Adoption and implementation of Health Information Exchange (HIE): An interpretative review

Full papers

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Abstract
Health Information Exchange (HIE) includes the process of electronic movement of patient-level clinical, demographic and health-related information across healthcare organizations. Although literature on HIE indicates the potential benefits of HIE in quality improvement as well as mortality and cost reduction, several studies mention various barriers to HIE adoption and implementation. The hindering factors can be classified into technological, organizational and environmental variables. A few studies have mentioned that adoption and implementation of HIE are different phenomena but the rest has used adoption and implementation interchangeably. Also, there is no comprehensive study to clearly delineate the difference between adoption and implementation process associated with HIE in United States. This study is aimed at reviewing the theories on adoption and implementation steps and explaining the differences between these two processes. This study attempts to distinguish the factors affecting adoption and implementation of HIE in the health care settings in United States. To do so, a literature review was conducted on both adoption and implementation of HIE. The related articles which were mainly available in Web of Sciences electronic databases reviewed and some additional articles accessed through Google Scholar. All the selected articles were published from 2008 to 2014. Eligibility criteria were HIE setting, English language, year of publication, and country setting. Articles were assessed against eligibility criteria and were coded into HIE awareness, HIE adoption and HIE implementation and HIE mixed to better identify the differences between different stages. The number of publications on HIE in United States significantly increased over time. Overall, twenty seven publications met the inclusion criteria. Based on the results, the study proposes a decision tree which includes all the possible stages to explain HIE adoption and implementation process. The decision tree analyzes the differences between adoption and implementation and clarifies factors affecting each process separately. Finally, the result shows five different types of decisions that can be made by health care institutes regarding adoption and implementation process of HIE. The findings provide a useful implication for researchers interested in HIE adoption and implementation. Also, the analysis can help the decision makers and policy developers in the health care setting to better understand factors affecting adoption decisions and implementation process.

Keywords
Awareness, Adoption, Implementation, Health Information Exchange
Introduction

Health Information Exchange (HIE) is the electronic transfer of patient data and health information among healthcare providers and institutions. Information exchange in healthcare in the form of sharing patient and clinical data can potentially improve safety, quality of care and efficiency (Walker et al. 2005), patient care coordination, facilitate public health efforts (Frisse et al. 2012) and reduce mortality and healthcare costs (Miller and Tucker 2011). Multiple models of clinical data exchange are being explored nationwide. The Direct project model automates point-to-point processes in which a provider sends patient data to a known recipient (Williams et al. 2012). In non-directed exchange model, a central organization is considered as a hub that provides a lookup for providers (Ancker et al. 2012). In query-based HIE, patient data are aggregated from multiple healthcare institutions (Campion et al. 2013). Another model is patient-centered exchange in which patient data and laboratory results are delivered to the patient to share as required (Ancker et al. 2012).

Under the 2009 HITECH Act, the United States federal government has considered $19 billion in financial incentives to healthcare providers in order to encourage them to adopt Electronic Medical Records (EMRs) (Miller and Tucker 2014). In line with the goals of the federal “meaningful use” program, the exchange of electronic data is also promoted among healthcare providers and institutions (Adler-Milstein and Jha 2014). Although the financial incentives offered by the federal government are very encouraging, healthcare providers will not simply adopt and implement effective HIE (Vest, 2010). The motivation of reducing healthcare spending and mandating adoption of a technology which is supportive of HIE are not enough for healthcare providers to simply adopt the technologies and share electronic patient data with other institutions (Miller and Tucker 2014). Also according to literature, adoption and implementation are completely different phenomena (Vest 2010) and different determinants are associated with adoption and implementation processes (Rogers 1995). However, most of the HIE literature has analyzed and explained the factors affecting implementation and adoption interchangeably. This study attempts to review the existing research on the differences between technology adoption and implementation and differentiate the two processes. Then, this research is aimed at explaining the differences between adoption and implementation of HIE by proposing a decision tree to categorize healthcare organizations on the basis of their decisions about these two processes in the healthcare setting.

Literature review: From awareness to actual use

One of the objectives of this study is to review a body of literature and existing theories related to adoption and implementation of IT systems. We try to explain the process from awareness of new IT system to actual use of the system. According to Cresswell and Sheikh (2013), in order to actually use an IT system eight processes such as adoption, deployment, diffusion, implementation, infusion, integration, normalization and routinization should be conducted. Basically, these concepts are all related to the processes by which an innovation is introduced and then incorporated (or not) into routine care and day-to-day activities by professionals and/or patients within organizational settings. Adoption of HIE can focus on the acceptance and incorporation of HIE applications into everyday practice. On the other side, implementation is more concerned with the consideration and the introduction of HIE applications. Implementation considerations are a function of procurement decisions and development pathways (Yang et al. 2013).

According to Hameed at al. (2012), taking the innovation literature and the stages of innovation adoption into account, all the stages illustrated by different research can be categorized more or less into three main stages as the initiation (pre-adoption), adoption-decision and finally implementation (post-adoption) phases. The initiation stage entails need recognition, knowledge or awareness of innovation, attitude formation towards the innovation and proposal for adoption of innovation (Gopalakrishnan, Damanpour 1997). According to Meyer and Goes (1998), the adoption-decision stage is related to the acceptance decision and the evaluation of proposed ideas from a financial, technical and strategic view, accompanied by the resource allocation for the upcoming acquisition and implementation. In line with Rogers (1995), the implementation stage reflects innovation acquisition, making the organization prepared for utilization of the innovation, confirming the innovation by performing a trial, user acceptance of the innovation and continuous actual use of the innovation. Therefore, according to this
model, the adoption process of HIE can include the need assessment and stage of awareness about the system (as pre-adoption), making adoption decision by conducting a cost-benefit analysis from various perspectives and allocating resources (adoption). Finally, preparing the organizations involved in HIE for use of the system as well as sharing the clinical information with other providers and motivating users to accept the system also making it as an integral part of their routine activities (implementation).

Based on this model, activities related to the acquisition of innovation are studied at an organizational level perspective and the processes involved in the user acceptance are examined in terms of individual level. The study discusses that the significance of different variables varies across the three stages. For the adoption processes at the organizational level, perceived innovation, organizational, environmental and CEO characteristics that affects pre-adoption, adoption-decision and implementation stages of innovation adoption are evaluated. At individual context, user normative beliefs towards using the innovation and user attitudes are perceived as influential determinants.

Kim and Garrison (2010) have discussed that a final decision about adoption or rejection of a technology depends on several steps users go through and also the type of technology (e.g., continuous vs. discontinuous) can affect the steps. According to Cooper and Zmud (1990), the IT adoption process can be categorized into six steps: initiation, adoption, adaptation, acceptance, routinization, and infusion. In line with Grover and Goslar (1993), the initiation stage focuses on evaluation of the organization on pressure coming from their internal and external environment. The adoption and adaptation stages are the pilot testing of a technology by allocating required resources. The acceptance and routinization stages are the phase that shows that adaptation stage has been passed and the organization involves in installation and integration of the adopted technology. Finally, acceptance and adoption of the technology throughout the industry signals the infusion stage. Some other studies on technology adoption demonstrate that the adoption process consists of a three-stage process such as evaluation, adoption, and integration (Damanpour, Schneider 2006).

In accordance with Claudy et al. (2010), the adoption is followed by awareness in the innovation adoption process. In the context of adoption decision process, Roger’s model indicates that individuals undergo five phases: knowledge, persuasion, decision, implementation, confirmation. Based on this model, decision process launches when a decision making unit faces an innovation and increases an understanding of how it works. Once people or involved units have been aware of the innovation, they start evaluating the innovation’s characteristics (persuasion stage). According to Rogers (1995), adoption decision is defined as the decision to make full use of an innovation or reject it. The implementation stage is more concerned with the individuals who actually adopt the innovation and involved in the evaluation of its usefulness. On the last stage (confirmation), an adoption decision might change to a rejection decision and vice versa. In other words, the decision making unit decides whether to continue using it. In order to apply Rogers’s innovation adoption process model to the context of HIE adoption and implementation, we can conclude that awareness and gaining an understanding of HIE and its goals and policies can be considered as the first stage. Then, decision making units (healthcare providers) evaluate the function and characteristics of HIE and decide whether to adopt or postpone the adoption process. Those providers who perceive high level of effectiveness and usefulness attached to HIE turn to the actual implementation process. The last stage of Roger’s model is not so rational in the context of HIE. In other words, it is very naive to believe that a hospital which has incurred the cost of implementation of HIE system decide to discontinue using the system later. One possible case is the healthcare providers that have acquired the HIE system but not yet implemented it. The other possibility is the healthcare providers which have adopted the system but they don’t want to share all of the clinical and health information with other providers outside of their practice.

Based on the study of Colapinto et al. (2014), in which a framework has been proposed for modeling diffusion of innovations. They have conceived of a two-stage process (awareness and adoption) in which the behavioral motives are driving the adoption process. Graham et al. (2013), indicate three stages of adoption to explain how institutions move from interest towards a mature institutionalization. The first stage is called awareness or exploration. The second stage is adoption or early implementation which is focused on institutional adoption of the technology and devising strategies, new policies and practices to support its implementation. The last stage is mature implementation or growth in which well-established strategies and structure make the technology as the integral of operations. The application of this model to the context of HIE is developing awareness of existence, functions, cost and error reduction of using
HIE, devising the strategies and practices required to implement the system and actual implementation of it by sharing clinical information with other providers.

In conclusion, almost all the theories on usage of new IT systems have three main constructs as awareness, adoption and implementation. All the stages and variables extracted from the existing theories can be categorized into these three key steps which begin with awareness, followed by adoption effort and ends by implementation process. Therefore, in this study we use this three-stage model as the main theory for HIE adoption and implementation processes.

**Methods**

**Eligibility criteria**

We considered both existing theoretical and empirical studies focused on either HIE adoption and implementation in United States. In this process, we excluded editorials and commentaries. We also excluded articles which were not directly related to HIE setting, didn’t use theoretical components or frameworks for explaining HIE adoption or implementation, were not conducted in United States setting, or were written in languages other than English. Therefore, the publications were mainly extracted based on country, type of study, methodological approach and year of publication from 2008 to 2014 which HIE effort were significantly planed and considered to apply in United States. Therefore the search selection criteria were:

- English language, year of publication (the last 7 years), country setting (United State), HIE setting (addressing HIE awareness, adoption or implementation), type of study (either qualitative or quantitative), theoretical or practical contributions.

**Search strategy**

A comprehensive literature review was conducted on both conceptual frameworks and theoretical models related to factors affecting adoption effort and implementation process of HIE in United States. The strategy of searching articles included three main keywords as HIE awareness, HIE adoption and HIE implementation. The articles were mainly searched in the database of Web of Sciences and the useful references were which explicitly referred to HIE setting in United States also extracted through Google Scholar. The search was continued till no new studies were found according to the selection criteria.

**Screening**

In the first step, titles and abstracts of articles were reviewed to exclude the manuscripts that did not meet the inclusion characteristics. Then, full text manuscripts were reviewed independently to identify which articles were eligible to be included in conducting this study. As we limited our study to some inclusion criteria, the articles were mainly retained based on being relevant to HIE adoption or implementation setting, the type of study (qualitative or quantitative) and having relevant contributions. To better distinguish the differences between adoption and implementation of HIE, the selected articles were categorized into four groups as HIE awareness, HIE adoption, HIE implementation and HIE mixed based on their abstracts. In the HIE mixed code, usually the studies were related to both adoption and implementation processes.

**Classification**

The key factors, concepts, and components for each category (HIE awareness, adoption, and implementation) were studied. The similarities, differences, hindering factors and reinforcing variables were analyzed and classified to better explain the journey of actual use of HIE effort from awareness to implementation process. The core concepts and variables extracted from the publications were saved in the Excel files. This method permitted the author to better present and analyze the core variables which were retrieved from the publications and the possible relationships between them. In the end, the variables affecting each category were compared to explain the discrepancies between the three stages in the HIE context.
Results

Based on the initial search, sixty five results were retrieved from the database. To expand search, nine additional studies were retrieved from the references of the selected articles. These articles were indexed by Google Scholar. We screened the titles and abstracts of total seventy four studies and excluded twenty two papers based on the initial exclusion criteria (not relevant abstracts, years, country setting and language). The selected papers (fifty two studies) were reviewed in full and assessed for eligibility. Twenty five additional articles were excluded mainly based on methodology, type of study, and having no evidence of theory, model, empirical work or contributions. Finally, twenty seven studies were selected for conducting this research through qualitative synthesis. Flow chart of search strategy is shown in Figure 1.

![Flow chart of search strategy]

Figure 1 Flow chart of search strategy

Characteristics of studies

In total, eleven of the twenty seven articles (40%) were just related to adoption of HIE, barriers and motivating factors to adopt HIE in United States. A total of eight articles of the studies (30%) directly referred to actual usage and addressed factors affecting the implementation of HIE effort. The remaining eight articles (30%) were related to both HIE adoption and implementation and explained barriers and
motivating factors affecting either both or one of these stages. A total of five studies (19%) also addressed the awareness concerns related to HIE effort.

**HIE adoption effort, implementation process and the differences**

Despite the potential benefits of HIE such as improving quality, decreasing duplicative treatment and costs to better coordinate patient care (Carr et al. 2014), studies have showed a number of barriers related to adoption and implementation process. In order to support the distinction between adoption and implementation of HIE, we have categorized healthcare providers based on their states on HIE adoption and implementation process. When, for instance, a hospital is exposed to HIE system they start increasing their awareness about the advantages and difficulties of participating in HIE project. In this stage, there are some hospitals which are not even aware of the existence of HIE. Therefore, they are stuck in the first step and they will be out of the HIE adoption process until they come back to the loop by being aware of HIE. As a result, the first barrier to HIE adoption and implementation is lack of awareness. If healthcare providers pass this stage, they will move from the awareness stage to the second stage which is adoption. Some hospitals which are aware of the HIE potential benefits, guidelines and requirement, have no plan to acquire it and they will go out of adoption process. But they might change their strategies and policies later and come back to adoption process. Some healthcare providers may still doubt the major impact of electronically viewing and sharing clinical and health information with other providers (Patel et al. 2011). They might have concerns about the efficiency and quality of the clinical care supposed to be delivered using HIE (Wright et al. 2010). Therefore, one of the most important barriers in this stage is funding concerns (DesRoches et al. 2008). Start-up costs, technical infrastructure payment and uncertain return of investment are considered as a significant variable affecting HIE adoption planning and decision making (Kern et al. 2009). The uncertainty also covers the notion of how potential financial benefits can be distributed among stakeholders (Kern, Kaushal 2007). Due to financial concerns, for-profit hospitals are less likely to adopt HIE than non-for-profit and public hospitals (Adler-Milstein, Jha 2014). Therefore, offering financial incentives for healthcare providers can overcome some concerns regarding HIE adoption (Patel et al. 2011).

The other types of hospitals develop an organizational plan to acquire it once their evaluation process is complete and they make the organizational decision to adopt HIE. These organizations have resolved the financial, cultural, organizational and legal challenges regarding the main function of HIE (health information exchange), and involved in resource allocation decisions for using it in their health care practices. Sometimes the adoption process is mandatory. Meaning we expect all the involved healthcare providers simply adopt the HIE without any problems. But mandatory adoption cannot remove the hindering variables (Rogers 1995). One possible response to mandatory HIE is resistance to the actual implementation (information exchange participation) by appealing to the state legislature (Vest 2010). This results show even if the adoption process is necessary, sharing clinical and health information with other providers outside of the practice cannot simply be mandated. The results of a study show that around 30% of hospitals in U.S. are engaged in actual clinical and health information exchange with other providers outside of their practice (unaffiliated) (Adler-Milstein Jha 2014). Therefore, stronger policies are required to push (motivate) healthcare providers to share clinical information.

When an adoption decision is made the organizations are moving to another stage which is implementation process. On the implementation stage, three types of healthcare providers can be considered. The first type is the organizations which have acquired the HIE system but not yet implemented it. This group is a proof for the fact that if healthcare providers adopt HIE (may be due to HITECH Act), it doesn’t necessarily mean they will successfully implement it (Vest 2010). This type of healthcare providers prefers not to engage in HIE due to some concerns. Physicians are viewed as one key stakeholder to the success of HIE implementation but their perspectives and attitudes related to HIE are still not well studied (Fontaine 2010). Based on Vest and Jasperson (2010), the availability of the system associated with health information exchange cannot guarantee the usage of it. One of the main challenges affecting the implementation process is lack of resource and technical assistance. Physicians and staff of healthcare institutions might not fully aware of the technical functions, HIE software which is developed by vendors, guidelines and features of HIE in sharing clinical information and it may hinder them from actual usage of the system (Fuji et al. 2008).
One of the indicators showing an effective HIE implementation is broad information sharing with many different involved organizations (De Brantes et al. 2006). Some studies have mentioned that competition among different health care providers can impede actual implementation (De Brantes et al. 2006). Lack of trust among hospitals and between hospitals and other involved health care organizations is demonstrated in the form of fear that if sensitive patient data and clinical information are shared it gives competitors a competitive advantage (Grossman et al. 2008). Sharing sensitive and key clinical data with unaffiliated organizations can arise stakeholder concerns on the competitive aspects of data sharing associated with HIE. Moreover, privacy and security of sensitive patient data impedes electronically exchanging data with regional and unaffiliated hospitals. As quoted in Vest (2010), the chance of HIE implementation for hospitals which engaged in high competition is 85% lower than those in areas of low competition. Adler-Milstein and Jha (2014) have found that hospitals in less competitive markets are more likely to engage in information exchange. Therefore, although some health care providers have already adopted the HIE and invested valuable resources in health care, they may not likely to actively be involved in the implementation process due to competitive gain. In conclusion, this group of health care providers have simply adopted the HIE (due to the mandatory requirements or incentives) but they don’t actively share electronic patient data with others in the same system (internal exchange) and outside the system (external exchange). They may become reluctant to share clinical information with others because they see the medical records as part of their property (Miller, Tucker 2014). They might also perceive that they are able to meet patients’ needs and expectations and they see no additional value from data exchange with others. Some providers will be stuck in the adoption stage and the rest will probably defer actual information exchange and implementation process.

The other types of healthcare organizations which have adopted the HIE and are partially convinced that clinical data sharing is worthwhile, are in process of partial HIE implementation. These types of hospitals are engaged in exchanging at least one type of patient data or clinical and health information through regional HIE or with unaffiliated hospitals. They might still have concern about competitive gains as well as data privacy and exclude patient demographics when exchanging patient data with unaffiliated hospitals. Type of data and health care providers are the factor affecting their level of involvement in the actual implementation of HIE. Consequently, to address this concern, this group of hospitals will choose with whom they exchange clinical information and patient-level data. Despite the availability of nationally recognized standards (Cimino et al. 2014), most of organizations involved in HIE haven’t exchanged clinical information electronically. According to Miller and Tucker (2014), larger hospitals (which are part of a larger system) are more likely to exchange electronic patient information internally. But when it comes to external information exchange with other hospitals, they become less willing. In this case, larger hospitals perceive that if they facilitate data sharing outwards they might lose their patients. Therefore, they become less willing to exchange medical information with other similar hospitals by creating an information silo. This type of health care providers is more engaged in internal exchange rather than external exchange. Cooperative relationships, alliance between patient care providers and participating in networks may facilitate the implementation process.

The last group of hospitals is those have fully implemented the HIE system. These health care providers are supporting HIE policies and fully convinced that electronic patient-level clinical data sharing and other health information exchange are directly contributing to a high-performing healthcare system (Buntin et al. 2010). Therefore, they are actively engaging in a regional HIE effort as well as clinical information exchange with other providers outside of their practice and unaffiliated hospitals. In line with the three categories of health care organizations in the implementation process, literature shows that the majority of U.S. hospitals are not still involved in HIE effort and some states are moving quickly in supporting HIE and actively participation while others are lagging behind. The potential gains in health care quality, efficiency, patient care coordination, healthcare costs reduction and also patient benefits from HIE (Frisse et al. 2012) have called for some stronger policies and supporting strategies to address underlying concerns and increase health care providers participation in HIE implementation.
Discussion

Proposed model

After reviewing HIE adoption and implementation efforts, this study proposes a decision tree to better explain the different stages of awareness, adoption decision making and implementation process. This decision tree consists of all different states of health care providers and institutions in the course of HIE adoption effort and implementation. The pivot of the model is awareness whether the involved institutions are aware of the HIE system or not. The first stage (frozen zone) is when the awareness level is too little or organizations are not aware of HIE availability. On this stage, due to lack of awareness no adoption and implementation will take place. Therefore, we consider awareness as the main foundation for both HIE adoption decisions and implementation effort. The following stages will come into place later on the basis of HIE awareness. The second stage is where the health care providers and institutes are not in the frozen zone and are aware of HIE effort. At the beginning of this stage health care organizations have no plan for adoption and in turn they have no strategy for implementation of HIE. Their perspectives about HIE adoption will be changed when they are exposed to the potential benefits and gains (quality improvement, cost reduction, mortality reduction, patient care coordination) expected by the use of HIE. On this stage they still have no adoption plan but their awareness on HIE usage is growing. Then, if the health care organizations are provided with some financial incentives or imposed by mandatory requirement they are motivated (or forced) to make HIE adoption decision. With reference to the incentives or requirement of HITECH Act, a group of health care organizations become ready to devise plan for adoption. Therefore, organizational readiness makes them think of planning for adoption. This group of health care providers moves to the next step by resolving financial, organizational and legal challenges and devising plan for adoption HIE effort. Some institutions will be stuck in this process of organizational adoption and still struggling with the challenges and conducting a trade-off evaluation. They are more likely to stop the adoption efforts due to some unclear cost-benefit analysis. The other group of health care institutions which have passed the adoption analysis, move to the next stage where the original plan for adoption turns to practical HIE adoption when organizational adoption decision is made and it becomes the first milestone of this model. On this stage, they have acquired the HIE system but not yet implemented. After the final adoption decision, organizations also point out their plan for implementation of HIE. This implementation plan is a function of the degree to which they want to be engaged in health information exchange. Therefore, their might plan to whether be partially involved or fully engaged in the HIE effort with regional and unaffiliated providers or defer implementation process.

The health care providers which have adopted the HIE system are supposed to actually implement it in their organizational activities. In the implementation process, healthcare providers are facing and addressing concerns on actual usage and medical information exchange with others. Based on the original implementation plan, a group of involved organizations might choose not to exchange clinical information with other patient care providers (internal and external exchange) and defer implementation process. Another form of partially implemented HIE reflects the group which might use HIE to exchange health information with only regional institutions as internal exchange and see no advantage from external data exchange. Other types of health care providers will share selective clinical and patient-level data with some providers outside of their practice as external exchange. If health care providers are convinced that health information exchange with other providers (whether regional or unaffiliated) is useful, effective, practical and improves health care delivery, they will fully implement the HIE effort. On the last stage, health care providers consider HIE system as an integral part of patient care outcomes. According to the discussion, Figure2 depicts the proposed decision tree as follows:
Conclusion

Potential cost saving, quality improvements and patient care coordination as a result of HIE effort will come into play when medical providers share electronic patient data with other providers. Actual sharing of clinical and health information is reflected in the real use of HIE not simply in the capability and plan to share medical data. This study concludes that success of the HIE effort is a function of three variables as awareness, adoption and actual implementation. This research also reinforces that adoption decision is completely different from usage process and the factors affecting HIE adoption are not the same as those affecting implementation process. Although some health care providers have simply adopted the HIE effort, they might choose not to engage in information sharing with others or they might become less likely to share clinical and health information with some particular health care providers. Therefore, the adoption of HIE is necessary but is not enough for health care providers. The proposed decision tree indicates the potential stages taking place from awareness to implementation effort. Overall, five types of decisions can be possible to be made by health care institutes regarding adoption and implementation of HIE. The first type is no adoption and in turn no implementation of HIE effort. The second one is having an adoption plan but getting stuck in adoption process and cost-benefit analysis and in turn, no implementation is resulted. The third one is to make organizational adoption decision but having no actual implementation strategy and in turn, no actual usage. The fourth one is adopting HIE and choosing partially implementation. And the last type of decision is having a sound adoption plan and choosing fully implementation strategy.

The findings have theoretical implications for researcher working on HIE adoption and implementation to better describe the factors affecting these two processes separately. Since majority of hospitals are not actively engaged in the HIE system, stronger policies are required by policymakers to ensure health information exchange across health care settings both within local health area and with other providers outside of their practice. Forming alliance between health care providers and participating in larger networks will motivate them not to see medical records and health information as part of their property and to become more engaged in patient data exchange with others to gain collective benefits associated with HIE system.
References


