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Evaluating Telemedicine as a Tool for Smart Healthcare: Changing Indian Scenario

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Abstract-Telemedicine refers to provision of health services where information and communication technologies (ICT) play a pivotalpart in diagnosing, treating and preventing diseases and injuries without having a direct contact between the medical practitioners and the patients. With the increasing urbanizing trend, there has been a tendency of developing smarter urban environment of which having a thriving teleconsultation ecosystem through video, audio, text-based communications. Telecommunication, Internet of Things (IoT), cloud computing, bio-sensing, artificial intelligence with geospatial technologies help the ageing population, persons with disabilities, people with busy working schedule to opt for the alternative medical intervention other than the traditional physical hospital or health centre visits. The prolonged lockdown due to the COVID-19 outbreak has created a favourable environment to adapt to this new 'intelligent and efficient' approach. The government has also been proactive in implementing the National Digital Health. The paper attempts to trace what are the avenues through which telemedicine approach is being implemented – globally with special reference to India and to bring out the perceptions of the patients and medical fraternity from the metropolitan cities of India about this modern intervention. In spite of facing challenges like issues regarding privacy of personal database, reliability of services, lack of training and digital divide the trends globally and nationally indicate that telemedicine has come here to stay.

Keywords: telemedicine, smart healthcare, teleconsultation, technologies, remote care

INTRODUCTION

Telemedicine takes resort to electronic technologies and information to communicate and provide healthcare when distance is a concern (Brown, 1995). The healthcare segment in the modern era, regardless of perceiving numerous innovations in the arena of medicine and pharmacology, has still been unable to realize the dream of providing quality healthcare to all. The mounting healthcare expenses is a concern and there has been an enormous pressure on the ongoing traditional healthcare infrastructure. Advanced technologies allow health organizations to augment the access thereby reducing the burden on hospitalsin lieu of real-time consultations with doctors through various devices like personal computers, laptops, tablets or even smartphones.

Information and communication technologies (ICT) have countless potentials to counter the trials faced by both developed and developing nations for making provision of pocket-friendly and quality healthcare services. Access to medical facilities is another issue of concern (WHO, 2009). The dire need to make healthcare accessible to every corner of a nation, paved way for

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telemedicine, which indicates healing at or from a distance (Strehle and Shabde, 2006). Telemedicine uses ICT to subdue the geographical constraints thereby enabling entrée to health care services. Telemedicine can be categorized into two forms in terms of information communicability timing and reciprocity between entities involved (Craig and Patterson, 2005). The first method involves the exchange of stored pre-recorded data; contrastingly, real-time or two-way interactive communication (videoconferencing) is the other method where there is immediate exchange of information (Fig 1).

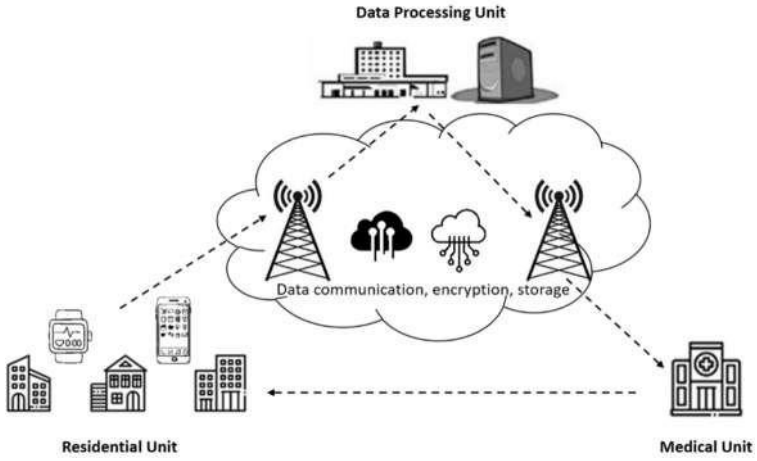

Figure 1: Schematic for remote health monitoring for smart telemedicine applicability.

The majority of telemedicine offer clinical diagnosis and even partial management on routine basis especially in the developed nations like United Kingdom, Ireland, America and Australia (Wootton, 2000). The developed countries of the world also offer biometric measuring devices like heart rate monitoring equipment, equipment for measuring blood pressure and glucose level. It is therefore expected that telemedicine in the developed countries will perceptively transmute the healthcare services from hospitals and clinics to individual residences (Heinzelmann et.al., 2005). On the contrary, the developing countries and countries with low infrastructure telemedicine is primarily used to connect the healthcare professionals with specialists and referral hospitals.

Telemedicine has been utilized non-consistently in the Indian healthcare system. The Covid-19 pandemic has enabled the country's healthcare system a prospect to increase the scope of telemedicine. India being the second populous country of the world, there are insufficient number of trained doctors to cater to this huge population (Census of India, 2011). India has a paucity of around 600 thousand doctors and 2 million nurses till 2019. India has a doctor-patient ratio of 1:834 (PIB, 2022) better than the standard set by World Health Organization (WHO) of 1:1000. But there is shortage of beds in the hospitals which makes hospitalization difficult at times (The Economic Times, 2019). Thus, teleconsultation is the desirable solution to manage healthcare facilities better specifically addressing the wide divide between the rural and urban areas. Telemedicine in India was initiated in 1999 and Indian Space Research Organisation (ISRO) has been a pioneering unit in setting up Satellite Communication (SatCom) based telemedicine network (ISRO, 2020). Steps taken by national government like setting up of National Telemedicine Task Force, framing of telemedicine guidelines, involving SAARC and African countries into eNetwork projects as well as the regional initiatives taken by the several state governments have strengthened the entire fabric and have strategically helped Indian telemedicine place itself in the global scenario (Sudhamony et.al., 2008).

Today, technological progression has made an easier approach to digital tools and convenient for the mass with approximately 49 percent of world's population having access to the internet

in 2017 and almost 7 billion people having cellular subscription in 2019 (World Bank, 2019). The accessibility to this digital world has shown a compelling potential in mitigating the problems faced by the health sector.

PRIOR WORKS

Vishnevskii (2006) has mentioned three distinct functional schemes of telemedicine system for biophysical experiments monitoring; for monitoring the patient functional state at home and of cancer diseases screening management. White et al. (2006) pointed out the major hitches to raise the quality of healthcare facility and has gave suggestions to make healthcare affordable through following distributed diagnosis and home healthcare approaches. Gaddam et al. (2008) tried to find out various issues that may arise during the implementation of sensor networks for home healthcare and emergency. Raad and Yang (2009) has started the application of internet services for reporting real time health standings and actions of elderly people. Bramanti et al. (2010) carried out a kind of applied study using Geographical Information System (GIS) as a technology which can identify optimal locations of clinics which are able to provide neurological telemedicine services to patients. Chen et al. (2010) planned a smart gateway to connect a home-based wireless senor network with a public communication network. Menkens and Kurschl (2010) evaluated the role of Voice over Internet Protocol (VoIP) enabled communication platforms and put forth a scheme to monitor health status regularly and to intervene in case of emergency situations. Li (2013) carried surveys regarding state-of-the-art smart home technologies and telemedicine systems to evaluate their competency. Mars (2013) found that telemedicine has the competency to improve the healthcare quality in rural areas. Weinstein et al. (2014) remarked about the gradual explosive growth of mobile health resulting rapid innovations in healthcare service that includes gap service coverage, urgent services, mandated services and the propagation of video-enabled multisite group chart rounds. Ye et al. (2016) had marked the advancement of new wearable computers such as Google Glasses and Vuzix Glasses and wide uses of smart phones installed with device software apps facilitating healthcare access to most remote areas. Pasichnyk et al. (2018) has done a detailed review of 'Smart City Elements' and has analyzed how human health status is affected with the application of telemedicine devices.

Cook et al. (2018) tried to judge the effect of ICT on the improvement of healthcare effectiveness and affordability for smart city residents. They examined techniques which are used to analyze data that are accumulated from mobile and ambient sensors for the purpose of assessing health status and intervention at a personal and at a community level also. Lastly, they tried to discuss about the challenges for future development of a smarter healthcare system. Mishra et al. (2009) have provided material on various facets of telemedicine like chief projects backed by various ministries of Government of India, activities commenced by healthcare and academic organizations, policy initiatives, scientific publications etc. Mishra et al. (2012) tried to discern progress of telemedicine service and e-health in India due to the convergence in the areas of Information Technology, Communication and Healthcare along with the e-health schemes launched by the Ministry of Health and Family Welfare (MoHFW), Government of India and its contribution to sort out the problem ofinequality between rural and urban areas regarding health services. Bhowmik et al. (2013) did put an effort to find out the role of telemedicine services to serve healthcare facilities to the rural people of remote areas who have to travel long distances and have to spend additional costs to have the access to super-specialty medicare. Mathur et al. (2017) revealed that healthcare affordability to all is still a major challenge in India, mainly in the rural areas where a major portion of underserved people lives. Chellaiyan et al. (2019) unfurls the historical perspectives of telemedicine development throughout the globe with special attention to its advancement in India in recent times.

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OBJECTIVES

The main objectives of the study are –

To study the evolution of health care system in smart society, highlighting the growing importance of telemedicine, in the critical juncture of global pandemic.

To carry out perception survey of patients taking resort to telemedicine in India in the post-COVID 19 times and analyse the nature of acceptance of telemedicine in urban and rural pockets of the country.

To create a blueprint on how the hybrid medical strategies in Indian health care system would take the system forward in the 'new normal'.

MATERIALS AND METHOD

The paper is based on both primary and secondary data sources. A theoretical framework has been constructed highlighting research questions and research design. This paper is based on literature review and is explanatory in nature.Secondary data has been derived from various reports, books and journals relevant to this sector.

A questionnaire was prepared including checklists, Likert Scale and open-ended questions to ensure randomness and quantity of data. A survey was conducted involving 1040 respondents across India to know about their first-hand experience about using telemedicine facilities. A structured interview has been conducted through google form for the primary data on the basis of purposive sampling. For the perception studies of the urban areas, people (n=624; 156 from each city) from four metropolitan cities – Mumbai, Delhi, Chennai and Kolkata were taken into account who were linked with the personal and work spheres of the authors and the doctors who were interviewed on this issue also helped by snowballing the questionnaire to their respective patients. For carrying out the survey for the rural section, the authors apart from their personal acquittances relied on selected health-related non-government organization workers for circulating the online questionnaire in the remote villages of rural India. Attitude measurement and participatory research design has been conducted to measure the societal impact of telemedicine. Conversation with the service providers along with doctors are the basic scenarios which have been taken into consideration.

Statistical analysis has been done based on the framework designed and primary data generated with the help of SPSS V23. Regression analysis both linear and logistic have been carried out to test the hypotheses formulated beforehand regarding the ease of the elderlies in handling medical teleconsultation and the spread of telemedicine across the rural and urban areas respectively. Apart from these, dendrograms – showing hierarchical clustering were done for both rural and urban scenarios, taking six factors into account - wait time, cost, service outcome, use of technology, accessibility and lastly frequency of use.

GLOBAL SCENARIO- CHANGING PARADIGM IN ACCESS TO HEALTH

Telemedicine is much more than a mere online consultation. It is summary of end to end delivery of health care facilities with the help of using IT/ITES, including diagnosis, remote monitoring and beyond. The developed countries are leading the way in telemedicine. US have been one of the countries with technologies developed for telemedicine where approximately 100,000 consultations are performed each month (Boxer, 2015).

Telemedicine which is now a vital constituent of smart society attracted worldwide attention in the 2000s (Li, 2013). First published record of telemedicine was the reported case of ECG done over telephone lines in the first half of twentieth century when ECG was done over telephone lines (WHO, 2009). Santana et al. (2017) categorized smart city technologies into

four – “cyber-physical systems, Internet of things, Big Data and cloud computing”. WHO identified over 104 definitions (Weinstein et al. 2012) among which it has accepted the following definition: "Providing health services under the conditions where distance is the critical factor, by health workers using information and communication technologies for exchange the necessary information in order to diagnose, treat and prevent diseases and injuries, carry out research and assessments, as well as continuous education of medical professionals in favor of improving the public health and local communities development" (WHO 2009). In 1959, the doctors at University of Nebraska utilized interactive telemedicine to spread neurological examinations which is recorded as the first real time video consultation in the arena of e-health service (Merilynk, 1996). National Aeronautics and Space Administration (NASA) firstutilized telemedicine services after the 1985 Mexico City earthquake, then during the Soviet Armenia earthquake in 1988, telemedicine service was effective in disaster management (NASA, 2020). Till the widespread usage of mobile phones began, telemedicine services through telephonic dialing like ‘911’ or ‘101’ etc. was the order of the day. Average annual growth rate of telemedicine service was 19% in 2015 (Scott, 2015) and was predicted that by 2020, around four million patients throughout the world will be benefitted by the remotely monitored healthcare system (Chamberlin, 2016). Accelerated increase of health-related web pages i.e. 134% amplification between 2010 and 2011 proves the above fact (Scott, 2015).

Internet of Things (IoT) is a concept of network where physical devices with built-in sensors as well as software are interconnected and are used to transmit and exchange data between physical world and computer systems by means of standard communication protocols (Weinstein et al., 2012). The basic requirements of IoT based telehealth services are smartphones, tablets, computers, enabled with 4G/5G network connection on the patients’ end and the doctors’ terminal has to have access to telemetry statistics regarding patient’s regular health condition where as smart devices like bracelets, plasters, belts, sensors are directly fixed to the body or clothes. MQTT (Message Queue Telemetry Transport) is a simplified messaging protocol which provides simple method of telemetry information distribution (Rouse, 2020), operating on the publisher/subscriber principle where patients and doctors interact directly.

WHO (2009) categorized telemedicine into few groups – A. according to the timing involved in information transmission: a) Real time or synchronous: where both the sender and receiver are live online at same point of time b) Store- and- forward or asynchronous: where sender and receiver are online at different point of time and each responds at their convenience) Remote Monitoring type where it uses a variety of technological gadgetsfor health screening and clinical signs of a patient remotely. B. According to the interaction between the individuals involved: a) Health professional to health professional: where referrals, consultation services are taken care of b) Health professional to patient: where the unreached population are provided remote healthcare by a medical professional.

Tele-homecare is an innovative way to provide care, monitor a patient, and provide information using the latest technology in telecommunication. Monitoring allows early identification of diseases, preventing chronic conditions. Tele-homecare programs are also initiated in countries, including the Whole System Demonstrator (WSD) project in the United Kingdom, Veterans’ Health Segmentation (VHA) project in the United States, and the TELEKART program in Denmark. These tele-homecare programs manage, reduce and avoid chronic diseases by remote monitoring of patients. Tele-home services provide an opportunity for significant savings for patients and hospitals. Thus, the increasing adoption rate of tele-homecare services is directly affecting the growth of the telemedicine market.

INDIAN CONTEXT- AT A CUSP OF CHANGE

In 2005, health ministry of India had set up Telemedicine taskforce, an important milestone in increasing awareness on digital consultation. In India, the second populous country of the world, there is an extreme dearth of health professionals. Telemedicine is the avenue which provides access to specialist care especially in the rural areas reducing the need of the rural patients to travel far for mitigating their medical needs (Chandwani and Dwivedi, 2015).

75% of the doctors are concentrated in cities and towns and rest is quite insufficient for 68.84% of rural population and 60-80% vacancies of physicians of various reveal a major inequality between rural and urban healthcare services. But now a day's rapid development of ICT, satellite transmission, high-speed broadband connectivity and mobile telephony are paving the way for the development of telemedicine in India to bridge the gap of this shortage of manpower, lessening the number of physical visits.

One of the major advantages of telemedicine service is its efficiency to provide affordable smart health care facility. Through this the patients are able to get proper consultation even specialized ones without consuming much time, as rural as well as elderly people need not to travel a long distance to visit to a hospital or a doctor's chamber minimizing the travel ordeal and costs. Practicing telemedicine can check transmission of communicable diseases as doctors or medical staffs can provide guidelines to the patients without exposing to viruses or infections. The Indian government is committed to its every citizen to provide quality healthcare service and e-health service is the ideal solution for that. Formally, telemedicine in India was launched on 30th March, 2000, through Bill Clinton— the then president of the United States, who commissioned the rural first telemedicine unit in in Southern India (Asiabiotech, 2006). Indian Space Research Organization (ISRO) is the pioneering institute for telemedicine in India with a Telemedicine Pilot Project in 2001, in collaboration with Chennai's Apollo Hospital with the Apollo Rural Hospital at Aragonda village in the Chittoor district of Andhra Pradesh (ISRO, 2000). In the initial stage, MoHFW implemented Integrated Disease Surveillance Project connecting all district hospitals with medical colleges of the state to accentuate the public health system and presently telemedicine service has been included into the realm of National Rural Health Mission and has formed National Rural Telemedicine Network (NRTN) (Mishra et al., 2009). Across the country, in early 2000s more than 75 nodal centers were set up for research and development of telemedicine (Mathur et al., 2017). Indian Satellite System (INSAT), ISRO established a telemedicine Network entailing of 384 hospitals in collaboration with state governments out of which 306 are situated in rural areas with 60 specialty hospitals and 18 telemedicine units (ISRO, 2020). In 2005, MoHFW has established a National Telemedicine taskforce for further development of digital health services (Chellaiyan et al., 2019). The concerned ministry has taken up National Cancer Network (ONCONET) project that will connect 27 Regional Cancer Centers with 100 Peripheral Cancer Centers to facilitate National Cancer Control Program (MoHFW, 2020), National Rural Telemedicine Network, National Medical College Network and the Digital Medical Library Network to acquire health related information (Mishra et al., 2009). The brand names like Apollo, Narayana, and Escorts are the major private players actively involved in telemedicine sector in the country (Mehta and Chavda, 2013).

In 2004, North Eastern Space Applications Centre (NESAC) in a collaborative venture initiated a telemedicine project applying satellite communication involving 72 regional nodal centers in all the seven districts of north-east, connecting district hospitals to specialty tertiary care hospitals in these infrastructurally backward regions. Till 2017, 25 regional telemedicine centers have come into operation remaining 47 are in various stages of implementation. NESAC has taken initiative to form village resource centre (VRC) in all the northeastern states

of India paving the way for tele-education and telemedicine (North Eastern Space Applications Centre, 2020).

MoHFW in collaboration with Department of Space has setup telemedicine nodes for health awareness, screening of non-communicable disease and for providing specialty consultation riding over National Knowledge Network (high speed bandwidth connectivity) with the motive to deliver e-Education and e-Healthcare service (MoHFW, 2020). The national rural telemedicine network has extended their services to the Ayurveda, Yoga and Naturopathy, Unani, Siddha, Sowa Rigpa and Homoeopathy (AYUSH) branch so that its benefit reaches to a larger population (AYUSH, 2018). Hardware and software system are the backbone of telemedicine industry, which in India is being provided by several designated companies across several metropolitan cities of the (Telemedicineindia, 2020). South Asian Association for Regional Co- operation (SAARC) Telemedicine Network Project is also an international project taken by Ministry of External Affairs. ISRO took initiative in 2009 for mobile teleophthalmology service under National Blindness Control Program for early diagnosis and treatment of ophthalmic diseases. Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS) has established School of Telemedicine and Biomedical Informatics for empowering the medical institutes with technical knowhows (Mishra et al., 2004) and is recognized as a National Resource Center for Telemedicine by DIT (Mahapatra and Mishra, 2007).

Telemedicine service in India comes under two departments – Department of Ministry of Health and Family Welfare and the Department of Information Technology. Uniform telemedicine practice guidelines are outlined by the Department of Information Technology for the entire country, but still there is no legislation on the practice of telemedicine, through video, phone, ICT based platforms (web/chat/apps etc.). There are several existing legal provisions involving medical council, drugs, clinical establishments, information and technology which are instrumental in governing telemedicine practices. Board of Governors in supersession of the Medical Council of India in partnership with NITI Aayog has prepared a group of guidelines to be followed by the medical practitioners pursuing telemedicine through amalgamating legislative and non-legislative measures followed by other countries as telemedicine guidelines that covers norms and standards of a Registered Medical Practitioner (RMP) to consult patients via telemedicine; (Agarwal et al., 2020) issues of liability and negligence; dealing of emergency services; issue of informed consent; confidentiality of medical records;medical reimbursement; health education and counseling which strictly excludes digitally monitored surgical operations, delivery of tele-consultation outside Indian jurisdiction etc (Dinakaran, et al., 2021). These guidelines have also notified that RMPs who are using telemedicine have to follow similar professional norms and standards as applicable to traditional in-person care, including providing the registration number accorded to by the Medical Council of India for prescribing medicines and it is bound to ask patient's age for issuing a prescription. But it is another thing that in absence of proper enforcing laws these guidelines in most cases are left aside as pious arguments. However, Indian healthcare market is gradually improving and becoming preferable healthcare destination to neighboring countries also (Mishra et al., 2012).

The concept of tele-health is somehow different from telemedicine as it facilitates patients by delivering healthcare facilities rather than traditional healthcare provisions with the help of telecommunications and digital technologies, e.g. virtual home healthcare. Telemedicine service provides a Computer Telephone Integrated system aiding the doctors to closely monitor therecurrently ill patients and also get hold of live vitals alerts when emergency situation arises. The two main types of tele-consultations operable in India are – a) First Consultation: Which refers to the initial session or sessions having a gap of six months or sessions for different

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ailments. b) Follow-up consultation: In this case the patient continues the session-chain within six months with reference to the same health problem.As per mode of communication tele-consultation can be divided in to three main types – a) Video Based b) Audio Based (c) Text Based (Table 1). Though all are currently available in India, due to poor mobile coverage and network connectivity audio-based ones are more common even today. According to the individuals involved in tele-consultation telemedicine is four types – a) Patient to RMP: Patients directly consult a doctor b) Caregiver to RMP: Telemedicine service between care givers and RMP for transmission of knowledge aboutduties regarding patients c) RMP to RMP: A RMP contacts another RMP to discuss about one or more patients, or to promulgate knowledge about specialized treatment d) Health worker to RMP: A health worker collects case history of the patient, examines the patient and conveys the reports to the RMP.

Table 1: Enlisted classification of medicines based on the type and mode of consultation

List Group	Mode of Consultation [Video/Audio/Text]	Type of Consultation [First-consultation/ Follow-up]	List of Medicines
O	Either	Either	Safe to be prescribed over tele-consultation and available 'over the counter' like cough lozenges, ORS solutions, paracetamolsetc.
A	Video	First Consultation Follow-up, for continuation of medications	Prescribed during first consultation and re-prescribed or re-fill during follow-up for chronic diseases like asthma, hypertension, diabetes etc.
B	Either	Follow-up	Medicines which are prescribed during follow-up consultations.
Prohibited	Not to be prescribed	Not to be prescribed	Cannot prescribe medicine in this list as these falls under the purview of the Narcotic Drugs and Psychotropic Substances, Act, 1985

Source: Modified by authors from information provided by Medical Council of India, 2020

APPRAISING THE GROUND REALITY: WHERE DO WE STAND?

To understand the scope and usage of telemedicine across India a perception study was conducted (n= 624 for urban area and n= 414 for rural area). From the study it was found that about 7 percent of urban population took resort to telemedicine prior to this pandemic. The number has shown a rapid increase to roughly 15 percent during the COVID-19 phase and likely to increase more during the post COVID phase. The most inspiring fact can be seen in case of rural areas. The mere 3 percent population banking on telecalls and helplines for treatments are now actively taking interest in telemedicine. Roughly 10 percent of the surveyed rural population are now using telemedicine for medical support. This indicates a progress towards a smarter society.

The regression analysis has been done to analyse the acquaintance of the elderlies with this new system of health care. The pandemic has contributed to the understanding of myriad ways in which technologies can be better used.

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i) H_0: Elderlies are habituated with usage of telemedicine

Here the p value is 3.84. So, the null hypothesis is rejected as the p value is less than the calculated value. Hence it can be concluded that elderlies are not habituated by the telemedicine. Here the R^2 is 0.451 means45.1% variability of response variable (age category) is explained by the predictor variables (Gender, education, profession, income, area, frequency of usage, satisfaction level and ease of use). Gender, income, frequency of usage and ease of usage are negatively related with the age category while it's positively dependent on education, profession, area and satisfaction level (Tables 2a and 2b).

Table 2a: Calculation of R Square values

R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
.671	.451	.447	.3585	105.567	.000[a]

Source: Computed by Authors based on Primary survey, 2023

a. Predictors: (Constant), Easeofuse, Income, Gender, Satisfactionlevel, Profession, Education, Frequencyofusage, Area

b. Dependent Variable: Age category

Table 2b: Analyzing the coefficients to the derive the significance level

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.781	.156		5.021	.000
	Gender	-.076	.028	-.078	-2.682	.007
	Education	.090	.018	.191	5.053	.000
	Profession	.006	.008	.021	.768	.443
	Income	-.040	.011	-.127	-3.595	.000
	Area	.222	.041	.226	5.475	.000
	Frequency of usage	-.222	.019	-.360	-11.862	.000
	Satisfaction level	.042	.024	.051	1.790	.074
	Ease of use	-.210	.018	-.341	-11.749	.000

Source: Computed by Authors based on Primary survey, 2023

a. Dependent Variable: Age category

ii) H_0: There is no significant association between the characteristics of users of telemedicine and area.

The overall prediction is 60.1%. In rural areas there are only 414 people while in urban it is 624. The pseudo r-square is 0.862 which measures the 86.2% variability of the dependent variable that is explained by this LR model. The null hypothesis is rejected as the p value is less than 0.05. Hence there is significant association between the users of telemedicine and area. Gender, Age group, education, profession, income, satisfaction level and ease of use have a significant positive relation with the area of the telemedicine usages persons while frequency of usage has a positive relation but it's not statistically significant (Tables 3a, 3b, 3c and 3d).

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Table 3a: Classification Table

	Observed		Predicted		
			Area changed code		Percentage Correct
			Rural	Urban	
Step 0	Area changed code	Rural	0	414	.0
		Urban	0	624	100.0
	Overall Percentage				60.1

Source: Computed by Authors based on Primary survey, 2023

a. Constant is included in the model.

b. The cut value is .500

Table 3b: Model Summary

Step	-2 Log likelihood	Cox and Snell R Square	Nagelkerke R Square
1	343.682[a]	.637	.862

a. Estimation terminated at iteration number 9 because parameter estimates changed by less than .001.

Table 3c: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	**Step**	1052.511	8	.000
	Block	1052.511	8	.000
	Model	1052.511	8	.000

Source: Computed by Authors based on Primary survey, 2023

Table 3d: Determining the level of significance

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Gender	1.464	.332	19.394	1	.000	4.324
	Age Group	-2.000	.307	42.570	1	.000	.135
	Education	3.536	.336	110.409	1	.000	34.315
	Profession	1.081	.169	40.763	1	.000	2.948
	Income	2.697	.420	41.237	1	.000	14.837
	Frequency of usage	.143	.289	.245	1	.621	1.154
	Satisfaction level	-1.718	.493	12.151	1	.000	.179
	Ease of use	-4.229	.718	34.691	1	.000	.015
	Constant	-1.065	2.163	.242	1	.622	.345

Source: Computed by Authors based on Primary survey, 2023

a. Variable(s) entered on step 1: Gender, Agegroup, Education, Profession, Income, Frequency of usage, Satisfaction level, Ease of use.

Logic model has been applied as the dependent variable are of binary character. The model shows that there is significant association of telemedicine usage and area. The predicted value shows that the urban area is getting more benefited from telemedicine compared to the rural areas especially in terms of service outcome. Therefore, area is significant highlighting more development in the rural areas. Coefficient logic model explains the ratio of two odds which means the change in odds in the multiplicative scale for a unit increase in the corresponding predictor variable. The expected B value indicates the probability of success. The expected B value more than 1 indicates a positive impact that is contributing positively to the dependent variable. The value for gender, which is 4.324 indicates a probability of success is four times

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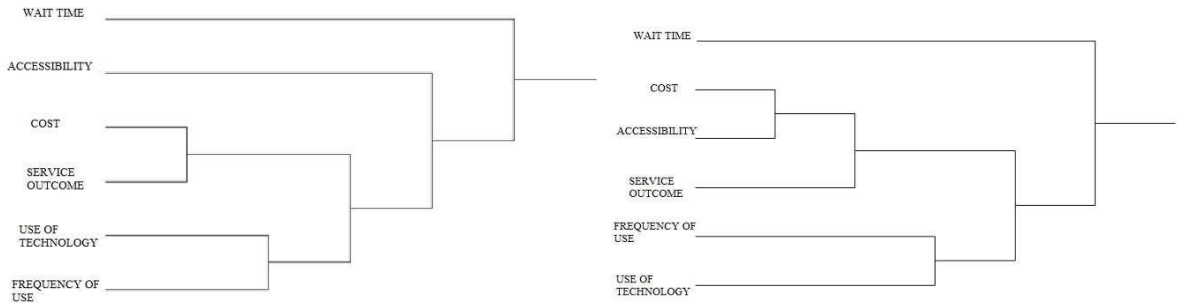
to the probability of failure. Similarly, the values less than 1 contribute negatively to the dependent variable.

This signifies that telemedicine will decrease the time of consultations and progress the quality of healthcare services in the urban as well as rural areas of the country, eliminating several infrastructural challenges. The difficulty in adopting with the technology will persist with the aged population but with time a better and simpler system can contribute to a smart society.

Post covid-19 the medical sector showed a vast change. With the introduction of technology telemedicine has become a new alternative for potential users to get a quick access to medical services. To study the potential use of this technique and application of telemedicine into tourism industry has been the main focus. Six factors have been taken into consideration to get an image of the overall service perception.



a. b.

Figure 2: Dendrogram analyzing the key factors involved in generating perception about telemedicine both for urban (a) and rural (b) scenarios.

The dendrogram drawn is bifolious one (Fig 2). It clearly highlights two distinct cluster comprising of wait time and accessibility. Telemedicine has helped in reducing the travel time both for the urban and rural population. Patient's satisfaction of availing telemedicine facilities, various aspects that are related to communication incidence have been considered including frequency of answered calls, medical help and attitude of doctors. These were grouped under accessibility. These two are substantially different from the other two chunks. Due to restrictions in travelling in this new normal phase, people find this telemedicine efficient enough for consultations. The reliability of service providers and service safety denotes the service outcome. It defines respondent's belief in improved performance or better outcome with new technology. The doctors and the hospitals are communicating with the patients on a regular basis which otherwise was not the same before the pandemic. Cost, service outcome and usefulness show a similar character. People are giving a thought to this technique of medical assistance and are thus relying on telemedicine. Though this age group is technically lagging behind they prefer to use telemedicine during this new normal phase. The online payment method, proper searching techniques, online booking assistance are few of the challenges faced by the patients. Though there is a preference for telemedicine, people especially above 60 years of age, still wish for a physical visit to the doctors.

The rural areas like the urban respondents have agreed to the efficiency of time in using telemedicine. Using telemedicine has helped in reducing the cost involved in travelling, registration and medical services. Use of technology remains an issue for both the urban and rural areas. The network issues and a technical support system can help both the urban and rural areas overcome the challenges they are facing. However, the transformation of the rural areas shows a significant level of change helping to build of a smarter society in future.

CHALLENGES FACED

The chief concern about the telemedicine sector has been the protocol and security issues associated with modern technology assisted homecare; through various modes of communication like telephone, mobile, computer etc. Stankovic et al. (2005) and Simpson et al. (2006) highlighted that the integrity and security of transmitted data generated from continuous monitoring is of utmost importance. One has to be very careful that data privacy should not be violated; apart from family and health practitioners no third-party should have access to the medical data and information generated. Scholars like Mantas et al. (2009) and Guennoun and Khalil (2009) suggested for cryptography and context-aware access control regulations. Apart from data security, network infrastructure reliability and scalability are issues affecting the data processing of developing nations with huge population pressure and limited infrastructural framework like India. The other crucial aspect is reliability while handling wireless technologies for implementationof smart homecare. Often issues like physical hindrances, atmospheric disturbances, system failure, inadequate profit margin etc. affect the reliability especially in the remote rural areas (Fong and Pecht, 2010). In the developing nations the robustness, finesse of the sophisticated infrastructure (sensors, network coverage, power supply) is missing which affects the authenticity of real-time data acquisition, its management and quality of service in general (Gaddam et al., 2008).The section of people like the elderly, rural residents are not really aware about smart embedded devices or on-invasive sensor technologies, leave aside using them on a regular basis to be a part of smart telemedicine sector. Though several web pages, apps have been developed the interface has to be more user-friendly with clear graphical and textual formatting. For real-time data transfer and effective communication connection among the devices have to be very strong for which faster network with greater areal coverage is imperative which is yet to be achieved in many developing countries. Weinstein et al. (2014) pointed out barriers like telemedicine service reimbursement, interstate telemedicine license issue and hospital credentialing as three critical development factors affecting long-term success of in-home healthcare and in turn of telemedicine industry.

In spite of these challenges faced, popularity of telemedicine was growing in India especially among the busy urbanites who found difficult to spare time for one-to-one consultations and was at ease with the newer technologies. But with the outbreak of the global pandemic, the entire situation changed – the patients from far off rural pockets found it almost impossible to reach the specialized clinics during the lockdown, the elderly and physically-challenged weary of viral infections preferred to stay back at home avoiding regular check-ups at the chambers. So, suddenly there was a huge shift towards the remote care facilities, teleconsultations became the order of the day, many emergencies were handled competently fetching faith on the system. Even the doctors, medical institutions favored these smart healthcare solutions as they could devote exclusive treatment to the COVID-19 patients without compromising the care and therapy to their regular patients. As this telemedicine system with its diverse interfaces gradually made its mark in almost every households of India there is a ray of hope that even after the pandemic is over, in the ‘new normal’ phase people will continue with this smart healthcare option at least to certain extent and with the increased usage, the economies of scale will be coming into play improving the cost effectiveness along with faster technological and infrastructural upgradation will be there to cater to needs of the many.

PROGRESS IN DIGITAL HEALTHCARE SYSTEM

Conferring to NITI Aayog, the National Health Stack (NHS) is a virtual digital platform which will hold the health care management system of the country. NHS study also purposes to have digital health records for all citizens of the country by 2022 to make telemedicine and E-Health

available to all (NITI Aayog, 2018). With the introduction of Ayushman Bharat Scheme in 2017, a healthcare financing scheme, Indian government has stressed upon with the ICT concentrating on the growth and development of health sector in the country. This scheme embraces tele-health development philosophy, especially for effective, efficient, patient-centered long-distance medical care and health management environment (NHA, 2020).

The other major initiatives taken for the betterment of telemedicine service in India has been jotted down by the MoHFW (2020)-

- Department of IT has taken the key role in escalating telemedicine service within the country. There are over 100 centers all over the country developed by DIT.
- Enumerating and tallying a standardized and homogeneous Electronic Medical Records for the entire nation.
- To make people aware about health related government programmes and services National Health Portal (NHP) in six different languages have been launched.
- NHP Directory Services, a mobile application, delivers information related to hospital across India.
- Hospital Management System, e-Hospital@NIC, workflow-based ICT based generic software that includes major functional areas like medical records management, laboratory services etc.
- Online Registration System (ORS) deals with the provision of services to the citizens for making online registration and appointment, payment of fees, viewing diagnostic reports online, online enquiry of blood availability in several public hospitals.
- 'MeraAspataal', an IT based feedback system set-up to assemble information on patients' satisfaction level using a multi-channel method like Outbound Dialing, SMS, Web Portal and Mobile App that helps government to improve healthcare delivery system.
- 'Indradhanush Immunization' is an online tracker which assists parents in tracking immunization of their children and timely vaccination.
- Under National Health Mission a web-based portal Health Management Information system has been developed which is integrated with GIS.
- 'eAushidhi' deals with the entire infrastructure of medicine (drugs, surgical items) handling and delivery to various District Drug Warehouses, District Hospitals and even to the lowest tier of Primary Healthcare Centres
- mDiabetes, a mobile-based initiative for prevention and care of diabetes has been popularized.
- At Lucknow, National Resource Center for Telemedicine and Biomedical Informatics is being set with primary goal to improve telemedicine and e-health facility of the country.
- Tobacco Cessation Programme a mobile-based interventional initiative has been designed to counsel individuals to quit tobacco.
- 'Kilkari' is a messaging application that delivers free, weekly-timed fitting seventy-two audio messages regarding pregnancy, child birth and child care through mobile phones.
- 'Pradhan Mantri SurashitMatrivaAbhiyan' mobile app provides pregnancy care related information from across states.
- Mother and Child Tracking System (MCTS)/ Reproductive Child Health application system implemented throughout the country to facilitate and simplify delivery of prenatal and post-delivery care services along with vaccination to children.
- 'eraktKosh' is an online application system which is linked to all the licensed blood banks (public and private) all throughout the country.

All these initiatives would help in realizing the dream project of National Digital Health Mission of creating master health records for all the citizens of India, so that while giving

advice to the patients remotely the medical practitioner will be able to access the medical history along with the current condition.

THE ROAD AHEAD

The main factors that determined the functionality of the telemedicine sector are – energy supply, computing power, web connectivity with comprehensive bandwidth, individual accesses to mobile (Taylor and Dajani, 2008; Moritz et al., 2009). There have been several efforts to set up an integrated grid portal for all the wireless personal digital assistants (PDAs) of a certain region for safe storage of personal medical records (Li, 2013).

There needs to be a holistic planning for the telemedicine services sector. The government needs to step up and formulate legal policies to ensure standard security of the medical data generated. Pharmaceuticals delivering drug and other medical devices at the doorsteps should also follow certain procedural regulations, price charts and discount ceilings to keep the playing field level for all. It is also important to integrate health problems to ICT solutions and develop an understanding and acceptability of the common people about it, this requires to impart eHealth literacy and user-friendly platforms. A kind of all-inclusive bouquet of services including teleconsultation patient portal, diagnosis and treatment, counselling, monitoring of medication adherence can attract the clients more. 4G/5G connectivity and big data analytics with real time access with cloud-based storage is needed for the smooth operation of the entire system. Besides, medical sector the technological industries also needs to be upgraded as that is responsible for providing ICT solutions like widespread networks with highspeed for reliable real-time data transfer especially when the question of emergency management arises. A new business model emphasizing on value-focused clinical outcome through public-private-partnership is on the anvil for the success of the initiatives For smooth functioning co-operation among all the stakeholders like health ministry, local administration, political leaders, legal advisories apart from companies directly involved in the trade along with the beneficiaries are much needed.

Though the case of digital divide is there in India (for the rural residents, older segment, economically backward section) which has been evident during the pandemic phase and also in the ‘new normal’ but the perception of the people in general, feedback from the medical fraternity and the emerging trends indicate that telemedicine has come here to stay.Undoubtedly, there are ample scope for further research and development to improve the telemedicine sector and especially in India, where it is in a nascent stage, to make ‘digital health’ a ‘connected’ one further investment needs to be made to upgrade the infrastructure to make remote careat par with the world standards.

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