

Electronic Health Technology and its Application Area: A Review

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ABSTRACT

Electronic (E)-health is the use of ICT in the health sector for clinical, education and administrative purpose, at both local site and distance. E-health enable the uses of computer, network and information technology to improve healthcare quality, patient safety and secure confidential access to health information to enable individual and communities to make the best possible health decision. E-health reducing the cost incurred on healthcare by cutting the heavy administration bill normally associated with public healthcare program, hereby improved reliability, secure and efficient of health delivery. (E)-health encouraging healthier lifestyles in the entire population, including increased physical activity, better nutrition, avoidance of behavioral risks, and wider use of preventative care. This paper review some of the research carried out in the area of e-health. Aside from the general reviews, discussion is made on agent oriented software engineering, agent oriented programming, e-health application, its benefit and challenges have been presented in a chorological order.

Keyword: E-health, Patient, ICT, Agent-oriented System, Data, Healthcare

Aims Research Journal Reference Format:

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1. INTRODUCTION

E-health can basically be defined as the movement of client information without moving the client using information and communication technology tools to deliver and support health services (Emuoyibofarhe, 2012). According to Eng definition, E-health is the use of emerging information and communication technology, especially the internet, to enable health and healthcare (Eng, 2001). This term encompasses a range of covering disciplines that relate to application of computer, information and communication technology to healthcare or population health. The field includes telehealth, telemedicine, medical informatics and consumer health informatics (Eng et al., 1999). The nature and function of e-health communication are expanding rapidly, and are therefore burdensome to define precisely. E-health portray the application of information and communication technologies across the whole range of functions that affect the health sector from patient to administrations, data processing specialist, nurse, hospital manager and medical doctor. E-health communication strategies encompass computer assisting learning, health information on the internet, online collaborative communities, computer control in-home telephone counseling, patient provider e-mail contact, bio-metric assessment, among others. The aim is to study technical progress in e-health, its application and area which need to be improved.

2. HEALTH INFORMATION SYSTEM TERMINOLOGY

The following terms have been developed to provide some of consistency in discussion and data collection regarding health informatics based in e-health activities.

2.1 Database Management System (DBMS)

A software management system designed to manage a database, and run operations on the data requested by multiple clients. Examples are Laboratory Information System (LIS), Radiology Information System (RIS) and Order/Entry System.

2.2 Clinical Decision Support System (CDSS)

CDSS is a software or system application primarily used to consolidate, summarize and transaction data especially designed to assist healthcare providers in making on. Example is pharmaceutical information systems decisions on care option by rule-based information on treatments, diagnoses and medication.

2.3 Health Information Management System (HIMS)

HIMS is a systematic collection of continuously updated and current information designed to help healthcare managers plan and direct business and organizational operation.

2.4 Electronic Medical Record (EMR)

EMR is a repository to electronically maintained information about an individual's health status and health care. It can store multiple legitimate records. Example is physician's clinical practical-based record.

2.5 Electronic Patient Record (EPR)

EPR is a patient-centered record with information from multiple institutions. It supports healthcare providers by offering complete and accurate data, practitioner reminders and alerts links to the bodies of medical knowledge. Example is Hospital-based e-record.

2.6 Electronic Health Record (EHR)

Electronic health record is a digital form of patient's medical record. In this record, personal information, medical records and issue related to patient health are stored. Features of electronic health records is time sharing giving authority to patient in his care and increasing health through the use of medical records (Armstrong et al., 2007).

Table 1 shows and compares the manual health record with electronic health record.

Table 1: Manual health record (MHR) VS E-health Record (EHR)

S/N	Area	MHR	HER
1	Space	Non-Compact	Compact
2	Cost	Expensive	Compact
3	Show	Only one specific form	All format
4	Retrieval	Sometimes impossible	Quick and easy
5	Location	Available always but special place	Always available
6	Save information	Inactive	Active

3. OVERVIEW OF E-HEALTH TECHNOLOGY

In the early 1990s, Internet exploded into public consciousness and number of e-terms began to appear and proliferate. During these period, e-mails brought new possibilities for people to communicate fast and share information among one another; e-commerce proposed new way to conduct financial and business transaction through the use of (Eysenbanch, 2001). Whereas, introduction of e-health represented the promise to improve healthcare system through information and communication technology, at the present time, the term e-health is widely used by many organizations, individuals' academic institutions and professional bodies.

In recent decades, grate advances have been made in development of e-health technology as a way for telemedical care which is supported by modern digital communication media. E-health was introduced by National Aeronautic and Space Administration (NASA) to offer medical advice to the astronauts and their treatment by telemedicine (Miller, 2007). E-health makes use of computer, network and information technology to store, manage and electronically retrieve patient information instead of using paper and wardrobe with a full of confusions. Therefore, e-health can be referred to as improving quantities of health care, access improvement to service and integrated health care. The feature of electronic health systems are considered as protection of patient's information privacy and fairness in the enjoyment of e-health independent of color, culture, language, geography and collaboration between information systems (Marlene and Mahen, 2001).

Aside from the increasing use of information technology in the area of healthcare today, numerous research projects have been carry out to study how to increase the efficiency of e-health delivery and management. In the work of Eysenbance (2001), he suggested that an emerging tendency in e-health today in business is driven by non-professionals; namely patients that with their interests drive new services even in the healthcare field, mostly to empower themselves through access to information and knowledge.

Olaniyi et al. (2015), developed securing digitized campus clinical healthcare delivery system for comprehensive automation of clinical delivery of seven operation of eight operation unit of Federal University of Technology Minna healthcare services. These operations Unit are Medical Record Unit, Nursing Unit, Consultant Unit, Laboratory Unit, Pharmacy Unit, Radiology Unit, dentist Unit and Cashier Unit. This system was developed using real time communication framework for real time teleconsultant and advance encryption standard of symmetric cryptography algorithm to provide data confidentiality and privacy.

In 2004, World Health Organization professed that E-health is one of the main pillars for improving public health in the whole world (Dixon, 2007). E-health has established association between medical science and engineering and in this way medical community is able to use engineering facilities such as information technology infrastructure to improve the public health level. Among the main reason of creating electronic health seem to be creating security and privacy for citizens, protection of various cultures and languages, interaction ability between information systems, saving money and time and improving access to the services. E-health is use for errands such as: helping the hospital on admission, updating hospital, increasing proficiency, discharging, medical request, getting answer and referring to previous information.

In addition to all factors mentioned above, e-health increases patient gratification and provides a better service (Annicchiarico et al 2008). According to the characteristic of autonomy, agent oriented programming (AOP) has added interest to e-health; this technology can be used to design critical, intelligent and sensitive systems in order to help and improve community health status. Among these agent technologies are:

3.1 Agent Oriented Software Engineering (AOSE)

AOSE was introduced to rapidly respond to software engineering rudimentary need and agent based computing. Depend on agent-based computing; software engineering has been able to create secure application in the field of e-health (Annicchiarico et al). The main goal of agent oriented software engineering is to create tools, methodology and facilitates for simple preparation and maintenance of the agent-based software. The appearance of agent technology caused a revolution in the software industry and has had great advantage, such as intelligent, interaction, knowledge based and autonomy. As a result it can be considered as an abstraction level of software (Camarinha-Motor.). In overall it can be assumed that agent software engineering has the characteristics inherited from the object software engineering that make it able to do things independently to accomplish the chore instead of its users. Agent can make the best decision in the shortest period of time and negative impact of environmental factor. Among the features of agents include: Autonomy, Adaptability, Metals mechanism Cooperation and Concurrency.

3.2 Agent Oriented Programming

Agent oriented programming is a relatively software exemplar that bring concepts from the theories of artificial intelligence into the typical realm of distributed systems. Agent technology has been the subject of many extensive discussion and research within the scientific community for several years. In recent times, it gained a significant degree of exploitation in commercial application. Agent oriented systems are being used in an increasingly extensive diversity of applications, ranging from comparatively small systems for personal assistance to open, complex and mission critical systems for industrial application such as system diagnostic, transportation logistics, process control, network management and manufacturing (Bellifemine et al, 2007). In adopting an agent oriented technology to solve an independent issue that must always be solved like; ways to allow agents to communicate, rather than expecting developers to develop the essential infrastructure themselves.

3.3 Multi-Agent System

Multi-agent systems growing the field of distributed artificial intelligence. The main goal of multi-agent systems is to provide structure principles of complex systems involving several agents and mechanism to coordinate the behavior of these agents (Deloach, 2006). Coordination subject in multi-agent systems is the fundamental issue and without it the benefit such as interaction and social behavior of agent fades (Deloach, 2009). Multi-agent systems are helpful in the creating and developing vital, dynamic, heterogeneous, complicated, distributed systems and so on among agents to make e-health programs possible and practical.

Agents work together to meet the common goals of the system. This cooperation enhances the system speed through its unique features including intelligence and knowledge. A specialist right decision on a patient and successful achievement of the operation are the noticeable example of this point. Nowadays agents play important roles in the practical programs of e-health, which includes diagnosing system, facilitating and accelerating the treatment process and avoiding disorganized data system. Special feature of e-health including interaction and communication increase the need for agents. The best way to create e-health practical programs and supports the future generation is multi-tasking system. The important reasons for using multi-tasking systems are to improve the speed with parallelism and necessity of some domain to multi-agent systems.

4. APPLICATION OF E-HEALTH

Nowadays, data computing, network and communication have move on and the multiplicity of e-health application have improved. The increase of transfer rates over networks and data processing have moved most of the impediment to exchange medical data such as medical imagery, physiological signal, among others. E-health combined the use of electronic communication and information technology (ICT) in the health sector and it is identified by the use of digital data transmitted, stored and retrieved electronically for clinical, administrative at distance (Mitchell, 1999). E-health is compared to terms like “e-learning, e-business, e-solution, among others to highlight the processing and management of digital data through the uses of internet (Mahen, Whitten and Allen, 2001). Fig1 illustrate secure-clinical diagnostic system proposed by Olaniyi et al. 2015. The secure design consideration was based on the principle of symmetric cryptography using advance encryption standard.

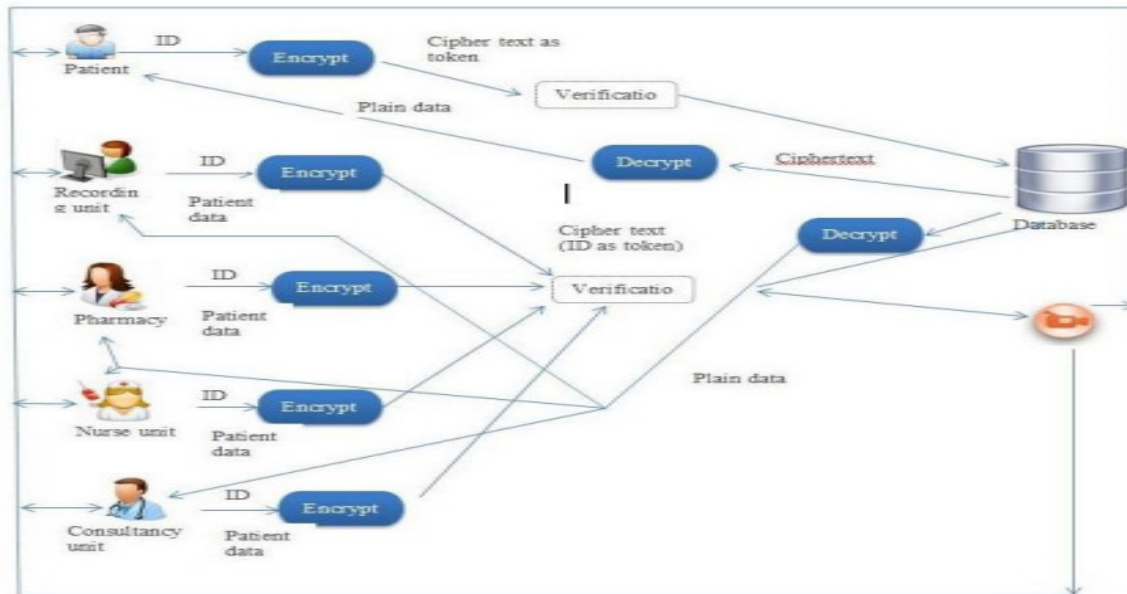


Fig 1: Secure Tele-Clinical Diagnostic System (Olaniyi et al, 2015)

E-health application is viewed as an end-to-end process irrespective of the cultural or national context (Iakovidis, Healy and Wilson, 2004). Fig. 2 demonstrate a typical example where a patient is related to a work station such as a home PC or any other medical module oriented to process medical data at which medical professionals have totally access either remotely or locally in order to plan and provide healthcare.

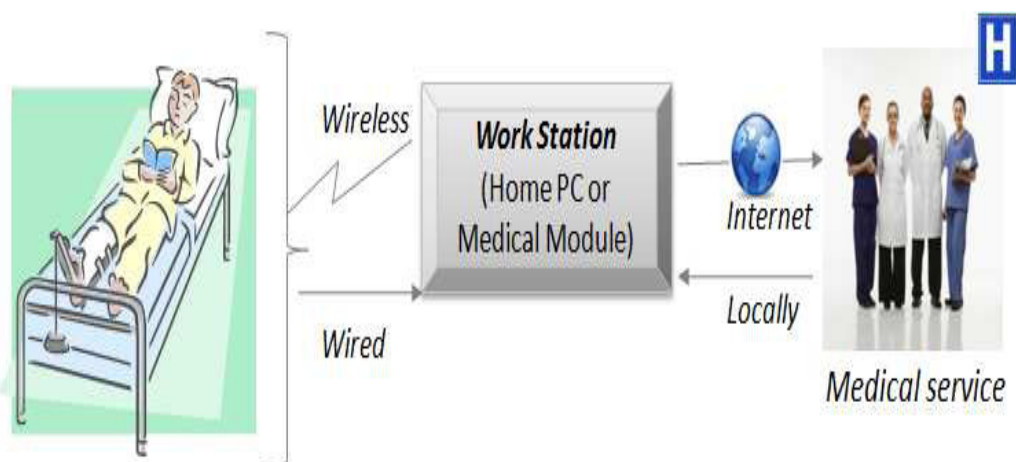


Fig. 1: Typical E-health Monitoring Application (Claudia, Gutierrez and Michel, 2014)

5. BENEFIT OF USING E-HEALTH TECHNOLOGY

E-health has various advantages which makes it promising in improving healthcare system through the use of ICT. Below analyzed the benefits of using electronic health:

- i. Enhancing quality of care: E-health enhances the quality of healthcare by allowing comparisons between different providers involving consumers as additional power for quality assurance, and directing patient streams to the best quality providers.
- ii. Efficiency: One of the objectives of e-health is to increase efficiency in healthcare which also leads to decrease in cost.
- iii. Empowerment of Consumer and Patient: This can be done by making the basic knowledge of medicine and personal electronic record accessible to the consumers over the internet.
- iv. Reduction of cost: Other possible way of decreasing cost of healthcare is by avoiding duplicative or unnecessary diagnostic or therapeutic interventions, through enriched communication possibilities between healthcare establishment and patient involvement.
- v. Knowledge provision: Educating physicians through online and consumer through the health education and preventive information.
- vi. Encouragement of new relationship between the patient and health professionals towards a true partnership where decisions are made in a shared manner.
- vii. Extending the scope or domain of healthcare beyond its conventional boundaries in geographical sense as well as conceptual nous.
- viii. Equity: This is one of the objectives of e-health that is to make healthcare more equitable.
- ix. Enabling Information exchange and communication in a standardized way between healthcare establishments.

6. CHALLENGES OF E-HEALTH

This report observes some potential menace to e-health which should be taken into consideration. These challenges differ among the countries. Views of them are data ownership and user, legislation for IT-security, economics, attitudes of health professionals and patients to new development (innovation) and interoperability.

According to the study (Desiree et al, 2013), many e-health projects have been delayed or failed, frequently because there was no long term vision that all stakeholders adhered to or because of a lack of skill, unrealistic prospects and a lack of internet, system and standards. Hence, e-health has improved the quality of healthcare, extending relationship between health professional and patient and increasing domain of healthcare beyond conventional boundaries. However, to improve the performance of e-health, confidentiality and integrity of patient data must be ensure. Application of cloud computing can be included in the further studies.

7. CONCLUSION

E-health is an emerging field in the intersection of medical informatics, public health and business through the internet and related technologies. This study gave an overview of e-health technology, its application and benefits; however various issues such as network, privacy and security, financial and attitude of users toward the invention of e-health need to be improved.

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