Bridging the Health Divide: The Role of Telemedicine in Advancing Healthcare for Rural Areas and Implementing Sdgs in India

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Abstract

Telemedicine, formerly considered an experimental concept, has become a highly specialized and convenient way to receive healthcare, especially for patients in remote areas. **(Ateriya, et al., 2018)**.Telemedicine refers to the remote diagnosis and treatment of patients utilizing telecommunications technology, thus delivering significant healthcare services to low-income areas. The first known use of telemedicine was in the early 20th century, when electrocardiograms (ECGs) were sent over the telephone**.. (Chellaiyan, et al.,2019)**In India, the adoption and integration of telemedicine services remain limited due to several obstacles. Key factors include the absence of legal and administrative clarity regarding the use of technology for service delivery, as well as the reluctance of health service providers to embrace new advancements However; the

dynamics have changed in the face of the coronavirus disease (COVID-19) pandemic. The Telemedicine practice guidelines issued in March 2020, along with the Tele psychiatry operational guidelines released in May 2020, seem to eliminate these barriers and foster equitable access to healthcare. This article examines the implications of these process **(Dinakaran, et al.,2020).**As services resume their normal operations, it is crucial to investigate if the utilization of tele health services during the shutdown has influenced any trends regarding the acceptance of telehealth as a dependable substitute for conventional in-person health care services**. (Kichloo, et al.,2020).** Telemedicine provides useful assistance to family doctors through the convenience of access to specialist consultations and continuous monitoring of patients. Telemedicine involves a number of service models—such as store-and-forward, real-time communications, and remote or self-monitoring—which allow for education, delivery of healthcare, disease screening, and disaster relief on a global basis. Though telemedicine cannot solve all issues in the healthcare system, it works significantly to alleviate the workload **(Sud, E, et al 2019)**

Keywords: Telemedicine application, types, , SDG-3, COVID-19, Future possibilities in India

1. INTRODUCTION

For more than 30 years health professionals, researcher, and other have sought to improve healthcare through the application of cutting-edge computer and telecommunication technologies. Telemedicine

which combines cutting-edge and telecommunications technology, has become a key component of healthcare delivery system. **(Institute of Medicine „1996**).An early Telemedicine application dates back to the 1940s in Pennsylvania, during which radiology images were sent over a telephone line 24 miles between two towns. It was probably the world's first electronic medical record transfer.**(QuicSolv Technologies Pvt. Ltd., 2023).**

Telephones, as well as other network features, quickly expanded over the years next to improved signal quality. By the 1900s, telephones were extensively employed to relay information from a distance. Willem Einthoven employed the telephone in 1905 to send heart sounds from a sanitarium to his laboratory. The initial American review of electrocardiography appeared in 1910 by cardiologists in New York, which documented the successful cable transmission of electrocardiograms (ECGs) among wards and ECG rooms. As part of the first venture of the telemedicine, doctors sent neurological examination through campus via interactive video communication to medical student interns in 1959 (**Gali, C. 2022, February 8).**

The COVID-19 pandemic has tested global health systems to unprecedented levels, unlike any event in recent history. The necessity for restricted travel, social distancing measures, and the closure of businesses has negatively affected numerous sectors of society, all aimed at curbing the virus's spread. Within this framework, telemedicine has been advocated and broadened to minimize the likelihood of viral transmission**. (Kichloo, et al.,2020**). With rising chronic diseases and aging populations in devolved nations, so has the need for medical services and, alternatively, the demand for individuals to transfer health services from hospitals to the home. As a result of Telemedicine, patients living in remote areas can obtain medical care from home and receive emergency care. Telemedicine can also be used in chronic disease management and emergency situations.(**Marcu,O.A.,et al.,2023).**

2. Telehealth Infrastructure in Indian scenario

Telemedicine focuses to provide innovation-enabled primary healthcare at cheap prices at areas ofIndia where basic healthcare is hard to reach. Two basic forms of technology are employed in telemedicine. The first is not in real time technology, where the past recorded information is exchanged between parties at disparate points in time and locations. This process, referred to as 'store and forward,' entails the application of a digital camera to take pictures that are saved and forwarded to another site through computer. It is widely used in tele-radiology, tele-pathology, and tele-

dermatology. The second model is Synchronous technology, where there is real-time data transfer. In this case, the specialist is at a referral site, and the patient or the telemedicine coordinator remains at a single site. Both have videoconferencing software installed, allowing consultations in real-time. It is highly effective and commonly used across specialties like psychiatry, internal medicine, paediatrics, cardiology, obstetrics and gynaecology, and neurology.(Ramya, N., & Shanthini, R. (2018). (A study on telemedicine in India)

Unlike the difficult situation in healthcare, internet skills are growing rapidly in India. Health personnel are now starting to see remote medicine as an important option. It is unchallenging to create good electronic communications systems at rural and suburban areas than to send many doctors to these places. We understand that satellite technology and fiber optic cables will be the main ways to improve communication in the future. (Grigsby B et al.,1999)

Telemedicine facilities have been established in two district hospitals of West Bengal and the School of

Tropical Medicine (STM) in Kolkata. Initial centers were launched at the Coronary Care Unit (CCU) of Siliguri District Hospital on June 24, 2001, and Bankura Sammilani Hospital on July 21, 2001.

In addition to the deployment of STM, Webel ECS developed yet another model of telemedicine implemented at two referral hospitals, namely — Nil Ratan Sircar Medical College and Hospital (NRS MC&H) in Kolkata and Burdwan Medical College and Hospital (MC&H) in Burdwan — and four nodal centers: Purulia District Hospital, Behrampur District Hospital, Suri District Hospital, and Midnapore (West) District Hospital.

The project runs on a 512 kbps leased line, which is facilitated by the West Bengal State Wide Area Network (WBSWAN) that has a 2 Mbps fiber optic backbone.

Table 1 - Initiatives by the Ministry of Health and Family Welfare, Government of India, to advance telemedicine in order to address the healthcare needs of India's rural population:

Initiative	Year Launched	Description	Impact on Rural Healthcare
eSanjeevani	2019 (scaled post-2020)	This is a nationwide telemedicine platform that connects doctors with other doctors and with patients. It offers two types of online consultations: doctor-to-doctor (eSanjeevani-HWC) and doctor-to-patient (eSanjeevani OPD).	There have been more than 200 million medical consultations conducted. This service helps people in remote areas gain better access to specialists.
Ayushman Bharat Health & Wellness Centres (AB-HWCs)	2018	HWCs are the first point of contact for basic healthcare services. They often provide facilities for tele consultations, allowing patients to consult doctors remotely.	Allows live video visits from rural areas to district and higher-level hospitals. This helps doctors and patients connect quickly without travelling long distances. Patients in remote places can now get advice from specialists and doctors in larger hospitals through real-time video calls. This makes healthcare more accessible and reduces the need to travel far for consultations.
National Telemedicine Service Guidelines	2020	This framework sets the rules for registered doctors to provide medical advice through online consultations. It ensures they do so in a way that is both ethical and safe. The guidelines cover how doctors should conduct	Expanded the use of both public and private healthcare providers, particularly in outreach to rural areas

		themselves during these consultations and what standards they must follow. They aim to protect patient health and confidentiality while allowing doctors to use telemedicine as a valuable tool. This legal structure helps doctors understand their responsibilities and reduces risks for both parties. It promotes clear and responsible communication in virtual healthcare services.	
Ayushman Bharat Digital Mission (ABDM)	2021	Intends to create a telemedicine support system, digital health records, and health IDs as part of an integrated digital health infrastructure.	promotes interoperability and safe access to health data even in remote settings
Mobile Medical Units (MMUs)	Ongoing	Mobile units featuring diagnostic and telemedicine capabilities are dispatched to serve isolated rural regions.	Video consultation with experts and mobile teams for last-mile healthcare delivery.
Training of ASHAs and ANMs	Ongoing	Providing rural health workers with tanning on how to use digital equipment and promote tele consultations at HWCs	Increases public confidence in telemedicine systems in pastoral areas and strengthens original support for them.
Collaboration with ISRO for Satellite-based Telemedicine	Since early 2000s, renewed use during pandemic	Uses satellite communication to provide telemedicine in location with no internet connection. The telemedicine project presently covers a large number of states and territories of India, such as	Facilitates the connection of distant areas such tribal belt and mountainous areas to urban hospital.

| | | Ladakh, Jammu & Kashmir, the Andaman & Nicobar Islands, Lakshadweep Islands, the North Eastern States, and Karnataka, tribal districts of Kerala, Chhattisgarh, West Bengal, Odisha, Andhra Pradesh, Maharashtra, Jharkhand, Punjab and Rajasthan. Currently, ISRO's telemedicine network reaches around 384 hospitals, connecting 60 specialist hospitals with 306 remote, rural, district, and medical college hospitals and 18 mobile telemedicine units. | |

source of table: Ramya, N., & Shanthini, R. (2018).

2.1 Application of telemedicine in India

Telemedicine has emerged as a critical medium in the shift towards healthcare delivery in India, particularly by enhancing access to medical care in rural and underserved areas.

Table: 2 shows how use telemedicine in the area

Application area	Explanation	Impact
Tele- health home care	Telemedicine technology allows healthcare providers to give care at home for elderly patient who stay there because ongoing health issues	These methods save both time and money. Remote Patient monitoring makes it easier and less expensive. (Chatterjee, K., & Kar, S. (2021).
Disaster management	Telemedicine playing vital role during both natural disaster like earthquake, tornadoes, manmade disaster events such as wars or riots.	These systems allow medical help to reach affected areas quickly and stay connected even when traditional lines fail.(Kumar, A., Babu, R., Kumar, A., & Ranjan, A. (2023).
Remote consultation	Telehealth can be used for consultations, follow up and prevention. It also helps to	These well equipped with video system allow visual consultation.

	solve problem at large gathering area for example: Maha Kumbh mela. Uttar Pradesh uses mobile telemedicine vans.	They let doctors in remote areas connect with hospitals that offer telemedicine. (.(Kumar, A., Babu, R., Kumar, A., & Ranjan, A. (2023).

It allows for distant consultations   between physicians and patients via videocalls, minimizing travel requirements and the load on urban healthcare facilities

Training and updates on the newest medical treatments	can be delivered more easily thanks to tele-education's adaptable and engaging long-distance learning platform.	It is very interactive, flexible and also help more accurate and effective. ((Chatterjee, K., & Kar, S. (2021).
Mental health support	Online counselling and therapy session.	Reduce stress
Health education	Online seminar, webinar	Preventive care awareness.

Source : author's completion
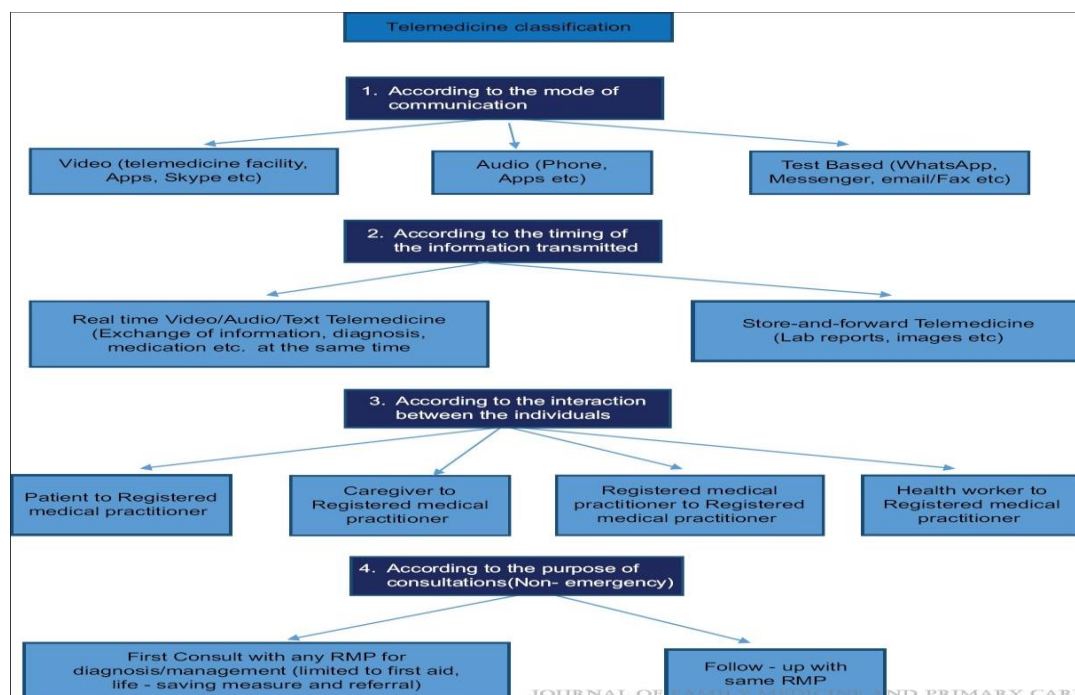
2:2 Types of telemedicine in India:

Fig : 1 shows various types of telemedicine for benefits healthcare sector Source : Kaeley et al., 2021

3. The role of telemedicine in achieving the SDGs

Tele-health can be a very useful way of progressing the SDGs as it can help ensure that health eventually stops being limited by geography, time, and money, and it can allow for cheaper care that's more accessible, accountable, and understood by beneficiaries and other participants. The Sustainable Development Goals (SDGs), which were formulated by the United Nations in September2015, represents a collection of 17 goals with 169 targets across a wide range of the human experience. We mentioned 4 goals of telemedicine in healthcare delivery. (Ricci et al., 2016)

Fig .2 model of SDG goals
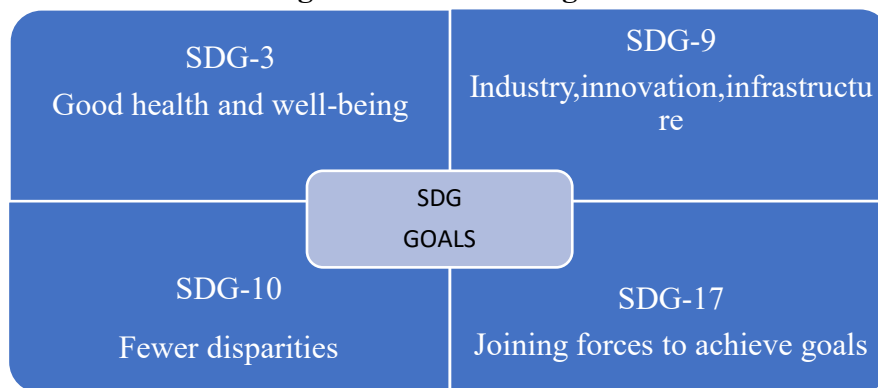
Source : author's completion

Fig .3 shows the description of model
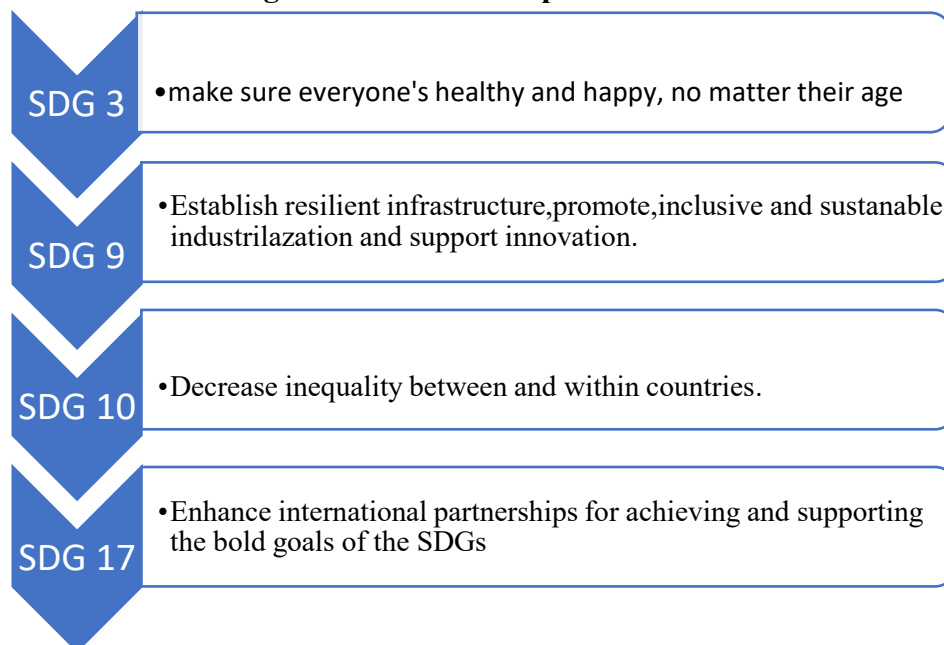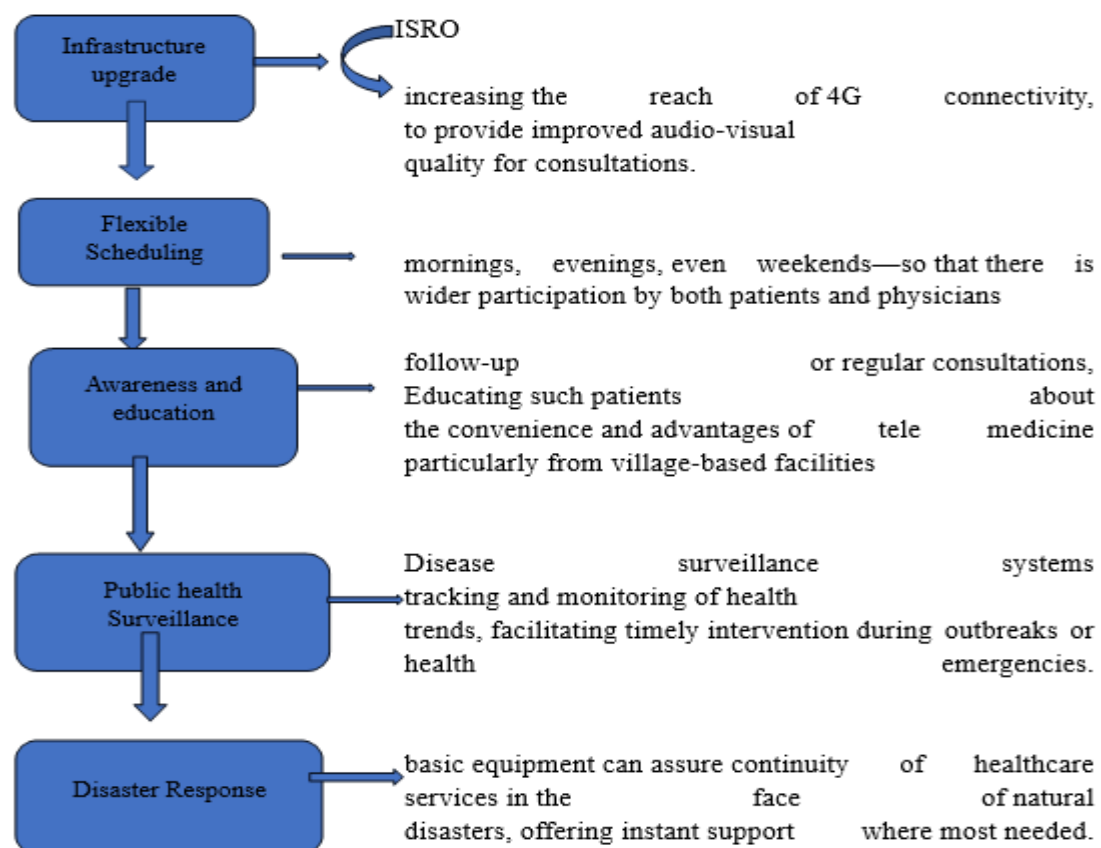

Source : author's completion

Telemedicine is key to meeting several United Nations Sustainable Development Goals (SDGs). It improves access to healthcare, increases efficiency, and promotes fairness.Table: 3 shows how the SDG goals are achieved through the Telemedicine.

SDG-3	SDG-9	SDG-10	SDG-17
• telemedicine improves healthcare service acess perticularly among remote and underserved populations,narrowing disparities and enhancing health outcomes.	• telemedicine is based on digital infrastructure and fosters technological innovation in healthcare delivery system.	• telemedicine reduces the disparity in healthcare acess bettween rural and urban populations and between low and high income individuals	• telemedicine promotes cross sector partnership(healthcare technology,government)to devolop scalable health solutions.

4. Future trends of telemedicine

Telemedicine has already proved its capability to enhance patient care with a decrease in the overall cost of healthcare. Programs such as the National Health Protection Scheme, which is among the world's largest government. (Kaeley, N. et al., 2021)

Reports from expert organizations such as NITI Aayog and consultancies such as McKinsey indicate that digital health solutions hold the potential to transform healthcare delivery. The National Digital Health Mission (NDHM), spearheaded by NITI Aayog, is a case in point—it plans to create a frictionless digital health system in which telemedicine services are plugged into an aggregated national health database so that coordination and data sharing can be improved among providers.(Aishwarya Kulkarni, February 07, 2025)

Fig: 4 Future possibilities by telemedicine into healthcare sector

Source: Author's completion

The future of telemedicine in India is about to move into a fascinating new era, driven by fast-paced technological advancement and increasing demand for affordable healthcare. In the years ahead, the convergence of advanced technologies such as virtual reality, block chain, and 5G connectivity will inevitably expand the reach and effectiveness of telehealth services. (Sheetal Verma and Ahlam Kazim, 2023)

5. Barriers of telemedicine

A telemedicine service does not replace conventional medical treatment; it complements it for basic functions. There are many potential drawbacks to using telemedicine in comparison to conventional treatments. Medical data can be hacked easily if a patient connects to telemedicine from an unencrypted channel or public network. The technological advances cause a delay in the delivery of emergency care, mainly because a doctor cannot remotely give life-saving treatment or perform laboratory tests. It may be difficult for patients with some disabilities, such as hearing or vision impairments, to use telemedicine**. For patients**: The elderly who grew up seeing monitors as televisions may not feel comfortable. Some patients with mobile health or m-health interventions might give false alarms, requiring immediate action to their non-emergency situations. This can be a

burden on the medical team. **For doctors**: It is illegal to prescribe, distribute, and deliver controlled substances without a valid prescription, which entails at least one face-to-face consultation. Therefore, it is illegal to distribute certain medications**. For hospital**: hospitals and other health care facilities may face issues related to infrastructure planning, telecommunication regulations, and reimbursement procedures with the government, licensure, and other issues when implementing telemedicine.

Fig: 5 frequent barriers during delivery through telemedicine

Source: Haleem et. al, 2021

6. Conclusion

Telemedicine has changed the health industry by transforming how people receive, access, and experience health care. It enables remote consultations, ongoing monitoring, and real-time health

services, which greatly improves health care access, especially for those in rural and less developed areas. It has also proven vital during crisis, such as the COVID-19 pandemic, when traditional health care delivery faced challenges.

Although it has numerous benefits—such as decreased patient travel, improved chronic disease control, and cost savings—telemedicine is also confronted by challenges like technical limitations, privacy of data, and gaps in regulation. Overcoming these challenges by strong infrastructure, digital literacy, and policies will be critical in order to realize its full potential.

In general, telemedicine is not a stopgap but an essential part of a patient-focused, future-proofed health system. Its ongoing development and incorporation will be central to the realization of affordable, efficient, and sustainable care for all.

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