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Full Length Research Paper

Effective elements on e-health deployment in Iran

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The structural features of Iran's health system obligate the development of information technology in medical field and design of an effective e-health system. Due to the importance of this issue, the current study was performed to identify the effective elements on e-health deployment in order to codify a comprehensive plan for Iran. The practical, descriptive-comparative study was conducted using semi-qualitative methods with mathematical analysis. The study populations included the following countries: Australia, Germany, Japan, Sweden, Britain, Turkey and Iran. Due to the comparative nature of the study, there were no samples and the selected countries were chosen as the sources of information. This study was performed in four stages including studying the current situation and the history of issue in Iran through documents and evidences, comprehensive study of e-health in selected countries by searching through books, materials and also the web, suggesting the primary proposal and eventually determining the proposal's credibility and presenting the final plan using the semi-Delphi technique. The findings of the study indicated that e-health deployment priorities included individual health care identifier (IHI), patient ID, e-health card, increasing investment in information technology, electronic appointment registration, electronic prescribing and finally, telemedicine service. Strategies commonly aimed to use the information technology to provide health care services based on patients centrality. E-health infrastructures included physical networks, legal infrastructures, education, preparation and performance of e-health operation. The necessary resources to establish e-health included financial, data and other resources. The deployment of e-health included e-health record, e-health card, telemedicine service and health portals. The major obstacles to establish e-health in Iran included lack of a specific strategy, ambiguous and complicated information technology infrastructure, two cultural and educational problems in relation to training and practice in information technology and communication skills, rapid changes of managers especially in Ministry of Health and Welfare, not being able to attract skilled information technology technicians in e-health field, unclear mechanism to fund e-health system, lack of codified technical standards and weak health service implementation methods. Infrastructure of information and communication technology in Iran is complex and ambiguous and e-health strategies and priorities have not been determined yet.

Key words: E-health, prerequisites, resources.

INTRODUCTION

Information technology has had a profound impact on various businesses. As well as improving the jobs quality, this technology also reduces the businesses' clerical costs. Health care institutions are not exempted from this effect. These institutions generate a high volume of information which should be collected, distributed, registered, retrieved and summarized. The application of technology in health care in forms of electronic health record and e-health system is one of the most important issues to improve the quality of health care (Farahmand and Ahmadzade, 2007). E-health is a new field in medical information, public health and commerce (Seker and

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Savini, 2009). Important goals must be considered and set based on patient-centered concept (Haux et al., 2002). One of the first steps could be providing the hardware, national standardization of protocols and improvement of computer skills of caregivers (Tran et al., 2006; Kluge, 2007; Yu et al., 2009). Support of different ministries and non-governmental organizations is important in effective e-health implementation (Moisil and Jitaru, 2006).

Various e-health applications such as telemedicine, e-mail consultation and distance education are performed in strategic programs of different countries (Eysenbach, 2001). Implementation and practice of these applications also reveals higher attention in some countries. World Health Organization, expressing the benefits of e-health, has announced that e-health must be one of the essential parts of any strategy and the most important plan in order to vicissitude the health care system in the 21st century (World Health Organization, 2008).

The structural characteristics of Iran's health system which remind the necessity of information technology development in medical field are as follows: variation of disease in reprobated areas and concentration of resources in large cities, dramatic effect of awareness in improving health and reducing the disease incidence, the necessity of immediate access to patients' health records by physician, access to information and disease statistics in medical research, medical cooperation as the essential requirement for synergy, the need of professional counseling without the physical presence of patients, the necessity of increasing treatment efficiency, patients' reverence and providing the best service with the least concern for patients and relatives and also providing the necessary equipment for physician (Farahmand and Ahmadzade, 2007). It seems more attention is required to present the strategies which increase the probability of success in implementation of any practical fields of this technology in Iran. E-health has stepped into international health system with time in order to increase the quality of treatment and access the economic treatment. The extended demand for education and research has made e-therapy the only solution to these challenges (World Health Organization, 2008).

Various researches on elements and barriers in implementation of e-health system have identified and confirmed the followings as the main obstacles to the deployment of e-health in Iran: cultural and social factors, financial and economic factors, technical and technological factors, management process, legal and regulatory factors and absence of special trustees in this field. Compared to other countries, Iran not only has the lowest standards, there are also mismatches between the set standards and the records. Lack of a control system to produce the related standards for system assurance, easy access, and security and loss of some information are all indications of defects and deficiencies in Iran's Ministry of Health to establish the essential standards in information recording system (Pourdehzad and Feyzi, 2009).

Designing an effective e-health system requires individuals' cooperation including health information management experts and users, digital communication infrastructure, medical health centers' computer standards, national data sources system, management theories' practical software, new education system, regulations on health insurances and the health insurance systems, effective systems, performance and compliance capabilities in e-commerce system, public, educational and security systems of electronic health services, and promoting a culture of mutual cooperation between health care system and information technology personnel (Høstgaard and Nøhr, 2004; Pourazin, 2004; Yu et al., 2009).

Attention should be paid to evaluation (Yusof et al., 2008). Data registry, patients and physician's satisfaction, the quality of patient care, length of stay in hospital, patient-nurse and patient-physician relationships all must be evaluated in this regard (Ho et al., 1999; Hundt et al., 1998; Kari et al., 1990; Marill et al., 1999; Schumock et al., 1992).

MATERIALS AND METHODS

This research was conducted as a practical, descriptive-comparative study. The current study aimed to investigate the effective elements on e-health deployment in Iran which was performed using semi-qualitative methods with mathematical analysis in four stages. At the first stage, the current situation and the history of issue in Iran was studied through documents and evidences, policies and procedures, the trustee agencies' guidelines and the ministries that are engaged in these activities. At the second stage, selected countries' e-health systems were comprehensively studied and the related data were collected through searching books and materials, the web by using e-health key words, e-health prerequisites, priorities of e-health implementation and necessary resources and methods to implement e-health system. At the third stage, based on the findings of the study, the initial plan was designed and proposed. Finally, semi-Delphi technique was used to perform the proposal's credibility and for this purpose, the designed questionnaires were sent to 20 professors, experts and relevant authorities on several occasions and their comments were considered in the plan.

Due to the comparative nature of the study, there were no samples and the selected countries were chosen as the sources of information. These countries included Australia, Germany, Japan, Sweden, Britain, Turkey and Iran (Al-Shorbaji, 2008; Bitaraf et al., 2007; E-Health ERA report, 2007; Haux et al., 2002; Holliday and Wai-Keung, 2004; Pourdehzad and Feyzi, 2009; Seker and Savini, 2009; Voss et al., 2005).

RESULTS

The Ministry of Health plays the main role in effective e-health in relation to prioritizing of e-health implementation in all selected countries. The e-health strategies in selected countries are as follows: in Australia, individual health care identifier (IHI), in Germany, patients' ID and adequate e-health card, in Sweden, national action plan

Table 1. E-health strategies in studied countries.

Australia	Germany	Sweden	Britain	Turkey	Japan	Iran
Individual Health Record (IHR)	Patient's ID, E-health card, adequacy center	National Practice Plan to use IT in health and social services	Increased investment in IT, electronic appointment service, e-health record and electronic prescribing	Citizen centric e-health projects	Studying patients direct care system, ICT Agencies' cooperation for development policy	Security and standards architecture, creating integrated data sources of health information system, management development of public knowledge to access health information

to use information technology in health and social services, in Britain, increased investment in information technology, electronic appointment booking system for patients, electronic prescribing, connecting GP practices to national health service network and telemedicine facilities, in Turkey, citizen-centric e-health projects, in Japan, studying patients direct care system and Japan's International Information and Communication Technology Agencies' cooperation for development policy, and in Iran, security and standards architecture, creating integrated data sources of health information system and management development of public knowledge to access health information. The objectives of these strategies are different in the studied countries but the common goal of all countries is to provide patient-focused health care services by using information technology (Table 1).

E-health infrastructure included physical networks infrastructure, legal infrastructure, education, preparation and implementation of e-health operation. The physical networks infrastructure in Germany is structured by accommodating and updating computerized hardware in practices, hospitals, pharmacies and other locations. There is fast internet in electronic public kiosks and the main aspect of e-health records is managed by patients and citizens. Sjunet is the Swedish health care network compromising of a fiber-optical network separated from the internet with an IP-based network infrastructure which allows secure and reliable transmission of confidential data. In Britain, the new network is a secure wide-bandwidth network infrastructure which connects all sectors of the National Health Service in the country together and enables electronic selection and registration for general operations, record services, communication systems and picture archive. In Australia, the national infrastructure is a key element in enabling e-health infrastructure, reducing costs and the likelihood of redoing the job. And, in Turkey a physical network is the source server of health coding system. Infrastructure of information and communications technology (ICT) in Iran is complex and ambiguous. So that the trustee, policy makers, implementers and operators of information technology are not exactly clear and various institutions claim to be the trusteeship of the country's ICT and separately ratify the related acts. Lack of adequate telecommunications coverage in some parts of the country and limited access to proper internet speed in many parts of the country are some of the other obstacles of the country's e-health development (Table 2).

Regulatory and legal infrastructure

In Germany, the new patients' ID which preserves the citizens' independence in e-health system is protected by law. The mandatory and legal application of e-health cards are determined and managed. In order to protect the patients' data privacy, the law has guaranteed the citizen's civil rights and the tools to maintain it. In Sweden, the regulatory and legal framework redacts the periodic review of current laws and the local performances through patients' care records to coordinate rules and regulation structures in order to increase the use of information technology. In Britain, the Data Protection Act 1998 covers the telecommunications data protection and confidentiality. In Turkey, the regulatory and legal framework is in fact a formulation of the national health information network, national health data dictionary, minimum health data sets and the source server of health coding system which are combined with other technologies such as digital security mechanisms in order to provide appropriate national infrastructure for effective sharing of e-health records as minimum data sets. In Australia, the regulatory and legal framework provides the active participation of the key stakeholders of health care in designing and proposing e-health options. In Japan, the regulatory and legal framework supports the information and communications technology applications. In Iran, lack of binding rules to ensure more rapid e-health development and also lack of regulations that set e-health among the country's major priorities are some of the existing defects.

Table 2. E-health infrastructures in studied countries.

Country	Physical networks	Regulatory and legal framework	ICT education	Preparation and performance of e-health operation
Germany	Updating computerized hardware in health centers	Patient' ID and confidential data protection by law	Educational programs in national levels to improve the general public capability and ICT skills	Telematics Projects
Sweden	Fiber-optical network separated from internet	Coordinating rules and regulation structures in order to increase the use of information technology	Educational programs in national levels to improve the general public capability and ICT skills	
Britain	Secure wide-bandwidth network infrastructure	Data Protection Act Telecommunication Digital signature	Educational programs in national levels to improve the general public capability and ICT skills	
Turkey	The source server of health coding system	Protection of minimum health data sets and the source server of health coding system by law	Educational programs in national levels to improve the general public capability and ICT skills	Structured decision-making supporting system on the national health information network
Australia	Strengthening national e-health infrastructures	Active participation of the key stakeholders of health care in designing and proposing e-health options	Educational programs in national levels to improve the general public capability and ICT skills	More effective practice and measurement of e-health activities
Japan	Using information technology in health services	Law protection of the information and communications technology applications	Educational programs in national levels to improve the general public capability and ICT skills	
Iran	Complex and ambiguous ICT infrastructures	Lack of binding rules to ensure more rapid e-health development	Lack of educational programs in national levels or sub-sectors to improve the general public capability and ICT skills	Managers' rapid changes prevent the operational preparations.

Another e-health infrastructure is education and training in information technology skills. In Germany, Sweden and Britain, there are educational programs in national levels to improve the general public capability and ICT skills. Also, there are several related fields available for medical informatics and health in medical education framework in universities. There are graduate programs in management for physicians after obtaining their public education in business studies and related business courses, and related fields to hospital informatics and health care system. "ICT health expert" and "executive director of health information" are known as specific jobs. In Turkey, distance learning services are provided within the ministry of health and research universities to access education and digital libraries. In Japan, there is a very strong relationship between the Japanese' universities in medical education system and for many universities, it is a great mistake to seek advice outside the scope of affiliated medical institutions. In Iran, there are two cultural and educational issues concerning training and practice to obtain ICT skills but there are no national education programs to improve the general public capability and ICT skills or in medical education in universities and related informatics fields.

Other e-health infrastructure is preparation and implementation of e-health operation. In Germany, telematics project was performed by a group in three months to prepare implementation of e-health card followed by a better IT better health project (bit4health) in order to operate its results and to develop the concept

and architecture of a specified e-health card. In Turkey, a decision-making supporting system was structured on the national health information network to prepare and operate the development of e-health system. This system was initially performed in the GPs information system. The following points were emphasized in Australia in order to prepare and operate the development of e-health system: identifying different start points, more effective practice and measurement of e-health activities across the country, regulating and coordinating e-health activities and ensuring that sufficient prepared professionals are present to protect the performance of the national e-Health strategy.

In Iran, policy and decision-making and successful implementation of national projects implicate a stabilized national management. Rapid changes of managers especially in Ministry of Health and Welfare is one of the major obstacles to the e-health development system. The afore-mentioned issue and also the managers' personal view interference often caused the lag of decision-making and consequently, the implementation of e-health suffered of repeated delays. Also, not being able to attract skilled information technology technicians in e-health field due to finance and recruitment limitations is another obstacle to the development of e-health in the country (Table 2).

The necessary resources for deployment of e-health in the studied countries and Iran included financial, data and other resources. The specification, establishment and operation of an interoperable e-health infrastructure are undertaken by a specialised company named Gematik in Germany. Gematik's equity is financed in equal parts by health insurance funds (45% statutory, 5% private) and healthcare providers. In Sweden, the funding for implementation of e-health systems and its applications is provided and financed through a decentralized health care system by the county councils and municipal councils. Health care services are entirely funded by the government in Britain. In Istanbul (Turkey), universities and private health care providers have several private hospitals which also have a local network, but the e-health funding status is uncertain. In Australia, investment and funding resources to share electronic information is at the national level. In Japan, the central government and local authorities fund some parts of the costs and the rest is paid by the medical insurance funds. In Iran, the funding state of e-health is uncertain.

The other sources of e-health are data sources. In Britain and Germany, the structure of data application is based on the HL7 standard. In Sweden, different technical standards in health information technology and communication application are applied which encompasses a full range of standards. In Australia, data resources include backup plans for medicine management and test orders, chronic disease management solutions, electronic consultation and telemedicine protection. The information resources include health services' research and reporting data bases, health information knowledge bases and individual health care information (IHI). In Iran, standard data sources and ICT include fixed GB networks with top memory which store an unlimited number of addresses and are highly secured (Table 3).

E-health deployment methods include electronic health record, electronic health card, telemedicine services, health portals and other methods (Table 4). The main concept of e-health strategy in Germany, Sweden, Turkey and Australia is citizen-centered individual electronic health records. In Britain, NHS care records service is a live, interactive patient record service and available 24 h day by health professionals. Iran's electronic health record system (SEPAS) is defined by the Ministry of Health's statistics management centre and IT in order to coordinate citizens' health information across the country. Another e-health deployment method in Germany, Sweden, Turkey, Australia and Japan is e-health card. There are a very limited numbers of smart e-health cards available in Iran.

The third method used in deployment of e-health in Germany, Sweden, Turkey, Australia and Japan is telemedicine services. In Iran, there are telemedicine services in form of medical consultation network services. The objective of launching such a service is investing in telemedicine services for the country's reprobated areas. Another e-health deployment method in Germany, Sweden, Turkey, Australia and Japan is health portals. In Sweden, service via internet (information and "ask the doctor/nurse") and information leaflets/books has been provided and scheduling activities have been started for patients' medical advice in a national network through phone. There is a comprehensive project of hospital information in Iran which is used by all hospital units to access electronic record information in a computerized network. The usage level of these records is determined by the data managers. Also, the financial record elements are more involved than treatment records elements in patient's records cycle and the expertise record elements in the sectors are rarely completed. Another e-health deployment method is electronic prescribing. In Britain and Germany, electronic prescribing service (EPS) is a system that allows prescribers to send prescriptions to distributers. In Turkey and Australia, electronic prescribing is a related service sector at the national level that allows the consumers to obtain prescriptions from preferred pharmacy of their choice regardless of their position. There are no electronic prescribing in Japan and Iran.

DISCUSSION

According to the findings of the current study, e-health strategy in Iran is general; in other words e-health strategies and priorities are not determined. The findings

Table 3. E-health resources and its funding methods in studied countries.

Country	Investment and financial resources	Data standards and other resources
Germany	Health insurance funds and health care providers	HL7 Standards
Sweden	A decentralized health care system by the county councils and municipal councils	A wide range of different technical standards
Britain	Entirely funded by government	HL7 Standards
Turkey	Universities and private health providers	Telecommunications with radio connections, satellite systems and national health data dictionary
Australia	Investment and funding resources at the national level	Health services' research and reporting data bases and health information knowledge bases
Japan	The central government and local authorities and medical insurance funds	Insurance resources and physical resources (digital TV systems, voice recognition and handwritings)
Iran	Uncertain funding state	Fixed GB networks with top memory, 3GB and 3.5GB mobile network

Table 4. E-health implementation mechanism in studied countries.

Country	E-health record	Electronic prescribing	Electronic health card	Telemedicine	Health portals
Germany	√	√	√	√	√
Sweden	√	√	√	√	√
Britain	√	√	X	√	√
Turkey	√	X	X	√	√
Australia	√	√	X	√	√
Japan	√	√	√	√	X
Iran	√	X	X	X	X

of Bitaraf and colleagues' study (2007) indicated that the most invested priorities in e-health field and its development plan in the world are as follows: telemedicine health record, education and supervision system of disease, clinical information system and data exchange standards. Three goals that need special attention are as follows: recording of medical data based on patient-centered concept, decision support by process-integrated method, and complete use of data for health care's and research (Haux et al., 2002). Information communication technology (ICT) infrastructure in Iran is complex and ambiguous. So that the trustee, policy makers, implementers and operators of information technology are not exactly clear and various institutions claim to be the trusteeship of the country's ICT and separately ratify the related acts. Implementations of e-health concept in European countries were possible by strong support and cooperation of Ministry of Health, Ministry of Information and Technology, Ministry of Education and Research and non-governmental organizations (Moisil and Jitaru, 2006).

Lack of adequate telecommunications coverage in some parts of the country and limited access to proper internet speed in many parts of the country are some of other obstacles of the country's e-health development. National health information infrastructure, personal health management and health care services should focus on public health and researches. Lack of binding rules to ensure more rapid e-health development and also lack of regulations that set e-health among the country's major priorities are some of the existing defects. There are two cultural and educational issues in relation to training and practice to obtain ICT skills. The first step in establishment of e-health in Vietnam was training and providing the hardware at all levels of health care (Tran et al., 2006). Secure e-health needs national standardization of professional education and protocols plus global interoperability of regulations and laws (Kluge, 2007). All efforts should be made to form positive social norms and to improve computer skills of caregivers (Yu et al., 2009).

The biggest problem in implementing electronic health

records is organizational culture or in other terms, user resistance other than technical limitations. On the other hand, in Iran, policy and decision-making and successful implementation of national projects implicate a stabilized national management. Rapid changes of managers especially in Ministry of Health and Welfare is one of the major obstacles to the e-health development system. Also, not being able to attract skilled information technology technicians in e-health field due to finance and recruitment limitations is another obstacle to the development of e-health in the country. In Al-Shorbaji's study (2008), it is indicated that one of the main issues facing the health system in the area is weaknesses in planning the human resources development. There is no specific mechanism to maintain the e-health system finance resources at the moment. Technical standards in health care services have not been codified. ICT tools in the e-health system are one of the solutions to meet the challenges of the health sector (Blobel and Pharow, 2003). In relation to implementation of e-health, although there are limited numbers of smart e-health cards in Iran, the telemedicine program in form of medical consultation network services are not still operational and there is no electronic prescribing (Pourdehzad and Feyzi, 2009). For every step of implementation, evaluation is an important and complex step that should be considered and carefully paid attention (Yusof et al., 2008). It seems the documentation in e-health records included more detailed data (Apkon and Singhaviranon, 2001; Daly et al., 2002; Essin et al., 1998; Holzemer and Henry, 1992; Lilford et al., 1985) and improved the completeness of data (Cheung et al., 2001; Ho et al., 1999; Hu et al., 2002; Larrabee et al., 2001). Physicians were satisfied and accepted the new instructions because they were structured, directed and facilitated the patient care and research (Ammenwerth et al., 2001; Ho et al., 1999; Hundt et al., 1998; Kari et al., 1990; Marill et al., 1999; Schumock et al., 1992; Quaak et al., 1986). Patient care, length of stay in hospital, patient-nurse and patient-physician relationships were not negatively affected by implementation of e-health system (Essin et al., 1998; Nahm and Poston, 2000).

Conclusion

The major obstacles to establish e-health in Iran included lack of a specific strategy, ambiguous and complicated information technology infrastructure, two cultural and educational problems in relation to training and practice in information technology and communication skills, rapid changes of managers especially in Ministry of Health and Welfare, not being able to attract skilled information technology technicians in e-health field, unclear mechanism to fund e-health system, lack of codified technical standards and weak health service implementation methods. Infrastructure of information and communication technology in Iran is complex and ambiguous and e-health strategies and priorities have not been determined yet.

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