Impediments to the Implementation of Healthcare Information Technology: A Systematic Literature Review

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The healthcare industry has seen a splurge in information technology investments largely due to the incentives offered by the government for its adoption as well as the penalties imposed under the HITECH Act of 2009. This has resulted in extensive research on Healthcare Information Technology (HIT) in recent years. In this study, we follow a systematic literature review across diverse disciplines ranging from management, information systems, and healthcare, and find that successful implementation of HIT follows three inter-related stages - adoption stage, integration stage, and sustenance stage. Given the uniqueness of healthcare industry with respect to knowledge-intensity and power hierarchy within job positions, we ascertain impediments that impact HIT implementation. Major impediments we identified include limited user buy-in, lack of risk assessment and safety measure during the adoption stage, physician resistance, spillover effect, standardized training, negative viewpoint in the integration stage, and lack of interoperability in the sustenance stage. Identifying and classifying impediments through a systematic literature review is the first step towards operationalizing these impediments and creating effective interventions to minimize their effect on HIT performance.

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I. INTRODUCTION

Driven by the incentives for adopting healthcare information technology (HIT) under the HITECH Act of 2009 as well as the penalties for lack thereof, hospitals have dedicated significant capital resources to adopt and diffuse some form of HIT within their organizations. With such a strong push towards faster adoption and use of information technology in healthcare industry, hospitals are quickly and drastically implementing HIT and eagerly looking for positive performance outcomes in terms of quality improvement and cost reduction. Nevertheless, organizations and employees are struggling to ascertain the best approach to adopt and diffuse such a vast organization-wide initiative. This sometimes results in less than optimal use of HIT for effective coordination between support team and their healthcare

partners (e.g. pharmacy, laboratory) for high quality patient care. While lack of structured planning, risk assessment, and systemic integration seems to be an apparent hindrance to the successful implementation, a systematic study has not been conducted to identify and classify the impediments for the adoption and diffusion of HIT. Buntin, Burke, Hoaglin, and Blumenthal (2011) aptly illustrate the key issue hospitals face, saying "the realities highlight the need for studies that document the challenging aspects of implementing information technology more specifically and how these challenges might be addressed". We respond to this timely concern, with this review article exploring a broad range of literature to identify significant challenges and impediments healthcare systems encounter when they decide to execute HIT.

Past literature has focused on positive outcomes due to healthcare information technology implementation. Chaudhary, Wang, Wu, Maglione, Mojica, Roth, Morton, and Shekelle (2006) reviewed 257 studies and found that increased adherence to guideline-based care, enhanced surveillance and monitoring, and decreased medication errors as the three major benefits of HIT implementation. Buntin *et al*. (2011) reviewed 100 articles and found that 62% of these articles showed positive effect of HIT on outcome measures such as efficiency of care, effectiveness of care, provider satisfaction, patient safety, patient satisfaction, and care process. Gupta and Sharda (2013) say that the impact of HIT systems on productivity, cost, and quality of performance in the hospital setting is one of the six areas for future research in HIT.

While there exists extensive literature on the positive impact of HIT on cost, quality and effectiveness, we also find studies present the risks and challenges involved in HIT implementation. For example, Menachemi and Collum (2011) found that high acquisition costs, ongoing maintenance costs, and disruptions to workflows are some of the drawbacks of implementing an EHR (Electronic Health Record) system, which is an HIT application. Buntin et al (2011) also indicated that 10% of the articles reviewed showed negative performance from HIT implementation. The negative outcomes were due to the increased time to e-prescribe, lack of leadership, staff skepticism, work-flow problems, changed responsibilities, and patient-related factors affecting health information exchange. Others find lack of interoperability, cost of setup and maintenance, reduced productivity, delays in communication to be the 'bads' of the EHR implementation while improved data accessibility, ease in computerized order entry and capturing charges, and preventive health are the 'goods' of EHR (Palma, 2013). Goldzweig, Towfigh, Maglione and Shekelle (2009) in their review paper found lack of integrated and interoperable technologies, while there was prolific use of patient-focused applications and independent IT systems. They argue that there is limited information about the contextual factors and process changes critical to the success of a broad-scale implementation of health IT systems. Given these differences in thoughts and findings, it is timely for healthcare administrators to fully comprehend the barriers and impediments to implementing HIT. Review articles significantly discuss the importance of positive and negative performance outcomes as a result of HIT but does not substantiate the factors that affects the performance outcomes. This points us to our research direction: what are the factors that impede the performance of HIT?

To answer this question, we focus on conducting a systematic literature review across the areas of management, information systems, operations and healthcare. Through the systematic literature review, we find that the impediments can be categorized into a framework comprised of three interrelated stages of adoption, integration, and sustenance. Next section presents the methodology we used for the literature review which is then followed

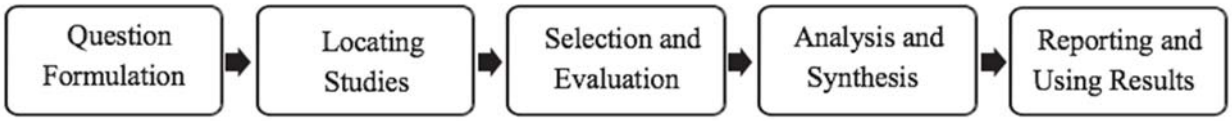
by the summary and the synthesis of our findings. We conclude the paper with a discussion of our finding and conclusion.

II. METHODOLOGY

We followed the methodology used by Zimmerman, Ferreira and Moreira (2016) for systematic literature review which is comprised on the following five steps (see Figure 1):

1. Definition of research question
2. Location of studies
3. Selection and evaluation of articles
4. Analysis and synthesis
5. Presentation of results

In what follows we interweave the insights we obtained from the systematic literature.



Source: Zimmerman. Ferreira and Moreira (2016); Adapted from Denyer & Tranfield (2009)

FIGURE 1: FIVE-STEP PROCESS FOR SYSTEMATIC LITERATURE REVIEW.

2.1 Defining Research Question

Our preliminary analysis of review articles relevant to Healthcare information technology helped identify an interesting research question that has not been answered, yet vital for researchers and practitioners moving forward with HIT implementation whether it is for the first-time adoption or an on-going use. Specifically, we ask the following question:

What are the impediments for successful implementation of HIT in health systems?

U.S. Department of Health & Human Services (HHS) defines HIT as "the application of information processing through computer hardware and software to the storage, retrieval, sharing, and use of healthcare information, data, and knowledge for communication and decision making" (Brailer and Thompson, 2004). Use of HIT can range from a simplistic application that stores raw patient records electronically such as use of EHR to a sophisticated system that uses information for strategic decision-making such as executive decision support systems. In this literature review, we used the definition of HIT as defined by the U.S. Department of HHS and seek to identify the impediments that hinder the successful implementation of HIT.

2.2 Locating Articles

Our next step is to locate the articles to review. Our study period for the systematic review ranged from January 1999 to September 2018. During our preliminary search, we found that the term 'healthcare technology' was being conceived and initiated in the early 2000's and did not find articles highly relevant to healthcare information technology prior to 1999. Most articles prior to 2000's was oriented towards the use of medical technology and instrumentation. Therefore, our search ranges from the year 1999 to 2018.

We conducted the article search through two premier academic databases, PROQUEST and EBSCO for business. These business-related journal databases include not only the management journals but also the healthcare journals. Research in the healthcare area is vast and multiple disciplines such as management, information systems, operations and supply chain management, and healthcare management have addressed the topic. Therefore, we included the following disciplines in our systematic literature review: (1) management,

(2) information systems, (3) operations and supply chain management, (4) healthcare management. Table 1 summarizes the journals included in the final list of articles included in the review.

2.3 Selecting and Evaluating Articles

Our next step was to choose keywords and the exclusion criteria. We used the following keywords search, 'health care (and healthcare) information technology.' The search result was very broad and included any article with the term 'health care (or healthcare) information technology'. We did not include additional search terms such as 'barriers' or 'challenges' or 'impediments' in implementing healthcare technology for two reasons. First, preliminary search with those terms (barriers/impediments/challenges) returned limited number of articles. This was mainly because of the fact that the focus of the articles was significantly on other aspects of HIT and barriers or impediments were discussed as a sub-topic. Most articles paid full attention to other areas of HIT but mentioned the barriers within the body of the text. Second, we did not want to exclude articles that discussed 'barriers' or 'challenges' or 'factors' or 'issues' in implementing HIT without using such terms explicitly as keywords. The two search terms yielded 1,953 articles from scholarly journals.

Exclusion criteria:

From our initial search, we read the titles and the abstracts for each article and excluded articles that focused on stand-alone medical technology (such as MRI scanner) or any medical technology without information processing aspects. With our primary focus on HIT, we also excluded articles that solely studied 'Healthcare information system (HIS)'. However, articles that discuss healthcare information system under the umbrella of HIT were included in our study. We excluded articles that used healthcare as a small sample of the entire dataset. This abstract screening resulted in 186 articles.

Lastly, we reviewed the articles to make sure the article was about adoption, integration, or sustenance of HIT, and used terms such as 'barriers', 'impediments', 'challenges', 'factors', 'issues' or qualitatively describes it in the article. Articles that were anecdotal or opinion-based were excluded from our literature review. This resulted in 37 articles that are then used for analysis and synthesis. Figure 2 provides a visual illustration of the literature search procedure and outcomes.

Table 1 lists the journals where the final 37 articles have been published. They are categorized into the four disciplines - management, information systems, operations and supply chain management and healthcare. We find highest number of articles from Journal of Healthcare Management, Information Systems Research, and Decision Support Systems. Each of these journals had three articles in our final sample. 35.1% of the articles is from the management discipline followed by 29.7% of the articles from the information systems discipline. Figure 3 shows the article count for the years ranging 1999 to 2018. We find that our final sample did not include articles published in year 1999 and 2000. These were the early years when healthcare management was conceived and implemented. We also find that the year 2011 had the most number of articles and more articles have been published post-2011 than pre-2011. This is because of the HITECH Act of 2009 which spurred both practitioners and researchers to delve into HIT.

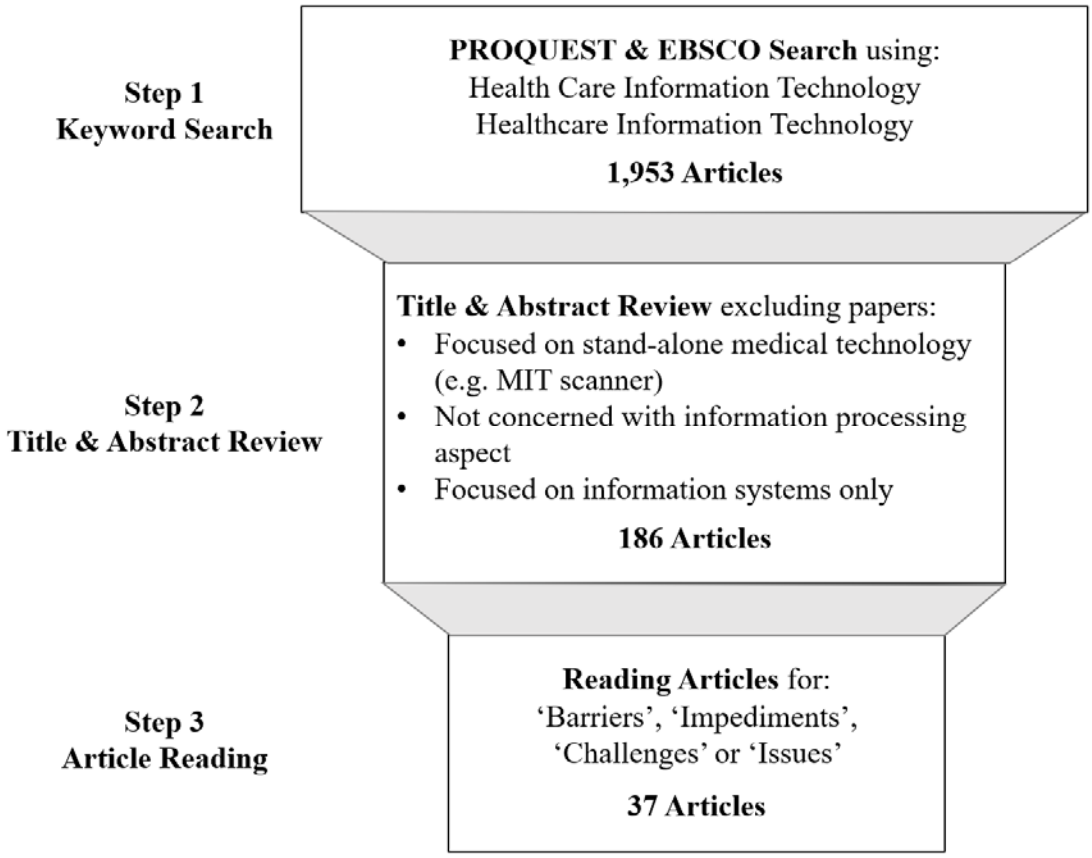


FIGURE 2. LITERATURE REVIEW SEARCH PROCEDURE AND OUTCOMES.

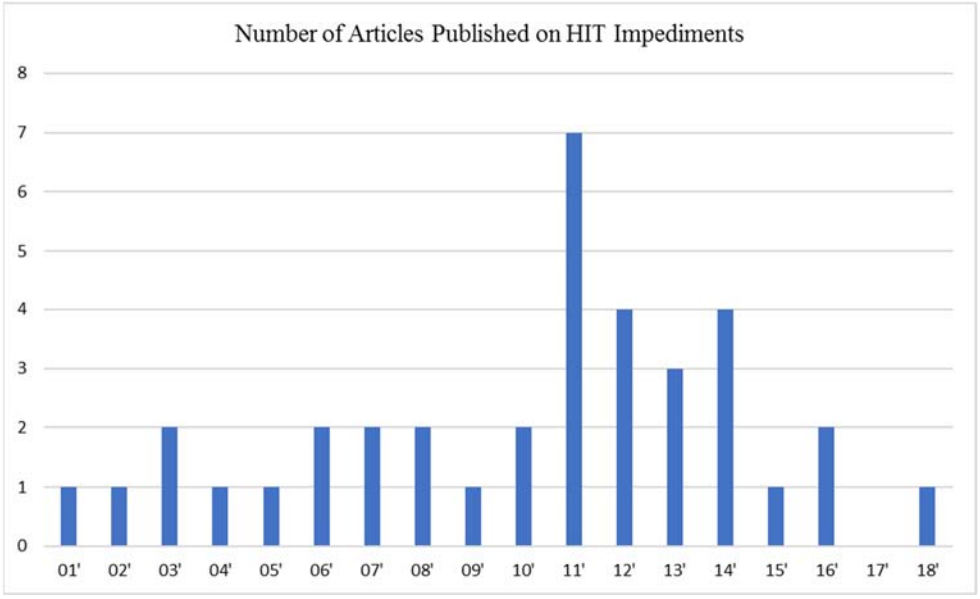


FIGURE 3. NUMBER OF ARTICLES PUBLISHED ON HIT IMPEDIMENTS.

TABLE 1. LIST OF JOURNALS BY DISCIPLINES.

Disciplines	**Management**	**Information Systems**	**Operations/Supply Chain Management**	**Healthcare**
Journal Titles	- *Engineering Management, IEEE Transactions [1]* - *Health Care Management Science [2]* - *International Journal of Industrial Ergonomics [1]* - *International Journal of Healthcare Management [1]* - *Journal of Health Organization and Management [1]* - *Journal of Healthcare Management [3]* - *Journal of International Technology and Information Management [1]* - *Journal of Management & Marketing in Healthcare [1]* - *The Journal for Quality and Participation [1]* - *Work [1]*	- *European Journal of Information Systems [2]* - *Information Systems Frontiers [1]* - *Information Systems Journal [1]* - *Information Systems Management [1]* - *Information Systems Research [3]* - *International Journal of Medical Informatics [2]* - *MIS Quarterly [1]*	- *Decision Sciences [1]* - *Decision Support Systems [3]* - *International Journal of Quality & Reliability Management [1]* - *Management Science* - *Production and Operations Management [1]*	- *Annals of Internal Medicine [1]* - *BMC Health Service Research [1]* - *Health Affairs [1]* - *Hospital Topics [1]* - *International Journal of Health Care Quality Assurance [1]* - *JAMA [1]* - *New England Journal of Medicine [1]*
Journal count	*10*	*7*	*5*	*7*
Article count	*13*	*11*	*6*	*7*
Article count (in %)	*35.1%*	*29.7%*	*16.2%*	*18.9%*

2.4 Analyzing and Synthesizing

Prior to reading individual articles in the final set, we established a broad guideline to help organize our findings. We used the following three overarching categories—organizational, behavioral, and project-related issues—as the initial structure and started reading individual articles to look for specific 'Impediments', 'barriers', 'challenges', 'factors' or 'issues' that impedes HIT implementation performance. As we label the individual barriers and list them in the initial framework, we found that the impediments that pose significant challenges occur in three distinctive and sequential stages as follows: 1) Adoption of HIT, 2) Integration the incorporation of the adopted HIT with people and processes, and 3) Sustenance—the continued diffusion and use of HIT. Table 2 summarizes our findings of impediments in relation to our initial structure as well as the final research framework which is depicted in Figure 4.

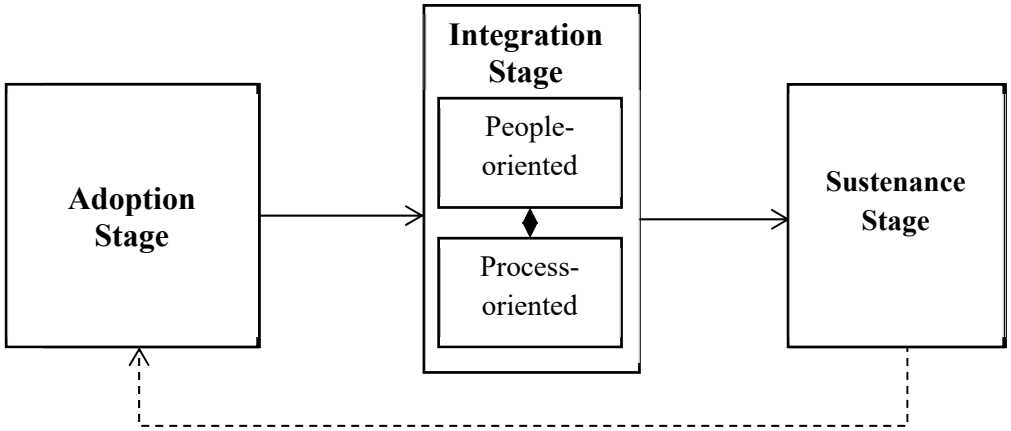


FIGURE 4. HIT IMPLEMENTATION FRAMEWORK.

TABLE 2. LIST OF INITIAL CATEGORIZATIONS AND IDENTIFIED IMPEDIMENTS.

Initial Categorization	Identified Impediments	Stages
Organizational barriers	HIT complexity	Adoption
	Lack of risk assessment and safety measures	Adoption
Behavioral barriers	Limited user buy-in	Adoption
	Negative spillover	Integration
	Physician resistance	Integration
	Standardized training	Integration
	Negative viewpoint	Integration
	Lack of Interoperability	Integration
Project-related barriers	Lack of continuous improvement	Sustenance

In the adoption stage of a HIT initiative, hospital administrators establish champions at the top-management level who can ensure smooth implementation of the technology. The first stage specifically focusses on the design and development of HIT and should consider managerial and behavioral factors necessary to manage a project such as leadership commitment, feasibility analysis, cost-benefit analysis, budget planning and resource allocation. However, our study specifically aims in finding factors that act as a barrier for adopting IT in a healthcare setting, which is

both knowledge-intensive and has power hierarchy built into its culture.

After the HIT system or part thereof has been implemented, there needs to be a good integration between people, processes, and systems without which resistance from physician group and a sub-optimal use of technology arise. Once the integration has been completed, the last stage in HIT is the sustenance stage which includes maintenance and continuous improvement of the HIT systems and processes. Literature in quality management literature such as TQM and Six-Sigma show that there is a need for continuous quality improvement following the adoption of a quality program. Once quality improvement systems are in place after the implementation of HIT and when a need to upgrade or add new technology arise in the future, organizations circle back to the first stage of adoption to implement the newer technology. This is critical for health care organizations adopting HIT to progress from 'meaningful use' stage 1 to stage 3. This is shown as the dotted line in Figure 4.

This can also be viewed as a response to Agarwal, Gao, DesRoches, and Jha (2010), who calls for research particularly in the area of design, implementation, and meaningful use of HIT. Our synthesis of data leads to proposing a framework comprised of three interrelated sequence of stages - adoption, systems integration, and continuous improvement or sustenance of HIT. Moreover, our analysis (refer identified impediments and stages in Table 2) highlights the contextual factors (impediments) that pose significant challenges in each of the three distinctive stages.

III. ANALYSIS AND DISCUSSION

In this section, we discuss each of the three stages of HIT and each of the impediments identified in our literature review.

3.1 Adoption Stage

3.1.1 HIT Complexity

To streamline technology adoption and to provide a consistent understanding for future research, Rippen, Pan, Russell, Byrne and Swift (2013) create an organizational framework for health IT. The five major facets of the proposed framework are technology-specific HIT, use of technology, environmental factors that affect the use of technology, outcomes when using the technology, and developmental track of the processes involved. While Rippen et al. (2013) show the need for understanding an organizational-level framework for technology implementation, Jha, DesRoches, Kralovec, and Joshi (2010) argue that hospital managers should understand the level of complexity involved in different types of HIT as well. Jha et al. (2010) classified HIT into four categories with increasing level of complexity. (1) Clinical documentation (medication lists, physician notes, problem lists), (2) viewing results (lab reports, radiology reports and images), (3) CPOE (Computerized Physician Order Entry), and (4) clinical decision support system (CDSS: clinical guidelines and reminders, drug allergy alerts, drug-drug interactions and drug dosages). Das, Yaylacicegi, and Menon (2011) also analyzed how levels of information technology affect hospitals investments and labor productivities. They found that capital investments in transactional IT has immediate effect on medical and administrative labor productivities and a lagged but durable effect on operating costs. Capital investment on administrative IT has immediate but short-term effect on medical labor productivity. Therefore, during the adoption stage, understanding both the

organizational framework and levels of IT are initial factors hospital managers should consider.

While leadership commitment, feasibility analysis, cost-benefit analysis, budget planning, and resource allocation are typical factors impacting any project implementation, our literature review shows two key barriers that play a critical role in adopting HIT. The two key barriers which can become a strong impediment are 'user buy-in', and 'risk assessment and safety' that are further discussed in the following sub-sections.

3.1.2 Limited User Buy-in

During the adoption stage of HIT, literature has specified that it is crucial to identify important actors who would use and manage the HIT. Mantzana, Themistocleous, Irani, and Morabito (2007) show that the actors can be categorized as organizational and human (individual) and further sub-categorized into provider, acceptor, supporter or controller. Mantzana *et al.* (2007) say identifying different actors is a baseline to the business process. Prior literature did not consider the role of the actors and therefore, Mantzana et al. (2007) research shows the importance of people buying-into a specific HIT project.

Cohn, Berman, Chaiken, Green, Green, Morrison, and Scherger (2009) suggest that poor planning, miscommunication, mismanagement, and rejection by users are some of the common reasons for ineffective implementation of HIT project. While 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 adoption and integration of HIT. These articles also highlight the fact that human factors integration not only occur at post-adoption of the project but emphasizes the need to develop a strategic system where end-users such as physicians and clinicians are in the adoption stage. Increasing the contribution of the end-users will also increase their buy-in of the project and future use of HIT.

One of the ways in which users can be involved in the design and adoption of HIT is through the use of physician champion. Physician champions are typically a veteran and well-respected head who conducts exercises and illustrative cases in their respective departments which later lead to faster buy-ins among other physicians and supporting clinicians (Cohn *et al.*, 2009). Interestingly, Walston, Bennett and Al-Harbi (2014) find that perceived barriers, especially in technological capabilities, leads to higher perceived benefits by the users. When buy-in is obtained as users understand the potential technological impediments like software incapability, they are more likely to accept potential benefits. We also find that earlier buy-in by the users with good allocation of resource capabilities is a way to minimize the impediments in Adoption stage. Teoh, Pan and Ramchand (2012) argue for an enterprise-wide system to manage organizational resources (users) during the process of adoption and they say that resources (users) should be structured on the chartering phase, bundled and leveraged in shakedown phase, and maximized in onward and upward phase.

In healthcare setting, power hierarchy through position is high compared to other knowledge-oriented contexts such as IT or consulting. Therefore, this factor 'user buy-in' in the early stage plays a strong role in the adoption of HIT.

3.1.3 Lack of Risk Assessment and Safety Measures

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 that the design guideline should include the potential risk assessment of failure points in the adoption stage. One example of such is that the potential risk involved in physicians' copying online examination notes from prior appointments for repeat patients, which may not reflect the actual and accurate examination of current symptoms and may fail to document the examination as occurred in real-time for the current appointment. Other risks which may create barrier for patients are the privacy and security of information available in EHR (Shah, Murtaza and Opara, 2014). Harrington, Kennerly, and Johnson (2011) cautions executives, clinicians and technology professionals that adoption of specific HIT such as Electronic Medical Record (EMR) is very complex and may lead to patient safety issues.

Ford, Silvera, Kazley, Diana and Huerta (2016) found that early adopters of EHR strategy were more likely to elicit patient safety culture in the organization compared to those who were just going to meet the "meaningful use" standards. Healthcare leaders should understand the safety mandate when designing, developing, implementing and using EMR or EHR within each of the processes, technology, people and work environment. Unlike other knowledge-oriented industries, the potential failures due to ineffective risk assessment and its impact on patient safety is significantly higher and could affect mortality. Therefore, the level of risk assessment and patient safety systems while adopting HIT is a key factor for healthcare and needs to be closely monitored. Ludwick and Doucette (2009) argued that some of the implementation concerns due to negative risk assessment and lower safety can be alleviated by establishing strong leadership, project management techniques, standardizing, and training.

3.2 Integration Stage

After the adoption stage, people, procedure, and processes integrate the collection, transformation, dissemination of information within an organization using the recently implemented HIT. Therefore, integration involves both the people and the processes. 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. 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 such lack of interoperability becomes a key barrier. 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".

With an understanding that an integrative system of technology, people and process is vital, Hikmet, Bhattacherjee, Menachemi, Kayhan, and Brooks (2008) categorized the adopted healthcare information technologies into three levels based on the business value derived by the

organizational hierarchy: clinical, administrative, and strategic HIT. Clinical HIT are technologies designed to improve direct patient care, administrative HIT are technologies intended to streamline and improve internal data processing while strategic technologies are designed to improve critical decision making. They found that clinical HIT is the only system that had significant positive impact on the operational performance. Continuing the path of clinical, administrative and strategic HIT, Hikmet, *et al.* (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 and therefore, integration of processes and people are a pre-requisite. With the goal to successfully integrate HIT, in this study we analyze the key impediments that affect integration of HIT with people, as 'people-oriented' integration, and integration of HIT with process, as 'process-oriented' integration.

People-oriented Integration:

Lawler *et al.* (2011) reviewed the literature taking a critical look at the impact of HIT medication error when using CPOE, CDSS, and bar-codes of medication, and identified a list of people-factors that impact design. Kaye, Kokia, Shaleve, Idar, and Chinitz (2010) 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. 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", which illustrates the critical need for people-oriented integration.

Without adequate orientation and training, physicians and other clinicians find it difficult to move to an electronic system in which they have reduced expectations of delivering an effective care. Literature has extensively focused on the key issues that healthcare employees face during the adoption and integration of HIT. Given that our study reveals the importance of the people-oriented integration, we identify key themes of impediments that specifically deals with positive and negative interaction among people and its success or barrier to HIT performance.

3.2.1 Negative Spillover

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 found that doctors with strong ties within and outside their group of physicians negatively affect the use of all other groups. When paraprofessionals (e.g. nurses or clinicians) and administrative (e.g. front desk or billing) have strong in-group and outside their group ties, they positively impact the use of both those groups but have no effect on physicians 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. Therefore, they corroborate the common knowledge that physicians buy-in and their involvement are extremely important and mandatory for adoption, integration, and effective use of HIT.

Kane and Labianca (2011) found that when people most central to the healthcare group avoids the information system after it has been adopted, this is more likely to negatively affect patient outcomes. These negative effects are significant compared to the negative effects due to the average level of avoidance by doctors or within a group of healthcare providers. They suggest targeted and direct intervention on the central person who drives the team which may result in that individual quitting or resisting. These articles emphasize the need for project implementers to identify and work with the people group that has the greatest influence and impact. As healthcare setting is unique in terms of the power hierarchy among employees and being knowledge-intensive organization, the network effect on the performance of HIT becomes highly critical for adoption and diffusion of HIT. Therefore, we identify negative spillover as a key barrier in people-oriented integration.

3.2.2 Physicians Resistance

Physicians resist technology due to two primary reasons: uncertainty of the unknown system and fear of causing medical errors from the system. Jensen and Aanestad (2007) portrayed the surgeons' perspective on the adoption and use of healthcare information system. Although surgeons considered the system as a means to facilitate the medicine prescription procedures, the hostility towards 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 such as electronically referring patients to other physicians; surgeons considered it as a control mechanism of themselves; surgeons were not consulted in the selection and decision-making process. They conclude that surgeons welcomed the use of HIT when it provided a direct clinical benefit, but positive and negative attitudes co-existed. Davidson and Heslinga (2006) 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.

Cohn *et al.* (2009) continue to show that the perception among physicians that medical errors are higher in HIT system, leads to their resistance. Physician residents may not thoroughly analyze the medical history of patients when examining patient using a HIT system. Physicians also believe that the maximum benefit for implementing and using HIT system is the insurance companies and payers, but not the physicians, thereby increasing the resistance to change. Either because of the perception of errors in HIT systems or because of perception of loss of control, physicians resist the system when they do not see a direct clinical benefit. Even though some physicians may have been involved in the buy-in in the adoption stage, the decision to adopt or not is at the organizational level. However, when it comes to actual use of the adopted technology, it is at the personal level affecting their daily workflow and therefore, physicians may resist to the use of the technology. Therefore, we identify 'physician resistance' because of physicians' perceived hindrance of HIT to their work (due to added activities) or for possible errors (due to miscommunication) as a key factor that impedes people-oriented integration.

3.2.3 Standardized Training

One of the key elements in the integration between people and process is the necessity and adequacy of training for all members involved. Aron, Dutta, Janakiraman, and Pathak (2011) performed a systematic study of the multiple units in hospitals to identify factors that impact automation and help in reducing medical error rates. They found that training of hospital staff in quality management and automation of control systems improves the outcomes and reduces error due to subjective decision making. They also find that hospital staff realize that they are accountable through the automated system and hence are more cautious and monitor to avoid potential errors.

In addition to training, some literature studies the why and how of resisting information technology use. Mantzana, Themistocleous, Irani, and Morabito (2007) investigated a healthcare training process for older employees in the use of IS. The training process consisted of four phases where the first phase is identification of staff (people) related to training such as learner, mentor, tutor and teacher. The second phase evaluated the existing skills and pre-competencies; the third phase delivered the education tool and methods to the different people in the training process; and the last phase assessed the overall training process. They found that older employees require training for the information system, but the training method needs to be customized to the theories that they are already familiar with. Therefore, inadequate and standardized training programs can be a growing hindrance to the integration of people with the HIT systems. Healthcare setting is a unique context in which employees are not required to have basic computer skills to conduct their job responsibilities (although this is changing with the newer and younger workforce). Nurses who were being trained to use a tele-health system complained that they trained with a dummy, because of which the realities of patient monitoring were masked (Sharma and Clarke, 2014). Focus group with 65 healthcare professionals shows age, level of training and understanding of new technology as factors of resistance for EHR (Vadillo, Rojo, Garces and Checton, 2016). Therefore, if adequate and customized training programs are not provided to different groups of hospital employees (e.g., physician, clinician, nurse, pharmacy groups) based on their level of technology use skill, it can become a strong impediment to the day-to-day integration with HIT systems. A most recent study by Avgar, Tambe and Hitt (2018) found that work practices such as discretion and training play a vital role for learning-by-doing outcomes. The work practice of discretion and autonomy of the front-line nurses actually resulted in higher learning of the new technology.

3.2.4 Negative Viewpoint

Chau and Hu (2001) found that attitude of physicians mediated the effect between perceived usefulness and intention to use. Having a good attitude towards technology helps physicians to adopt and actually use the technology. Although Chau and Hu (2001) determined that attitude matters the most, Devaraj and Kohli (2003) found that actual usage of the technology (could be enforced through positive attitude) correlates strongly with the best positive performance outcome of the firm. They found that when physicians and staff actually use the available technology, there is a positive payoff on hospital performance such as reduced mortality, increased revenue per day and revenue per admission. These payoffs do not account for continued "actual" usage by the healthcare associates.

Not just the physicians, nurses play significant role in the use of the HIT. Samara, Real, Curtis, and Meunier (2012) based on a case-study approach show that when there is

increased dissonance between what the nurses' want and need in the technological process, there is increased dissatisfaction for nurses, which may result in threat to patient safety and higher occurrence of errors. Positive attitude of all employees (physicians, nurses, clinicians) created either through perceived usefulness or through positive performance outcomes is very critical in the continued use of HIT. Therefore, specific to healthcare setting, additional interventions or processes are required to communicate the usefulness and positive outcomes of HIT so that healthcare associates continue to use HIT.

In summary, we find that the key impediments under people-oriented integration when not addressed sufficiently could cause deficiency in successful implementation of HIT are spillover effect, physician resistance, standardized training, and negative viewpoint for continued use.

Process-oriented Integration:

Similar to the people-oriented factors we discussed above, that helps with integration, the following section emphasizes a key factor, interoperability that helps with the process-oriented integration.

3.2.5 Lack of Interoperability

One of the concerns identified widely in literature regarding HIT management is lack of system interoperability (Hersh, 2004). Lawler *et al.* 2011 provide a good explanation of interoperability. They indicate that it is important to provide essential standard operating procedures and protocols which reflect that the new work processes are not completely different from the old processes and procedures, but the new work process is important for successful integration of the HIT system. 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). Chaudhary *et al.* (2006) in their extensive review suggest that an important future research direction is the issue related to organizational change, workflow redesign, human factors and project management. They also indicate that much work is needed on interoperability and consumer health technologies followed by development of uniform standards of reporting in implementation of HIT.

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. Bradley, Pratt, Byrd, Outlay and Wynn (2012) studied the effect that enterprise architecture which indicates the level of software and hardware resources that the hospital owned, and the impact of the architecture on the IT strategic alignment and operational effectiveness. They found that the level of enterprise architecture maturity has a positive influence on the effectiveness of IT resources and thereby its effect on achieving strategic goals. However, authors have not considered the role of both people and their influence in the effective implementation and use of these IT resources. At a micro-level, front-line staff had developed practical ways of integrating IT into their work, even though they viewed it as inflexible systems (Cranfield et al. 2015).

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. Therefore, using the time-tested simulation or system dynamics will be the best model to test and integrate operational philosophies such as PDSA (Plan-Do-Study-Act cycle), JIT (Just-In-Time), Lean Thinking, TOC

(Theory of Constraints) with the physical healthcare systems. Simulation not only aids in estimating future cost savings but also monitors the complex interactions within the system that could occur in the future. 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 have 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. Gupta and Sharda (2013) also urge researchers to look at the comprehensive clinical decision support and systems design and development and its impact on specific clinical functionalities, workflow, and process orientation. The emphasize on the process-oriented integration as discussed above is the interoperability of existing medical technologies with systems, and re-engineering of processes and flows with those systems. Both of these leads to successful implementation of HIT.

3.3 Sustenance Stage

At the sustenance stage, there is significant need in establishing quality principles of continuous improvement in HIT management. Even though McLaughlin and Kaluzny (2004), Shortell, Bennett, and Byck (1998), and Blumenthal and Kilo (1998) have discussed the usefulness and effectiveness of TQM (Total Quality Management) and continuous quality improvement in healthcare, research has been limited in the area of quality management and continuous improvement specific to HIT for the betterment of patient care. 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". Lorence and Jameson (2002) found a time lag between adoption of healthcare information system and the adoption of automated quality assessment methods. Traditional paper-quality audit seems to be the favored channel of assessment. Barton (2014) calls for IT initiatives to work with enterprise-level quality management and change system to ensure organizational success. Once quality systems are in place for the implemented HIT, organizations will find the need to upgrade or add new technology sooner or later and will encounter these barriers in their next level of HIT implementation. Therefore, it is pertinent not only for IT managers in healthcare system, but also the healthcare managers and staff to be cognizant of these potential pitfalls when implementing HIT.

Table 3 provides the list of papers in the final data set within the HIT implementation framework developed in the previous section.

IV. DISCUSSION

Our preliminary review across management, information systems, operations and supply chain, healthcare disciplines showed a gap in literature where the healthcare information technology articles and ideas are fragmented across these disciplines and we did not find a study that comprehensively looked at all the disciplines to understand the key impediments which reduces the efficacy of HIT implementation. In this study, we bridge that gap by answering the research questions: What are the key factors that impedes the implementation of HIT? Our comprehensive literature review across management, information systems, operations and supply chain, and healthcare disciplines yielded us 37 methodologically rigorous articles for us to analyze.

Our first contribution through the synthesis of the literature is in forming an inter-related implementation stages – Adoption, Integration and Sustenance – for HIT implementation through systematic analysis of articles across diverse disciplines (management, supply chain, IS and healthcare). Our second contribution to literature is derived due to the unique setting of healthcare as knowledge-intensive industry but continues to have power hierarchy within their job positions. Using this uniqueness, we extricated *key factors* specific to healthcare (with articles from business, IS, operations and SCM, and HCM literature) that impedes the performance of HIT and juxtaposed them under the implementation framework.

Literature in management and IS has extensively focused on studying factors that impact organization-level implementation and individual-level adoption in other industries. However, in our study we contribute through identifying strong themes of impediments that hinders implementation, specifically in healthcare information technology, in the last few decades and consolidate it into an implementation framework.

V. CONCLUSION

Spurred by current regulatory trends, healthcare IT spending in large North American organizations is expected to hit more than $34.5 billion in 2014 (Hampton, 2013). Heavy investments in healthcare technology have encouraged a lot of research in the implementation and effectiveness of HIT systems. After reviewing research articles from multiple schools of thought in HIT ranging from information systems, medical informatics, healthcare management, and operations management literature, we found a gap where researchers were analyzing a portion or thereof in the cycle of adoption, integration and sustenance when managing HIT. In this paper, we establish a framework comprised of three inter-related stages useful for managing HIT implementation. These three stages are adoption, integration, and sustenance stages, which are vital in the implementation and continued use of HIT for the performance of the health system. Barriers in any one or all of these stages impedes the effectiveness in implementing and it continued use of HIT. Identifying such barriers in the healthcare environment is critical for hospital project managers when the culture of corporate management can be construed as lack of respect for authority in the healthcare world.

Our study has also shown that the three stages, adoption, integration, and sustenance, have few critical but highly relevant contextual factors that may hinder the performance of HIT. Under the context of healthcare systems, these factors play a vital role. In addition to typical project planning and implementation issues, we find that users/actors pre-participation and buy-in, risk assessment and safety are particularly critical factors in healthcare that needs to be accounted for while implementing HIT. At the integration stage, administrators should prioritize people-oriented factors such as spillover effect, physician resistance, standardized training and negative viewpoint as issues that most concern the implementers while interoperability as the significant issue for the process-oriented integration. While operations literature has studied the usefulness of continuous quality improvement, healthcare literature has not explored the process of continuous improvement pertaining to HIT at the sustenance stage. The process of continuous improvement will further lead to upgrade or change in technology leading to a new cycle of planning and adoption, integration and sustenance.

TABLE 3. LIST OF ARTICLES WITHIN THE HIT IMPLEMENTATION FRAMEWORK.

<table>
<tr><th>Adoption stage</th><th colspan="2">Integration stage</th><th>Sustenance stage</th></tr>
<tr><td rowspan="2">- Rippen, Pan, Russell, Byrne and Swift (2013)
- Das, Yaylacicegi and Menon (2011)
- Jha, DesRoches, Kralovec and Joshi (2010)
- Mantzana, Themistocleous, Irani and Morabito (2007)
- Cohn, Berman, Chaiken, et al. (2009)
- Lawler, Hedge, and Pavlovic-Veselinovic (2011)
- Teoh, Pan and Ramchand (2012)
- Bates and Gawande (2003)
- Harrington, Kennerly and Johnson (2011)
- Ludwick and Doucette (2009)
- Ford, Silvera, Kazley, Diana, Huerta (2016)
- Shah, Murtaza and Opara (2014)
- Walston, Bennet and Al-Harbi (2014)</td><td colspan="2">- Hikmet, Bhattacherjee, Menachemi, Kayhan, Brooks (2008)
- Angst, Devaraj, Queenan and Greenwood (2011)</td><td rowspan="2">- Lawler, Hedge, and Pavlovic-Veselinovic (2011)
- Lorence and Jameson (2002)
- Barton (2014)</td></tr>
<tr><td>People-oriented Integration
- Lawler, Hedge, and Pavlovic-Veselinovic (2011)
- Kaye, Kokia, Shaleve, Idar and Chinitz (2012)
- Venkatesh, Zhang and Sykes (2011)
- Kane and Labianca (2011)
- Jensen and Aanestad (2007)
- Davidson and Heslinga (2006)
- Cohn, Berman, Chaiken, Green, Green, Morrison and Scherger (2009)
- Aron, Dutta, Janakiraman and Pathak (2011)
- Mantzana, Themistocleous and Morabito (2007)
- Chau and Hu (2001)
- Devaraj and Kohli (2003)
- Samara, Real, Curtis, and Meunier (2012)
- Sharma and Clarke (2014)
- Vadillo, Rojo, Garces, Checton (2016)
- Avgar, Tambe, and Hitt (2018)</td><td>Process-oriented Integration
- Lawler, Hedge, and Pavlovic-Veselinovic (2011)
- Hersh (2004)
- Chaudhary, Wang, Wu, Maglione, Mojica, Roth, Morton, Shekelle (2006)
- Thrasher and Revels (2012)
- Bradley, Pratt, Byrd, Outlay and Wynn (2012)
- Young (2005)
- Huerta, Thompson, Ford and Ford (2013)
- Gupta and Sharda (2013)
- Cranfield et al (2015)</td></tr>
</table>

This paper paves the way to understand the most critical issues that healthcare administrators should be targeting in order to avoid potential problems among the IT team, administrators, physicians and clinicians. It pushes administrators and IT implementers from their near-sighted approach of just project planning and implementation to use a longer perspective and understand the healthcare context for actual integration and usage of HIT by the administrators and clinicians. A limitation of the paper is that we have not analyzed explicit interventions that can be utilized in specific context or under specific conditions to improve the effectiveness of HIT implementation. For example, the construct of users' pre-participation and buy-in is found to be a critical, however, we have not explored the different ways in which this type of pre-participation can be planned and integrated. Several interventions need to be created and assessed in order to operationalize the framework presented here.

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