COVID-19 PANDEMIC AND AI-BASED TELEMEDICINE IN BANGLADESH: A COMMUNICATIONAL ANALYSIS

Written by ***Abdullah-Al Mahmood* & Salauddin Ahmed*****

** Masters in Information and Communication Technology (MICT), Bangladesh University of Professionals (BUP), Dhaka, Bangladesh*

*** Independent Researcher and Content Marketer, Virtunus Inc., Middletown, Delaware, USA.*

ABSTRACT

Telemedicine, a modernized method of providing equal healthcare services to people living in urban and rural areas, is not a new thing. Developed countries have already adopted this technology for years and are moving forward for the next big upgrade in healthcare called Artificial Intelligence (AI). The term "AI based Telemedicine" is relatively new for countries where sufficient use of technology in the healthcare sector is infrequent. That the implementation of telemedicine started long ago in many underdeveloped and developing countries remains as an ornamental thing for most of them. Just in the recent past after the global pandemic spread out, countries like Bangladesh and others realise, telemedicine is a highly anticipated method of providing healthcare service effectively and remotely. A surge of fear and consternation strikes people throughout the world over fast transmission of coronavirus and becomes riskier for patients to go to a doctor or hospital which includes COVID-19 positive ones too. Thus telemedicine becomes imperative for help seekers in Bangladesh where the ratio of patients and doctors are inadequate. Improvement of Information & Communication Technologies (ICTs) and implementation of AI-based machine learning techniques create a huge change in the world of telemedicine. In Bangladesh, different government and non-government organizations were working on telemedicine-based solutions for the last decades but advancement of telemedicine has got hyped during the outbreak of the novel coronavirus pandemic. This paper analyzes the applicability of AI-based telemedicine in

Bangladesh and explores the challenges, difficulties and future scope of its inclusion within existing health care services.

Keywords: Pandemic, COVID-19, Artificial Intelligence, AI in healthcare, Telemedicine, Bangladesh, Coronavirus, Telemedicine users, ICTs, Online platforms, Website.

INTRODUCTION

One of the biggest achievements and felicity of ICTs[i] is telemedicine. This e-business[ii] service can become the next big thing to maintain and develop societies in developing countries like Bangladesh. Blending this promising e-service with more advanced technology like AI[iii] Based machine learning can be proven as the cherry on the top.

Artificial Intelligence is a vast term that can be simply described as a method by which machines can automatically get adjusted to new inputs and perform tasks that humans can accomplish. (Artificial Intelligence – What it is and why it matters, n.d.). When AI gets integrated with Telemedicine it becomes more efficient, user friendly and cost effective to the distant users.

A process that uses electronic communication to integrate authorised medical doctors to consult with patients from distant places is known as telemedicine. It is also able to share individual patients' medical information with healthcare practitioners for better service.

The implementation of this new system in any sector is not an easy task especially if it relates to something as sensitive as the healthcare sector. In a developing country like Bangladesh, inclusion of new ways of healthcare support depends on economic circumstance, geography, transportation and communication system. Socio-cultural factors and political conditions are included in this criteria.

Majority of Bangladeshi people live in rural areas. According to a report of the World Bank which is published in Tradingeconomics (2019), 62.6% of the total population of Bangladesh lives in rural areas.

Shortage of doctors not only in rural areas but even also in urban areas the numerical gaps between doctors and patients is high in Bangladesh. But providing medical care is in the constitutional obligation of the government of Bangladesh.

Second goal of national health policy (2011) stated "To develop a system to ensure easy and sustained availability of health services for the people, especially communities and urban areas"

This situation even gets worse when the pandemic of COVID-19 caused by SARS-CoV-2 has become a global concern due to its outbreak in early 2020. (Who.int. n.d.) Where people around the world were receiving telemedicine services both from government and non-government organizations, Bangladesh faced difficulties to utilize the full benefit of telemedicine which became essential in the time of pandemic crisis. (Hoque, 2014, Ahmed, 2014, & Bullock, 2017)

Several attempts have been made to initiate and implement project-based telemedicine service through different organizations to provide services in remote areas of Bangladesh from the late '90s of the past century. (Nessa, Ullah and Kwak, 2009)

The initiative to implement telemedicine In Bangladesh was first taken by the charitable trust named Swinfen Charitable in 1999 (Vassallo, Hoque, Farquharson Roberts, Patterson, Swinfen, Swinfen, 2001)

The Government of Bangladesh took necessary steps to develop the overall infrastructure of the internet to boost up the process of e-health locally. In 2006 Bangladesh got connected to the submarine cable network of SouthEast Asia-Middle East-West Europe. (Prothomalo, 2017). In the previous few years, ICT infrastructure of Bangladesh also saw a large improvement.

All of the development and infrastructure improvement did not work as expected when the outbreak of COVID -19 started spreading in Bangladesh. First three confirmed cases of COVID patients were reported on 8 march 2020 by the local epidemiology institute named IEDCR. (Who.int. 2020)

Fear of this coronavirus grows on people and it becomes riskier for them to go for any kind of treatment physically. Online Based healthcare support, especially telemedicine platforms appeared as a solution in that pandemic crisis time.

Some government, non-government institutions and voluntary groups came up with healthcare services through virtual platforms in that situation. Organizations like Enzaime Bangladesh[iv] tried to push the limit to the next level. They included AI into their telemedicine platform to make it more efficient and user friendly.

The aim of this commentary was to describe the importance of AI-based telemedicine, while COVID-19 pandemic outbreaks in a developing country like Bangladesh. It's also been described here how effective use of AI-based telemedicine can reduce medical errors and cost, increase productivity, patient satisfaction and better management.

LITERATURE REVIEW

Medicine, Treatment & Prescription

The progress of science has revolutionized the social perspective in every point where medicine is one of them. Depending on many artificial things has drastically changed the lifestyle of human beings that makes them suffer from various diseases for lack of a proper immune system. Usage of medicine has been continued for thousands of years to cure people from their health issues. Diseases recognized as different things in history like witchcraft and sometimes even called as the willpower of God (Williams and Michael 2013).

Believed as the regulator for every disease and cure of life, medicine can be described in many ways. According to Goldberg, Ragland, and Distelzweig (2016), medicine is not only the treatment but also the prevention of disease that includes practice of diagnosis with promotion of health as well. Medicine has been discovered in several regions with different types of medical practices including Greek, Roman, Ayurveda, Egyptian, Babylonian and few more. Ancient people of Greece believed in herbal treatments and had faith that treatment was the healing of God (Perlman, 2013). According to Stanley (2015), methods of Hippocrates[v] were followed and modified by other practitioners over time. Aristotle and Plato, the famous Greek practitioners of all time, started researching and studying internal parts of the human body.

Prescribing medicine, a formal communication system, is made by a physician to a pharmacist that often abbreviated as ℞ or Rx. The term prescription refers to handwritten or computer printed instructions from doctors into pads or authenticated paper. Advancement of technology

facilitates the prescribing system; Therefore, physicians can prescribe treatment or medicine via computer over the internet. Electronic prescribing involves doctors using computers containing extensive drug information to help choose and order the right medications for particular conditions. Comparatively an error-free and easily understandable prescription, e-prescription, a technological framework, allows healthcare experts to send prescriptions to a pharmacy, instead of using faxed notes and can be sent directly to the patient and to the pharmacy.

Disastrous Disease: COVID-19 Pandemic

Medicine, treatment, and prescribing have evolved with time and got advanced. Simultaneously, diseases have evolved for the past thousands of years and various diseases have attacked humans. For over centuries humans faced natural disasters, environmental changes and most diseases that wiped up millions of them. These diseases impact mankind, few of that horrified diseases are: The Athenian Plague, The Justinian Plague, The Black Death, "Spanish Flu" Pandemic, New World smallpox, Great Plague of London, The cholera pandemics, "Swine Flu" or H1N1/09 Pandemic, and COVID-19 Pandemic.

The deadliest pandemic COVID-19 caused by the novel coronavirus has begun in late 2019 from Wuhan, China and spreads like a flame of fire to the world. In march 2020 WHO[vi] declared it a global pandemic and till April 2021 total infected rises up to 146,242,308 and deaths are 3,099,618 (Worldometers.info., 2021). Past pandemics made people concerned about how to defeat the disease with innovative methods and new sorts of medicine. The age is advanced enough and many new innovations are ready to support people in the pandemic phenomenon. One of the innovations that has proven helpful in times of pandemic is Telemedicine.

Telemedicine: New Form of Treatment

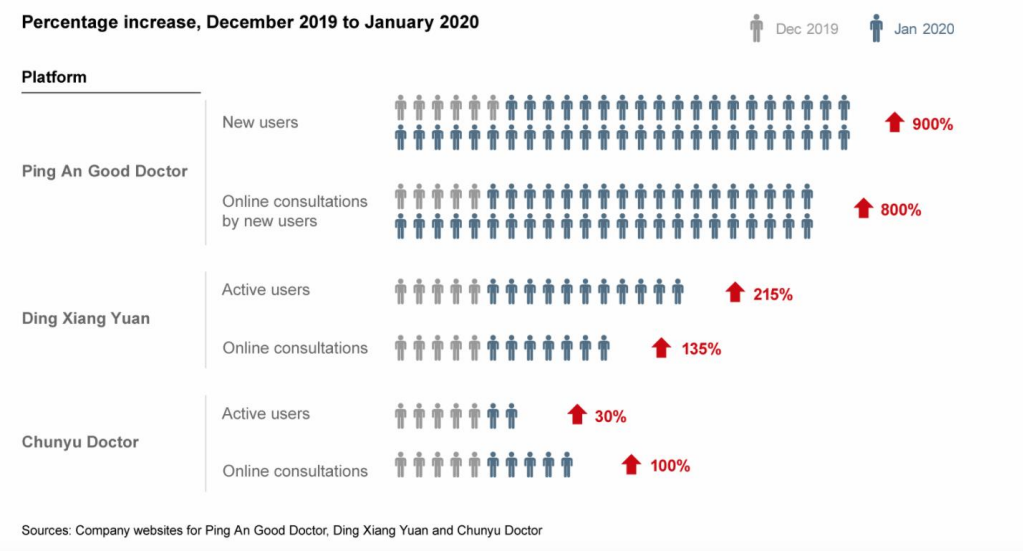
The term "Telemedicine" was coined in the 1970s which means "healing at a distance" that is designed to break down the geographical barriers, connecting help seekers and service providers who are not in the same physical location involve the use of various types of ICT

with the prime vision of improving health outcomes throughout the world (Strehle & Shabde 2006). Telemedicine can be found from the mid to late 19th century according to the study of (Craig & Patterson, 2005). In its early years, telemedicine was exclusive for military and space technology sectors, and for few individuals who have commercial equipment to use it (Currell & et al. (2000). Telemedicine can become a blessing for countries where access to basic care is of primary concern.

Usage of Telemedicine Globally During COVID-19

Prediction on usage of telemedicine was high even before the pandemic strikes globally. As online service receivers rise exponentially with time, availability of already existing telemedicine services has been bolstered. Till 2018 global telemedicine market was valued at USD 38,046 million which was expected to rise to USD 103,897 million by 2024 (Marketreportsworld, n.d.). A massive rise in telemedicine services has been observed globally especially in Asia after COVID-19 pandemic broke out.

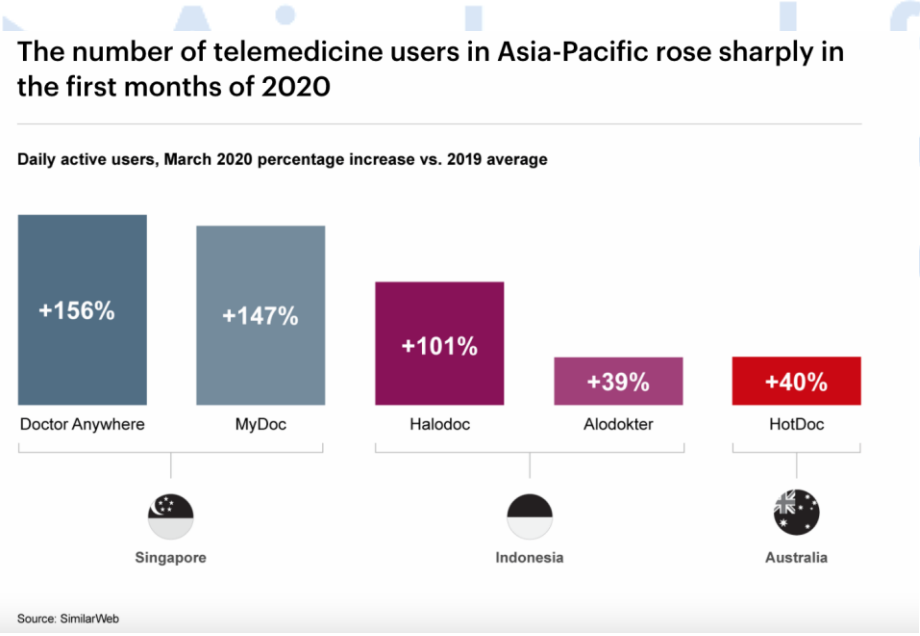
The number of new users on Ping An Good Doctor, a Chinese healthcare services platform, rose nearly 900% in January 2020, compared with December 2019, before the World Health Organization identified the virus.



ISSN 2582 8088
Volume 2 Issue 2 [April - May 2021]

At MyDoc, a telemedicine platform based in Singapore, the number of daily active users rose 60% in February and more than doubled again in March. Users' visits on their online platform have risen more than 160% from the beginning of 2020 till the end of March 2020.

After COVID-19 announced as a global pandemic, different governments declared digital health platforms available to the general public as a tool to contain the spread of the virus. Australia extended medicare coverage for telemedicine, South Korea eased restrictions on telemedicine to treat Covid-19 patients remotely, and Japan launched a free government-backed remote health service using digital health tools. Indonesia's ministry of health partnered with ride-hailing giant Gojek and telemedicine provider Halodoc for quick Covid-19 diagnostics in remote areas.



Usage of Telemedicine in Bangladesh

Bangladesh does not have sufficient healthcare support for some segments of people and the balance gets worsened among patients, doctors and healthcare organizations. Bangladesh is implementing telemedicine for treating patients during COVID-19 pandemic. This advancement did not start within a year or so. The first initiative of telemedicine was taken

back in 1999 in Bangladesh. Swinfen Charitable Trust in the UK established a telemedicine link in this country that was cheap for its time and used a camera processed image which was emailed after capturing. This telemedicine model worked well and was used as a reference model for further telemedicine projects (Vassallo & et al. 2001).

Al Ameen, Ullah & Kwak (2010) created a summary about past telemedicine projects in Bangladesh. TRCL[vii] started a project in July 1999 to help doctors identify diseases at an early stage. Their work model was to link specialist doctors who can offer their expertise to rural doctors. The Ministry of Health and Family Welfare of the Bangladesh Government helped the organization to implement it at that time. Plus, Grameen communications started to take telehealth initiatives for rural people using wireless technology. This project was initiated around mid-2000. BUET[viii] and comfort nursing homes started a telemedicine project in 2003 which was collaborated by the EU[ix].

Bangladesh DNS diagnoses centre started a telemedicine centre in collaboration with comfort diagnoses and nursing homes in 2004. But it got discontinued because of a shortage in funding, lack of people's interest and poor marketing. GTC[x] and DAB[xi] launched a telemedicine service in August 2005. The concept of this project was to communicate and provide support to distant patients through video conference. In this project, DAB's Dhaka BIRDEM hospital is connected with DAB's Faridpur general hospital. TRCL and Grameen Phone started a health line dial-based telemedicine service in November 2006 which provides emergency services like text messages based laboratory reports, ambulance support and real-time medical consultation over the mobile phone etc. All of these telemedicine projects were worked through the past two decades and a few of them worked well but most of them got shut down and didn't sustain for long. Reasons were versatile from lack of funding to rejection from people.

AI-Based Telemedicine Trends

People from all around the world are getting more inverted in this healthcare field so workload is maximizing. The inclusion of revolutionary technology like AI can make improvements in different segments of telemedicine:

I. Monitoring Patient

With the help of AI, doctors will be able to assess a patient's clinical history and learn about their current state from a long distance. It will become easy, efficient, more accessible and cost-effective compared to physical patient monitoring. Inclusion of healthcare robots to move around hallways and rooms can be implemented. These robots will have a software interface, remote-controlled and will be connected to users through a Wi-Fi connection (iRobot Corp, 2013).

II. Information Compiling Together

AI has the ability to compile massive amounts of data together frequently. According to Demiris (2003), Gathering information is essential but compiling them and making them usable is equally important and AI can help to make it possible. Using cloud storage is another factor that can be used in AI-based telemedicine. According to Matlani and Londhe (2013), Cloud computing-based telemedicine service enhanced the speed of medical analysis by transferring ECG wave signals to any place of the world in any internet-connected device like laptops, tabs or mobile phones.

III. Self-diagnosis and Automated Apps

AI-based self diagnosable apps can become the next big thing in the healthcare world. These can be used as smartphone applications for self-diagnosis (World Health Organization, 2010). This software can make quick evaluations of vital signs such as pulse, heart rate, breathing and generate instant reports based on AI models.

IV. Information Analysis and Collaboration

For medical research and academic training, AI can help. AI will be able to help researchers to work on complex topics which were not possible before because of barriers like language, distance, resources and technology.

The above discussion about Medicine, Telemedicine and Inclusion of AI in telemedicine can be defined in terms of communication theories.

Communication Theories

Crossmatching the above study with DOI[xii] shows the adopter categories of the theory matches completely. Innovators are the developers who created this telemedicine platform, early adopters were aggressively technology-based developed countries, Early majority were the other developed countries, in this case, late majority were developing countries who tried to implement new things but can not make it in time because of different barriers. Laggards are the underdeveloped and undeveloped countries in this study sense. Crossmatching this study with UGT[xiii] shows five needs of the theory matches as well. First, cognitive needs are applicable for patients as they are acquiring knowledge. Affective needs match with the mental satisfaction doctors get after successfully treating patients and emotions that patients feel after getting cured by the treatment they receive. Personal Integrative needs match all users who are upgrading their lifestyle by adopting technology in their life. Social Integrative needs can be justified here by the term of using single patient ID for all members of a family. Finally, Tension-free needs can be matched here as receiving healthcare solutions anytime, anywhere which make its users tension free.

METHODOLOGY

Study Design

This study integrates mixed methods where quantitative and qualitative data collection and analysis combine together while studying about the usage of AI-based telemedicine in Bangladesh. The data was collected from one of the few AI-based telemedicine providers of Bangladesh named Enzaime Limited. These data were on experiences of practitioners and help seekers who used AI-based telemedicine platforms during the first wave of the corona pandemic in Bangladesh from May 2020 to October 2020. The quantitative data used cross-sectional research techniques and collected simultaneously. Questionnaires from the

researchers were supplied to some selective doctors, patients and service providers. The participants were selected through a purposive sampling method.

Study Population

The study population of the qualitative research was different for each category. Doctors were categorized from freshers to senior practitioners. Inclusion criteria were they must have used AI-based telemedicine platform previously to prescribe patients, Doctors who did not use AI-based telemedicine platform and were not willing to participate in the study were excluded. Ten doctors responded to the study.

The same criteria were applied to the patients as well. Using AI-based telemedicine platforms and willingness to participate. Patients were categorized by their age, gender, occupation and reason for choosing AI-based telemedicine platforms. Total twenty patients were finally augmented.

In the case of AI-based telemedicine providers, two members from the support team, Two members from the marketing team and One member from the technical team joined the group discussion and in-depth interview.

Study Procedures

Doctors and patients who used AI-based telemedicine previously were approached by the research team virtually. Survey questions were sent to them via email. The respondents were asked mostly to choose the best answers from given options. In the case of telemedicine service providers, focus group discussion (FGD) was arranged online. For the selection of practitioners and service receivers, both purposive and random sampling methods were used.

Analysis

All the answers collected from qualitative research were managed physically, using google forms and the qualitative data were analyzed using Microsoft Excel. The researchers reviewed

all the transcripts of qualitative research and found out the primary outcomes. Separately they analyze the numeric data and filter out information. Finally, after combining both of the research parts they calculate the future probability and potentiality of AI-based telemedicine in a developing country like Bangladesh

Result

Table 1: Socio-demographic information of AI-based telemedicine users

Variable	Level	Frequency		Percentage
		Doctor	Patient	
Age (in years)	20 - 30	3	9	40.00%
	30 - 40	5	8	43.33%
	40 - 50	2	3	16.67%
Gender	Male	7	15	73.33%
	Female	3	5	26.67%
Occupation	Doctors	10		33.33%
	Student		7	23.33%
	Service Holder		9	30.00%
	Business Person		4	13.33%
Place of Using AI-based	Dhaka	6	15	70.00%

Telemedicine	Outside of Dhaka	4	5	30.00%

Table 2: information of AI-based telemedicine service provider participants:

Variable	Level	Frequency	Percentage
Work Position	Technical Team Member	1	20.00%
	Marketing Team Member	2	40.00%
	Support Team Member	2	40.00%

In this study, 35 in-depth interviews (IDI) were conducted. Two separate methods were applied in this interview process. Interviews of users were collected via Google form. These participants are AI-based telemedicine user doctors and patients. Interviews with platform providers were arranged in group meetings online. As per agreement none of the personal details are revealed and only their written forms were analyzed for the study.

73.33% of the users and all the providers were male. 33.33% of end-users were Doctors, 23.33% were students, 30% of them were service holders and 13.33% of the users were business persons. 70% of the users and all of the providers live in Dhaka city and 30% of the users live outside Dhaka. All of the socio-demographic information of AI-based telemedicine users is listed in Table 1 and information on platform providers were shown in Table 2.

Theme-1: Necessity of Advancement Over Traditional Telemedicine Service

Inclusion of advanced systems like Artificial Intelligence (AI) in telemedicine is not a new thing, but including it on a local telemedicine platform was not an easy task, stated by one of the members of the technical team of Enzaime Limited, an AI-based telemedicine platform

provider of Bangladesh. When participants were asked about the difficulties they faced while assembling AI with telemedicine features, the member of technical team explained his perception about this matter as,

> *"Converting each and everything in Bangla (local language) was undoubtedly challenging, It is a process that never stops as different modules and features are getting included all the time. But that was not the hardest part, the most difficult part was to make people believe that a computer can suggest or generate health-related answers."*

Most of the participants from the provider's end say similar things. Points that other participants included can be described in the following way:

One of the members of the marketing team says,

> *"Digitalizing a decade-old traditional treatment system was the primary focus of telemedicine. With time things get changed, people's demands get changed, a time-consuming telemedicine system that can learn and suggest is needed right now. AI-based telemedicine is offering exactly that thing."*

Another participant from the support team included that,

> *"In most cases, both health care receiving audiences and support providing sources are not aware about the necessity of Artificial Intelligence on telemedicine platforms."*

Theme 2: Reason Behind Choosing Telemedicine as a Platform in Time of Pandemic

When both service-providing doctors and receiver patients were asked about the reason behind using this platform specifically in the pandemic situation, maximum participants shared their experience that they chose the platform concerning safety. There were differences in viewpoint for the same question to separate type users.

Sub Theme 2.1: Doctors Find it as a Promising Way to Serve More Patients and Ensure Everyone's Safety

Ensuring safety of near ones and serving people who are in need of help both were major responsibilities. Majority of participating doctors (80%) state they choose online serving platforms during the time of COVID-19, as it was the best way to serve patients effectively, frequently without hampering the safety of their own family or near ones.

Sub Theme 2.2: Patients Chose the Telemedicine Platform to Consult with Doctors Timely While Maintaining Safety

Every health service receiver was panicking and trying to sort out a safe way to communicate with the help-providing doctors and receive necessary consultation. Two-third of the patients of this study mentioned they chose online-based healthcare service, as it was the safest way to communicate with doctors at that time. The rest of the reasons were mixed which includes emergency need of doctors consultation, time-saving, choosing any specific doctor who was only available on some telemedicine platform etc.

Sub Theme 2.3: Influence of Promotion

When it was asked to the help sender doctors about the influence behind using AI-based telemedicine, 40 % of the participant doctor says they came to know about AI-based telemedicine platform from SMS promotion, 30% says they came to know about it via social media post, and the rest of them answered they came to know about it from newspaper's article and get suggested by friends & colleagues. Answers came differently in the case of help receiver patients for the same question. 35% of patients say that they came to know about AI-based telemedicine platform from their near ones or friends, just below that 30% patients mentioned they get aware about AI-based telemedicine from newspaper articles, rest of the participants say they learned it from personal online search and from social media promotion.

Theme 3: Difference That Artificial Intelligence Made in Telemedicine Users Experience

When participants were asked about their user experience while using the AI-based telemedicine platform, versatile types of opinions stand out in both doctor and patient cases.

Sub Theme 3.1: It Saves Time and Reduces Human Error Rate in Doctors Opinion

Eight out of 10 doctors find the inclusion of AI on telemedicine platforms satisfactory and It makes a difference in serving patients. Automated suggestions in selecting symptoms, suggesting medical tests, selecting specific medicine based on the patient's previous history were really helpful to prescribe patients. It not only saves their precious time but also reduces the rate of error while writing a prescription. Practitioners marked their satisfactory level on average of 70 % after using the platform for several months.

Sub Theme 3.2: Receiving Treatment was the Main Focus From Patients Viewpoint

Presence of artificial intelligence on telemedicine platforms did not create any major difference in patients' user experience. Twelve out of twenty (60%) patients answered they did not notice any difference while using an AI-based telemedicine platform and six out of twenty (30%) mentioned they found a slight difference. But when it comes to saving time and money over chamber-based physical treatment, more than two-thirds (70%) of participants say they get advantage on AI-based telemedicine platforms. When they were asked about their satisfaction level after using this platform, the average answer was around 50%, which puts their feelings about the platform in neither satisfied nor dissatisfied state.

Sub Theme 3.3: Doctors Find it More Resourceful Than Patients in Platform Providers Opinion

When a question was asked on which sector of users finds AI-based telemedicine more promising, most of the participants mentioned doctors find it more promising as they

are getting more benefit as this technology makes their virtual practice compiled. A member from the marketing team says,

> *"AI-based platforms are designed so that both doctors and patients can find computerized suggestions. For example, patients can check about their disease with an AI-based symptom checker, create personal diet charts with the help of AI. Doctors have AI-based prescription writing service where they can get suggestions on selecting the reason, diagnostic tests, suggestion providing, selecting medicine by name within a shorter time than traditional prescribing method. Between both types of users, doctors find it more resourceful"*

A member from the support team mentioned a similar thing, He says,

> *"Support sender doctors get adjusted to the system within a short time and seem satisfied with the output of AI-based telemedicine. But patients mostly focused on oral conversation with practitioners and collecting prescriptions instead of taking advantage of AI."*

Theme 4: AI-based Telemedicine's Barriers to Getting Established in Bangladesh

Changing a traditional way was never easy, especially when it comes to the healthcare sector. When people started practising allopathy, it was resisted too. Telemedicine was introduced in Bangladesh over two decades ago. But still, it remains in a developing state because of some critical factors. When participants were asked about what are the barriers in the path of AI-based telemedicine in Bangladesh they mentioned a few of them which are categorized below:

Sub Theme 4.1: Lack of Interest to Understand and Learn About AI-related Things

General people did not find interest to take deep dive into scientific complex things unless it's essential to know. The same thing happens to AI-based telemedicine. More than half of the participants (55%) answered they feel interested in Artificial intelligence and its inclusion in telemedicine only if it's needed. Though it doesn't mean no one is interested in AI-related things. 10% of the doctors and patients responded as they are interested in AI.

Sub Theme 4.2: Technical Difficulties to Use AI-based Telemedicine as a Platform

While platform providers were asked about which common difficulties their users face while using AI-based telemedicine? one of their support team member responded,

> *"Not following or understanding proper instructions is the most common issue here, missing steps to complete the procedure is another one."*

A junior member of the support team added,

> *"Users often hesitate to ask questions and it makes solving problems more difficult."*

According to them, technical knowledge of both types of users is within the average range (below 50%).

Sub Theme 4.3: Insufficient Internet Connection and Device Related Problem

When participants at the users end were asked which difficulties they faced while using AI-based telemedicine as a platform, More than half (60%) of doctors and patients mentioned they faced Internet and device-related issues, where connection losing issues was their top problem. Second top answer was not clearly understanding what to do, 25% of the users mentioned it as an answer. When platform providers were get asked about these common issues of users, one member from Marketing team says that,

> *"Internet connectivity has developed over the past decade but it's still in the developing phase. Uninterrupted Internet facility is not sufficient in places outside of Dhaka. Availability of the internet is poor in some remote places where people mostly need telemedicine support".*

Member of Technical team says,

"Solving software-related glitches or difficulties of users in understanding the process can be solved, but basic issues like internet connectivity or hardware-related problems make our work difficult in some cases."

Theme-5: Predictability on Future of Ai-based Telemedicine in Post-pandemic Time

Here a conflict between platform developers and users can be noticed. Healthcare service sender doctors feel positive but service receiver patients are not so sure yet about the future of AI-based telemedicine. Platform developer as channel states that their analysis on users satisfaction and growth make them believe it has a brighter future.

Sub Theme 5.1: Patients Feel Its Not Settled Yet What Will Happen to AI-based Telemedicine After the Pandemic Get Over, Doctors Feel Positive

When both doctors and users were asked about will they continue to use AI-Based telemedicine after the pandemic gets over they give a mixed reaction. More than two-thirds of the user doctors and around one-third of patients say they will continue to use Ai-based telemedicine as a serving platform or service receiving platform. And 30 % of doctors and 60% of patients mentioned that they are not sure about it. A little fragment of the participants also says they will not use AI-based telemedicine as a platform at all after the pandemic gets over.

Mix reaction came from the user participants when they were asked about their thought on AI-based telemedicine's future in Bangladesh. 56% of the users feel positive that with time AI-based telemedicine will grow, 23% of users think it will only be used in emergency time and 20% of users mentioned they think people will go for physical treatment and AI-based telemedicine's future will not be bright.

Sub Theme 5.2: Internal Analysis of Platform Providers Makes Them Feel Positive About the Future of Telemedicine

When service providers were asked what they think about the future of their platform, one senior member of marketing team states,

"Advancement in the healthcare sector is going on fast-paced, various government and non-government organizations related to healthcare are getting interested to include AI in their system. Future of the healthcare sector is with AI, that's what my calculations say."

Member of the technical team believes,

"People from all standards will understand the essentiality of artificial intelligence as it's getting everywhere. From driving a car to the home entertainment system. Within a few more years, AI-based telemedicine will become the most promising online healthcare platform in Bangladesh. "

Another senior employee from support team says,

"Internal surveys and outcomes of our platform show, more and more people are using this AI-based telemedicine platform every day. We feel confident. If this AI is properly promoted and features get advanced with time, then AI-based telemedicine platforms will become the number one health care service providing platform in near future".

DISCUSSION

In this study, we found views of AI-based telemedicine service senders, producers and receivers from many aspects like user experience, barriers behind its slow progress and perception of its future in Bangladesh after COVID-19 pandemic. This study exhibits the perception of help-seeking patients, practitioners and AI-based telemedicine provider's sole employees regarding the condition of artificial Intelligence-based telemedicine service during and after COVID19 pandemic. The viewpoint of providers suggested inclusion of AI makes telemedicine a time-efficient system that can learn and suggest instantly and have tons of opportunities in Bangladesh. But users from all categories are not ready yet to realize its potentiality. Here, according to the diffusion of innovation theory, doctors as senders are early

majority; Patiences as receivers are late majority to laggards; AI based platform providers as producers are the innovators.

A previous erudite study gave cognition about the potential scopes of AI in telehealth and how it can improve the quality of existing clinical practice, help to develop new models of care and more (Kuziemsky & et al., 2019). Our study found that most of the doctors are interested in the telemedicine platforms to serve patients effectively, frequently in pandemic time without hampering the safety of their near ones. Scenario of patients suggested that they were in need of doctors' attention and more than two-thirds of the patients agreed they chose online-based healthcare service as it was the safest way to communicate with doctors in COVID-19 situation.

This finding is consistent with another study that showed, telehealth can provide a sufficient level of healthcare to the people in need and ensure safety for providing health services online. It can also potentially minimize the transmission of diseases like coronavirus, (Monaghesh and Hajizadeh, 2020). In this research, we found the reason behind getting invested in AI-based telemedicine varied for doctors and patients. Practitioner participants state they came to know about AI-based telemedicine platforms mostly from SMS [xiv] campaigns created by the providers, promotional posts on social media and articles in newspapers. While patients learned about this platform mostly by recommendation of trustworthy near ones, newspaper articles or from organic search on the internet. An article from Membrillo (2020), also suggested similar types of strategies to promote telehealth marketing by creating a seamless digital experience, sharing telehealth success stories, attracting and converting patients with proper messaging etc.

In our study, users' experience gets analyzed precisely. Opinions from doctors, patients and service providers were compared and analyzed. Study suggested that doctors mostly use AI-based telemedicine platforms as it saves their valuable time to serve patients within a shorter period and the power of artificial intelligence minimizes any kind of human error while prescribing. Patients' experience suggested inclusion of AI in telemedicine do not change much for them, they get more interested in consulting with doctors from a safer place and in their convenient time. As per providers, artificial intelligence can equally perform for both types of uses but doctors find it more resourceful till date.

One previous study shows the capability of artificial intelligence and its potentiality. That study shows AI can analyze medical records and other data which provide more reliability, manage electronic consultation, and automate repetitive tasks from manual to digital (Secure Medical, 2020). Which ensures a better user experience.

This study also pointed out the major obstacles in the way of AI-based telemedicine in a developing country like Bangladesh. Experience of platform providers makes it clear that users are not much familiar with AI-based platforms or AI-related online services. Their interest in knowing about it is also minimal. Issues, like not understanding the technicality of AI-based telemedicine's working procedure or hesitate to ask questions, are also counted as obstacles in their opinion. Insufficient internet connection and hardware-related problems were also mentioned.

A previous study showed that a major barrier to providing telemedicine service in rural areas is insufficient speed and lack of affordable broadband internet connection. (Ruralhealthinfo.org., 2019). According to the findings of this study, a mixed reaction on the future of AI-based telemedicine after the pandemic in Bangladesh can be seen. Here practitioners seem more positive about the future than patients. AI-based telemedicine service providers believe the potentiality of AI in the healthcare sector is huge and people are starting to adopt this technology. A previous study on the potentiality for artificial intelligence in healthcare shows, AI-based telemedicine can help in many potential activities like developing medicine with precision, examining radiology and pathology images, reduce challenges on diagnosis and treatment recommendations and a lot more (Davenport, and Kalakota, 2019).

We found the viewpoint of Bangladeshi users and providers upon AI-based telemedicine, reasons behind using this platform during COVID-19 pandemic situation, what differences AI is making while using it and barriers that it has to overcome. The study above had some limitations. Due to privacy regulations on interviewing users of AI-based telemedicine platforms and pandemic related public health restriction, we were only permitted to collect doctors and patients user experience through google forms and email, it creates a communication gap between interviewees and interviewers.

CONCLUSION

This study disclosed that the perception of AI-based telemedicine users and service providers varies based on their point of view. Doctors as users find this new technology potential especially during COVID-19 pandemic situations to practice safely and efficiently. They have an expectancy that even after the corona pandemic gets over AI-based telemedicine has scope to spread in Bangladesh. Patients as users find this platform more promising to have healthcare consultation than AI-based facilities. They are not yet totally conversed about the future of AI-based telemedicine after the pandemic gets over. While providers feel positive about the future of Artificial Intelligence-based telemedicine in Bangladesh. Though they share similar thoughts as users to improve internet facilities, educating citizens of Bangladesh with basic technical knowledge and aware people about the advantages of AI in the overall healthcare sector are needed for the betterment of AI-based telemedicine's future.

ETHICAL APPROVAL

The above study was accomplished with Institutional Research Ethics and the Declaration of Helsinki or its comparable ethical standards. In addition, the study's protocol was approved by the healthcare service providing platform Enzaime Limited, Bangladesh. User participants were informed about the procedure, purpose of the study and they were ensured about the confidentiality of their personal data. Provider organization's authority was briefed in detail and they were also ensured that all of their information will remain confidential. All the data were collected anonymously, and all the participants and AI-based telemedicine organization Enzaime provided informed consent.

REFERENCE:

Nessa A, Ameen MA, Ullah S, Kwak KS. (2009) "Applicability of telemedicine in Bangladesh: current status and future prospects," *International Arab Journal of Information Technology 1(2),* November 2009. doi:10.1109/ICCIT.2008.236

Ahmed T, Bloom G, Iqbal M, et al. (2014) E-health and M-health in Bangladesh: opportunities and challenges. *Evid Rep No 60; Horiz scanning (Tomorrow Today).* March 2014. https://assets.publishing.service.gov.uk/media/57a089f240f0b652dd0004a8/ER60.pdf.

Bullock DR, Vehe RK, Zhang L, Correll CK. (2017) Telemedicine and other care models in pediatric rheumatology: an exploratory study of parents' perceptions of barriers to care and care preferences. *Pediatr Rheumatol Online J. 2017;15(1):55.* doi:10.1186/s12969-017-0184-y.

Bain. (2020) *Covid-19 Accelerates the Adoption of Telemedicine in Asia-Pacific Countries*. [online] Available at: <https://www.bain.com/insights/covid-19-accelerates-the-adoption-of-telemedicine-in-asia-pacific-countries/> [Accessed 24 April 2021].

Craig J, Patterson V. (2005) Introduction to the practice of telemedicine. *Journal of Telemedicine and Telecare, 2005, 11(1):3–9.* doi:10.1258/1357633053430494

Currell R et al. (2000) Telemedicine versus face to face patient care: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews, 2000, Issue 2. Art. No.: CD002098.* doi:10.1002/14651858.CD002098

Demiris, G. (2003) Integration of Telemedicine in Graduate Medical Informatics Education. *Journal of the American Medical Informatics Association 10(4):310-4.* July 2003. doi:10.1197/jamia.M1280

Davenport, T. and Kalakota, R. (2019) The potential for artificial intelligence in healthcare. *Future Hospital Journal 6(2):94-98,* June 2019. doi:10.7861/futurehosp.6-2-94

Encyclopedia Britannica. (n.d.) Black Death | Definition, Cause, Symptoms, Effects, Death Toll, & Facts. [online] Available at: <https://www.britannica.com/event/Black-Death> [Accessed 24 April 2021].

Goldberg B, Ragland E and Distelzweig P (2016) Introduction, Early Modern Medicine and Natural Philosophy, *Vol. 14, 2016, pp 1-15,* doi:10.1007/978-94-017-7353-9

Hoque MR, Mazmum MFA, Bao Y. (2014) e-Health in Bangladesh: current status, challenges, and future direction. *Int Technol Manag Rev. 2014;4(2):87.* doi: 10.2991/itmr.2014.4.2.3.

iRobot Corp. (2013) "FDA Clears First Autonomous Telemedicine Robot for Hospitals | Business Wire." [Online].

Available:http://www.businesswire.com/news/home/20130124005134/en/FDA-Clears-Autonomous-Telemedicine-Robot-Hospitals. [Accessed: 24-Apr-2021].

Internet Subscribers in Bangladesh February 2021. BTRC. http://www.btrc.gov.bd/content/internet-subscribersbangladesh-february-2021. Accessed April 24, 2021.

Khatun F, Khanam Sima MR. (2015) Impact of ICT on health services in Bangladesh: a study on Hobiganj Adhunik Zila Sadar hospital. *SSRN Electron J. 2015;26(April). Series no. 26.* doi: 10.2139/ssrn.2591201.

Kuziemsky, C., Maeder, A., John, O., Gogia, S., Basu, A., Meher, S. and Ito, M., (2019) Role of Artificial Intelligence within the Telehealth Domain. *Yearbook of Medical Informatics 28 (01).* doi:10.1055 / s-0039-1677897

Londoni. (2017). Muktijuddho (Bangladesh Liberation War 1971) - first hospital of Bangladesh, Bangladesh Field Hospital (aka Bangladesh Forces Hospital or Bangladesh Hospital), for wounded muktijuddhas - History of Bangladesh. [online] Available at: <http://www.londoni.co/index.php/23-history-of-bangladesh/1971-muktijuddho/141-muktijuddho-bangladesh-liberation-war-1971-first-hospital-of-bangladesh-bangladesh-field-hospital-aka-bangladesh-forces-hospital-or-bangladesh-hospital-for-wounded-muktijuddhas-history-of-bangladesh#:~:text=First%20hospital%20of%20Bangladesh%2C%20'Bangladesh,Field%20Hospital'%2C%20treats%20wounded%20muktijuddhas> [Accessed 24 April 2021].

Lirneasia.net. (2018) AfterAccess: ICT access and use in Asia and the Global South. [online] Available at: <https://lirneasia.net/wp-content/uploads/2018/10/LIRNEasia-AfterAccess-Asia-Report.pdf> [Accessed 24 April 2021].

Mohfw.gov.bd. (2011) Health Policy 2011. [online] Available at: <http://www.mohfw.gov.bd/index.php?searchword=health+policy&ordering=&searchphrase=all&Itemid=1&option=com_search&lang=en> [Accessed 22 March 2021].

Mobile Phone Subscribers in Bangladesh February 2021. BTRC. (2021) http://www.btrc.gov.bd/content/mobile-phone-subscribers-bangladesh-february-2021. Accessed April 24, 2021.

Mahmud SZ, Amin MS, Tarafder MA, Hossain SM. (2017) Measurement of oral health literacy level among Bangladeshi adults seeking dental care and its relationship with socio-

demographic characteristics. *Anwer Khan Mod Med Coll J.2017;7(1):34-39.* doi:10.3329/akmmcj.v7i1.31611.

Marketreportsworld (n.d.) World MR. Global Telehealth Market Size, Status and Forecast 2020-2026. (2020). Available

online at: https://www.marketreportsworld.com/global-telehealth-market-14569204 (accessed

April 24, 2021).

Membrillo, A. (2020) Telehealth Marketing Best Practices. [online] Cardinal. Available at: <https://www.cardinaldigitalmarketing.com/blog/how-to-use-digital-marketing-to-grow-your-practice-with-telemedicine/> [Accessed 30 May 2021].

Monaghesh, E. and Hajizadeh, A. (2020) The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. doi: 10.21203/rs.3.rs-23906/v1

Prothomalo, (2017) Bangladesh opens 2nd submarine cable with 1500/gbps capacity. [online] Prothomalo. Available at: <https://en.prothomalo.com/science-technology/Bangladesh-connected-with-2nd-submarine-cable-with> [Accessed 22 March 2021].

Perlman, R (2013) Evolution and Medicine, *Oxford University Press, UK, 2013, pp. 1-159.*

P. Matlani and N. D. Londhe, (2013) "A cloud computing based telemedicine service," *in 2013 IEEE Point-of-Care Healthcare Technologies (PHT), (IEEE, Bangalore, 2013), pp. 326–330.*

Ruralhealthinfo.org. (2019) *Telehealth Use in Rural Healthcare Introduction - Rural Health Information Hub*. [online] Available at: <https://www.ruralhealthinfo.org/topics/telehealth> [Accessed 29 May 2021].

Sas.com. (n.d.) Artificial Intelligence – What it is and why it matters. [online] Available at: <https://www.sas.com/en_us/insights/analytics/what-is-artificial-intelligence.html> [Accessed 21 March 2021].

Stanley, J (2015) Presidential Inauguration Speech: The Evolution of Medicine, *Missouri Medicine, 2015, Vol. 112, No. 3, 228-239*

Strehle EM, Shabde N. (2006) One hundred years of telemedicine: does this new technology have a place in paediatrics? *Archives of Disease in Childhood, 2006, 91(12):956–959.*

Secure Medical. (2020) Artificial Intelligence, and its Impact on Telemedicine | Secure Medical. [online] Available at: <https://www.securemedical.com/telemedicine/artificial-intelligence-and-its-impact-on-telemedicine/> [Accessed 29 May 2021].

Tradingeconomics.com. (2019) Bangladesh - Rural Population - 1960-2019 Data | 2021 Forecast. [online] Available at: <https://tradingeconomics.com/bangladesh/rural-population-percent-of-total-population-wb-data.html> [Accessed 22 March 2021].

The Daily Star. (2019) Mobile, Internet Use: Women far behind men. [online] Available at: <https://www.thedailystar.net/business/telecom/news/mobile-internet-use-women-far-behind-men-1711996> [Accessed 24 April 2021].

Tradingeconomics (2021) Bangladesh - Literacy Rate, Adult Total (% Of People Ages 15 And Above) - 1981–2018 Data. 2020Forecast. https://tradingeconomics.com/bangladesh/adult-literacy-rate-population-15-years-gender-parity-index-gpi-wb-data.html. Accessed April 24, 2021.

Uddin, G (2012) E-governance of Bangladesh: present scenario, expectation, ultimate target and recommendation. *International Journal of Scientific & Engineering Research, Volume 3, Issue 11,* November-2012

Vassallo DJ, Hoque F, Farquharson Roberts M, Patterson V, Swinfen P, Swinfen R. (2001) An evaluation of the first year's experience with a low-cost telemedicine link in Bangladesh. *J Telemed Telecare. 2001;7(3):125-138.* doi:10.1258/1357633011936273.

Vassallo D., Hoque F. et al. (2001) "An evaluation of the first year's experience with a low cost telemedicine link in Bangladesh," *Computer Journal of Telemedicine and Telecare, vol. 7, no. 3, pp. 125,138, 2001.*

Who.int. (n.d.) Naming the coronavirus disease (COVID-19) and the virus that causes it. [online] Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it> [Accessed 22 March 2021].

Who.int. (2020) Covid-19 Situation Report No 10. [online] Available at: <https://www.who.int/docs/default-source/searo/bangladesh/covid-19-who-bangladesh-situation-reports/who-ban-covid-19-sitrep-10.pdf?sfvrsn=c0aac0b8_4> [Accessed 22 March 2021].

Williams, S and Michael, C. (2013) Modern Medicine: Lay Perspectives and Experiences, *Routledge Talyor and Francis Group, London, pp. 2-265.* doi:10.4324/9781315072395

World Health Organization. (2010) "2010 Opportunities and developments Report on the second global survey on eHealth Global Observatory for eHealth series -*Volume 2 TELEMEDICINE in Member States WHO Library Cataloguing-in- Publication Data," Report, WHO Press, 2010.*

Zobair KM, Sanzogni L, Sandhu K. (2020) Telemedicine healthcare service adoption barriers in rural Bangladesh. *Australas J Inf Syst. 2020;24:1-24.* doi:10.3127/ajis.v24i0.2165.

ENDNOTES

[i] ICT - Information and Communication Technologies

[ii] E-business is any sort of business transaction that includes sharing information across the internet.

[iii] AI - Artificial Intelligence

[iv] One stop AI based Healthcare solution provider in Bangladesh

[v] The founder of western medicine

[vi] World Health Organization

[vii] Telemedicine Reference Centre Limited

[viii] Bangladesh University of Engineering & Technology

[ix] European Union

[x] Grameen Telecom

[xi] Diabetic Association of Bangladesh

[xii] Diffusion of Innovation

[xiii] Users and gratification theory

[xiv] Short message service