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Healthcare Information Technology (HIT) in Saudi Arabia health care systems: An overview

Keywords: Health Information Technology, Impact Assessment, Saudi Arabia

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Abstract

In the last decade, healthcare in Saudi Arabia has been significantly improving. This has been accompanied by advancements within the field of Information and Communications Technology (ICT), more specifically Health Information Technology (HIT), whose applications in health have been a necessity for hospitals to achieve objectives such as enhancing of healthcare and reducing the time and the cost of healthcare delivery. This paper focuses on a number of research questions. These are:

- What is the current status of healthcare in Saudi organizations?
- What is the current status of ICT and HIT in Saudi healthcare organizations?
- What are the critical factors influencing the adoption process of HIT in Saudi healthcare organizations?
- What are the factors that influence organizational (technology) of HIT?

Research

This research forms the introduction to a work program being developed in the objective analysis of the impact of HIT. The initial research work is focused on the development of metrics that can be used to assess the impact in terms of both economic and social measures of technology within a health care environment. This initial paper focuses on the development of HIT and in particular focusing on a context within one country, that of the Kingdom of Saudi Arabia.

The initial work objectives are

1. To conduct a comprehensive literature review related to health data standards and Saudi healthcare systems.
2. To review the existing adoption models and consider how these models could be extended or modified to reflect the adoption process of HIT related standards at the decision-making stage.
3. To develop a theoretical model, based on the models identified in Objective 2, of the critical factors influencing the adoption of HIT - related standards in healthcare organizations at the decision-making stage.
4. To identify the current health data standards adopted in Saudi healthcare organizations.
5. To assess how the current health data standards in Saudi healthcare organizations are adopted and are being supported.
6. To examine the roles of the current health data standards adopted in Saudi healthcare organizations.

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Globally, healthcare costs are rising every year faster than inflation and faster than most countries can afford. The greatest threat to governments and citizens in delivering sustainable health services is the burgeoning impact of chronic or non-communicable diseases which threaten to overwhelm most developed and developing nations. The growing socio economic divide between rich and poor is further exacerbating the problem. The World Economic Forum recognized recently in Davos that this growing problem requires new ways of thinking and new ways of working.

Technology is a general term that refers to the use and knowledge of tools and skills, and the implementation of these skills which there by affects our ability to control and adjust to social and physical environments (Banta, 2009). Banta, Kazem and Robert contend that technology itself originates from the Greek word techne, meaning 'every art', i.e (Chaharbaghi and Willis, 2000). the ability to perfect what seems imperfect in nature. However, in 1978, both Daft and Macintosh (1977) defined technology as "the basic task of the organization, subunit technologies, and the tools and techniques associated with individual job technologie, It also could be work-flow or the tools, equipment, and work related tasks within an organization, used to frame form inputs into outputs" (Daft and Macintosh, 1977).

Viewed differently, Orlikowski (1992) defined technology as 'hardware', that is the equipment, machines, and instruments that humans use in productive activity, both industrial and informational.

However, technology is not only "hardware" but also 'software'. According to Epp (2001), software is the instruction executed by a computer, as opposed to the physical device on which such software runs. In other words, software is a general term for the various kinds of programs used to operate computers and related hardware devices.

The concept of IT refers to both hardware and software computer systems across all forms of application, information, and systems of work. IT includes general information, human knowledge, equipment, as well as systems to process information.

According to Daft and Macintosh, IT is "the use of hardware and software in an effort to manage and manipulate data and information consists of devices that input process, an output data, and information" (Daft and Macintosh, 1977). In information technology theory, both Aksoy and Denardis (2007) describe IT as system of hardware and/or software that processes, exchanges, stores, and/or presents information, using electrical, magnetic, and/or electrometric energy (Aksoy and DeNardis, 2007). In summary, IT combines two elements: information, and technology. The information component comes from data and text separated or combined together in order to give meaning and or help explain life phenomena, while technology refers to the equipment, tools, and systems of work. When these are combined in a systematic manner, they become known as IT.

Information and communication technology (ICT) is defined by Razani (2012) as an umbrella term that includes any communication device or application such as radio, television, cellular phone, computers, network hardware and software, and satellite systems, as well as various services and applications associated with these devices. According to the Word Bank Group in April 2002, ICT is defined as the technology that consists of the hardware, software, networks, and media for collection, storage, processing, transmission, and presentation of various forms of voice, data, text, or image information (Trade and Development, 2003)

HIT has been defined in many ways. It has been described as a method of managing health information, as a mechanism to improve patient care, or as a process that enables patient care coordination. According to Ciampa and Revels (2013), HIT is defined as "the use of hardware

and software in an effort to manage and manipulate health data and information" (Ciampa and Revels, 2013).

Davis and Lacour defined HIT as "the specialty in the field of health information management that focus on the day-to-day activities of health information management that support collection, storage, retrieval, and reporting of health information" (Davis and LaCour, 2014)

In utilising HIT systems, it is critical that a standardized approach is used. One such method has been developed for medical devices in the form of technology assessment. Technology assessment arose in the mid-1960's as a result of the critical role that technology plays in modern society, and its potential for unintended and sometimes harmful consequences. Health technology assessment considers the effectiveness, appropriateness and cost of technologies.

There are several advantages of HIT for healthcare. According to Ciampa and Revels (2013), the cost of healthcare has been dramatically increasing. They state that using HIT can improve healthcare provision and reduce cost. For example, the use of Electronic Medical Records (EMR) can eliminate the use of transcription, reducing the need to physically retrieve patients' charts or files, reminding prescribers less costly, and reducing the number of duplicated diagnostic tests (Ciampa and Revels, 2013). Similarity, both Behkami and Daim (2012) agreed that EMRs reduce health care costs and also improve health care quality, prevent medical errors, increase administrative efficiencies, decrease paperwork, and expand access to affordable care. An important benefit of using HIT also lies in the early detection of infectious disease outbreaks throughout a region, improving the tracking of chronic disease management, and providing evaluation of healthcare based on anonymous price and quality information that can be compared across facilities (Behkami and Daim, 2012).

In addition, Aldosari (2014) proposes that HIT has a positive impact on healthcare outcomes such as the efficiency and effectiveness of care, a reduction in error rates, and the reduction of healthcare costs. Therefore, the importance of EHR systems to provide better management of healthcare and resulted in increased research interest in relation to the rates and levels of adoption of these systems, and of the determinants of differential adoption rates. A literature review by Buntin et al. (2011) indicates that HIT provides benefits in the form of lower costs, better quality of care, and improved patient outcomes. This review of recent literature on the effects of HIT is interesting, as it indicates that the expansion of HIT in the healthcare system is worthwhile.

Patient electronic health records (EHR) are a central component of the HIT infrastructure. An EHR is an individual's official, digital health record, and can be shared across multiple facilities and agencies. Other essential elements of HIT infrastructure include: the Electronic Medical Record (EMR), which is an individual's health record within a specific healthcare facility; the Personal Health Record (PHR), which is an individual's self-maintained health record; and the Regional Health Information Organization (RHIO), which oversees communications among all other elements and geographically unifies them.

Healthcare systems often involve a variety of definitions and applications in academic literature, with a range of terms often used. A study by Furukawa et al. (2008) classified applications for prescribing in healthcare to include Electronic Medical Records (EMR) and Computerized Physician Order Entry (CPOE). In addition, further studies mentioned other applications such as Personal Health Records (PHRs), E-prescribing, Electronic Dental Records (EDR), and Electronic Patient Records (EPRs). It is important to mention that while these terms might be used interchangeably, there are slight differences between each system. The primary applications using these term in HIT will be discussed below.

Research by Horowitz et al. (2008) described Electronic Medical Records (EMRs) as "an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization" (Horowitz et al., 2008). In addition, EMRs have advantages over paper records. For instance, EMRs allow clinicians to track data over time, easily identify which patients are due for preventive screenings, check how their patients are doing on certain parameters such as blood pressure readings or vaccinations, and monitor and improve the overall quality of care within the practice (Seidman and oshua, 2011).

In contrast, Electronic Health Records (EHRs) are "an electronic record of health-related information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one healthcare organization" (Horowitz et al., 2008).

According to Kaelber et al. (2008), one of the key challenges in delineating a PHR research agenda is the absence of a consistent description of what a PHR entails. They define PHRs as "a set of computer-based tools that allow people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it" (Kaelber et al., 2008). They also noted that their definition is just one of many PHR descriptions, that such definitions are evolving, and that the future for PHR definition remains unknown.

Additionally, PHRs allow individual patients to collect, view, manage, or share their health information electronically. A wide variety of PHR products exist, ranging from online resources available to the general public to those available to patients using a specific clinic or healthcare system. PHRs let patients track medical and dental treatments and progress. Furthermore, patients can use such portals to renew prescriptions, receive reminders and health education messages, and schedule appointments. While these systems continue to evolve, at present only dental notes and not laboratory results and x-rays are available (Kaelber et al., 2008).

An international review by the Centre of Medicare and Medicaid Services in the United States defines e-prescribing as "the transmission, using electronic media, of prescription or prescription-related information between a prescriber, dispenser, pharmacy benefit manager, or health plan, either directly or through an intermediary, including an e-prescribing network. E-prescribing includes, but is not limited to, two-way transmissions between the point of care and the dispenser" (Care, 2012). Medication orders to be received and processed electronically thereby completely eliminate the use of paper in the processing of prescriptions in pharmacies (Odukoya and Chui, 2013). E-prescribing can achieve the following: reduce medical errors, decrease pharmacy costs, improve both prescriber and pharmacy efficiency, eliminate handwriting interpretation errors, reduce phone calls between pharmacists and physicians, reduce data entry, and expedite prescription refill requests. The use of e-prescribing systems has led to an increase in the number of e-prescriptions being processed by pharmacies (Odukoya and Chui, 2013).

Furthermore, medication errors caused by illegible handwritten prescriptions in pharmacies are being reduced. E-prescriptions are generated within e-prescribing systems, and are electronically transmitted to pharmacies via a secure network between prescribers and pharmacies. E-prescribing involves the direct computer-to-computer transmission of prescriptions from physician offices to community pharmacies (Moniz et al., 2011). It is clear that e-prescribing allows clinicians and patients to use electronic systems to submit, transfer, and order prescriptions. A provider can enter prescription information into these electronic systems from their home or office computer, which will then be submitted to the pharmacy for dispensing and made available to the patient.

Studies by Khanna and Yen (2014) suggested that the concept of CPOE has evolved over time, but that in practice, the meaning of CPOE has changed very little. In 2003, researchers in Harvard defined CPOE as "a variety of computer-based systems that share the common features of automating the medication ordering process and that ensure standardized, legible, and complete orders" (Kaushal et al., 2003). In 2010, the Center for Medicare and Medicaid Services (CMS) defined CPOE as "the provider's use of computer assistance to directly enter medication orders from a computer or mobile device. The order is also documented or captured in a digital, structured, and computable format for use in improving safety and organization". Both definitions agree on the role of the physician, who enters orders directly through a digital interface, and on the general standardization/structure of such systems.

In reviews by Leapfrog Group (2007), CPOE systems are electronic prescribing systems that intercept errors when they most commonly occur at the time medications are ordered. With CPOE, physicians enter orders into a computer rather than on paper. Orders are integrated with patient information, including laboratory and prescription data. The order is then automatically checked for potential errors or problems.

Specific benefits of CPOE include prompts that warn against the possibility of drug interaction, potential allergies or overdoses, accurate, current information on new drugs introduced into the market, drug-specific information that eliminates confusion among drug names that sound alike, improved communication between physicians and pharmacists, and reduced healthcare costs due to improved efficiencies.

The purpose of the following review, relating to the diffusion of innovation theory, is to describe the field of technology use in healthcare organisations. The following section also aims to present a detailed literature review on Rogers (2010) Theory of Diffusion of Innovation. This is a process of new adoption amongst people in an organisation or group in order to achieve goals and maintain a significant position in society or within an organisation.

Rogers explained the diffusion of innovation theory as an adoption model that comprises of innovation, communication networks, phases/time periods, and social structures as the four fundamental mechanisms in the diffusion of innovations. Rogers' theory is highly applicable when examining the adoption of technology in many different settings, industries and organizations. Moreover, much diffusion research includes technological innovations so Rogers frequently used the term 'technology' and "innovation" interchangeably. Theories of innovation in industry have stemmed primarily from the efforts of economist Joseph A. Schumpeter. He observed innovation as notably different from invention, which he suggested arose from the segregation of innovations, and which might be better combined with innovation. Schumpter further discussed innovation as categorised by the creation of new plants and equipment, the development of new businesses, and the growth of leadership among new generations. From this viewpoint, innovation is considered as an irregular occurrence (Fitzgerald et al., 2002).

It is only in recent years that social scientists have given more consideration to the concept of innovation, with a noticeable focus on creativity and specifically, how the creative process takes place. A study by Mustonen Ollila and Lyytinen (2003) and Barnett (1942) indicated that innovation is the foundation of social and cultural change, and describes innovation as "any thought, behaviour, or thing that is new because it is qualitatively different from existing form".

In contrast, the practice of diffusion is defined by Greenhalgh et al. (2005) as the acceptance over time of a specific idea, piece of knowledge, or belief, by persons, groups, or other entities, associated with precise networks of communication, in a social system, and in a

provided system of standards, or practices. The differences in academic debate across sociology, anthropology, mass communications and other fields are revised and clarified by Greenhalgh (2005).

Rogers (2010) described diffusion as "the process in which an innovation is communicated thorough certain channels over time among the members of a social system". Diffusion research examines how ideas are circulated between sets of individuals. Diffusion moves beyond the two-step flow principle, focusing on the circumstances that increase of reduce the probability that an innovation, novel idea, creation or practice is adopted by followers of a specific culture. In multi-step diffusion, an opinion leader has the greatest impact on the behaviour of people (termed adopters). Nonetheless, there are likewise additional influencers, including the media, and an individual's own decision-making. One influencer is the change agent, somebody who reassures opinion leaders in their adoption or discarding of innovations.

Furthermore, Dearing (2009) proposed that few social science theories have a history of theoretical and pragmatic study involving the diffusion of innovations. The strength of this theory behind Diffusion of Innovation originated from various criticisms and different fields of study in which diffusion has been researched. Initial speculation at the beginning of the twentieth century was progressively replaced by post hoc experimental research that defined and clarified diffusion processes. By the late 1950's, diffusion researchers had collated the shared knowledge of real diffusions in the assessment of innovation diffusion processes. In recent times, this has provided a proposed system of the science of diffusion in which evidence-based practices are undertaken.

One of the most important aspects of innovations in health care are related to product, process, or structure (Varkey et al., 2008). Healthcare innovation can be defined as "the introduction of a new concept, idea, service, process, or product aimed at improving treatment, diagnosis, education, outreach, prevention and research, and with the long term goals of improving quality, safety, outcomes, efficiency and costs" (Omachonu and Einspruch, 2010). Furthermore, information technology remains an important key driver of innovation in healthcare. Gupta (2008) claims, while hospitals and other care providers have long been quick to adopt breakthrough technology in medical devices, procedures and treatments, far less attention has focused on innovations in networking and communications. The reason behind that it is concerns about breaches in security and patient privacy, and because healthcare until recently was a service always performed locally and in person.

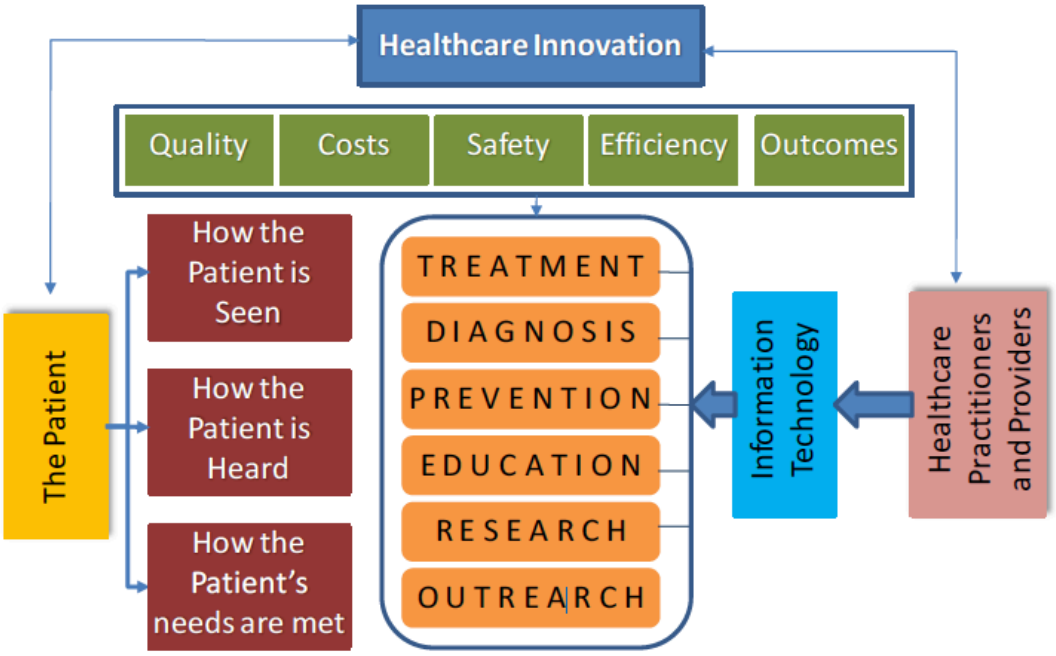

Figure 1 A Conceptual Framework for Innovation in Healthcare (Omachonu and Einspruch, 2010)

As indicated Figure 1, healthcare organizations serve six distinct purposes which are treatment, diagnosis, prevention, education, research and outreach. In serving these purposes, healthcare organizations must effectively manage quality, costs, safety, efficiency and outcomes. At the very core of healthcare innovation are the needs of patients and the healthcare practitioners and providers who deliver car, healthcare organizations arrive at innovation by relying on new or existing information technology. When successful, healthcare innovation focuses on three areas the most are how the patient is seen, how the patient is heard, and how the patient's needs are met (Omachonu and Einspruch, 2010).

Many of the innovations in healthcare have been initiated by following healthcare stakeholders (patients, affected person advocacy groups, health organizations, physicians, other healthcare professionals, and so forth.) In a few cases, the need intended for change is pressured upon the healthcare organizations from the government in an effort to mitigate healthcare worries and challenges. If the need is recognized, the next challenge lies in determining whether the healthcare innovation company can fulfil the necessity internally (Omachonu and Einspruch, 2010). If the innovation hails from within the health organization, it is usually tested, modified as well as adopted. If it not originates from inside the healthcare organization, the healthcare technology company should develops, exams and markets this technology to health organizations instead meets the necessity. In a number of cases, a healthcare advancement company takes what could possibly be an imperfect test at innovation from the healthcare organization as well as refines it in a better product, and markets it to be able to healthcare organizations. It is important to understand that the internal means of innovation within a healthcare organization like a hospital, nursing household, home health, or perhaps managed Care Corporation. These organizations typically do not have the luxury of the huge research and development department, and so must count on the raw ability and creativity of internal staff as well as work teams (Omachonu and Einspruch, 2010).

As figure 2 describes, a managed care company may rely upon the feedback from its sales and marketing field staff; a hospital might rely upon feedback from patients, physicians and staff; and both groups may rely on information regarding competitors in order to commence the search for improvement. In some cases, the limitations in the resources available to the healthcare organizations force them to partner with a healthcare innovation company to create a product that meets their needs(Omachonu and Einspruch, 2010).

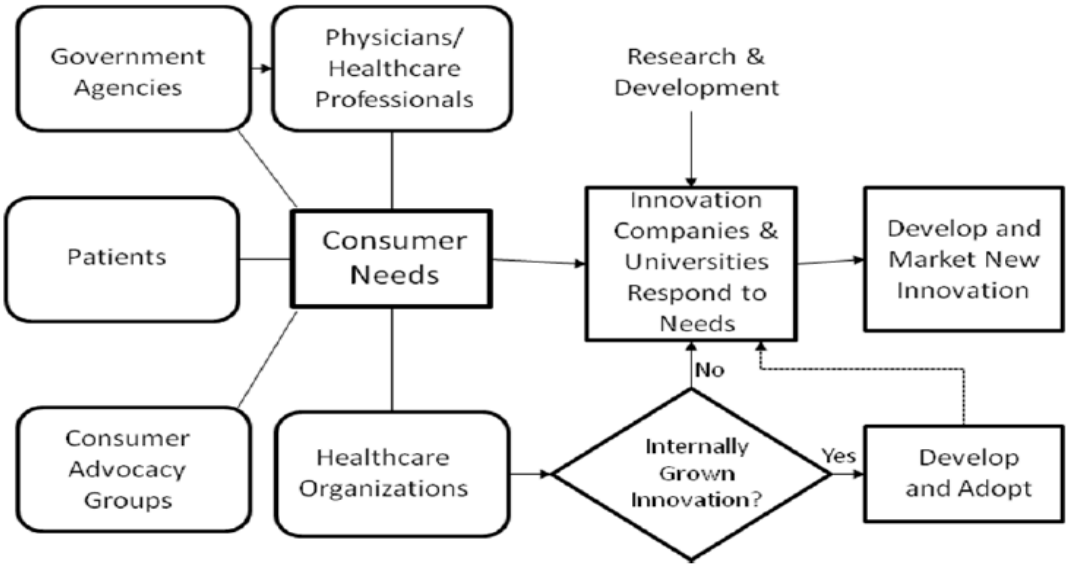

Figure 2: The Process of Healthcare Innovation (Omachonu and Einspruch, 2010).

Berwick (2003) points out, there are seven critical success factors for the dissemination of health care innovation. Firstly, a formal mechanism to find sound innovations should be disseminated. Following by finding and support innovators as well as invest in early adopters. In addition, it also includes making early adopter activity observable so, it can trust and enable reinvention and creating slack for change, lastly lead by example. Varkey notes that in the healthcare, the best of innovations may not be successful if the market or environment is not ready for adoption (Varkey et al., 2008).

Health information technology (IT), such as computerized physician order entry and electronic health records, has potential impacts on quality, cost, and efficiency and of health care. However, impact is defined as "The action of one object coming forcibly into contact with another, using as a verb (Impact on) Have a strong effect on someone or something." (Ciampa and Revels, 2013). As following the impacts of HIT on health care.

In the physicians literature, (Chaudhry et al., 2006) the impact of HIT on quality of health care has been comprehensively examined. According to Chaudhry et al. (2006) in the term quality measures, average quality was higher for hospitals with electronic health records and computerized physician order entry. The major impact of HIT on quality of care is its role in increasing adherence to guideline or protocol-based care. In addition, as Chaudhry et al. (2006) studies showed that the impact of HIT on the capacity of health information technology is to improve quality of care through clinical monitoring based on large-scale screening and aggregation of data. As well as, health information technology mediated effects on quality a reduction in medication errors.

In the impact of HIT on efficiency of healthcare, Chaudhry et al. (2006) contributed on efficiency of utilization of care and provider time. Tierney et al. (1990)have shown decreased rates of health services utilization; computerized provider order-entry systems that provided decision support at the point of care were the primary interventions leading to decreased utilization. Furthermore, Tierney et al. (1993) and Overhage et al. (2001) studies the Regenstrief Institute examining in patient order entry showed increases in physician time related to computer use. Another study by (Pizziferri et al., 2005) on outpatient use of electronic health records from Partners Health Care showed a clinically negligible increase in clinic visit time. Wong et al. (2003) and Pierpont and Thilgen (1995)studies showed slight decreases in documentation-related nursing time that were due to the streamlining of workflow.

The most of the impact on cost of HIT based on institution all leaders were related to changes in utilization of services due to health information technology (Chaudhry et al., 2006). In a study of Wang et al. (2003) found that the most impact of HIT on cost is the aspects of system implementation or maintenance. There are two studies provided computer storage costs; these were more than 20 years old, however, and therefore were of limited relevance(McDonald, 1976) and (Wilson et al., 1982). Moreover, Teich et al. (2000) reported that system maintenance has high costs were about $700 000. The reason behind that, these systems were built, implemented, and evaluated incrementally over time, and in some cases were supported by research grants, it is unlikely that total development and implementation costs could be calculated accurately and in full detail.

This research will initially focus on one country context, that of the Kingdom of Saudi Arabia. With a population of 26 million residents and an annual growth rate of 2.2%, the healthcare sector in Saudi Arabia needs to service a growing population alongside an increased demand for healthcare. The Saudi Arabian Ministry of Health (MoH) is the main government agency entrusted with the provision of preventive, curative and rehabilitative medical services. MoH public hospitals provide healthcare services at primary, secondary and tertiary levels to all citizens free of charge (Suginaka et al., 2014). As shown in Figure 3, approximately 60% of all hospitals in Saudi Arabia are public hospitals which fall under the jurisdiction of the MoH. The remaining healthcare providers consist of the private sector, university hospitals, and other governmental departments such as the Ministry of Defence and Aviation (Hasanain et al., 2014).

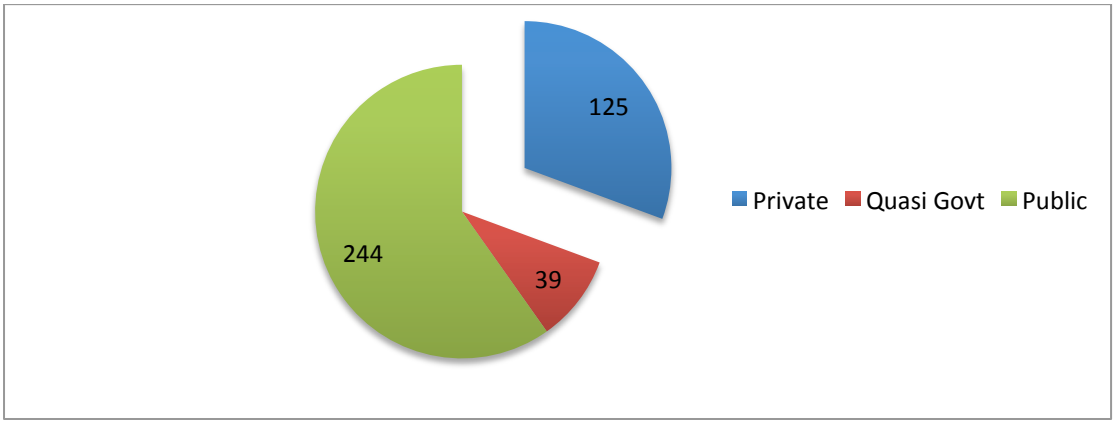

Figure 1 The number of healthcare organizations in Saudi Arabia as per The Ministry of Health (MoH) 2014

In the early 1950s, health services in Saudi Arabia had fewer than 100 hospital beds. However, at present, the Ministry of Health has a total government budget of more than $277 million (Hasanain et al., 2014). There are 387 hospitals in total, some of which are advanced medicinal healthcare organizations that provide a variety of sophisticated treatments such as open-heart surgery, kidney transplants, and cancer therapies. The total number of beds in all hospitals is 53,519, with 31,420 of these existing in MoH hospitals; this corresponds to 58.7% of the total number of beds in the Kingdom. There are 2.2 beds per 1,000 people, equating to one bed for every 453 people. The total number of physicians in the Kingdom (including dentists) is 47,919; 21.6% of these are Saudi. The total number of dentists is 6,049 (excluding those that work in private clinics). 21.1% of these (1,275) are Saudi-born. The total number of pharmacists is 15,043 (excluding those working in the private sector); 1,875 pharmacists (12.5%) are Saudi, while 99% of the pharmacists working in private pharmacies are non-Saudi. The total number of nurses is 93,735; 28.8% of these are Saudi, while allied health personnel total 51,288, with 59.1% being of Saudi nationality (MOH, 2010).

Technology has become an important strategic management asset for the private and public sectors in Saudi Arabia. As technology can provide distinctive advantages, it may contribute significantly to the success of a firm. As such, technology may be the source of competitive advantage. Therefore, managing technology effectively has become crucial in today's competitive environment.

ICT plays a significant role in all contemporary economies. Saudi Arabia's information and communications technology (ICT) market is one of the largest across countries in the Middle East. The Ministry of Communication and Information Technology was formed in 2003, and the Saudi National Plan for ICT was announced in 2005, with the express purpose of controlling, regulating and developing ICT services and plans in Saudi Arabia.

In evaluating Health Care there are a number of factors to be measured. These could include

- Patient costs / quality of care
- Diagnostic costs
- Treatment costs
- Accuracy of data
- Quality of data

IT provides distinct advantages for healthcare systems operations. The new concept of Healthcare Information Technology (HIT)has been described by Ciampa and Revels"(HIT)as the use of hardware and software in an effort to manage and manipulate health data and information". (HIT) is the area of IT involving the design, development, creation, use and maintenance of information systems for the healthcare industry. Automated and interoperable healthcare information systems are expected to lower costs, improve efficiency and reduce error while also providing better consumer care and service (Ciampa and Revels, 2013) .

Patient electronic health records (EHR) are a central component of the health IT infrastructure. An EHR is an individual's official, digital health record and is shared among multiple facilities and agencies. The other essential elements of the HIT infrastructure are the electronic medical record (EMR), which is an individual's health record within a healthcare provider's facility; the personal health record (PHR), which is an individual's self-maintained health record; and a Regional Health Information Organization (RHIO), which oversees communications among the other elements and unifies them geographically.

In exploiting these systems it is critical that a standardized approach be taken. One being developed for the likes of medical devices is that of Technology Assessment. Technology Assessment arose in the mid-1960's from an appreciation of the critical role of technology in modern society and its potential for unintended and sometimes harmful consequences. Health technology assessment considers the effectiveness, appropriateness and cost of technologies. It does this by asking four fundamental questions. Does the technology work, for whom, at what cost and how does it compare with alternatives? It is a structured analysis of health technology, a set of related technologies, or a technology-related issue that is performed for providing input to a policy decision. It is a multidisciplinary field policy analysis, and as such encompasses medical, social, ethical and economic implications of development, diffusion and use of health technology.

Work carried out in other jurisdictions such as the UK has been reviewed. As such in Ireland HTA 2 is governed by HIQA. It is proposed in examining the impact of HITs that an evaluation framework be established. This would be based on two distinct areas of analysis – a budget impact analysis and an economic evaluation.

Table 1

Parameter	Budget Impact Analysis	Economic Evaluation
Underlying concept	Affordability	Value for Money
Purpose	Financial Impact of introducing a technology	Efficiency of alternative technologies
Study Timeframe	Usually short-term (1-5 years)	Usually Long term (e.g lifetime – can be built using models)
Health Outcomes	Excluded	Quality Adjusted Life years
Discounting	NO	5%
Result	Total and incremental annual costs	Incremental cost per unit of health outcome achieved.

Consideration of life cycle costs is also relevant here ensuring that the an evaluation framework investigates the total life cycle costs of the commissioning of the new technology and takes into account the need to change the technology in the future. There are a wide variety of models available for life cycle costing and the selection of an appropriate model requires development and consultation not just internally between stakeholders, but also should involve consultation with industry that have developed such models.

The commissioning of medical devices and associated technologies is quite complex. There are many issues that must be considered. These can include the existing medical support infrastructure, the supply of services, such as utility e.g. electricity or even staff training. To procure medical devices could be seen in certain instances as being a strategic activity. It generally involves a medium to long-term perspective. The Total Cost of Ownership (TCO) is a tool that can serve to analyse indirect costs Wynstra, and many organizations are trying to achieve the lowest TCO with their suppliers in supporting their strategy, which in turn is seen as integrating purchasing into company policy.

There are two interlinked issues – the final design for the intervention, and the final evaluation. As part of this research it is proposed to design an evaluation based on the general principles of realist evaluation (Pawson and Tilley, 1997); (Pawson, 2000); (Pawson, 2000) and (Pawson, 2013). This is an evaluation approach originally designed to assess the effects of complex community based interventions, which certainly well describes the 20:20 fit study. It has been extensively used over the last few years in the health sector e.g. studies on

the effect on cycling and walking of infrastructure (Ogilvie et al., 2011) , wholesale community health reform in London (Greenhalgh et al., 2009).

The realist evaluation question is not “does it work or not?” but rather, “what works, for whom, and in what circumstances?”

What would such an evaluation look like? A basic principle is that the evaluation is constructed for the individual project, to meet the needs of the project, the project participants, and other stakeholders. Realistic evaluations are usually complex, and cover several domains. They often combine qualitative methods, and quantitative methods, sometimes in very creative ways.

The key insight, which drives realistic evaluation, is that the impact of an intervention depends critically on the context in which it is offered, and that knowledge of how this works, is of great practical importance. This context includes the individual receiving the intervention. This contrasts with the classical randomised controlled trial (RCT) approach (Cipriani and Geddes, 2009) where the aim is to make every participant able to change, between the treatment groups, and the hypothesis is that there is a true average treatment effect, and that subgroup differences are nuisance variables to be analysed, or better yet, designed out.

This is not a critique of the RCT approach, which is very powerful, and highly effective in many settings. However, realistic evaluation can give answers to a different, and wider, set of questions from an RCT, typically, what effects does an intervention have, how are these effects achieved, or blocked in different groups of participants, in what settings does the intervention work best, and so on. All of these questions are very important for practitioners, and for those charged with implementing, or sustaining programs in the longer term.

A useful phrase to grasp what a realistic evaluation looks like is the maxim'mechanism + context = outcome'

A useful piece of jargon is the 'context mechanism outcome' triad (CMO). This emphasizes that a realistic evaluation is not just interested in what happened (or failed to happen) but in why it happened – in the mechanism.

The project will be examined from several perspectives. The structure used by Greenhalgh et al. (2009) has much to commend it. There are several dimensions of the work that need to be captured. First, the costs of delivery need to be clearly identified. To do this a formal costing exercise will need to be built into this work.

This paper proposes to show the initial development of an assessment tool for analysing the impact of HIT in Saudi healthcare. The qualitative method will be addressed and paradigm concentrates on investigating subjective data, in particular, the perceptions of the people involved. The intention is to illuminate these perceptions and, thus, gain greater insight and knowledge.

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