

Systematic Review of Telemedicine Technology and Its Future Impact in Bangladesh

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Abstract - This paper is the systematic review of peer-reviewed research papers and research journal articles about telemedicine technology and its future in the Bangladesh context. Telemedicine technology, Clinical applications, Communication technology, Wireless technology, Modern tools in telemedicine are mainly needed to describe for a better understanding of the telemedicine area. Although uses of telemedicine at all over the world are increasing day by day, still now in Bangladesh it is a matter of concern because of its quality, services, and effectiveness. In this paper, we will show that the available research on telemedicine are failed to provide satisfactory specifications of the exact telemedicine technologies and to explore perfect technologies in depth and also the generalize satisfaction with telemedicine technologies are needed to improve because of deficiencies in the methodology of the current standard. We will describe all the technologies and then propose a new pathway of telemedicine for the future of Bangladesh. All technologies will be in the same article and compare it with future scope for using in Bangladesh.

Keywords - *Telemedicine, Technologies, Applications, Systematic review, Effectiveness, Future of Bangladesh.*

1. Introduction

To provide clinical health care from distance telemedicine is used in telecommunication and information technology sectors. It overcomes distance barriers which improve access to medical services that are not available in distant rural communities. For this, technologies are playing a great role to serve the patients. For economic and social development, recent advancement of Information and communication technologies (ICTs) play vital roles. Telemedicine provides services on all the time of a day. Through technologies, a patient can directly get medical facilities even if he lives in a rural or remote area. Telemedicine is obviously a hopeful cost-effective and reasonable alternative that has been displayed to impede deaths and uplift functional recovery [1].

Telemedicine commits a great possibility of providing remarkable improvement and cost-efficient ingress to the quality of health care facility to the unprivileged communities [2]. Furthermore, ICT is not widely used in the health care sector in Bangladesh. But we can say uses of telemedicine will make a notable contribution to the betterment of the health-related sector and surely improve

the present situation [3]. Bangladesh has successfully launched her first satellite & this satellite will bring enormous development in the telemedicine sector in Bangladesh. It opens the door of Telemedicine. Technology has not been introduced significantly in the health care sector to provide perfect services though the government of Bangladesh is trying to focus on that field to help with the help of non-government organization [4]. Many books and papers focus on the transmission of medical information over wireless networks and presents topics such as communication networks and its services such as monitoring of the patient, processing of information, deployment of the system, security of data and privacy of system with data, and so on.

Basically, we focused on the popular technologies used in telemedicine in recent time. MEMS (Micro Engineer Machine Systems), Data integrity and validation, knowledge robots, Human-machine interaction, technology transfer are the focused area for technological aspects of telemedicine [5, 6, 7, 8]. We will focus on Medical Information Websites, Mobile Apps, Live Video and Audio Conferencing, Remote Patient Monitoring Equipment, Secure email etc. types technologies in our

work. In this paper, we argue that the researches which are available fail both to provide satisfactory specifications of the exact telemedicine technologies and to explore perfect technologies in depth and generalize satisfaction with telemedicine technologies are needed to improve because of deficiencies in the methodology of the current standard. To support this aspect, we have tried to provide the consequences of a systematic literature review of research into the telemedicine technologies and its future in Bangladesh.

2. Literature Review

To attain our research aspect, we reviewed many research articles and journals, conference papers, magazines, books and also visited different sites related to telemedicine technology. In addition to that most up-to-date journals are discussed in this part with their weaknesses as well as strengths.

Internet-based telemedicine is proposed by Hasan, Jahidul considering the cost and accuracy [9]. In this paper, they focus on the importance of implementing telemedicine applications in Bangladesh with recent technologies. They propose an internet-based cost-effective optimal solution with video conferencing system using the digital camera, the digital scanner, color television, and computer. They illustrate cases from the Diabetic Association of Bangladesh.

M. Sanaullah et al. [3] proposed existing fiber optic telemedicine network architecture is the backbone of Bangladesh. They have also presented telemedicine overview in Bangladesh perspective which is more rigorous, cost-effective and speedy model. Its applicability to communicate between patient and doctors is also shown in this paper. According to this paper, the telemedicine network architecture can be linked with WBAN with the internet of the mobile system network.

This research was conducted by Johnston and others titled "The cost-effectiveness of technology transfer using telemedicine" described transferring system between South Africa and United Kingdom (UK) using teleophthalmology can be possible as a mode of technology. This paper has reported on the practitioner's convenience and cost-effectiveness surround a technology transfer project using teleophthalmology to provide advice of a specialist to practitioners in South Africa. For a developing country, the set-up costs were the biggest proportion of the entire costs. On the other hand to make in the health care system an entire set-up cost of around £27000 can be seen as an unpretentious investment for an

industrialized based country [10]. This research project shows using telemedicine to transfer technology to help the capacity raising in the health care systems is a cost-effective way for wealthier countries than poorer countries. Pavlopoulos et al. [11] developed a portable medical device uses GSM mobile telephony that links and allows the acquisition and transmission of requisite biosignals, bidirectional telepointing capability and still images of patients which is worked for emergency telemedicine applications. And also allows the paramedics to work in a hands-free mode enhances the system functionality of an advanced man-machine interface, while receiving data and communicating with experts in a hospital. This was successfully exhibited in 4 European experimental sites.

An article by Perednia et al. titled "Telemedicine technology and clinical applications" said that the medical community should exercise telemedicine as both a means of communication and a new diagnostic or therapeutic modality. Proper skepticism and caution should be matched by the decisive implementation when there are well-defined opportunities to serve distressed populations. Research into safety, efficacy, cost-effectiveness, and satisfaction must be a high priority, and providers should be kept up to date with telemedicine developments [12].

The authors Enrique DorrnoroZubiete, Luis Fernandez Luque and Ana Veronica described current systems embodiments in the WSN domain and there were several applications that concentrate on telemonitoring and fall detection using wireless technologies like BlueTooth or ZigBee [13].

A review paper conducted by Pamela Whitten and others suggested that delivery of healthcare via telemedicine is satisfactory to patients in a variety of situations, but, by addressing this point in a rather perfunctory way most studies have raised numerous questions than answers [14].

3. Proposed Methodology

To identify telemedicine technologies and its future in Bangladesh several studies we have investigated like INSPEC, MEDLINE, PROQUEST, EMBASE, CINAHL, TIE which is known as the Telemedicine Information Exchange database. Covering up the problems, we here proposed a new affordable, cost-effective and easy technology methods which can be used by everyone. We proposed "Minimum Cost Doctor Service over Video App" developed for smartphones or any handheld device. This application will help everyone for consulting a doctor easily just a simple click on the "Call" button on the screen. The architecture of minimum cost doctor service

over a video calling app for consulting a patient using the internet is shown in Fig. 1.

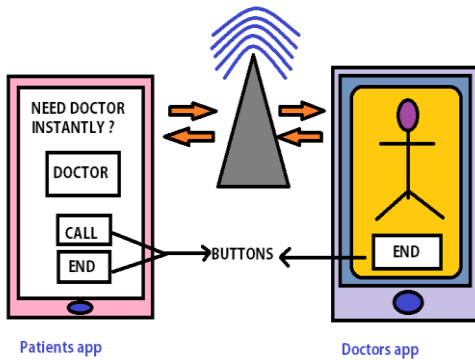


Fig. 1 Proposed Android App run in Mobile Devices

It originates with the hypothesis that someone, i.e. a patient who is suffering from fever does not need to go to a doctor for initial treatment. He/she must have the app already installed in his/her device. Then he/she just open it with an internet connection and press the call a doctor button. On another side, a doctor will receive the video call on this preinstalled app into his/her smartphones with having a proper internet connection. After finishing observation doctor directly send prescription via SMS. This will help the doctor to see a patient from home. This app will be the most user-friendly and free for download so that every smartphone user can easily download and use it without any age barrier.

4. Implemented Technologies

Bangladesh is a densely populated country. The population density of Bangladesh is higher than in neighboring countries India (nearly three times) and almost five times that of Pakistan. Because of the huge population in Bangladesh, almost 1142 people per sq. Km live. If we look over the internet subscribers in Bangladesh then we can see that almost 90.501 million subscribers who use the internet continuously. According to the Bangladesh telecommunication regulatory commission, mobile internet subscribers are increasing day by day. Analyzing statistics in this field it could be mentioned that mobile internet subscribers are extending that shown in TABLE 1.

Table 1: The Internet Subscribers (Data At The End Of August, 2018) [18]

OPERATOR	SUBSCRIBERS (Million)
Mobile Internet	84.685
WiMAX	0.083
ISP + PSTN	5.733

If we can develop a proper telemedicine architecture then it can be possible to utilize these huge internet subscribers for the betterment of the healthcare sector of Bangladesh. Union Information Service Centre performs a great role in telemedicine sector. Here we have shared an exact number of UISC's and some of the related sectors who brandish telemedicine in Bangladesh below in TABLE 2.

Table 2: Number Of Uisc's With Some Of The Related Sectors

Total UISC	4501
Solar panel based UISC	1013
The Laptop with Internet facilities	2000
Community Health Clinic	11000

There are so many telemedicine technologies found in the recent era. Some of these are currently applicable and available. We discussed some of the popular technologies in telemedicine in this review article.

By searching technology in telemedicine, we found Voice and data communication facilities (email via VHF radio) were successfully installed in a very few numbers as thirty-nine previously unfastened health advantages in Peru. The government of Bangladesh is providing high-quality telemedicine services in different levels of hospitals. Among these, there are 2 reputable hospitals named National Institute of Cardiovascular Diseases and Bangabandhu Sheikh Mujib Medical University, 3 district hospitals in Gopalganj, Nilphamari and Shatkhira including 3 sub-district hospitals in Pirgonj, debhata and Dakope provide telemedicine services. Patients who are admitted to different districts and sub-districts level hospitals can receive advice from experts from specialized hospitals instead of going to the renowned hospitals. A huge number of web-camera has been given in each district including sub-district, different medical college, and different post-graduate institute hospitals. Therefore, these hospitals can provide telemedicine services easily by using some of the video conferencing platforms such as Skype. Bangabandhu-1 satellite has opened the door of advanced technologies for use in telemedicine and other sectors with high-speed internet.

The videophone technology to provide directly observed therapy called DOT program cognized a muscular cost saving. The entire cost for per 5 units of the total videophone equipment was \$1000. During 304 doses of treatment, fidelity to videophone DOT was 95%, and acceptance of the technology by the patient was tremendous. And they say videophone technology use can sustain a high level of cling to DOT in a cost-efficient

manner in selected cases. Micro Engineer Machine Systems (MEMS) which is another form of nano-technology presents some new possibilities for telemedicine. Another review suggests either still telemedicine implementation service is not a part of conventional health services, or it is not being reported in the peer-reviewed literature. And the quality and the depth of data sets were variable on studies, minimizing the generalization ability. Planning strategies and implementation of services and reports should be induced. To understand how to implement sustainable services, given speed technology-driven environment of telemedicine may enable others. Another review reported that, at the moment, the most reliable published proof on telemedicine effectiveness which deals with teleradiology, tele-neurosurgery as transmission of computed tomography images before transfer of patient, transmission of echocardiographic images, telepsychiatry and the use of electronic referrals enabling email consultations and video conferencing within primary and secondary clinical care providers [17].

On the other hands, some of the research articles describe the Technology Acceptance Model (TAM). Davis developed a model named Technology Acceptance Model (TAM) to describe computer-usage behavior. The theoretical grounding for TAM is Fishbein and Ajzen's theory reasoning action (TRA). According to TRA, attitudes influenced by beliefs which in tum lead to intentions after that generate or guide behaviors. Belief-attitude-intention-behavior relationship to an IT user acceptance model is adapted by TAM. Provide an explanation is the main goal of the assessor of computer acceptance generally, capable of defining user behavior across a wide range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified. There only a few numbers of hospitals have successful telemedicine technology with a very less amount of uses and they are Birdem general hospital, Ad-din medical college hospital, Telehealth365 Bangladesh, Apollo hospital and popular diagnostic and Medinova medical services.

5. Comparative Analysis

Only a few numbers of hospitals in Bangladesh have telemedicine technology. It is very costly and the equipment for accessing telemedicine technology is not affordable for hospitals in Bangladesh. One of research journal said there are two mechanisms for telemedicine in Bangladesh. But here we got the exact number of mechanisms- Teleconferencing, Videoconferencing, Store and Forward.

It also looked over the tools and trades, machines and also described future in telemedicine. But it could not give us exact concept on the tools. Here we found there are some of the companies who provide telemedicine services in Bangladesh such as E-health solutions, DGHS-Telemedicine service, DU Telemedicine, Grameenphone mobile operator- Tonic, Banglalink mobile operator-Healthlink, Robi mobile operator- RobiShassthosheba, Airtel mobile operator- Airtel Shasthosheba. So, we brought out the telemedicine providers who are trying to meet people with technology. Our article describes all telemedicine technologies and providers that no other reviews couldn't give that. Prior to this knowledge, we proposed a comparative analysis here. A comparative analysis of research reviews in telemedicine technology is shown here in TABLE 3. From this comparison table, we can understand which technology is possible to implement our country based on different issues. Here, a total of nine technology is listed to determine the implementation possibility in Bangladesh.

VHF radio technology is not possible to establish in Bangladesh and it is not cost-effective. Video-dot and Standard-dot technologies are also can't be possible to run. On the other hand, they are not cost-effective and successful. To represent new opportunities for telemedicine, Micro Engineer Machine Systems (MEMS) and other forms of nanotechnology are introduced [6]. But it is very costly and can't be possible to successfully run in Bangladesh. Knowledge Robots can open new opportunities in telemedicine but it is highly expensive to implement and right now it is not possible to run in Bangladesh but in future, it may be possible. Using mobile calls directly is a very expensive method. A research work by Md. Rakibul Hoque et al. [4] said in May 2009, mHealth which is named as Health Service through the cellular network was recognized by the ministry of health in each of all district hospitals and Upazila level hospitals of Bangladesh. But govt. could not run the program for a long time.

Table 3: Comparative Analysis Of Research Reviews In Telemedicine Technology

WORK DONE	OBJECTS DEALT WITH (DOMAN)	COST EFFECTIVE	SUCCESS	POSSIBLE IN BANGLADESH
1	VHF- Radio	NO	NO	×
2	Video- DOT	NO	YES	✓
3	Standard- DOT	YES	YES	✓

4	MEMS	NO	NO	×
5	Mobile Network	YES	YES	✓
6	TAM	YES	NO	✓
7	Artificial Intelligence	NO	NO	×
8	Transfer-Technology	NO	NO	×
9	Wireless Network	NO	NO	✓

Wireless Sensor Network technology is not an easy process to use and has security use. So, it is difficult to maintain and implement in health sector properly.

In the developing world, Email telemedicine link and the CRP digital camera is model for furthermore telemedicine related projects. In Bangladesh, for our patient management at CRP, telemedicine has provided tremendous support [15].

The transferable Technology for the use of Teleophthalmology proposed by k Johnston and the team cannot be applicable for Bangladesh. Though it is cost-effective the success rate of using it very low in South Africa where it was used. Technology Acceptance Model (TAM) proposed by Paul J Hu and team is cost-effective and can be possible to establish is Bangladesh but its success rate was very low. There have lots of limitations in a clinical way. However, for illustrating the telemedicine technology acceptance by the medical practitioners, we evaluate 408 physician's data collections and the utility of TAM. The results recommended the general capacity and applicability of TAM in this known context as indicated by reasonably goodness-of-fit indexes for the model [16].

Portable tool kit designed by Uzzal Kumar Prodhon and team was cost-effective but it had lots of limitations for diagnosing a patient because it could not identify all kinds of diseases with their tool kit. So, it failed in success rate.

6. Conclusion

By this systematic survey of the literature on the telemedicine technology systems, we see only 20% shows actual telemedicine technology, and publications that we searched, only 2 used material experiments. To determine technical parameters, the vast majority used subjective measures. No research work meets perfect systematic review of the entire end to end system. Therefore we have evaluated and proposed an evaluation method based on objective testing.

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