesRoches, Kralovec and Joshi (2010) surveyed about 3,100 hospitals on any use of HIT related products for completing core objective requirements of ‘meaningful use’ stage I implementation. They found that 11.9% hospitals had at least a basic HER. Their classification in increasing level of complexity includes clinical documentation, viewing results, computerized physician order entry (CPOE) and clinical decision support system (CDSS). However, Rippen, Pan, Russell, Byrne and Swift (2013) found a need to create an organizational framework for health IT that provides a consistent understanding for future research. They organize it into technology-specific HIT, use of technology, environmental factors that affect the use of technology, outcomes and developmental track of the processes involved. In addition to the framework, hospitals should also identify the level of technology required to attain meaningful use as specified by the HITECH Act of 2009. Typical project implementation factors are leadership commitment, feasibility analysis, competitive assessment, cost-benefit analysis, budget planning, resource allocation and risk assessment. In addition to these, our analysis shows two additional but very significant factors, user/actor pre-participation and buy-in, and risk assessment and safety, that play a critical role in implementing information technology for healthcare.

***Users/Actors pre-participation and buy-in:***

Mantzana, Themistocleous, Irani and Morabito (2007) show that actors are categorized into organizational and human (individual) actors and further sub-categorized into provider, acceptor, supporter or controller. They find that the business process should be used as a baseline to identify different actors, however, the role of the actors specifically people buy-in was not considered in prior models. Lawler, Hedge, and Pavlovic-Veselinovic (2011) points out that HIT is not a standalone implementation project by a third party but requires a development of structured implementation strategy so that end-users participate throughout the implementation planning and later in the integration stage. Cohn, Berman, Chaiken et al 2009 suggest the use of 'Physician Champions', a veteran and well-respected head who conducts exercises and illustrative cases in their respective department which later lead to faster buy-in's among other physicians and supporting clinicians. In addition, Teoh, Pan and Ramchand (2012) argue that an enterprise-wide system to manage organizational resources through resource-based view during the HIT implementation stage.

***Risk Assessment and Safety:***

Although the highly cited Bates and Gawande (2003) show that there are different ways that information technology can reduce errors, a contrary factor raised by Lawler et al (2011) show the potential risk assessment of failure points in the project implementation stage is a must. For example, the potential behavioral risk of physicians in copying examination notes from prior appointments for repeat patients may not reflect the actual and accurate examination of current symptoms (which may be different from past visits) and documentation of the exam as occurred between patient-provider in real-time. Further, Harrington, Kennerly and Johnson (2011) caution executives, clinicians and technology professionals that project implementation of specific HIT such as electronic medical records (EMR) is very complex and may lead to patient safety issues. However, a systematic literature review by Ludwick and Doucette (2009) show that some of the project implementation risks can be alleviated by establishing strong leadership, project management techniques, standardizing and training.

**Integration Stage**

Integration after HIT has been implemented includes integration of both people and processes. Angst, Devaraj, Queenan and Greenwood (2011) posit that there is an added value in the integrative systems approach where the stand-alone medical technologies are converted into information system using a sequence of technologies. Without the *interoperability* among the agents such as the people, procedures and the technologies, the value of the IS cannot be effectively achieved. As Lawler, Hedge, and Pavlovic-Veselinovic (2011) aptly said "Perceived or real inefficiencies and limitations with EHR due to poor integration of the system with work processes and expectations may encourage care providers to continue using paper-based alternatives for which there is an electronic solution, or supplement perceived deficiencies of an electronic system with paper-based cognitive aids". Bhattacherjee, Hikmet, Menachemi, Kayhan, and Brooks (2007) categorized the adopted health care information technologies into three levels based on the business value derived by the organizational hierarchy: clinical, administrative, and strategic HIT. Continuing the path of clinical, administrative and strategic HIT, Hikmet, Bhattacherjee, Menachemi, Kayhan, Brooks (2008) found that higher the bed capacity in hospitals (larger hospitals) tend to adopt clinical and strategic HIT systems while for-profit hospitals adopts fewer administrative and clinical HIT. Standalone hospitals systems are less likely to adopt administrative and strategic HIT systems. Our analysis of the articles showed that there were two main integration factors: people and process and each face varying contextual issues in the integration stage of HIT.

***Integration stage – People***

In 1988, when University of Virginia Medical Center implemented medical information systems, the medical center faced several challenges (Massaro, 1993). The authors' conclusion is still valid and relevant for today's HIT: "Real progress toward the integration of the systems into the center's operational culture

occurred only after a senior management team representing important sectors of the hospital staff and administration began meeting regularly to address institution-wide issues that have been raised". Lawler et al's (2011) review show people as an important consideration when using CPOE, clinical decision support system, and bar-code of medication and its impact on medication error. Kaye, Kokia, Shaleve, Idar and Chinitz (2012) found that behavioral factors for people involved can create barriers to or aid the success of HIT use. The barriers identified were lack of clear benefits, insufficient incentives, and inadequate support for clinicians and payer-provider relationships while the success factors are innovative leadership, integrated management and collaboration with doctors based on specific needs. Our analysis shows that there are four contextual factors related to people integration in HIT.

***Member centrality and hierarchy:*** Venkatesh, Zhang and Sykes (2011) hypothesized that healthcare employees in different hierarchy have the power to gain knowledge about the system and diffuse them positively or negatively within their group and outside their group. They conclude that the member with highest power (physicians) have the ability to negatively influence the use of the system and thereby hinder the success of the system. Kane and Labianca (2011) also found that the avoidance of the use of information system after it has been adopted is more likely to negatively affect patient outcomes when the IS avoidance is by the people most central to the healthcare group. The negative effects are significant compared to the average level of avoidance by doctors or within a group of healthcare providers.

***Physician barrier:*** Resistance to technology from the physicians is due to two primary reasons: uncertainty of the unknown system and fear of causing medical errors from the system. Jensen and Aanestad (2007) show that surgeons considered the system as a means to facilitate the medicine prescription procedures. The hostility against the HIT arose on the surgeons' side because of the following reasons: surgeons had to take on new tasks which are typically not considered their responsibility; surgeons considered it as a control mechanism of themselves; surgeons were not consulted in the selection and decision-making process. They conclude that though surgeons welcomed the use of HIT when it provided a direct clinical benefit, but positive and negative attitudes co-existed. They also found that attitudes changed over time. One other reason that physicians resist is the perception that medical errors are higher in HIT system (Cohn, Berman, Chaiken, et al 2009) indicate that one of the reasons for physicians' resistance. Davidson and Heslinga (2007) identified several barriers to adoption of EHR systems for physicians in small offices. In addition to the cost of adoption, the software and systems require higher amount of training in some cases, with very little benefit. Hence, physicians especially in individual offices are not motivated to adopt, assimilate and integrate some aspects of the HIT systems in their daily work.

***Training:*** Aron, Dutta, Janakiraman and Pathak (2011) found that training of hospital staff in quality management and automation of control systems improves the outcomes and help in reducing medical error rates. Mantzana, Themistocleous and Morabito (2007) found that older employees not only require training but the training method needs to be customized to the theories that they are already familiar with.

***Attitude:*** Chau and Hu (2001) re-evaluated the technology acceptance model (TAM) and theory of planned behavior in the healthcare setting. Right attitude, followed the perceived usefulness of the technology, as a factor that impacts the behavioral intention for physicians to adopt and actually use the technology. Among the physicians and staff, Devaraj and Kohli (2003) found that actual usage of the technology correlates strongly with the best positive performance outcomes such as reduced mortality, increased revenue per day and revenue per admission. Not just the physicians, nurses play significant role in the use of the HIT during the integration stage. Samara, Real, Curtis, and Meunier (2012) using a case-study approach show that increased dissonance between what the nurses' want and need in the technological process, leads to increased dissatisfaction for nurses, and may result in threat to patient safety and higher occurrence of errors.

***Integration Stage - Processes:***

***Interoperability:*** Some of the concerns identified widely in literature in managing HIT are system interoperability, privacy and confidentiality, lack of well-trained clinicians, technical issues (Hersh, 2004). In their extensive review Chaudhary et al (2006) point out that interoperability and consumer health technologies, development of uniform standards of reporting are potential research area for HIT implementation. Providing the essential standard operating procedures and protocols reflect that the new work processes is not completely different from the old processes and procedures but the new work process is important for successful integration of the HIT system (Lawler et al., 2011). In addition, it is important for the new work flow to be flexible, reliable, consistent, intuitive and uncluttered user-interfaces between medical devices and software integration (Lawler et al., 2011).

Thrasher and Revels (2012) emphasize the need for interoperability through the network integration rather than simply adding latest technology. The more holistic view includes management commitment and complementarity between IT and organizational integration.

While Bradley, Pratt, Byrd, Outlay and Wynn (2012) found a positive influence of enterprise architecture on the effectiveness of IT resources and thereby its effect on achieving strategic goals, they failed to consider the role of people and their influence for effective implementation. Young (2005) has aptly identified that the decision to acquire a healthcare system is typically based on cost of acquiring and savings over the next few years. However, he highlights that the interaction of the system with several of the processes is critical to the success of the post-implemented system. Huerta, Thompson, Ford and Ford (2013) used DEA (data envelopment analysis) to test the total factor productivity of hospitals that adopted HIT. They found that total factor productivity actually decreases in the short-run for the hospital. The technical efficiencies has gone up for the hospitals, however, the process has to be re-engineered to match the workflow of the clinicians so that the workflow efficiency can be increased as well.

**Use Stage**

Lawler et al (2011) said "Establish a reliable mechanism by which HIT is continuously evaluated and improved to ensure that HIT continues to adequately and accurately support the needs of the user and ultimately patient safety". One such approach could be Total Quality Management (TQM). Though McLaughlin and McLaughlin (2004), Shortell, Bennett and Byck (1998), Blumenthal and Kilo (1998) has discussed the usefulness and effectiveness of TQM and continuous quality improvement in health care, research is limited in the area of quality management and continuous improvement specific to HIT for the betterment of patient care. Lorence and Jameson (2002) conducted a nation-wide survey assessing the extent of use of automated quality audit systems for processing information. They found that there is a time lag between adoption of health care information system and the adoption of automated quality assessment methods.

## CONCLUSIONS

In this research, we provided a quantitative mechanism to identify and categorize the varying facets of HIT implementation, integration and use stages using a formalized review of articles from diverse set of disciplines. The diverse set of disciplines range from medical, business, information system, and they all portray a sense of apprehension and barriers to HIT. This is the first study to our knowledge to gather information from a wide variety of sources, classify, and categorize contextual factors through a HIT management framework to understand the true necessity of research in this area. Future research includes how each of these six contextual factors - actors/user pre-participation and buy in, risk assessment and safety, member centrality and hierarchy, physician resistance, training, attitude and interoperability – can be effectively managed in HIT implementation and use.

*References will be provided upon request*