

Telemedicine and IoMT: Its importance regarding healthcare in Bangladesh

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Abstract— Telemedicine is the process of having a remote diagnosis and medication with the help of technology. Besides, Internet of Medical Things is the use of different types of medical equipment and applications to provide health care services through internet. As a result, Telemedicine and Internet of Medical Things help a healthcare professional to keep track of patients in real time. It is also needed for a country to facilitate proper medical services to the deprived remote patients. In this paper, we have tried to unleash the need and use of Telemedicine and Internet of Medical Things. We have also tried to find out the prospects and importance of it in the context of Bangladesh. Hence, to make it more effective as well as trustworthy, the measures that should be imposed to overcome the current difficulties are also discussed.

Index Terms—eHealth, eMedicine, IoMT, Telemedicine.

1 INTRODUCTION

One of the most important basic needs of a human being is healthcare. It is also very important to avail healthcare facilities to the common people. However, there are some obstacles in this field and it is tough to overcome those overnight. In this situation, Telemedicine [1] and IoMT [2] help to improve the quality and availability of healthcare. In Bangladesh, it is essential to extend Telemedicine infrastructure and IoMT facilities.

This paper has three sections: Telemedicine, IoMT and its concernment on Bangladesh. In the first section, the definition of Telemedicine, related terms following the same procedures of Telemedicine are described. The benefits and drawbacks of Telemedicine are also pointed. The second section contains the description of IoMT, its positive and negative sides. The relationship and basic difference between IoMT and Telemedicine are also discussed in this section. The last section comprises of the importance and future scope of Telemedicine in the context of Bangladesh

2 TELEMEDICINE

Telemedicine, one of the best way to get healthcare from remote places is not a new method; Telemedicine first introduced in the 20th century.

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A healthcare system where healthcare professionals have the capability to evaluate, diagnose and treat a patient from a remote location and the patient has the ability to easily access the medical expertise quickly, efficiently and without any communications hazard with the help of telecommunication technology [3].

2.1 Telemedicine History

The term Telemedicine is new but it has been used an ancient method. It was first introduced in the 20th century. The first step in the history of Telemedicine is to transmit electrocardiograph data through the Telephone wire.

Television invention works like a magic in Telemedicine field. Nebraska Psychiatric Institute starts using TV link from the Institute itself to Norfolk State for education and training purposes [4].

After the invention of the cellular phone and widely used Internet Telemedicine became widespread. Its value in healthcare service and its advancement is increasing day after day. Its prevalence in healthcare helps to improve the civilian opportunity to get healthcare easily.

2.2 Classification of Telemedicine

Telemedicine can be classified into three categories. These are [5]:

2.2.1 Store and forward

Store-and-forward telemedicine process involves in acquiring data from a patient and then send the data to a medical professional to analyze it at a convenient time and of course in offline [6].

The main advantages of store-and-forward are that it does not require both patient and doctor to be present at the same time. This type of Telemedicine includes Teledermatology [7], Teleradiology [8] and Telepathology [9]. In this system, a health care person depends on the history report and audio or video information in exchange for a physical examination.

2.2.2 Remote monitoring

There are several terms we use to represent remote monitoring

such as self-monitoring or self-testing. In remote monitoring, the doctors, and the nurses use various types of electronic devices to monitor the patient and the patient has the capability to update the healthcare personnel on the exact schedule [10].

This type of monitoring is very efficient in chronic diseases as like as cardiovascular disease, diabetes mellitus, and asthma, however, there is some assumption about this method because the test that is conducted by the patient remotely may not be 100% accurate. Although there is a risk factor there are several advantages like a cost-effective, frequent monitoring and greater patient satisfaction.

2.2.3 Real-time interactive

Real-time interactive telemedicine works as real-time consultation but through an electronic device such as a computer, mobile or other interactive electronic devices [11].

Main advantages of real-time interaction are that it covers many activities such as history review, physical examination, psychiatric evaluations, Ophthalmology assessments etc. This method is the most convenient and an alternative to traditional in-person consultations.

2.3 Participants Categories in Telemedicine

Telemedicine participants can be categorized as follows [12]:

- a. *Healthcare Personnel to Patient*: This type of audience is far away from the hospital and communicate with their doctors via communication media.
- b. *Healthcare Personnel to Healthcare Personnel*: This is the type of communication where two healthcare personnel share their ideas and learn from each other where no patient is included.
- c. *Distant and contiguous Healthcare Personnel to Patient*: In this type of communication occurs when one physician communicates with a patient via the communication media and another physician physically present there. This is very helpful for patients because it helps them to understand how to operate Telemedicine devices because one of the healthcare personnel presents there. Another advantage is that it helps to operate a physical examination if needed, that is impossible otherwise.
- d. *Students in healthcare*: Future healthcare personnel is the most beneficiary of Telemedicine because they have the opportunity to get education remotely and at the same time they treat the patient voluntary basis.

2.4 Fields of Telemedicine

The scope of Telemedicine is quite large and this includes:

2.4.1 Telenursing

Telenursing [13] is the type of nursing, where the nurse is far away from the patient and provide nursing services via information technology. It has been popular in many countries because of some reasons. These are:

- Increasing the cost of healthcare
- Increasing aging ill people and
- Hard to find appropriate healthcare in remote areas

2.4.2 Telepharmacy

Telepharmacy is the service where different types medicine

and various pharmaceutical services are delivered by using telecommunication technology. Telepharmacy also used for educational purposes as like as training to how to manage a pharmacy and other educational purposes.

The main advantages of Telepharmacy are that it gives access to the rural people or the people from the remote area where pharmaceutical care was not previously available to them. There are some disadvantages despite its broad benefits such as the cost of Telepharmacy is quite same as average pharmaceutical care.

2.4.3 Telerehabilitation

Telerehabilitation is a rehabilitation service where rehabilitations are provided by an electronic medium. Another popular term used to describe Telerehabilitation is also termed as e-rehabilitation [14].

Telerehabilitation is divided into two categories. They are:

- a. Clinical Assessment
- b. Clinical Therapy

Telerehabilitation is widely popular in the following fields:

- Neuropsychology
- Pathology of speech-language
- Audiology
- Occupational therapy
- Physical therapy

2.4.4 Teletrauma care

Teletrauma Care is the type of care where the trauma specialist gives treatment to the personnel who is severely injured or in disaster situation through the Internet or telecommunication devices [15].

2.4.5 Telecardiology

Telecardiology is the modern way of providing clinical support to the people who suffered from heart diseases. In Telecardiology, doctors provide medical services by using electrocardiographic datum through electronic media or via the Internet [16]. The advantages of Telecardiology which makes it become more popular are:

- Provides clinical training to average practitioner
- Less consulting times
- Reduce cardiac failure and
- Long-term coronary heart disease monitoring

2.4.6 Telepsychiatry

Telepsychiatry is a term used in Telemedicine to describe the way of providing readily accessible, convenient and affordable- Psychiatric health services via telecommunication especially via video conferencing [17]. Fields where Telepsychiatric applications are most needed:

- Military
- Correction centers
- Educational Institute
- Long-term Psychiatric problem monitoring.

2.4.7 Telepathology

Pathology practice among different locations by using modern communications technology is called Telepathology [18]. Telepathology can be divided into three categories. These are:

- a. Static image-based
- b. Virtual slide and
- c. Real-time based systems

There are some advantages of Telepathology. Some of which are:

- Operation of Telepathology system is less expensive
- Available second options for healthcare provider and
- Doctors and pathologists can communicate from a remote distance

2.4.8 Advanced Telemedicine (Telesurgery)

Telesurgery is the most advanced process of surgery where there is no physical contact between doctor and patient, however, the surgery is done by a remote robot and that robot follows the instructions of the surgeon who is responsible for the surgery [19]. Applications of Telesurgery is given below:

- Training of new surgeons
- Performing surgical training for developing countries

2.5 Advantages of Telemedicine

There are various advantages of Telemedicine. Some of them are described before and few of them are listed below:

- 24/7, 365 available service is the most appreciated service of Telemedicine
- Less possibility of the reservation cancellation
- Cost efficiency
- The fewer possibility of contagious diseases
- The less waiting time
- Most effective in emergency situations
- Cost-effective
- Works as second eyes for Doctors and Nurses.

2.6 Drawbacks of Telemedicine

Telemedicine is the blessing of the century. However, it has some limitations which we may call disadvantages. Some of the limitations are listed below:

- Tough to handle the big stuff
- The level of trust may be lower
- Rural areas are still out of Telecommunications
- 3G data connection is still costly
- Frequent change of technology
- Consultation privacy is a big question.

3 IOMT-INTERNET OF MEDICAL THINGS

IoMT (Internet of Medical Things) is a healthcare system where various types of medical hardware devices which are connected via the Internet especially through Wi-Fi give the privileges to the machine to machine communications. In other words, it called Healthcare IoT [20].

3.1 Possibilities of IoMT

IoMT gives us the opportunity to get a better quality, higher personalized and cost-effective healthcare services. Basically, IoMT offers various healthcare support via connected devices. There are lots of advantages of IoMT, some of them are listed below:

- Cost Effective-IoMT gives the opportunity to the pa-

tient to get healthcare services by their connected devices. It reduces the hassle to wait in front of the doctor's chamber. The patients can get the consultation remotely.

- Foster Treatment Results-Connected devices provide a real-time observation of the patient that helps to improve the result of the medication.
- Effective Disease Management-IoMT enables devices to monitor a person 24/7, which sends the frequent data about the person's health. This data helps the health care personnel to take an advanced decision about the upcoming diseases. It prevents diseases from spreading out in a certain area.
- Shrink Errors-Though all the data and the patient must be under surveillance that's why there is less chance to make errors.
- Ameliorate Experience of Patient -IoMT emphasis on the needs of patients because of proactive treatment, increasing accuracy and most importantly timely intervention by doctors which help to build patient trust and improve the quality outcomes of treatment.
- Improved Drugs Management-it help to improve the supply chain management of drugs.
- Innovations- IoMT is all about real-time supervision and automated results that help physicians to get decision not only that it is the key to new innovation in healthcare services.

3.2 Limitations of IoMT

IoMT requires wearable devices which are connected via Wi-Fi. The main problem is that Wi-Fi is not available everywhere and the devices are still expensive and out of reach. There are several other things that we have to consider. The most important issue is to consider the security of the data because healthcare data is sensitive and if it leaks then it will hamper the personal life even spoil the career.

Another thing is IoMT requires a hybrid cloud environment. It is tough to maintain the cloud security.

4 DISHARMONIES BETWEEN TELEMEDICINE AND IOMT

Telemedicine and IoMT both have a common service and that is to improve healthcare service and make it available to all class of people and both prohibit face to face doctors visit. Therefore, a question arise, is IoMT and Telemedicine is same [21]? In some cases, it acts identical but it is not the same method.

Telemedicine there must be some healthcare personnel who monitor the situation as well as give advice to the patient as required. It does not require any special devices or a special form of Internet. It just needs telecommunication services and there is always another person on the opposite side to respond.

On the other hand, IoMT is all about the device. It requires a special device in which it is embedded a system that helps it to take a decision about the situation. Not only that all devices require high-speed connectivity and access to cloud network to send their data for further analysis. Basically, IoMT is a broader idea whereas Telemedicine is a part of it.

5 BANGLADESH AND TELEHEALTH CARE

5.1 Healthcare in Bangladesh

Bangladesh is a small country of only 147570 SQ km with 152 million people. It is one of the densely populated countries in the world. The density is 1319/sq km. Literacy is about 75.4% where the male literacy rate is 77.1% and the female literacy rate is almost close which is around 71.5%. Here in Bangladesh, around 56% people use hygienic sanitation [22].

TABLE 1
BANGLADESH BASIC STATISTICS [23]

Criteria	Value
Area (sq. km)	147,570
Population density (per sq. km)	926
Crude birth rate (per 1000 population)	19.2
Crude death rate (per 1000 population)	5.5
Life expectancy at birth m/f (2011)	67.9 /70.3

However, it has some limitations in it's for huge populations healthcare. The table below describes the overall healthcare scarcity in Bangladesh.

TABLE 2
HEALTHCARE STATUS IN BANGLADESH [24]

Criteria	Total Number
Number of Population	152 million
Number of Govt. Hospital	678
Number of Private Hospital	1005
Number of Doctors	69000
Number of Dentists	7000
Number of Nurses	26644

So, there is a huge gap between the number of population and the healthcare facility. The table below shows a comparative status of the healthcare facility in Bangladesh.

TABLE 3
HEALTHCARE FACILITIES IN BANGLADESH [25]

Facility	Current Ratio	World Ratio
Hospital Bed (per 1000 people)	0.58	2.9
Physicians (per 1000 people)	0.4	1.539
Nurses	0.2	3.28
Health expenditure per capita (USD)	31	1060
Health expenditure total (% of GDP)	2.8	9.945
Health expenditure, public (% of total health expenditure)	27.9	60.128
Community health workers (per 1,000 people)	0.334	-
Out-of-pocket health expenditure (% of total expenditure on health)	66.976	18.154

All the data describes the scarcity of healthcare in Bangladesh. So, to meet the need of common people's choice Telemedicine is the most effective solutions.

5.2. Current status: How Telemedicine helps to improve healthcare in Bangladesh?

Bangladesh is growing market for mobile phone subscriber. Here the table shows the relative figure of the total number of the mobile subscriber in Bangladesh.

TABLE 4
TOTAL NUMBER OF CELLPHONE USERS [26]

Network Provider	Total Subscribers (million)
Grameenphone Ltd.	58.689
Banglalink	31.309
Robi	26.443
Airtel Bangladesh	8.049
Citiyell	0.00
Teletalk	3.791

So, it's very clear now that Telemedicine has the highest possibilities to become one of the main branches of healthcare in Bangladesh and that's the main reason for all the cellular network providers and also, the government to promote Telemedicine.

In Bangladesh, healthcare is out of reach from common people. So, here telemedicine works like a magic. Telemedicine helps the people from a rural area to communicate with doctors who live in the capital city.

There are some success stories about Telemedicine in Bangladesh. One of them is Grameen phone healthcare services. It is one of the popular rural health care services by whom a person from a remote area can easily connect to a specialist doctor by using a small money, however, not only Grameen phone but also Banglalink, provide the same services which are known as the HealthLink and also other companies provide the same services.

Local government also helps a lot to Telemedicine. Recently Bangladesh government open a hotline 16263 to provide healthcare services for people who live in a remote area and need emergency support.

There are some private organizations called NGO such as BRAC [27] is a pioneer to provide Telemedicine in the rural area to improve maternity healthcare.

Therefore, till there is some problem in Telemedicine field as there is no suitable method of payment is available in Bangladesh. Today BKASH [28] or other mobile payment service is very popular over the country but still, people suffer from a convenient payment system.

Because of Telemedicine, it is very easy for unprivileged people to get doctor's help from anywhere and any moment.

5.3. Future of Telemedicine in Bangladesh

The total number of Smart Phone user in Bangladesh is still growing at a high rate, highspeed Internet connection is nearly available all over the country and becoming available by means of 3G. That gives us the opportunity to see a bright future of Telemedicine here in Bangladesh.

Today, IoMT (Internet of Medical Things) get popularity and it needs wireless Internet as like Wi-Fi. Though the Internet is available in Bangladesh, however, Wi-Fi is still hard to find at every corner in Bangladesh. It is an obstacle for the future of Telemedicine future and also there is a problem when we talk about video conferencing because of the conservative social system.

6 CONCLUSION

Telemedicine is the future healthcare. In Bangladesh, Telemedicine is badly needed to spread because of its huge population and limited resource in healthcare. Therefore, Telemedicine and IoMT is the most effective solution to improve healthcare services and its government duty to remove the barrier.

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