



INNOVATIVE PRACTICE PAPER

Health data standards and adoption process

Health data standards

Preliminary findings of a qualitative study in Saudi Arabia

345

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Abstract

Purpose – This paper seeks to carry out a critical study of health data standards and adoption process with a focus on Saudi Arabia.

Design/methodology/approach – Many developed nations have initiated programs to develop, promote, adopt and customise international health data standards to the local needs. The current status of, and future plans for, health data and related standards in developing countries are still questionable due to the absence of government actions, plans and related studies. However, the development of interoperable standards not only technically defines a method of interoperation between the different systems in a network but most importantly represents a proposal for the future of complex socio-technical systems that is the shape of a national health information network and therefore a complex balance between different types of requirements including organisational, social and managerial aspects must be managed. This reaffirms the need for a more in-depth study to evaluate the adoption of health information technology-related standards at the decision-making stage in developing countries. Based on diffusion of innovation theory and the theories surrounding the economics of standards, a case study method was applied in Saudi Arabia to study the adoption process of health data standards.

Findings – The preliminary analysis findings revealed that there are 18 factors influencing the decision-making adoption process of acquiring certain standards.

Research limitations/implications – Qualitative study methods have been employed in the present study that have shed light on the many issues that need to be addressed in this field. Studies involving other countries including advanced nations should be done for which the present results have economic, social and educational implications.

Practical implications – The present study and findings should help inform policy and decision makers in developing health systems with the potential creation of information and structure that can sustain future and improved systems.

Originality/value – This paper makes a novel contribution at both academic and practical levels since both the academics and practitioners, who are devoted to the ongoing use of health data standards, still lack a significant body of evidence with regard to the factors that influence their adoption.

Keywords Health data standards, Qualitative study, Health information technology, Adoption process, Saudi Arabia, Information exchange, Data handling

Paper type Research paper



1. Introduction

A rapid growth of investment and adoption of health information technology (HIT) applications in healthcare organisations worldwide can be seen today with the

promises that they will increase patient safety, reduce medical errors, improve efficiency and reduce medical costs. Since; however, healthcare system is a form of a complex system with many interrelated and independent components and agents (Plsek and Greenhalgh, 2001), HIT applications have been developed and deployed at different levels (Hakkinen *et al.*, 2003) and thus healthcare organisations are being left with the islands of HIT infrastructures which are difficult to integrate or manage (Khoubati and Themistocleous, 2006). This has resulted in potential limitations with regards to acquiring HIT applications adoption benefits and in particular reducing medical services costs (Chaudhry *et al.*, 2006). Therefore, HIT applications must be adopted in a way that different systems are interoperable with one another in order for healthcare organisations to realise such benefits (Park and Hardiker, 2009). This can be resolved by the implementation of consensus standards (Zhang *et al.*, 2007). The use of consensus standards is based on the idea of developing an agreed specifications or standards for data exchange that are not dependent on any proprietary IT applications and are universally understood and accepted for data exchange (Thomas, 2000).

Despite the fact that health data standards are expected to be a vital solution to medical data exchange (Zhang *et al.*, 2007; Berler *et al.*, 2006), the adoption of health data standards remains frustratingly low among healthcare IT vendors and organisations where do they exist (Hammond, 2005). Healthcare organisations considering in investing in standardisation cannot gain benefit directly and therefore prefer to invest in networks rather than in standardisation (Zhang *et al.*, 2007). This is because standardisation for health data is an authoritative field in which the market mechanism does not work (Zhang *et al.*, 2007). Therefore, standardisation for health data for every country must be launched by government and the funding and supporting from government are necessary (Zhang *et al.*, 2007). The role of the government in standardisation for health data is an important factor as to establish credible standards for the next decade, to maximise interoperability across the health sector and to decrease the risk associated with the implementation of non-standard applications (Hammond, 2005; Hovenga, 2008).

However, the development of interoperable standards not only technically defines a method of interoperation between the different systems in a network but most importantly represents a proposal for the future of complex socio-technical systems that is the shape national health information network (NHIN) (Williams *et al.*, 2004); and therefore, a complex balance between different types of requirements including organisational, social and managerial aspects must be managed (Mykkänen and Tuomainen, 2008). This has been also confirmed by a study (Brender *et al.*, 2006) which has advocated that standardisation aspects should be given special attention during the implementation of future national electronic health record (EHR) program which highlights the need of conducting such studies related to the soft site of health data standards such as the adoption process of health data standards in healthcare organisations. This has been also consistent with a study (Markus *et al.*, 2003) which has claimed that while technical content research into IT-related standards is well covered in engineering and computer science, there is still limited empirical research that addresses the issues relating to the development, the adoption and the outcome of IT-related standards.

In addition, Basole (2008) has stated that most enterprise adoption studies have primarily focused their efforts on established and already well-understood IT

applications and therefore little research has been conducted related to the adoption and implementation of healthcare IT applications or issues related to standardisation and data exchange. Moreover, Thomas (2000) has argued that the lack of published studies on the adoption of IT-related standards in information system (IS) field highlights the need for empirical studies concerning the adoption issues. This assertion is also further confirmed by Byrne and Golder (2002) who have explicitly stated that the literature surrounding IT-related standards adoption is limited and so there is a need for more empirical studies. The purpose of this paper is to investigate the adoption of HIT-related standards in Saudi Arabia and to identify the critical factors affecting the adoption process of HIT-related standards at the decision making stage. In doing so, the authors commence by presenting the current status of HIT applications in Saudi healthcare organisations in Section 2. Then, the authors give a background of health data standards in Section 3. Next, IT-related standards studies are presented in Section 4. Thereafter, the case study methodology is highlighted in Section 5 followed by the results in Section 6. The authors finish by concluding the main points raised by the research.

2. Current status of HIT in Saudi hospitals

Many countries have launched some initiatives and programs to foster the adoption of HIT-related standards. For example, Deutsch *et al.* (2010) have analysed national electronic health record programs of various countries including England, Germany, Canada, Denmark and Australia with regard to the most common critical aspects of national electronic health record programs documented therein. According to this study, the subject of standardisation for health data is regarded as the core tasks of any EHR program in most of those countries. However, the adoption of health data standards or HIT-related standards in the developing countries is still questionable due to the absence of government actions, plans and related studies. For example, Saudi Arabia is still lacking of the fundamental attributes that are required to set out NHIN as each part of the healthcare service provision is at a different stage in terms of the implementation of HIT applications (Altuwaijri, 2008). In addition, Al-Solbi and Mayhew (2005) have shown that Saudi healthcare sector is still lagging behind in terms of being ready for e-health and therefore there is a need for a clear e-health plan and an adequate budget. Further evidence comes from a study highlighting that the maturity of the Saudi e-health system is at level two, which means that there is a plan with limited implementations to adopt e-health. This study asserts that the Saudi e-health system should be at least at level three which means that a type of HER, telemedicine and teleconferencing services should be established with widespread use of HIT applications in hospitals and clinics (Qurban and Austria, 2008). Furthermore, Altuwaijri (2008) has stated that the movement toward e-health in Saudi Arabia is still very slow and therefore it is important that the government establishes a national e-health programme in order to realise some of the benefits introduced by HIT applications. Currently, the Saudi government has allocated a large amount of its annual budget to help the ministry of health in building its projects of HIT infrastructures. The Ministry of Finance would support the adoption of HIT project by allocating up to SR 4 billion (around USD 1.1 billion) over the next four years (Qurban and Austria, 2008). However, these projects will only widen the gap and increase the complexity of the interoperability between HIT applications since there are always

issues concerning conflict or overlapping of standards or the proprietary nature of some formats. Moreover, this contradicts the recommendations of Saudi e-Health Conference 2008 that emphasised on the importance of building a national e-Health strategy for the country, developing the specifications and standards for the HIT applications and EHR systems and building national registries for common diseases and epidemics (Altuwaijri, 2008).

3. Background to health data standards

HIT applications must be adopted based on interoperable standards in order for healthcare organisations to see the benefits introduced by these systems. Interoperability means that the communicated messages must be understandable by a computer at the receiving end of a communication (Hammond, 2005). This can be resolved by the implementation of consensus standards (Zhang *et al.*, 2007). The use of consensus standards is based on the idea of developing an agreed specifications or standards for data exchange that are not dependent on any proprietary IT applications and are universally understood and accepted for data-exchange (Thomas, 2000). According to Kim (2005), the creation of an interoperable healthcare system depends upon two important concepts: syntax and semantics. Syntax interoperability refers to the structure of the message content which is the equivalent of the rules for spelling and grammar that must be agreed and standardised in both the sending and receiving sites. In contrast, semantic interoperability conveys the meaning of the sent message, the equivalent of a dictionary and thesaurus. Without semantic interoperability, data can be exchanged but there is no assurance that it can be processed in a meaningful way at its destination (Kim, 2005). The available health data standards today address both types of interoperability. However, the literature has shown that there is no agreement among previous studies on a unified category of health data standards that enable interoperability. For examples, Spooner and Classen (2009) have listed three types of health data standards, namely, terminology standards, messaging standards and functional standards. Terminology standards ensure consistent definitions of terms by users. Messaging standards specify the communications between EHR and registries systems. Functional standards specify the rules to support decision making of correctly timed and properly administrative. Kim (2005) has come out with five types of health data standards including messaging standards (e.g. HL7 v2.x, DICOM), terminology standards (e.g. ICD v9 and v10, SNOMED, LONIC), document standards (e.g. CCR, CDA), conceptual standards (e.g. HL7 v3 RIM, EHRcom, OPENEHR), application standards (e.g. CCOW) and architecture standards (e.g. PHIN). Messaging standards allow transactions to flow consistently between systems by specifying format, data elements and structure. Terminology standards provide specific codes for clinical concepts such as diseases. Document standards indicate what type of information is included in a document and where it can be found. Conceptual standards allow data to be transported across systems without losing meaning and context. Application standards determine the way business rules are implemented and software systems interact. Architecture standards define the processes involved in data storage and distribution. Various health and related professional groups and public and private organisations have established different types of standard, each serving a particular healthcare information purpose. From an institutional perspective, four types of standard may be distinguished. Official standards are made obligatory

through regulation by governments (e.g. by law). Voluntary standards are developed by SDOs, normally on request from interested parties such as industry, but are not made mandatory by governments. For example, the European Committee for Standardisation (CEN) has the objective to develop voluntary technical standards. Industry standards are defined by one single company or group of companies and initially they are always proprietary: i.e., their specifications are not disclosed. Open standards are characterised by the circumstance that everybody can participate in development without being a member of a specific group or institution (Hammond, 2005).

4.0 Background to IT-related standards studies

According to West (2003), the IT-related standards research lies into four main areas. The first area is the technical content research, which typically focuses on the technical implications of a standard and aims to enable mainly technical readers to evaluate the standard for adoption or the construction of complementary software and products. The second area is IT standard creation research, which is subdivided into three main areas including the technical perspective, the economic perspective and the organisational perspective. The third area is standards adoption, which focuses on the adoption of standards, organisational decisions for standards adoption and the issues surrounding the competition between standards. The fourth area is the impact of standards, which assesses the economic value of the impact of standards and measures the effect that standards adoption has on measures such as efficiency, structure or collaboration. In the light of the adoption of IT-related standards, Thomas has stated that studies into the development and implementation of standards in general, and IT standards specifically, have been carried out from a variety of perspectives. However, Thomas has emphasised on that the application area relating to a business enterprise is the area that is relevant to the research of IT-related standards adoption. In this regards, two main streams of theories have been employed in previous researches, namely, the adoption theory and the economics of standards theory. While the adoption of an innovation theory perspective focuses on the characteristics of the innovation and the adopters, the economic perspective examines community effects and thus making both perspectives useful and providing a rich set of factors (Hovav *et al.*, 2004). In relation to adoption of innovation theory, Thomas has identified several theories from the business perspective that explain the mechanics of the adoption process. However, Thomas (2000) has argued that only the adoption of innovation (e.g. diffusion of innovation (DOI)) is the theory that is relevant and appropriate when looking at the adoption of IT-related standards at the decision-making stage from the business perspective. DOI theory; such as Roger's (1995) model, is well-grounded in theory and has proven its value in the IS literature such as in explaining individuals' behavioural intentions to adopt a technology or in providing managers with guidelines for designing intervention strategies to encourage IT adoption (Gallivan, 2001). However, the outcomes of applying DOI to IT adoption were sensitive to the fit between the assumptions underlying this theory and the specific features of the adoption context and the technology in question (Fichman, 1992). In other words, the application of this theory to complex adoption scenarios where the adoption decision is made at the organisational level and the technology adoption requires high levels of knowledge and coordination across multiple adopters, has produced mixed findings that show the greatest deviation from the expected results (Gallivan, 2001). Therefore,

researchers should consider abandoning such traditional adoption models or integrating them with new metaphors in order to build a theoretical model that fit these complex scenarios (Fichman, 1992).

This has resulted in a growing literature stream focusing on the adoption process at organisational level as a sequence of stages that should be studied in different contexts (Gallivan, 2001). These stages are valuable in describing how adoption process unfolds, with a focus on the time-ordering of events and identifying the events and conditions necessary for certain outcomes to occur (Shaw and Jarvenpaa, 1997). For examples, Darmawan has drawn a four phase conceptual model of innovation adoption process. These phases are initiation, adoption, implementation and evaluation phase. According to Darmawan, two levels of adoption are considered at organisational level including organisational level and individual level. Organisational level starts when an organisation begins to realise the need for strategic change and decides to incorporate IT. Individual level adoption begins the technology is implemented in the organisation and finishes when the technology is utilised. Darmawan (2001) has also identified and captured a variety of factors that may influence the technology adoption in an organisation. These include technological, institutional, personal, social and economic factors. Another stream of research has been emerged to focus on different contexts of factors in the innovation adoption process in organisations since the classical innovation attributes alone are not likely to be strong predictors of organisational technology adoption (Fichman, 1992). Hu *et al.* (2002) have suggested that the technological context, although important, may not sufficiently explain or predict technology adoption at the organisational level and therefore several additional contexts must be considered. In addition, Gallivan (2001) has argued that the theoretical adoption model should also capture longitudinal data on all three aspects including people, technology and organisation since there is always an assumption that people's innovative behaviour changes over time depending on the interactions of these aspects.

Another stream of theory is the economics of standards. The adoption of IT standards research based on the economics of standards focuses mainly on an innovation's inherent economic value for potential adopters (Thomas, 2000; Hovav *et al.*, 2004). Two main theories have been used within the economic stream research. The first theory is a network effect, which is often based on the theory of positive network effects, or network externalities. This theory describes a positive correlation between the number of users of an artefact and the utility of the artefact. According to Hovav *et al.* (2004), network externalities are predicated on the belief that the benefits of adopting an innovation will grow with the size of the community of adopters. Hovav *et al.* (2004) have identified several concepts related to the existence of network externalities that improve the attractiveness of an innovation for adoption by a community of potential adopters. First, economies of scale may emerge when costs decrease as volume increases. Second, the number of adopters increases when the accumulated experience of using the technology grows, which is referred to as "learning by using". Third, the development of a related technology infrastructure where the increased demand and market size spurs competition creates a large base of compatible products. The second theory concerns the switching costs, which refers to a standard-specific investment that makes organisations hesitant to change to a supported standard even if that standard is considered to be superior on the basis of objective criteria (Hovav *et al.*, 2004). There are several reasons behind this issue. The

first reason is that adopters may be unwilling to bear the transient incompatibility cost that they may incur from the delay in the innovation attaining sufficient network externalities. The second issue is that adopters may also be unwilling to bear the risk of being locked into the innovation before it reaches a critical mass. The third reason is that the presence of a large installed base of existing technology may lead to the existence of sunk costs, which may affect negatively the adoption of an innovation. Nonetheless, the literature has discussed several ways that might increase the adoption rate of an innovation by a community of potential adopters from the economics perspective such as communication channels, general industry knowledge and the external environment (Hovav *et al.*, 2004).

5. Case data

To investigate the factors influencing the adoption process of HIT-related standards at the decision-making stage, a case study was undertaken in Saudi Arabia. The empirical data presented here were collected using a variety of data collection methods such as unstructured interview, semi-interviews and documentation. Through data triangulation, the authors can overcome the bias that is considered to be a danger in a qualitative research (Ryan and Bernard, 2000). Eight senior managers were interviewed. Once the qualitative data was gathered, thematic analysis was applied to offer a flexible and useful research instrument which can potentially provide a rich and detailed, yet complex, account of data through its theoretical or epistemological freedom (Braun and Clarke, 2006). The studied healthcare organisation is National Guard Health Affairs (NGHA). NGHA aims at providing highest quality healthcare to patients who include Saudi Arabian National Guard (SANG) personnel, their dependants and other eligible patients. NGHA consists of six hospitals with approximately 2,700 beds located in different regions of the kingdom and more than 60 clinics distributed throughout of the kingdom of Saudi Arabia cities. Because of the excellence and expertise of NGHA in medical services, NGHA has been accredited by several and different types of national, regional and international institutions and commissions. NGHA provides also excellent academic opportunities, conducts research and medical education and participates in industry and community service programs in the health field. In the light of NGHA health information technology infrastructure, an action was taken in 2001 to replace all the incompatible and heterogeneous applications with a complete integrated hospital information system (HIS). In 2002, the system was adopted to become the heart of NGHA HIT infrastructure into which all other different systems must integrate. The HIS is HL7v2.3 complaint and so every new adopted system must be conformed to HL7 v2.3 in order to integrate into the HIS. In addition, NGHA implemented a corporate middleware integration solution engine that is HL7 v2.3 complaint to integrate the different separate systems into HIS and to minimise as far as possible the point-to-point integration links. With regards to health data standards, NGHA has adopted four international standards including HL7 v2.3, DICOM 3.0, ICD-10 Australian Modification (AM) and SNOMED.

6. Preliminary findings

Through the thematic analysis that has been conducted to analysis the qualitative data, the authors have identified 18 factors which have an impact at the decision

making stage on the adoption process of HIT-related standards. These factors are as follows:

Network externalities. The interviewees explained some communication channels which increase their industry knowledge regarding health data standard and understanding of some aspects of health data standards benefits, barriers, cost, applications, implementation. These network effects are consultants, conferences, vendors, site visits to some leading international hospitals, memberships and the internet. For example the manager of medical applications stated: "We think that being with a consultant regarding medical terminology will have a good impact on NGHA clinical information systems. From future point of view, we think to be with a consultant and set a plan for health data standards in regards medical terminology. One of the objectives to have a consultation with Harvard is to identify the direct and indirect cost associated with the standards."

External pressure. The authors have identified through the collected data that there is an external pressure from some government bodies on NGHA to adopt certain standards such as ICD-10 Australian Modification (AM) on behalf of for example Ministry of Health (MOH) and Saudi Council of Cooperative Health Insurance. In addition, NGHA must report some statistics of certain cases and diseases to other government bodies such as Saudi Oncology Centre and so NGHA has to be based on certain terminology standards in order to report those cases. For example, the pressure of the government on the healthcare organisations is verified by the executive director of information systems who said: "We used to have ICD-9 up to the end of 2008 and then at the beginning of 2009 we converted to ICD-10 AM according to the royal decree."

Integration. The collected data revealed that the ambitious of NGHA is to go further beyond the transformation of patient demographic information between different systems and to have a rigid integration infrastructure that is more interoperable and constructive and therefore while clinical information systems have to be HL7 v2.3 compliant, any imagery system must be conformed to DICOM v3.0 in order to enhance the work process flow between the systems and further across the hospitals with the executive director of information systems and informatics reported: "The ultimate goal in NGHA is to uniform the messages across the systems and even more complicated across the regions and hospitals through the integration engine that will provide us with total ownership solutions and easy integration between the solutions."

Data analysis. The data exposed that having structured and standardised data format will help the management in acquiring meaning insights from the data through accurate statistical treatment and therefore facilitating decision support system, reports, research, education and benchmarking with the associated executive director of enterprise application stated: "The management will be asking about the analysis of information stored on the system and when they find the analysis not presenting well or it is very hard to dig information from the collected data and this because we are not following certain standards then people have their motivation to adopt standards."

Accreditation. The data revealed that certain standards were adopted as one the requirements that NGHHA must meet in order to be accredited by some local, regional or international commissions. For example, the IT project manager stated: "Every department works closely with a consultant to be accredited. Currently, we have Joint Commission International (JCI) organisation and they have established standards and we are following those standards of JCI and they come regularly to the hospital to give the accreditation and certification."

Standards benefits. The interviewees listed many benefits of adhering to standards such as normalises the communications and data exchange between the systems; eases the replacement of the old systems with new ones or the upgrade to new versions; decreases the customisations needed by vendors and thus enhancing vendors support; facilitates changing and hiring staff; helps in capturing the right information while increasing the data accuracy, consistency, quality and ownership of the data; and increases work productivity, efficiency and safety and therefore enhancing the patients satisfaction which is the ultimate goal of the hospital.

Organisation characteristics. Throughout the data, the authors have identified seven characteristics which play major role in the adoption of HIT-related standards. These are organisation size (i.e. number of beds, employees and regional hospitals), organisation type (i.e. tertiary, medical university, research centre) organisation structure (i.e. regional or corporate structure), organisation culture (i.e. high employee turnover rate, 65 nationalities), organisation complexity (i.e. many interrelated and independent components and agents), the degree of politics in the organisation (i.e. lack of coordination and cooperation between the departments) and the degree of bureaucracy in the organisation (i.e. the application of the government tenders systems regarding clinical information systems purchasing).

Policy and procedure. The interviewees showed the importance of having clear policy and procedure with regards to the adoption of any new system. In the light of NGHHA, the interviewees explained that the hospital policy and procedure is based on a project management model standard such as Project Management Institute (PMI) standard. Thus, every purchasing decision must come through the steering committee which chaired by the hospital CEO and include a member from IT, planning, operation, medical services, and contract departments and the IT member will be the deputy of this committee as this will help and support system specifications gathering. The policy and procedure also stressed that the requested department of the new system must be a member of the steering committee to enhance the success of the new project. Once the new system is approved by the steering committee, several other subcommittees will be established to gather all the project needs, requirements and specifications and thereafter to draft the final project request for proposal (RFP). The collected data revealed that the RFP specifications have an impact on the quality of the clinical information system project in general and health data standards in particular. The interviewees exposed also the importance of the contract which must be conformed to the project RFP since there is an issue of missing some features and specifications. Due to the confusion surrounding clinical information systems

market today, the interviewees also stated that the role of the hospital policy and procedure is to support the best of breed solutions or best practices solutions although they are expensive comparing to other solutions but they have the advantage over others since they are built based on standardised way and so their costs are justified.

Organisation readiness. It is the organisation's capacity to manage the different activities and aspects required to the adoption of HIT-related standards. In this regards, the authors have identified throughout the data four essential issues influencing the adoption of health data standards in healthcare organisations. These are the availability of experts, resources availability and allocation, IT department structure and HIT infrastructure. The interviewees highlighted the importance of availability of experts of several considerations such as the newest of the area of health informatics and in particular health data standards to Saudi environment and the difficulty of the subject. The resources availability and allocation is a key attribute to the organisation readiness whereas there is need for the organisation to allocate the adequate budget and launch out the required resources such as education programs, training sessions, consultation, awareness camping, memberships, technical support. The IT department must be restructured to comprise a team with mixed different backgrounds people such IT, health informatics and clinical background since clinical information systems area is a multi-disciplinary field required people from different backgrounds. The data also exposed that there is a concern with the current HIT infrastructure and so the new system must be compatible with the available infrastructure and the current infrastructure must be capable and ready to comprise the new system.

Clinician engagement. The engagement of clinical people in the adoption process is an important factor to increase their awareness of the new system since they are the user of clinical information systems and therefore their commitment of using certain standards in the daily basis is essential with the executive director of information systems and informatics stated: "Clinical engagement and clinical champion are the key success factor for every system adoption."

Standards cost. The interviewees mentioned two main costs associated with the adoption of health data standards including the direct and indirect cost. The direct cost refers to any cost that can be traced and quantified throughout the different activities launched during the adoption process such as education, training, licence, awareness camping, conferences, memberships, consultations, maintenance, vendor supports. The indirect cost refers to the cost that cannot be conveniently traced or quantified such as business process reengineering, organisational restructuring and paying off people because they are in the training sessions.

External support. The collected data exposed that the external support is a necessary part when there is a need of activating certain standards in the daily routine. The support from the vendors or consultants is required since health data standards are a form of complex subject and so healthcare organisations seek to find out some solutions, advices and supports from the external parties with the associated executive director of enterprise application reported: "We

need also assistance to work with us in mapping because we can't do it through the individual efforts and therefore we need somebody to help us in mapping the proprietary dictionary of terminology codes to the international recognised standards.”

Standards characteristics. Several standards characteristics have been identified throughout the data which should be released and taken into consideration in the adoption process in order for hospital to facilitate their implementation in the daily basis. These characteristics are international (industry) standards, standards complexity and standards compatibility. The standard must be internationally (industry) accepted in order to be supported by other different clinical information systems and therefore any IT proprietary format application is rejected. Terminology standards are from of a complex subject requiring a lot of orientations by hospitals and therefore this might has a negative impact on the adoption of these standards. In addition, international terminology standards are comprehensive and therefore hospitals should concentrate only on those parts that meet the hospital local needs and exceptions. The standards must be also compatible with the country regulation, organisations' work and HIT infrastructure in order to accepted and adopted.

Information. Healthcare organisations rely on the information to pursue their visions in making healthcare services more sustainable. While adopting health data standards will bring the hospitals more closely to their visions, there are some concerns with the current information infrastructure and the mapping processes to certain health data standards. The historical data must be retained sufficiently at the transformation period since there is an issue of conflict and overlapping between the data. The manager of medical applications said: “There is much concern with the information infrastructure and mapping issues. For example, how we are going to deal with the historical data and map the data to the new system. This is a part of the consultation objective to help us to restructure the current and historical data.”

The immaturity of health data standards industry. The interviewees showed that there is confusion surrounding health data standards. Every vendor has its own customised standard version although the vendors advocate that their systems are conformed to the required standards and therefore there is always a need by healthcare organisations to work around the solutions and in particular in the integration part. The respondents emphasised that health data standards is just one of tools to facilitate the structuring of data and data exchange between the system but not to provide a comprehensive workflow exchange between the systems which is the ultimate goal with the associated executive director of enterprise application reported: “Although everybody is talking about standards, when we come to the reality there are lots of variation between the same versions of the standards. Every standard is customised based on proprietary format.”

Shortage of national knowledgeable experts. The data revealed that there is a shortage of national knowledgeable experts and this why the improvement and development in health informatics and in particular health data standards is still lag behind in Saudi Arabia with the manager of medical application reported: “I think the lack of expertise is the biggest barrier in Saudi Arabia. I think the

reason of the lack of national health data standards regulator in the country is due the fact that there is no expertise in the country.”

Lack of national plan for HIT applications and NHIN. The improvement of clinical information systems requires among other things the existence of national plan to drive the development of this area and so to maximise the successful factors and benefits. When this comes, hospitals authorities will release the importance of having structured data warehouse to facilitate the business processes workflow between different systems and further between different hospitals and so this will lead the authorities to acknowledge health data standards roles and having the systems based on standards. Nevertheless, the collected data exposed that there is a lack of national plan regarding health information technology in Saudi Arabia and moreover the establishment of Saudi NHIN which leads hospitals not adhering to certain standards whilst waiting to the situation to resolve with the manger of medical applications reported: “There is no national strategic plan for medical information systems because when we release the importance of IT in healthcare we will release the importance of health data standards [. . .] If the adoption of the standards is very expensive and should be allocated high portion from the IT annual budget, why we need to adopt health data standards and we are not exchanging data with others. There is no progress in the development of health data standards in Saudi Arabia or in the region because there is no data exchange between related healthcare organisations except within the organisation itself.”

Lack of recognised body. The lack of recognised body results in confusion between healthcare communities and who the reference of and health data standards regulator is in the country. The data showed that every commission speaks about health data standard but there is no official body which leads the development and promotion of health data standards. The respondents confirmed the importance of formal reference for health data standards. In addition, the formal reference body should get involved in the existing international standardisation initiatives rather than focusing its resources on developing its own standards and then customises the international standards to the local needs and exceptions. The executive director of information systems and informatics said: “Because there is no governmental decision about what standards should be adopted by the hospitals, we are still lacking unified standards.”

7. Conclusion

Despite that health data standards are expected to be a vital solution to integration and medical data exchange, the adoption of health data standards remains frustratingly low among healthcare organisations. This reaffirms the need for a more in-depth study to evaluate the adoption of HIT-related standards. Based on the adoption theories of IT-related standards, a case study was conducted in Saudi Arabia to study the critical factors influencing the adoption process of HIT-related standards at the decision stage. Through the thematic analysis of the qualitative data, the authors have identified 18 factors which have a direct impact at the decision making stage on the adoption process of HIT-related standards. The findings of this study will provide the decision-makers in Saudi healthcare organisations with a better understanding of the

adoption process of health data standards in order to design an appropriate strategy for integrating them and so tackling any future barrier associated with the adoption process. It will also provide the academics who are devoted to the ongoing use of health data standards with significant body of empirical evidences with regard to the factors that influence their adoption since the literature is still lacking of empirical research into the factors that impact the adoption of HIT-related standards and in particular within the Saudi healthcare context. More case studies are required to examine to what extent these factors contribute to the decision-making adoption process and this is an area for future research.

References

- Al-Solbi, A. and Mayhew, P. (2005), "Measuring e-readiness assessment in Saudi organisations preliminary results from a survey study", *Proceedings of the 1st European Conference on Mobile Government, University of Sussex, UK, 2005, July 10-12*, pp. 467-74.
- Altuwaijri, M. (2008), "Electronic-health in Saudi Arabia – just around the corner", *Saudi Medical Journal*, Vol. 29 No. 2, pp. 171-8.
- Basole, R. (2008), "Enterprise adoption of ICT innovations: multi-disciplinary literature analysis and future research opportunities", *Proceedings of the 41st Annual Hawaii International Conference on System Sciences*, IEEE Computer Society, Washington, DC.
- Berler, A., Tagaris, A., Angelidis, P. and Koutsouris, D.A. (2006), "roadmap towards healthcare information systems interoperability in Greece", *Journal of Telecommunications and Information Technology*, Vol. 2, pp. 59-73.
- Braun, V. and Clarke, V. (2006), "Using thematic analysis in psychology", *Qualitative Research in Psychology*, Vol. 3, pp. 77-101.
- Brender, J., Ammenwerth, E., Nykänen, P. and Talmon, J. (2006), "Factors influencing success and failure of health informatics systems", *Methods Inf. Med.*, Vol. 1, pp. 125-36.
- Byrne, B. and Golder, P. (2002), "The diffusion of anticipatory standards with particular reference to the ISO/IEC information resource dictionary system framework standard", *Computer Standards & Interfaces*, Vol. 24 No. 5, pp. 369-79.
- Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S. and Shekelle, P. (2006), "Systematic review: impact of health information technology on quality, efficiency, and costs of medical care", *Annals of Internal Medicine*, Vol. 144 No. 10, pp. 12-22.
- Darmawan, I. (2001), "Adoption and implementation of information technology in Bali's local government: a comparison between single level path analyses using PLSATH 3.01 and AMOS 4 and multilevel path analyses using MPLUS 2.01", *International Education Journal*, Vol. 2 No. 4, pp. 100-23.
- Deutsch, E., Duftschmid, G. and Dordaa, W. (2010), "Critical areas of national electronic health record programs: is our focus correct?", *International Journal of Medical Informatics*, Vol. 79 No. 3, pp. 211-22.
- Fichman, R. (1992), "Information technology diffusion: a review of empirical research", *Proceeding of the 13th International Conference on Information Systems, Society for Information Management*, pp. 195-206.
- Gallivan, M. (2001), "Organisational adoption and assimilation of complex technological innovations: development and application of a new framework", *The Data Base for Advances in Information Systems*, Vol. 32 No. 3, pp. 51-85.

- Hakkinen, H., Turunen, P. and Spil, T. (2003), *Proceedings of the 36th Annual Hawaii International Conference on System Sciences 2003*, Information in health care process – evaluation toolkit development.
- Hammond, W. (2005), “The making and adoption of health data standards”, *Health Affairs*, Vol. 24 No. 5, pp. 1205-13.
- Hovav, A., Patnayakuni, R. and Schuff, D. (2004), “A model of internet standards adoption: the case of IPv6”, *Information Systems Journal*, Vol. 14 No. 3, pp. 265-94.
- Hovenga, E. (2008), “Importance of achieving semantic interoperability for national health information systems”, *Texto & Contexto-Enfermagem*, Vol. 17 No. 1, pp. 158-67.
- Hu, P., Chau, P. and Sheng, O. (2002), “Adoption of telemedicine technology by health care organisations: an exploratory study”, *Journal of Organisational Computing and Electronic Commerce*, Vol. 12 No. 3, pp. 197-221.
- Khoumbati, K. and Themistocleous, M. (2006), “Integrating the IT infrastructures in healthcare organisations: a proposition of influential factors”, *Electronic Journal of E-government*, Vol. 4 No. 1, pp. 27-36.
- Kim, K. (2005), “Clinical data standards in health care: five case studies”, available at: www.kathykim.com/sitebuildercontent/sitebuilderfiles/ClinicalDataStandardsInHealthCare.pdf (accessed 10 June 2009).
- Markus, M., Steinfield, C. and Wigand, R. (2003), “The evolution of vertical IS standards: electronic interchange standards in the US home mortgage industry”, *Proceedings of the MISQ Special Issue Workshop on Standards Making: A Critical Research Frontier for Information Systems 2003*, pp. 80-91.
- Mykkänen, J. and Tuomainen, M. (2008), “An evaluation and selection framework for interoperability standards”, *Information and Software Technology*, Vol. 50 No. 3, pp. 176-97.
- Park, H. and Hardiker, N. (2009), “Clinical terminologies: a solution for semantic interoperability”, *Journal of Korean Society of Medical Informatics*, Vol. 15 No. 1, pp. 1-11.
- Plsek, P. and Greenhalgh, T. (2001), “Complexity science: the challenge of complexity in health care”, *British Medical Journal (BMJ)*, Vol. 323, pp. 625-8.
- Qurban, M. and Austria, R. (2008), “Public perception on e-health services: implications of preliminary findings of KFMMC for military hospitals in KSA”, *Proceedings of the European and Mediterranean Conference on Information Systems 2008, Dubai, May 25-26*.
- Rogers, E. (1995), *Diffusion of Innovations*, 4th ed., The Free Press, New York, NY.
- Ryan, G. and Bernard, H. (2000), “Data management and analysis methods”, in Denzin, N.K. and Lincoln, Y.S. (Eds), *Handbook of Qualitative Research*, 2nd ed., Sage, Thousand Oaks, CA, pp. 769-802.
- Shaw, T. and Jarvenpaa, S. (1997), “Process models in information systems”, *Information Systems and Qualitative Research: Proceeding of the IFIP TC8 WG 8.2 International Conference on Information Systems and Qualitative Research 1997, May 31-June 3*, pp. 70-100.
- Spooner, S. and Classen, D. (2009), “Data standards and improvement of quality and safety in child health care”, *Pediatrics*, Vol. 123, Supplement, pp. 74-9.
- Thomas, J. (2000), *The Adoption and Diffusion of Data-exchange Standards*, Department of Information Science, Loughborough University, Loughborough.
- West, J. (2003), “The role of standards in the creation and use of information systems”, *Proceedings of the MISQ Special Issue Workshop on Standard Making: A Critical Frontier for Information Systems, December 12-14*, pp. 314-25.

Williams, R., Bunduchi, M., Graham, I., Pollock, R., Procter, R. and Voss, A. (2004), "Understanding the evolution of standards: alignment and reconfiguration in standards development and implementation arenas", *Proceedings of the 4S/EASST Conference 2004, Paris, August 27-29*, pp. 27-9.

Zhang, Y., Xu, Y., Shang, L. and Rao, K. (2007), "An investigation into health informatics and related standards in China", *International Journal of Medical Informatics*, Vol. 76 No. 8, pp. 614-20.

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