Department of Electronics and Communications Engineering

Study on e-Health System in Bangladesh: Prospect and Challenges

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Declaration

I hereby declare that this research report is an original piece of work carried out by me, under the guidance and supervision of Dr. Mohammad Arifuzzaman. This report is the requirement for the completion of MS in Telecommunications Engineering under the department of Electronics and Communications Engineering.

I sate that the report along with its literature that has been demonstrated in this report, is our own work with the masterly guidance and fruitful assistance of our supervisor for the finalization of our report successfully.

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Abstract

Uses of ICT in health sector is increasing day by day all over the world. Modern equipment are being manufactured by Vendor Company and industry which is added value in health care sector. Recently in academia, various research is going on for getting optimum result by using modern equipment in health sector. Though Bangladesh is a developing country, it is not much lack behind that trend. Recently, a great impact of IT of health sector in Bangladesh become very visible. However, still in some sector of e-health, current scenario of Bangladesh is at its rudimentary stage and there are few gaps which need to be fulfilled at this stage. We identify these gaps and provide recommendation. In our work, first of all we try to analyze the scenario of multi packet perspective. Secondly, we compare the e-health system (electronic health record, electronic medical record, telehealth and telemedicine, mobile health) in Bangladesh with the other developed, developing and underdeveloped country. We also try to focus on the universal standard (HL7, FHIR, and CDA) of e-health practice and interoperability of health record data of DGHS website. We have tried to make a platform to migrate the data and also identified the challenge in doing this.

CHAPTER ONE

1. INTRODUCTION

Todays, e- Health technology is highly demanded for the end users throughout the world, due to its advantages such as increasing awareness about health issues, creating and securing e-record. It should be noted that by developing of information and communication technology (ICT), our daily life is subjected to remarkable changes in all affiliate including health sector. In the literature, it is shown that many developed countries are already benefited from the e-health system. This system can be implemented in those countries which are developing, like Bangladesh, to increase both quality and quantity of community life. Thus, the Bangladesh government emphasizes the e-health system for providing excellent healthcare facilities. The public hospitals in Bangladesh offer medical services to people at the community level which are completely free. According to the latest released reports by the government of Bangladesh, there are 678 public hospitals, 482 upazila and union levels hospitals and 196 secondary & tertiary levels hospitals, approximately. In addition, Bangladeshi people have access to 2,983 private hospitals and 5,220 private diagnostic centers [1-3]. The government hospitals have 49,414 beds and private hospitals have 87,610 for the patients and it apparently is not enough for our huge population [4]. Therefore, it is a great challenge for our government to provide high quality health care facilities. In the last a few years, the government of Bangladesh has been commenced to promote the e-health system in the entire country for providing comprehensive health care. The e-health system is included into the Digital Bangladesh campaign of government of Bangladesh. Various steps have been taken by the Ministry of Health & Family Welfare to develop the e-Health services. In this regard, a Management Information System (MIS) department which is under Directorate General of Health Services (DGHS) has been established. For improving the quality, efficiency and safety of the e-Health system, an extensive collaboration between multiple sectors, such as private organizations, NGOs, etc., has been made [2-4]. New capabilities delivery in healthcare is the main focus in

healthcare and for hospitals and healthcare providers. It is based according to the national ICT policy of Bangladesh (2002) [5].

In [4], the authors have discussed about e- health and its Current Status, Challenges as well as some Future Direction.

The authors in [6], have described about integrating data into electronic health record and challenges for quality improvement of electronic health record in developing countries.

In [7], there has been given a lot of information about Opportunities and Challenges of e- health and M-health services in Bangladesh.

In [8], the authors give a description about the factors which are influencing elderly People in Bangladesh for accepting m-health.

Similar works have been done in [9-12], the authors have discussed about the acceptance of m-health of patients and physicians and also present states and opportunity of telemedicine.

The thesis has been organized as follows. Chapter 2 will discuss about the definition of e-health and scope, chapter 3 will discuss about the brief overview of e- health trends, chapter 4 is about the health record and interoperability, chapter 4 and 5 will discuss the comparison between e-health in developed and developing countries and recommendation and finally chapter 6 will conclude the entire thesis.

CHAPTER TWO

e-HEALTH DEFINITION AND SCOPE

2.1. Definition of e-health

e-health is a concept which is a combination of medical informatics, public health and business using information and communications technologies in healthcare.

The term e-health characterizes a technical development as well as a mind's state. It is a way of improving healthcare. It has some attributes which include a networked commitment, global thinking. By using information and communication technology, it has thinking of locally, regionally, and worldwide. It has secure use of information and communication technologies. By using this technology, citizens are getting the cost-effective health services. [WHO and DGHS]

First it is used in 1997.E-health system is used for improving patient care, safety of all records. At the point of care, for patients the information it provides accurate, complete and up to date. It minimizes the costs for providing improved safety, reduction of paperwork, reduction of duplication of testing, and for providing improved health.

E-Health has some Sub-domains which include Electronic Health Records (EHR), Electronic Medical Records (EMR), Telehealth and telemedicine, Mobile Health (mHealth).

2.1. a. Electronic health record (EHR)

It is an electronic version of patient medical records. It is also maintained time to time. All the necessary clinical information of patient is maintained very carefully. It includes statistics, notes of improvement, critical health issues, and list of used drugs in treatment of the specific patient, major health issue, previous medical record, cure probability and all tests reports. [18]

The By Using EHR we are getting lots of benefits. It reduces the happening medical error. It reduces the repeat of same test and providing faster treatment. It helps patients to take better decisions as all information are well informed before. It makes the health information available which has improved the perfection and transparency of all medical records. It also enhances privacy and security of patient data.

EHR in Bangladeshi perspective:

In November 2015, Electronic health record was successfully put in the motion which was launched as experiment at Kaliganj sub-district and in Gazipur district in March 2016. To identify environmental and system challenges are the main goal of this experiment. Currently, Bahmni a thought Works-developed distribution of Open MRS. Sub-district and district hospitals are using this technology as the clinical system. EHR is also used as a cloud-hosted CHW application at community clinics. [19]

Some private hospitals and clinics are using this EHR method. Now -a -days some private and public hospitals are trying to adobe this method. The Ministry of Health & Family Welfare has an ongoing project which has a goal to evaluate and develop a plan for accepting EHR in Bangladesh. This project includes to use of EHR systems hospitals in Bangladesh.

There are some difficulties which are involved in using EHR systems in public hospitals of Bangladesh. There are a huge patient load but shortage of human resources and ICT resources. These are technical problems. On the other hand, some people do not consider the system helpful. People living in rural area do not have any knowledge and trust about using technical ways. Along with these problems, hospitals also not interested about adopting this methods because it will need human and ICT equipment. They think that it will increase their maintenance cost.

2.1. b. Electronic Medical Records (EMR)

Electronic medical record (EMR) is a paper chart which is a version of digital form having all of a patient's medical history. It is mostly used by providers for diagnosis and treatment.

An EHR is more details form of report of the patient health status while an EMR is a brief   of a patient's medical history. [20]

There are some benefits of using Electronic Medical Records. It is efficient in tracking data by time. It has efficiency in identifying patients for preventive visits and screenings. It can monitor to measure some certain parameters. The patients who come for vaccinations and checking blood pressure are monitored by this system. Practically overall quality of health care is improved. [21]

A few private hospitals are using EMR system. But the list is very short. Scarcity of ICT equipments, maximum hospitals are not using it. The situation is changing day by day.

2.1. c. Telehealth and Telemedicine

Telehealth is a method for providing care of health, public health, and education about health and support for providing health care by using telecommunications technologies. Telehealth encircles a variety of technologies for providing virtual medical, health, and education services.

The combination of telecommunication and information technology is used for giving service of clinical health care system from a certain range in telemedicine system. In overcoming discrepancy barriers it is used. In distant rural communities where medical services are consistently not available is accessible by telemedicine services. [22]

There are several befits of using telemedicine. Telemedicine helps patient to get access to healthcare faster. It can evaluate diagnose and treat patients remotely.

There are also some befits of Telehealth. With the help of remote consultations and monitoring, admissions and readmissions are reduced which were necessary before. It helps patients to manage health conditions more effectively at home. Patients can have benefit from having the staff easily

who are already using this system. They easily can have any medical records from specialists. This system has already improved the level of care. Any important information can be accessed quickly and efficiently still a patient is at home. More advanced solutions are offered by this system. It is making in a better light. Without the components of Telehealth, the community view to the people would not be possible. Physicians can provide their expertise suggestion who are in remote area. It would not possible to provide such health care service without Telehealth. Physicians need not to travel in order to see patients in the remote areas which is saving their time and money. [23]

In Bangladesh, a charitable trust, Swifne Charitable established first telemedicine link in 1999. It the link was established between the Centre for the Rehabilitation of the Paralysed (CRP) in Dhaka (the capital of Bangladesh) and Royal Navy Hospital, Haslar, UK . This project was email based. The Bangladesh project was successful. As a result, digital cameras and tripods were supplied to more hospitals in other developing countries by the swinfen charitable trust.

In mid - 2000: Rural tele-health initiatives were taken using wireless technology by Grameen Communications. A unique telemedicine Service "Health Line Dial 789" has started by Telemedicine Reference centre Ltd. And Grameen phone in November, 2006. Grameen phone which is GSM infrastructure based call centre have 10 million subscribers. These call center are providing different types of medical information facility such as emergency service (SMS based LAB report, ambulance) and real time medical consultation over mobile phone. [24]

Telenor Health launched via Grameenphone an initiative named Tonic. This service provides lots of health related services such as health and illness information, suggestions for positive health change and editorial style content. It has 24-7 helpline for GP users in which it charges BDT 5 per minute, for giving a basic diagnosis by doctors. A discount service is also offered for its members in selected hospitals in Dhaka by the startup. [25]

Lots of people are using tele- health services. But still, a large portion of our population is not using tele- health service because of lack of knowledge.

Now a day's some online website are launched for patients of Bangladesh. The names of some very well-known website names are   Doctorola.com, Doctorsbd.com, E-medicalponit.

Doctorola.com is such a website which is used for finding the required doctor, hospital or blood donor easily with a less effort. This website helps out patient in appointment process of the doctor or contacts the blood donor quickly with almost a single click. It has 8069 verified doctors who have specializations on different categories. It covered already 62 districts. [26]

Doctorsbd.com is also a very useful website for patients. It helps out patients in searching doctors in their required locations.

E-medicalponit is constantly trying to publish accurate and update Bangladeshi doctor's information but the doctors list is not accurate or complete. They are trying to improve the online doctors list of Bangladesh. [27]

2.1. d. Mobile health technology or mHealth

mHealth (mobile health) is a term which is used in medical care by using mobile phones and other wireless technology.

There are some basic differences between mHealth and telehealth. Telehealth is about providing healthcare by using latest technology. On the other hand, patient can take care oneself by using mobile in mhealth. Consumers can capture their own health data in smart phone and tablet apps. [28]

Patient can get access clinical information by using mobile apps. Patient can have communication with patients through patient portals. It offers monitoring of patients which is real-time and provides health care in remote. [29] These are the benefits of mobile health or mHealth. By using mobile apps user can get important information about cardio logical diseases, diabetes, obesity, chronic diseases, and smoking cessation. These mobile apps are used to monitor, to prevent, and to detect diseases. It is also used for providing more advanced services like present basic diagnosis. There are a huge number of mobile apps in Google play store such as Calorie Counter and Diet Tracker, Daily Carb - Carbohydrate, Glucose, Medication, Blood Pressure and Exercise Tracker, Noteness, Office-Fit ete. [30] Calorie Counter and Diet Tracker is used for Diet application for counting calories, food tracking, exercise, and weight goals. Furthermore, it explores social aspects

including links to friends as a motivation feature. Daily Carb - Carbohydrate, Glucose, Medication, Blood Pressure and Exercise Tracker is an application that tracks daily nutrition intake of food, crabs, fiber, fat, tracks quantity of water intake, readings of glucose, HbA1c, blood pressure, heart rate, weight, exercise, medications, and insulin. Noteness is multiple sclerosis diary application that allows a user to track and monitor injections and symptoms. Office-Fit is an application that contains and offers several exercises against work-related pains and stress.

A very few people are using this system but maximum people are not using it. As Bangladesh is a developing country, our maximum people still living below the poverty line. Most of the people are not using smart phones and tabs. The people who are using smart phones and tabs also not using mhealth because they don't have proper knowledge of mhealth .

2.2. e-health services and procedure for evaluating them

EMR, EHR, mhealth, Telehealth and telemedicine are the subdomain of e-health system. In Bangaldesh, mhealth, telehealth and telemedicine are available. Mobile phone companies are providing this telehealth and telemedicine services to people. Now, there are some mobile apps for health services. There are some website for finding and getting appointment to doctors [26]. People are becoming conversant of using mobile apps. There are some mobile apps with people can measure their daily calories, blood pressure, heart rate etc [27].These type of websites are approved and monitored by the government. But now a days some websites do not get permission for starting. But there are two types of threats in using websites and mobile apps. One is misled of information and other is privacy issue. By using these type of website, it may risk for people because these website can misuse the user information. It may be a threat for privacy and some websites do not have authentic content. Also, there are some apps are in play store which do not contain authentic information. It may be harmful for users. So there should be rules for creating and uploading apps for healthcare and also remove those apps as soon as possible. The condition of health sector in Bangladesh may find out the lacking by comparing with a developed country and other society.

2.3. The main stakeholders, e-health service beneficiary in the field of e-health

The patients, physicians, government, hospital owners, insurance companies and pharmaceutical companies are known as the main stakeholders. Patients are the citizens or sometimes may be a non-citizen of country. Bangladesh has some policy to provide service to patients which make them the service beneficiary. In e-health system, they can get healthcare services from home by using personal electronic device such as mobile phone, computer. Different NGOs are doing various awareness campaign about public health. They also doing campaign about the importance of vaccination. Sometimes they give free vaccine by going to door.

The provider are those who provide health services and maintain the services. Providers maintain a sound coordination with other providers about patient care. Some provider may have independent business. In that case, they has to manage and maintain all the sector of the company for proving smooth and continuous service.

The government is monitoring all the stakeholders. There are many plans for making the healthcare system electronic in Bangladesh. There are instruction for arranging training for managing ICT implementation in healthcare, campaigning for various health related issue. There are also instruction for controlling all the diseases. The national e-health guideline contain multiple projects which will be a great improvement for health sector [28].

2.4. Administrative, legislative and regulatory frameworks

Every country has their own rules and regulation which may not be same as others. The Government has rules and regulation for heath sector. There are lots of government law under the Ministry of Health and Family Welfare website [29]. For maintaining a proper standard e-health project, the implementation of administrative, legislative and regulatory frameworks are really important.

There are rules and regulation for health professionals, hospitals, and pharmaceuticals firms. There are rules from the government to health professionals to maintain the code of ethics in providing health services. There are rules for pre- operative test. Before an operation, pre-operative test is mandatory sometimes for saving life. Hospitals have been instructed to maintain hygiene and safety. As the hospital wastage are very harmful for human health, there are strict instruction about hospital wastage management. In Bangladesh, government is providing free medicine for the public hospital patients. So, there are rules for keeping record of medicine distribution and storage.

As still maximum hospitals are not following electronic system and no international standard, it is very difficult to maintain the privacy of patient's medical data. To ensure the privacy of data, a standard should be followed in healthcare system in Bangladesh. It is very easy to steal the paper based data. But still there is a possibility to steal electronic data. For electronic health record system, there should be rules in giving privacy in data. As government has already took project on this sector, for better result, Bangladesh can compare other developed country standard and their rules.

CHAPTER THREE

BRIEF OVERVIEW OF e-HEALTH TRENDS

3.1. e-health in the service of citizen-based health system

Though Bangladesh is a developing country, it has took enormous initiatives for improving health sector, especially for women and children health. Now our life expectancy is increased and some mortality diseases (tuberculosis and diarrhea) are completely under control. Though we have public hospitals but these are not enough according to the population. And unfortunately, the existing private hospital healthcare system depends largely on out-of-pocket payments that the poor cannot afford. Sometimes, people cannot have medical services because of remote area. Information and communication technologies (ICTs) could help to deliver quality, affordable healthcare to the most vulnerable populations. In spite of being developing country, the standard of medical practitioner and the standard of infrastructure of health sector is not below average. e-Health and mHealth services make it possible to get medical service easily from remote area. There are good number of information technologies facility in this area which is not enough. Sometimes, some hospitals of remote area have enough medical equipment and equipment ICT but there are no operator for those equipment. The government has arranged training in this sector. Still it is not enough. To solve this problem, there should be more opportunity for training in sector. The doctors are enough dedicated in the context of giving medical service. But with the increasing of using ICT in health sector, maximum hospitals are still running with the previous analog system.   The government has installed basic e-health infrastructure and guideline in draft form. But the measures are not adopted yet. To implement the e-health services to citizen, government, non-government and private organizations should collaborate with each other. [30]

3.2. Technical and financial trends

Technical and financial support is one of the most important issue for implementing any initiative**.** With the improvement rate in the use of ICT medical sector, some apps are developed for medical services. Though the literacy rate is increasing day by day, a large group of people are illiterate in Bangladesh [31]. Because of being illiterate, they are unable to use those apps. So they are not getting the service providing through apps. Sometimes, they missed the notification of some important events such as vaccination which are sending through apps. Now government is arranging medical campaigns on different issue such as woman are children health, vaccination, food and nutrition etc. But being illiterate, people don't give interest to attend the campaign. Sometimes, they don't understand the speech after attending it. The government has a few institution where people can have technical training in operating medical equipment. To make the technical support strong in this field, government should take initiatives for giving technical training in operating medical equipment as well as ICT related equipment.

As Bangladesh is a developing country, we don't have enough financial stability for implementing e-health in very recently. There are enough cost for buying sufficient equipment and operating cost. Government is trying to increase the budget in medical and ICT development sector in last few years but still this is not enough for our large population. With the government, private hospital owners should be co-operative in this sector. They can minimize the cost of treatment in private hospitals as poor people can afford the cost. International initiatives and cooperation will be necessary in order to achieve this objective.

CHAPTER FOUR

HEALTH RECORD AND INTEROPERABILITY

4.1. Interoperability

Interoperability is the exchanging and using of same information of computer system or software. In healthcare, lots of different information is produced by different computerized system. For better patient care, these information is very necessary. To make it possible, if different information systems will exchange and use that information very easily. Interoperability in healthcare can provide that standardized approach for seamless sharing of information between health information systems.

For supporting interoperability between different systems and meaningful use of that shared data, interoperability standards must cover both the syntax (structure) and semantics (meaning) of the data exchanged. Interoperability is not the software or hardware. Interoperability standards are the guidelines that helps the technology developers to develop a system for health care which is compatible with other same standards system.

Technical and the social aspects are two main aspects of interoperability. Technical interoperability is the ability of different IT systems and software applications for communicating, exchanging data, and using of the information which has been exchanged. The willingness of participants to share the collected data and the formation of a cross sector community to facilitate the data is defined as social interoperability.

Interoperability in other country

Every country has their own healthcare system which is different from other country. It is very difficult to make all system interoperable. Here we have choose two country randomly to describe their system.

Spain: Now a days, every country is trying to accessible patient medical information both by the hospital and patient. Spain is such a country who make it possible the interoperability system by removing all the complexity. Spain had launched their electronic health record system in the year of 2006. After launching the system, they have controlled the total healthcare system under the electronic health record system. In 2015, they have improved their system one step forward by implementing interoperability. Now patient can have electronic prescription.in year of 2017, they have launched the single national electronic prescription system and this system is used by different 9 communities of Spain. This interoperability of single prescription provides the more safety and comfortable zone in the time of having treatment [32].

Mexico: In Mexico, 30 hospitals in capital are now using interoperable healthcare system. The real time data accessibility project is announced by the health ministry of Mexico City. Around 4 million people are served by the 30 hospitals [32]. The ehCOS technology platform make inoperable the 30 hospital from the city. As a result patients get more safety and have hassle free treatment in case of admitting in any hospital of 30. The Medical Administration and Hospital Information System (SAMIH) has transformed the patient care process in Mexico City. By using electronic health record system, hospital in Mexico can give Electronic Birth certificate (CEN) very quickly. The hospitals can communicate and exchange the information of any new born very quickly so that the new born can get proper care [32]. The record of newborn helps to get various treatment in case of vaccinations, surgery, accidents, illness, accidents and any kind of health related problem or any kind of medical emergency. In 16 states in Mexico, CEN is implemented. 50,000 birth certificate has been issued under CEN system. The inoperability added some more features such as electronic signature, digital stamps and electronic biometric information [32]. There are different languages in Mexico. Before implementing the inoperability system, it was difficult to communicate and interact among the system with different languages. The inoperability feature removed the language barrier. The international standard like HL7 helps the communication smooth.

4.2 Interoperability in Bangladesh

In several documents in ITU give emphasizes in health record interoperability. As we know the one of the major function of ITU is to ensure the interoperability of the technologies. In order to minimize the digital defied all over the world, interoperability is one of the major function. Unfortunately, there is no standard from ITU for health data management. They are now giving emphasize in this sector because people from underdeveloped and developing country get this privilege.

The MIS of DGHS maintains four databases [33] covering majority of health organizations under Ministry of Health and Family Welfare (MOHFW). These databases are PDS, HRM, Field Staff Info and DHIS Data on organizations and human resources from these databases will be migrated in the new database system. Other ministries, agencies within MOHFW and non-state organizations may have their own databases. According to DGHS these data are available and are technically feasible to import, the same will also be tried to be imported in the new system. However, there are few challenges of migration of data. The first one is the protocol issue. According to DGHS website, there is a plan for data migration but no exact protocol name is not mentioned there. Being a middle income country, it is very challenging for the government to recruit more doctors and nurses in public hospitals. So private hospitals should play an important role on this issue. By this time, they could serve a huge number of patient every day. Some software will be used for data migration mentioned on the DGHS website. However we have built a platform [34]. With due the permission DGHS, we can access the DGHS data. However, we migrate the data of the DGHS, we face difficulties as mentioned in [34]. One of the major issue was that the number of fields mismatch with HL7 protocol. Another, example is that DGHS do not use the data. Though they planned for using code for various field, for the existing data there is no code.

In DGHS website, there are some specific objectives to provide technical guidelines on how the data for:

1. There are guidelines for data management and specific code will be used for every unit of Bangladesh such as divisions, districts, upazilas or thanas, unions, wards, village etc

2. There are guidelines and codes for health organizations and personal care providers. Assigned responsibilities, approved posts, human resources, assets, etc. will be departmentalized and performance will be measured by the enterprise systems.

3. Also, there will be a coding scheme for posting the data for several organization.

4. There are also guidelines and coding scheme for managing data for staffs, health care providers including personal care providers, trainees.

5. There are specific names and cods for different fields and for national and sub-national demographic location.

6. To provide technical guidelines on how there are coding techniques for the facility-based health services and guideline for estimating service utilization, disease burden, mortality statistics, performance and productivity.

7. There are coding guidelines for estimating the performance and productivity of training institution.

8. For monitoring and tracking the ICT based equipment, a different coding scheme will be implemented.

9. There are also guidelines for data migration from DGHS website to new ICT system [33].

CHAPTER FIVE

COMPARISON BETWEEN DEVELOPED, DEVELOPING AND UNDERDEVELOPED COUNTRY

Some developed countries are using those standard for their healthcare.

Standard name

HL7 Standard

Introduction to HL7: HL7 is a standard for the exchanging, integrating, participating, and recovery of electronic health records. This standard defines the packaging of information. It communicate with other party by setting language, layout and data patterns. It set up the whole system for smooth integration. The whole clinical system such as practice in clinic and the hospital management, delivery, and health services evaluation are supported by HL7 standard. It is the most used and recognized all over the world. It was first founded in 1987. American National Standards Institute (ANSI) accredited standards in 1994. A comprehensive framework has done by the developing organizations. HL7 is used in more than 50 countries by 1,600 members, including 500+ corporate members. It is giving services in all units of healthcare such as providers in healthcare, stakeholders of government, payers, pharmaceutical companies, suppliers, and consulting firms. Health Level 7 standards contains the definition of data exchange, decision support, rules syntax. Formats for messaging and common health data definitions are provided in HL7. It provides the clinical documents such as EHR, personal health record (PHR) and so on. It also maintain the attachments which is claimed, quality reporting, product labels for prescription medications and clinical genomics (35, 36).

Targets

The target group of HL7 is the IT vendors of healthcare and healthcare provider.

Benefits

It supports the maximum common interfaces which is used globally in healthcare industry. It provides a guideline which is not suitable with the standard. It is a backward compatible system and also cost saving. Moreover, it helps people to get better healthcare services [37, 38].

The main HL7 standards are:

- HL7 Version 2 is the most widely used standard for exchanging clinical information. This standard sends messages for patient care. It is one types of query language of database. It enables messaging system of healthcare providers to send requesting and containing health data.

- CDA standard is approved by ISO. CDA standard exchange various types of clinical documents such as discharge summaries and progress notes. Associated with the CDA are the CCD, a record of patient discharge and admission among separate facilities, and the Consolidated CDA (C-CDA), which is used in ONC meaningful use-certified EHRs to consolidate nine previous CDA templates into one document.

- EHR-PHR System Functional Models provide common language parameters for developing EHR systems and their components. The PHR Functional Model is a draft standard for functions that should be in a PHR and for data exchange between PHRs and EHRs.

- Fast Health Interoperability Resources (FHIR), a DSTU that underwent its first balloting round in spring 2015. It is a Web-based exchange language that makes interoperable healthcare applications faster, simpler and easier to write. [39]

CDA

Introduction

Clinical Document Architecture (CDA) is the version 3 of HL7. This standard is used to markup the clinical document and also for giving the specification of clinical documents structure and semantics. According to this standard, clinical documents have six characteristics; 1) Persistence,

2) Stewardship, 3) Potential for authentication, 4) Context, 5) Wholeness and 6) Human readability. Any type of clinical content can be contained in CDA such as any types of diagnosis report, summery admission information etc. Inter-enterprise information exchange is popular in US health information Exchange (HIE)

Targets

The target group of CDA are the IT vendors of healthcare, healthcare provider, EHR and PHR Systems, Departmental Systems and Transcription Vendors.

Benefits

Clinical documents can be exchanged with those who are involved in the care of patient. It supports the re-use of data such as public health reporting, quality monitoring, patient safety and clinical trials. These re-used data is implemented in multiple function.

Implementation and case studies

Health information exchange (HIE) is well established in Finland, Greece and Germany and familiar with international users. HIE is also used in Canada, Japan, Korea, Mexico, Argentina. For US HIEs and the US Military Health System, CDA is firmly in the plans for using. Many hospitals, university such as Queen Elizabeth II Hospital, Dalhousie University, The Mayo Clinic, and Columbia-Presbyterian in New York are using CDA for various clinical purpose [40].

FHIR

Description

FHIR is an interoperability standard intended to facilitate the exchange of healthcare information between healthcare providers, patients, caregivers, payers, researchers, and anyone else involved

in the healthcare ecosystem. It consists of 2 main parts – a content model in the form of 'resources', and a specification for the exchange of these resources in the form of real-time Restful interfaces as well as messaging and Documents.

Targets

The target group of FHIR are the Immunization Registries, Quality Reporting Agencies, Standards Development Organizations (SDOs), Regulatory Agency, Pharmaceutical Vendors, EHR, PHR Vendors, Equipment Vendors, Health Care IT Vendors, Clinical Decision Support Systems Vendors, Lab Vendors, HIS Vendors, Local and State Departments of Health, Medical Imaging Service Providers, Healthcare Institutions (hospitals, long term care, home care, mental health), Quality Reporting Agencies, Regulatory Agency.

Benefits

Healthcare information can be shared the FHIR's specifications. It enables the development of application. As a result high quality information can be accessed which implementers find easy to use easily. Value based healthcare services are supported by it.

Implementation and case study

It is used in Major vendors such as Epic, Cerner, Allscripts, Apple, Microsoft, and Google [41].

We choose some developed, developing and under develop countries to compare. Here table 5.1 and 5.2 are showing the comparison among develop, developing and under developed countries.

Table 5.1: Electronic health record (EHR) management system in Canada, Finland, Singapore, Japan, Nigeria & Bangladesh:

Idea	Canada	Finland	Singapore	Japan	Nigeria	Bangladesh
Protocol used [42,43]	HL7, FHIR	HL7, CDA	No standardization	No standardization	No Standardization	No standardization
Patient accessibility to HER[44, 45,46,47,48, 49]	Yes	yes	No	No	no	No
Year of protocol launch[50,51]	2002, 2003	1995	Not yet started	Not yet started	Not yet started	Not yet started
Tools for database[49, 50,51]	SQL,EDC	DICOM, SQL	ASCII, XML, PDF,SQL, TIFF	SQL	No specific tools	SQL, XML
Data Migration &protocol adoption plan [51,52]	Yes	yes	Yes	No	yes	No
National data set [49,50,51]	Available	available	Available	Available	available	No
Percentage of using IT [50,51,52,53]	81%	88%	56%	45%	No exact data found	22.8%
HDI rank[53]	12	15	9	19	157	136
WHO ranking [54]	30	31	6	10	187	88

Table 5.2: Health expenditure of Canada, Finland, Singapore, japan, Nigeria and Bangladesh

Country name	2017	2018
Canada [55,56]	11.5%	11.3% ($ 253.5 billion)
Finland [57]	22.1 %($17.3 billion)	25.5% ($ 19.9)
Singapore [58]	$10.48 billion	$10.23 billion
Japan [59]	9.18 % (¥42.2 trillion)	9.20 %
Nigeria [60]	4.17% (#304.33billion)	4.23%
Bangladesh [61]	0.92%	0.89%

CHAPTER SIX

RECOMMENDATIONS

The healthcare sector in Bangladesh is run by government and private sector. The public hospitals are run by government and private hospitals are run by private organizations. But still the health sector in Bangladesh is not completely developed and are not sufficient according to our population. In the context of developed counties, the hospitals of Bangladesh do not have sufficient experienced doctors, modern equipment and modern hospitals containing good health management system. To have developed countries health management system in Bangladesh, technological collaboration with technologically advanced hospitals are needed and follow health management organizations in the developed countries of Asia and the advanced nations of the West.

Governance, public, private co-ordination

To improve the present situation of health sector in Bangladesh, the private sector should collaborate with the government sector. To make the government and private sector collaboration successful, the commitment of stakeholder is very important. To ensure accountability and transparency in procurement in health sector, the civil society and human right organizations can play an important role. By ensuring transparency in Supply chain management and logistics, the whole management system will be improved. This system can ensure well-functioning services in getting quality medical products and technologies [62]. In Bangladesh, sometimes financial crises of patient is a big issue in getting medical service. To remove this problem, the health sector of Bangladesh need a system which has strong financial structure in giving support in health related financial crises. With all these aspects described above, other important aspect is a well-

functioning information. A well – functioning information system can proclaim information as well as critical health outcomes timely. Inflowing information is an important factor and the information should be flowed by health watch groups. For improvement of the quality of healthcare services both clinical and managerial skills, the existing plans of human resource development (HRD) should be reconstructed for long term objectives. It will help to address emerging health problems of Bangladesh. For implementation of all these initiatives, the major impedance is the financial crises. In implementing new ideas in practical field, training is very important. But the sufficient fund is not arranged from the informal health providers. As well as funding for community systems that mobilize demand for services. The programs which are made by the programmers in context of local needs. But delivering services is too hard to the vulnerable populations. There should be strategies for community involvement to increase awareness of, access to, and utilization of health services, and provision of appropriate services at the community level.

National Health Policy

The Management Information System (MIS) of DGHS has taken an initiative to develop e-health standards and inter-operability framework for developing the database systems or to be developed by the health organizations and programs under the Ministry of Health & Family Welfare and other ministries [63]. Health organizations and programs of the NGOs, development partners and private organizations will also benefit from the standards and inter-operability framework. A draft guideline has already been prepared which describes the standards and inter-operability procedures of the Bangladesh Health Information Systems Architecture (BHISA). For technical development some work have already finished such as geographic location registry, health organization and personal care provider registry; sanctioned or approved posts registry assigned to each specific organizations, health care professional registry, population health registry, public health service provision registry, facility-based health service provision registry, health academic/training institutions performance registry and equipment or asset registry [64]. Effective education and life style modification can change the societies scenario. To influence the healthy behavior of individuals and community and living conditions, government is trying to improve knowledge, attitude, practices and skills by creating a 'health literate society [65]. Medical education system

in Bangladesh has seen great development in last decade. Number of doctors, nurses, medical assistants and technologists have increased multiple folds. To meet the demand of the large population of Bangladesh and achieve the WHO standard of doctor-patient ratio [66]. Now Bangladesh has one registered physician per 1,847 people [67].Many education institutes have been established. To increase large number of doctors and nurses, government should take initiatives to increase medical colleges and nursing institute. In Bangladesh there are total number of nursing colleges and institute is 126 (public 54 &72). [66, 68] In Bachelor of Medicine and Bachelor of Surgery (MBBS) degree course the total number of seats is 15,815 [68] which is not enough for our large number of population. Government should increase more seats in MBBS course and nursing course so that we can have more doctors and nurses. Also, the same time the quality of training and education for medical personnel must be ensured. There should be more facilities for research for betterment in health sector.

Private sector contribution

Bangladesh is a very few country in the world where health service is free. Without any fee, public hospitals give free services. Being a middle income country, it is very challenging for the government to recruit more doctors and nurses in public hospitals. So private hospitals should play an important role. By this time they could serve a huge number of patient every day. However there are some cases published in newspaper and electronic media, there is a gap between their services and cost [70]. So, government should take a closer look on that issue. On the same time private hospital owners should be more responsive about their hospital service. There should be some volunteer organization who develop their service metric (for example: patient admission to cure ratio, satisfactory level, post follow scenario). There are registered 2554 non- government organization (NGO) (including local and international) under Bangladesh government [71]. All NGOs are playing very important role in heath sector. Very few NGOs have fully-equipped hospital ships those are going to remote areas reach of Bangladesh where people had no access to basic medicine previously [72]. Besides, some NGOs have mobile paramedical teams who regularly visit communities in the field bringing healthcare and medicine to people's doorsteps and also have static clinics for providing healthcare services. Most of the NGOs provide healthcare services through mobile phone, community health service. NGOs also arrange campaign on

various important topic such as health and nutrition, family planning& development of children, women's and children's health etc.

Public data management

Data management is a very complicated and difficult task. Healthcare organizations need to transition their operations towards a data-driven mentality: Administrators and physicians must be diligent about collecting patient data, marketing departments must base their programs around data insights, and patients must be prompted to provide updated data whenever possible A proper data management create 360-degree views of consumers, patients, and households. It also deploy personalized, guided interactions by integrating data from all available sources. It increases patient engagement with predictive modeling and analysis based on healthcare data. It also improves population health outcomes in specific geographic areas by tracking current health trends and predicting upcoming ones. It has high-impact business decisions based on data insights. It helps to understand physician activity and align them with the organization's goals. . The involvement from all players in the healthcare industry requires for data management. (73)

Software integration

All hospitals and organizations should develop clear standards of health care information to exchange between computer applications for an enhanced patient care. They should develop a methodology of HL7 interoperability standards from the HL7 Reference Information Model (RIM).The healthcare industries, policy makers and public should have education about the benefits of healthcare information standardization. It needs the promotion about the use of HL7 interoperability standards world-wide through the creation of HL7 International Affiliate organizations. Government need to encourage the domain experts from healthcare industry stakeholder organizations to join in HL7 for developing healthcare information standards in their area of expertise. Then it will collaborate with other standards development organizations and national and international sanctioning bodies (e.g. ANSI and ISO), to promote the use of compatible standards and also collaborate with healthcare information technology users to ensure that HL7 standards meet real-world requirements. [74]

Data ownership and privacy issue

Data which are reserved in private hospitals should not be shared with anyone. Data should be stored anonymous form. Before patients have their own data (prescription, diagnosis report), but being a middle income country sometimes they lost their data. So at the same time, their data should also be preserved in hospitals and private hospitals should be more careful about preserving their data. Sometimes, insurance companies can do business by using the patient's data [75]. So hospitals should be more careful about preserving the data. Because of socio- economic structure of Bangladesh, women, children, autistic child and the person who have any chronic disease (Acquired immunodeficiency syndrome (AIDS)) should be kept private their medical data. Otherwise, they face difficulties in regular life if people know about their disease.

Knowledge base

A good website can serve as a hub which will contain all medical related information. The website will hold names, specializations and contact details of all Bangladeshi doctors such as doctorola.com, Doctorbd.com, Healthprior21.com, Rx71. In October 2015, Doctorola has been launched officially. A huge numbers of doctors (near to five thousands) and hospitals (three hundred) has already been working with the company [up to December 2015]. [76] People are getting appointments of doctors through online. There is a website which have live chat option, mobile apps. To manage appointments and everything there is a call center. Appointment management is handled for a few hospitals in Dhaka by the startup. Doctorbd is largely a doctors' directory and appointment management system which is Started in 2004. It has database which have database of blood donor, information of hospital, information of medical institute, info of diagnostic center, clinics and kidney/eye bank. Appointments can be taken through online by Patient to their desired doctors. The online consultation is a great option where problems can be submitted by the patient to the chosen doctor and help is got within 24 hours. One of the earliest initiatives in the digital health space is Health prior. Health news and information is offered by the platform. Free medical books and videos can be gotten from e-library which is a part of e-appointment. E-appoinment also has an e-store. Doctors and hospitals directory can be provided

by a site named Rx71 by which patients can find doctors and hospitals. Appointment can also be made by it. A huge health related content in Bangla is building up by it. It has a vision to help people in living a healthy life by creating health awareness. It is also educating people on health issues. A mobile app has also launched recently by the startup. [76]It will help patient to find and reach their required doctor. It will also carry contact details of ambulance services and emergency medical equipments. There will also be contact details of all medical stores who can provide medicine in home delivery services. It will also contain the links of medical related apps. With the digitalization of Bangladesh, the number of smart phone user's increases and people are using various medical related mobile apps. So in the website there will be the numbers and rates in terms of using different apps.

Social networking

Now a day's people are using social Medias very usually. Social Medias can be used for medical awareness work. If there will be a social page or website where all patients of same disease share their survival experience then other patient will get inspiration for survive in case of severe diseases like Hepatitis A, Hepatitis E, Malaria, swine flu (H1N1), tuberculosis (TB), hepatitis B, cholera, meningitis, Ebola virus diseases, food-borne gastroenteritis, salmonellosis, and various types of cancer. There are some pages in social networking site and some websites. In those sites have a definition and the causes, symptoms and treatments of common diseases. There are information about various genetic diseases as well as infectious. There are full information of communicable diseases such as autism, strokes, skin conditions, eye disease, diabetes, cancer, heart disease.[77,78]When a patient suffers one disease, s/he has the exact information about that. The person who came back from the severe disease, his/her survival experience can motivate other patient for survival. As people of Bangladesh are being literate day by day, with the increasing literacy rate awareness in people are also increasing. Figure 6.1 is showing the increasing literacy rate of people. People are more conscious about their health issue [79].
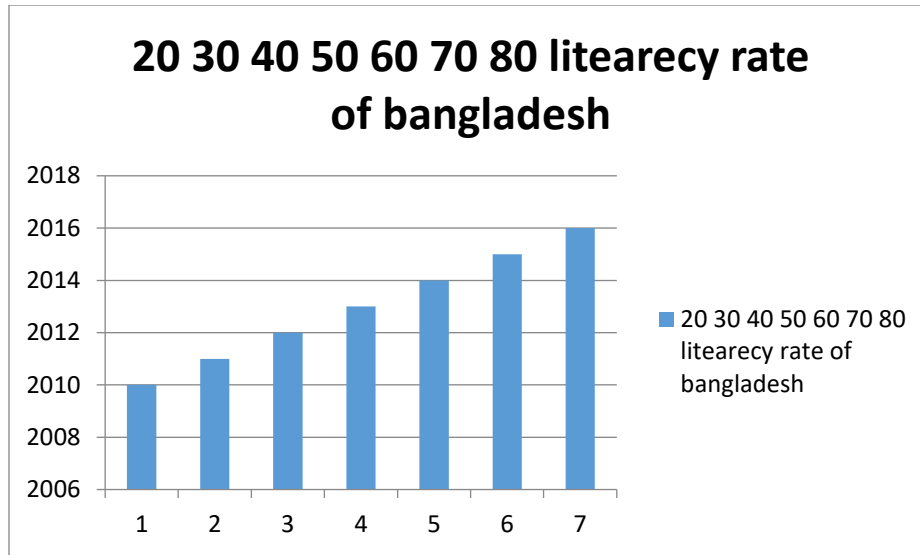
Figure 6.1: increasing rate of literacy in Bangladesh

In our country we are not totally developed. So our medical system is not sufficient for all over population. In case of some diseases we do not have the specialized hospital and privileges. So the all patients can raise their voice for hospital and other issues and they can make a group in social media for getting their wants. The patient can do pray to government for their wants.

Remote support for telehealth and telemedicine

Bangladesh Telecommunication Regulatory commission (BTRC) has published a report in which the total number of Mobile Phone subscriptions has reached 128.281 million till January 2017, and the total number of Internet Subscribers has reached 67.245 million till February, 2017. [80, 81] The table 6.1 has been giving the scenario of increasing rate of mobile users from year of 2012 to 2017. Thus, it is evident that uses of smart phone and internet is highly flexible in the context of Bangladesh.

Table 6.1: Increasing rate of mobile user in Bangladesh

Year	Mobile phone using rate in million
2017	141.679
2016	126.391
2015	133.72
2014	120.35
2013	113.784
2012	97.18

Therefore, touch screens and other technologies seem to be an acceptable idea. Rural population (% of total population) in Bangladesh was reported at 64.96 % in 2016, according to the World Bank collection of development indicators, compiled from officially recognized sources. [82] As we still do not have sufficient hospitals, telehealth and telemedicine are the solution of it. In our country a group of people think in the case of any silly diseases like normal virus fiver and flue they need consultations of specialized doctors. As a result, it is making a worse situation as we have not sufficient specialized doctors. The patients who need the specialized doctors really they are not getting proper treatment. For this case telehealth and telemedicine can be the best solution. We have some MBBS doctors who can give easily treatment in case of sufferings of common diseases.

e-health research

Every country has unique Geographic structure, culture and social views because of all uniqueness problems are unique. So we could not implement others countries research and problem solving strategies for our country. Our solutions should cover end user satisfactory level. Then we will retrieve maximum outcome.

CHAPTER SEVEN

CONCLUSION

As government of Bangladesh has made policy for implementing ICT in healthcare, it can be expected that in near future, people of Bangladesh will get completely electronic based medical system like other developed countries. Though we have tried to make a base line for initiating standard e-health record system in Bangladesh, there are many scope to work on it. The government has taken some initiatives and lunched some software for implementing e-health system in Bangladesh. But these software are not properly implemented yet in public hospitals. For the implementation, the data of the all hospital should be integrated. Data integration of hospitals is not an easy task and the scenario has been focused in this thesis. We also recommended some possible solutions considering the socio-economic and infrastructural facilities of Bangladesh.

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