Understanding Patient-Centric Barriers to Telemedicine Adoption in Hyderabad: Challenges and Opportunities

Ratan Singh[1], Amisha Wadekar[2], Dr. N. Rajesh Kumar[3]

[1]*Post Graduate Student, Department of Pharmaceutical Management, National Institute of Pharmaceutical Education and Research, Hyderabad, Telangana, India*

[2] *Post Graduate Student, Department of Pharmaceutical Management, National Institute of Pharmaceutical Education and Research, Hyderabad, Telangana, India*

[3] *Assistant Professor, Department of Pharmaceutical Management, National Institute of Pharmaceutical Education and Research, Hyderabad, Telangana, India*

Abstract

The study looks at patient-centric barriers to Hyderabad's telemedicine adoption using a quantitative survey of 215 patients.Using Exploratory Factor Analysis, the research identified five key factors explaining 53.3% of the variance in patient responses. The primary barriers are "Technology Access & Digital Literacy," "Privacy & Security Concerns," and "Perceived Inconvenience". Other significant factors include "Wearable Technology Inclination" and "Telemedicine Usage Intention". The study concludes that addressing the digital divide, improving platform usability, and strengthening data privacy are crucial for wider adoption.

Keywords: *Telemedicine adoption, Patient-centric barriers, Digital literacy, Privacy and security, Healthcare accessibility, Wearable technology, Usage intention.*

INTRODUCTION

Telemedicine has the potential to make healthcare faster, more affordable, and easier to access in cities like Hyderabad. However, many patients still hesitate to use it. Concerns about trust, correct diagnosis, and data privacy, along with poor internet access, limited digital skills, high costs, and language issues, make adoption difficult—especially for elderly people and low-income groups who often prefer face-to-face consultations.

REVIEW OF LITERATURE:- TELEMEDICINE IN INDIA

In order to improve the health of individuals and their communities, “The World Health Organization defines telemedicine as "the delivery of health-care services, where distance is a critical factor, by all health-care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health-care providers”**(Raju & Sistla, 2022).**

Future developments in telemedicine will be influenced by three factors: (1) economics, (2) technology, and (3) human concerns. Behaviours involving technology have an influence on change at the individual, business, and social levels. Technology-enabled healthcare in the developed world is mostly driven by a lack of workers and dwindling third-party reimbursement, particularly in the areas of home care and self-care. **(Heinzelmann et al., n.d.)**

Telemedicine has the potential to drastically alter how healthcare is provided, going beyond patient-to-patient interactions. Incorporating telemedicine into healthcare organizations' offerings is now crucial, supporting a hybrid approach that blends virtual consultations with traditional in-person care. It not only offers accessibility and flexibility but also addresses distribution-related challenges of medical supplies.**(Reddy Mallipeddi et al., 2017).**

Telemedicine has shown to be effective in a variety of challenging situations, including space shuttles and peacekeeping missions, in addition to the more conventional settings of the home, clinic, hospital, and long-term care institution. An "extended warranty" on medical education can be offered by medical schools using telemedicine, according to one observer.**(Grigsby & Sanders, 1998).**

Telehealth usage rose during the epidemic as patients and healthcare professionals looked for safer ways to receive and offer care. With a projected CAGR of 39.6%, the telehealth sector is the one in healthcare that is expanding the fastest. 3. According to a recent estimate, By 2020, the worldwide telehealth industry is anticipated to grow to a value of USD 10.6 billion. shown in Fig.1**(Kumar Roy & Dutta, n.d.).**

Telehealth has the ability to transform the healthcare industry in India in order to enhance medical value. Telehealth has changed the way that patients consult doctors in the traditional way.It's an effective way to get healthcare because patients can interact with medical specialists from anywhere in the world. **(Telehealth Expected to Revolutionize Medical Tourism in India in 2023, ET HealthWorld, n.d.).**

India is a large country with a population of about 121 crore. As a result, equitable healthcare distribution has continuously emerged as a primary goal in public health management.Furthermore, there has been a recent trend of healthcare facilities being concentrated in urban areas.**(Chellaiyan et al., 2019)**.

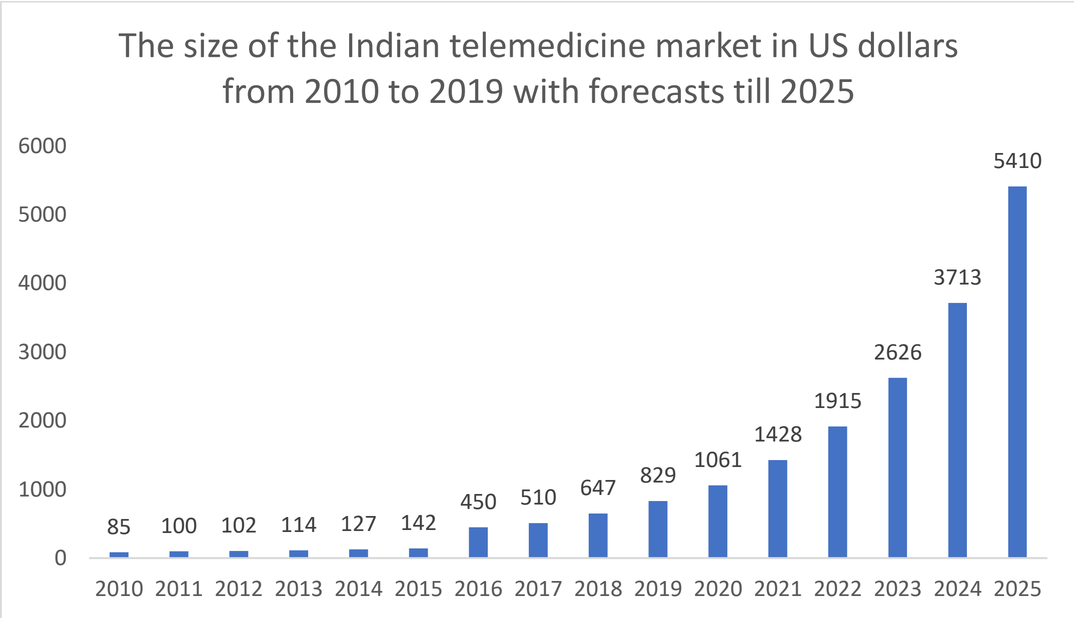


Fig 1 . Growth of the Telemedicine Market in India (2010–2019) with Projections to 2025 (in Million USD. (Chellaiyan et al., 2019)

Both public and private organisations have launched a number of telemedicine services in India, including some more recent ones as eSanjeevni, Services eHealth Assistance and Teleconsultation - SeHATOPD, and Swasth-app (Started in June 2020). The "AYUSH Sanjivani" app was released in May 2020. These include the Ayushman Bharat Health Account (ABHA), the South Asian Association for Regional Cooperation (SAARC), and the Pan-African e-network Project: Global Telemedicine Projects Initiated by India. examples of tele-mental health initiatives.**(*Current Trends in Telemedicine in India*, n.d.).**

The development of medical applications that have spread across several medical specialisations is anticipated in the future of telemedicine trends. These days, certain mental health, dermatological, chronic illness, and surgical consultations are done from a distance. These developments have proven effective in many healthcare settings, offering improved solutions for a range of medical requirements..**(*The Future of Telemedicine: 7 Telemedicine Trends for 2024*, n.d.).**

The global telemedicine market was valued at USD 97.15 billion in 2023 and is projected to reach USD 432.31 billion by 2032 and USD 107.52 billion in 2024, with a compound annual growth rate (CAGR) of 19.0%. North America dominated the global telemedicine market in 2023 with a 47.98% market share.**(*Telemedicine Market Size, Share, Growth | Global Report [2032]*, n.d.).**

The Indian e-pharmacy market is expected to develop at a 44% compound annual growth rate (CAGR) between 2019 and 2025, reaching a size of US$4.5 billion by that time. Both the growing dependence on digital healthcare solutions and the revolutionary influence of health-tech entrepreneurs in changing the Indian healthcare scene are reflected in this robust development trajectory.**(*Revolutionizing Indian Healthcare: Health Tech Boom | IBEF*, n.d.).**

India now has a doctor-to-population ratio of only 0.62:1000, when the WHO recommends a ratio of 1:1000. Given the substantial time and financial commitment required to train new physicians, the doctor-to-patient ratio is likely to be low for some time to come. The active telemedicine services that are offered nationwide are helping to somewhat offset this shortcoming.(***Revolutionizing Indian Healthcare: Health Tech Boom | IBEF*, n.d.).**

One of the most important components of giving those in need access to high-quality healthcare is the technology used in telemedicine, which enables patients and professionals to be almost anywhere. The development of telemedicine has made it possible for rural regions to get care without being constrained by distance. The implementation of mobile telemedicine units with satellite connectivity addressed the program's initial obstacle, which was the absence of a major centre for providing telemedicine services in a number of remote locations.**(Chellaiyan et al., 2019).**

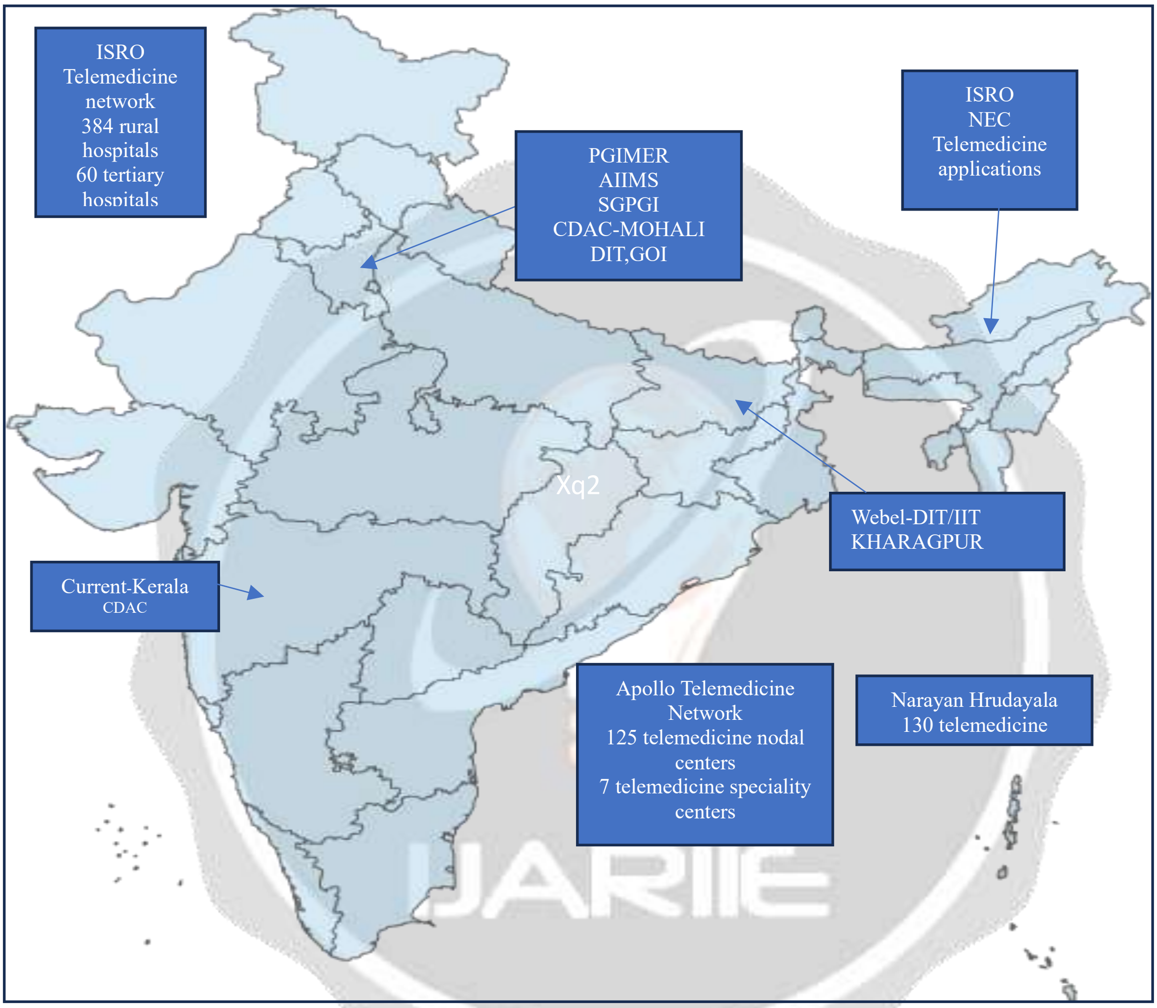


FIG 2. Telemedicine in India: role of private and govertment organization (Mathur et al., 2017)

OVERVIEW OF TELEMEDICINE ADOPTION IN URBAN INDIA

Overview Of Telemedicine Adoption in Urban India:-

Both the governmental and commercial sectors in India have launched a number of telemedicine projects. Interestingly, the nation's first telemedicine system was developed and put into place by Apollo Hospitals, a private organisation in the Andhra Pradesh hamlet of Aragonda that collaborates with ISRO (Indian Space Research Organisation).**(Chandwani & Dwivedi, 2015).**

The potential of telemedicine has also been realised by the business and healthcare sectors. The successful conclusion of several telemedicine pilot projects has established telemedicine as a strong and dependable hea lthcare delivery method in India. Inboth public and private organizations, as shown in **Fig.2(Mathur et al., 2017).**

Policy Initiatives

By Ministry of Communication & IT

a. Telemedicine Platform and Service Standardization:

The "Recommended Guidelines & Standards for Practice of Telemedicine in India" document was produced by DIT with the goal of standardizing the services offered by different telemedicine institutes.Its goal is to improve the interoperability of the several telemedicine systems that are being established around the nation.

b. Defining the IT Infrastructure of Health:

Additionally, DIT took the initiative to define "The framework for Information Technology Infrastructure for Health (ITIH)" in a project mode in order to effectively meet the information demands of various stakeholders in the healthcare industry**.(Mishra et al., 2011)**

PATIENT PERSPECTIVES ON TELEMEDICINE: TRUST AND ACCESSIBILITY

The SARS-CoV-2 epidemic has prompted swift changes in the healthcare system. The most notable of them is the shift away from physical clinics and healthcare facilities and toward eHealth and online care delivery.

By allowing people to receive medical care at home, telemedicine may have, in some ways, eliminated disparities and broken down geographical and physical barriers, but these quick and unreported changes may have also aided in the spread of inequities throughout the population.**(Majid & Wasim, 2020).**

According to the Jansen-Kosterink study participants [12], Numerous factors, such as a lack of intrinsic motivation on the part of the patient, impersonal communication, technical issues, worries about digital literacy, privacy violations, the potential for additional complaints, the impression of less intensive treatment, and the challenge of maintaining current content, can cause patients to reject or be less receptive to telemedicine.**(Moulaei et al., 2023).**

Telemedicine exposure did, however, alert patients and carers to benefits beyond pandemic safety as compared to in-person consultations. The majority of respondents cited the convenience of telemedicine visits, citing the benefits of telemedicine over in-person visits, including more efficient use of their time, no need to take time off from work, no time or expense required for transportation, and no need for child care.**(Berry et al., 2022).**

Among the often cited clinical limitations of telemedicine are the challenge of doing comprehensive physical exams, the loss of patient-provider connections, the fragmentation of therapy, and the potential for overprescribing or excessive health care consumption. These concerns are often unjustified, and while anticipating potential telemedicine problems is important, innovative solutions are always being employed to get over potential implementation roadblocks.**(Barbosa et al., 2024).**

The majority of participants were generally enthusiastic about the availability of telemedicine visits moving ahead due to their convenience and ease of use, even if their opinions of their use varied depending on the therapeutic treatment in the post-pandemic world. The majority of primary care patients shared their vision of a hybrid care paradigm and their want for telemedicine to be accessible in the future.**(Berry et al., 2022).**

There is a great chance to increase access to health information and resources to enhance health because mobile phones and smartphones are rapidly becoming more popular among groups who are more likely to have low health literacy.**(Mackert et al., 2016).**

In the digital era, people's methods for accessing and using health information have evolved. People may now access a wide range of health services at their fingertips due to the widespread availability of mobile technology and the internet. Social media platforms, telemedicine services, mobile health apps, and websites have all become popular channels for sharing health information.**(Niltakan, n.d.).**

A significant percentage of homebound patients—up to 80 to 90 percent—remain reluctant to even attempting to employ telemedicine therapies, despite the fact that they are widely acknowledged and effective for patients who are willing to use them. Only 21% of home health agencies already provide telemedicine services. The advantages of greater availability and better results would not materialise if people were less inclined to engage in telemedicine interventions.**(Huang et al., 2016).**

TECHNOLOGICAL AND INFRASTRUCTURE CHALLENGES IN TELEMEDICINE

In order to give people the features or services they need, telemedicine combines a number of elements, such as hardware and software technologies, information and communication technologies, and medical services.**(Khemapech, 2019).**

The following categories apply to telemedicine applications and communications:

• Body Area Communication: the exchange of information between patients and telemedicine tools, like wearable sensors

• Wide area network (WAN), satellite, internet, and GSM connectivity between the telemedical devices and distant servers

• Application-based communication, such as video conferencing, medical picture transmission, and emergency telemedicine **(Alenoghena et al., 2023).**

Technological challenges-

1The quality of the transmitted video images in meeting the clinical needs of the medical experts is one potential technological barrier. The teleconsultation equipment lacks digitising scanners that can send such images, and the video cameras that send the images do not meet the American College of Radiology's minimum resolution requirements for digitised radiography images. Despite this, doctors are routinely asked to review transmitted radiography images during teleconsultations.**(Paul et al., 1999).**

2) The advancement of telemedicine in developing nations is being hampered by technology itself. Many stakeholders cannot afford the high cost of updating the outdated systems.

3) High-speed, consistent internet bandwidth is necessary for most telemedicine apps to operate effectively. These applications include emergency consultations, real-time teleradiology, tele-ophthalmology, and tele-surgery. However, telemedicine services cannot be delivered smoothly due to erratic and slow internet connectivity**(Bali, 2019).**

Cost benefits

Teleophthalmology has boosted efficiency and cost savings, with telemedicine usage rising from 11% in 2019 to 46% in 2020 due to COVID-19. In Canada, teleglaucoma reduced travel costs, enabled earlier glaucoma diagnoses, and lowered blindness risk by 24%, improving vision retention by 13%. Over 30 years, it saved $27,460 per QALY compared to traditional care, showcasing its potential for substantial cost savings and long-term benefits through timely detection and treatment.**(Ramessur et al., 2021).**

The Value of Telemedicine Consultation for COVID-19 Pandemic Management

By integrating telemedicine, medical personnel may avoid burnout and healthcare systems can avoid overcrowding. Telemedicine is helpful for preoperative evaluation and permits the gathering of medical data prior to a patient's admission, even if it does not allow for in-person patient examinations. Additionally, it may be used to screen and triage patients with known or suspected infections, safeguarding both patients and doctors.**(Jnr et al., 2021).**

Telemedicine in remote areas

In rural areas, telemedicine and teleconsultation have been made possible by the widespread availability of high-speed internet, PCs, and mobile devices with high-definition cameras. In order to improve the current healthcare systems, telehealth technologies are also being used more quickly due to a number of factors. These trends include the ageing population brought on by longer lifespans, the acute lack of healthcare professionals, the increase of chronic illnesses and lifestyle-related disorders, more patient knowledge, and rising patient demand.**(Bakshi & Tandon, 2022).**

Difficulties in Deploying AI-Enabled Telemedicine in Resource-Limited Environments:

Limited availability of essential technologies such as computers, mobile devices, and high-speed internet hinders deployment and maintenance. A shortage of skilled healthcare providers and technical experts for developing, operating, and maintaining telemedicine systems poses challenges. Communication challenges arise due to diverse languages and cultures, which AI-powered natural language processing may only partially address.

Data Security and Privacy Issues: Inadequate infrastructure for data security makes it challenging to guarantee confidentiality and secure sensitive patient data.

Limited Funding: High costs associated with infrastructure, technology, and personnel (hiring, training, and compensation) strain resource-constrained settings**(Sathishkumar Chintala, 2023).**

Telemedicine in clinical practice

Psychiatrists have previously voiced concerns about flawed algorithms that could lead to missed or incorrect diagnoses, potentially causing iatrogenic risk**. Patients** and psychiatrists who prefer in-person consultations frequently feel inadequate with online services, and the disparity in computer literacy between healthcare providers and patients presents challenges in clinical practice.**(Thenral M l, n.d.).**

SOCIO-CULTURAL AND ECONOMIC BARRIERS

Organizational barriers

For telemedicine to be implemented successfully, a thorough grasp of the healthcare organization itself is just as important as an understanding of the system. In order to guarantee that medical systems are successfully integrated and in line with organizational goals, healthcare organizations are essential.

An examination of earlier research reveals a number of important obstacles brought about by organizational structures, **such as infrastructure constraints, weak strategic planning, insufficient training, ineffective monitoring, unfavourable media coverage, a lack of professional expertise, and issues with insurance and reimbursement**.**(Al-Samarraie et al., 2020).**

Personal barriers

There are common barriers that must be addressed when implementing telehealth practices in healthcare and its associated fields. These barriers include ensuring **privacy, maintaining confidentiality, preventing fraud and misuse, and providing accurate solutions**. Any shortcomings in these areas could lead to discouragement or complicate cases, especially when it comes to sensitive health matters.**(Haleem et al., 2021).**

Overcoming Socio-Cultural, Geographical, and Economic Challenges in Telemedicine

The digital divide can be widened by economic disparities that restrict the cost of gadgets and internet connections. Adoption is further hampered by sociocultural elements such as a lack of understanding, aversion to change, and problems with trusting technology or virtual consultations. Furthermore, these obstacles worsen healthcare disparities since underserved communities have a harder time obtaining telemedicine services, which limits their ability to enhance health outcomes for all groups**.(Coombs et al., 2022)**

A novel method to portable mobile technology has been studied as a telemedicine to overcome the geographic obstacles to accessing medical facilities and enhancing health status. **(Kumar et al., 2022).**

Challenges of Telemedicine

Despite its critical role during COVID-19, telemedicine faces numerous challenges. Varying stakeholder expectations, gaps in technical expertise, and uneven digital literacy limit its adoption. The rapid shift to healthcare ICT exposed issues like unreliable infrastructure, hindering data capture and storage, while insufficient training affects diagnosis, triage, and communication. Limited connectivity, weak data management systems, and inadequate technical support further reduce efficiency. **Additionally, medico-legal concerns, coupled with cultural, societal, and policy constraints, complicate its implementation, preventing telemedicine from reaching its full potenti**al. **(VERMA et al., 2023).**

Obstacles and Suggestions for the Elderly to Adopt Telehealth

Low digital literacy, susceptibility to misinformation, and lack of confidence hinder elderly individuals from adopting telehealth. Their use is influenced by demographics, sensory, physical, and cognitive abilities. Enhancing digital literacy and education is crucial, alongside designing user-friendly telehealth apps and devices tailored to seniors' needs. These measures improve accessibility and usability, ensuring equitable adoption of telehealth and empowering older adults and their caregivers to benefit from healthcare innovations **(Bastani et al., 2021).**

OPPORTUNITIES FOR ENHANCING TELEMEDICINE ADOPTION

Telemedicine Adoption

By using technology to provide medical treatments remotely, telemedicine is a revolutionary approach to healthcare. Adoption improves accessibility, allowing underserved and rural populations to receive care **(Cegarra-Sánchez et al., 2020)**.

Telemedicine guarantees prompt interventions, lowers expenses, and boosts productivity by combining cutting-edge technologies like teleconsultations, remote monitoring, and e-health platforms. Giving patients access to electronic information encourages self-care and well-informed choices **(Cegarra-Navarro et al., 2012).**

However, obstacles like technical literacy, regulatory compliance, and infrastructure issues must be addressed for adoption to be successful **(Scott Kruse et al., 2018).**

Moreover, telemedicine increases patient satisfaction and convenience by reducing travel and wait times, leading to improved healthcare outcomes. By encouraging a patient-centered approach to healthcare, telemedicine adoption opens the door to innovation and better health outcomes. **(Negredo & Warriner, 2016).**

Framework for Future Telemedicine Planning and Involved Infrastructure

The **Escalation Model** for telemedicine emphasizes an integrated approach, ensuring harmony across all ecosystem components. It includes:

1. **Government Policies**: **Establish robust regulations for secure, ethical practices.**
2. **ICT Industries**: Develop **innovative systems, sensors, and devices for** rapid data processing.
3. **Wireless Technology**: Enable real-time, low-latency data transmission.
4. **Industry Involvement**: Encourage investments and novel business models from tech firms, startups, and pharma companies.

Strategic coordination among these ensures sustainable telemedicine services, maintaining stability while driving innovation in the eHealth ecosystem **(Anwar & Prasad, 2018).**

Telemedicine Enables Innovative Visits

Telemedicine enables innovative care by virtually connecting patients, doctors, staff, and family members. For example, a distant daughter can join her mother's end-of-life planning via video. Hybrid visits enhance coordination, like joint video sessions between oncologists and cardiologists for prostate cancer and heart surgery. Virtual support from nurses during in-person visits boosts efficiency and safety. This approach fosters better communication, decision-making, and care quality, transforming healthcare delivery and collaboration **(Sinsky et al., 2021).**

Telemedicine Effectiveness and Emerging Technologies

The efficacy and equity of telemedicine in rural healthcare can also be improved by research on the efficacy of certain telemedicine treatments, such as telestroke services, telepsychiatry, and upcoming technologies like artificial intelligence and remote monitoring.These innovations improve patient outcomes, reduce disparities, and provide valuable insights for clinical practice and policy development. Continued research and innovation are vital to addressing evolving needs, optimizing healthcare delivery, and ensuring equitable access, ultimately realizing telemedicine's full potential to transform rural healthcare systems **(Lakshmi & Molli, n.d.).**

Opportunities in Telemedicine

1. **Enhancing Accessibility of Health Services**
   By enabling patients to consult with medical professionals without having to travel, telemedicine enhances access to healthcare, particularly in rural and disadvantaged areas.**(Leite et al., 2020).**
2. **Expanding Reach of Specialists**
   It connects patients to specialists who may not be available locally, bridging gaps in specialized healthcare delivery.
3. **Improving Service Efficiency**
   Telemedicine helps healthcare institutions use resources more efficiently by cutting down on wait times, administrative costs, and follow-up visits.**(Kaplan, 2020)**.
4. **Utilising Cutting-Edge Technologies**

   Telemedicine integrates seamlessly with advanced systems like remote patient monitoring, fostering innovation and enhancing healthcare delivery **(Albahri et al., 2021).**

5. **Reducing Geographical and Time Constraints**
   It helps overcome geographical barriers, making healthcare consultations more flexible and quicker **(Ganiem, 2021).**
6. **Improving the Management of Chronic Illnesses**
   Better chronic illness management and early health issue diagnosis are made possible by routine remote patient monitoring. **(Prawestiningtyas et al., 2023).**
7. **Promoting Cost Efficiency**
   Telemedicine reduces costs associated with physical infrastructure and patient transportation, making healthcare more affordable **(Bokolo Anthony Jnr., 2020).**

Research Methodology

In order to identify and examine patient-centric obstacles to Hyderabad's adoption of telemedicine, this study used a quantitative, cross-sectional research approach. Exploratory Factor Analysis (EFA) was the main analytical technique utilised to identify the underlying dimensions in the survey data that was gathered.

Method of Data Collection

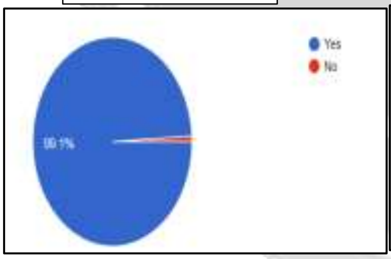
The data was collected through an online structured questionnaire with 20 questions. A total of 215 responses were considered.

Factors Identified

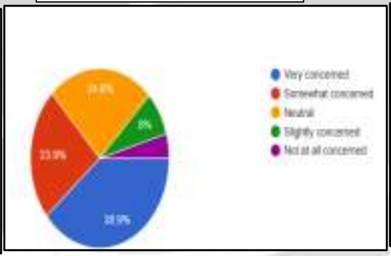
Factor 1: Technology Access & Digital Literacy

Variables: Device (0.674), Internet (0.591), Consultation Trust (0.544), Education (0.536).
Barrier: Many patients lack smartphones or internet access, struggle with digital literacy, and often mistrust online consultations. This reflects the digital divide, which is a key barrier to adoption.

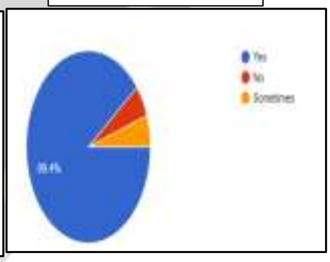
Device



Privacy Concern



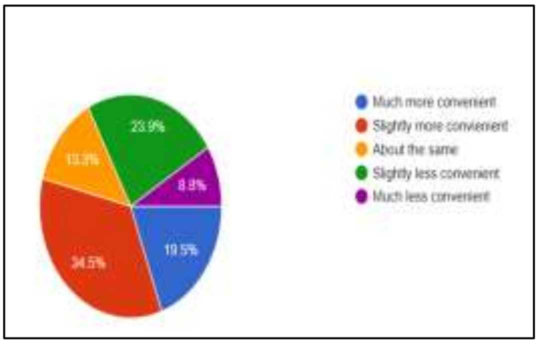
Internet



Factor 2: Perceived Convenience

Variable: Convenience (0.795)
Barrier: Telemedicine is often seen as less convenient than traditional care, due to usability challenges and lack of personal interaction.

Convenience in using Telemedicine

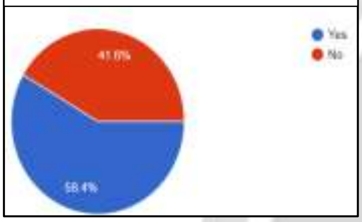


Factor 3: Wearable Technology Inclination

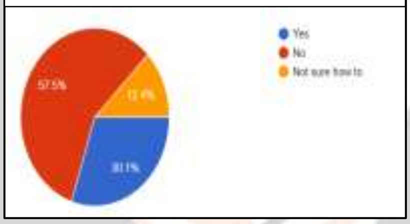
Variables: Wearable Device Use (0.676), Data Sharing (0.642), Wearable Device (0.534)

Barrier: Patients are hesitant to use wearable devices and reluctant to share personal health data with providers. This shows low readiness for tech-based health monitoring.

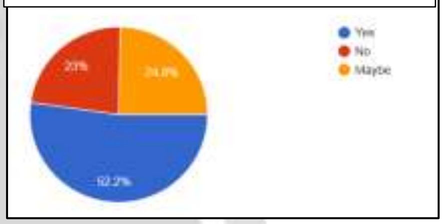
People having health related wearable device



People who shared wearable device data to HCPs



People who are comfortable in using wearable device to monitor your health remotely

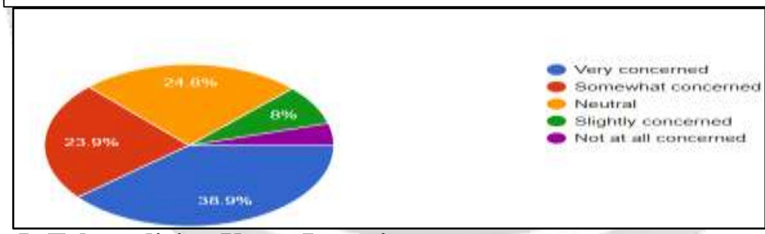


4: Privacy & Security Concerns

Variable: Privacy (0.486)

Barrier: Patients fear data breaches and misuse of personal health records, leading to mistrust in telemedicine platforms.

People who have privacy concerns while using Telemedicine

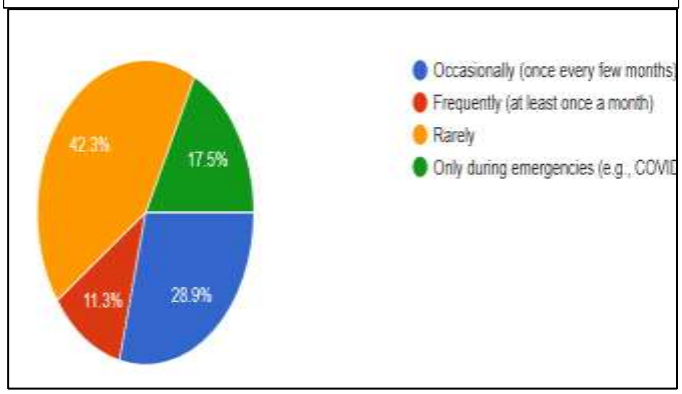


Factor 5: Telemedicine Usage Intention

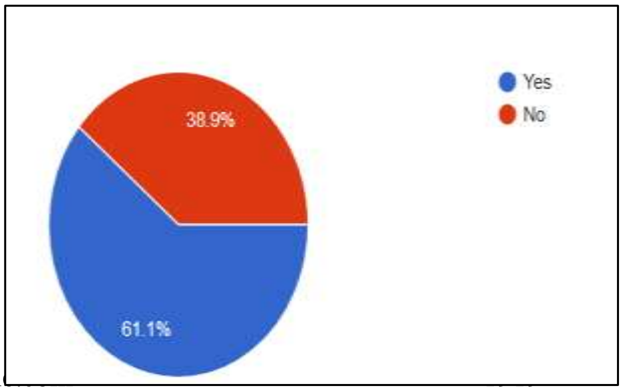
Variables: Telemedicine Use (0.605), Frequency Use (0.601)

Barrier: Lack of habit or willingness to regularly use telemedicine. Adoption is still sporadic and need-driven, not consistent.

Frequency of using telemedicine by people



People who use telemedicine services



6. Summary of Factors

1. Technology Access & Literacy – Patients need better digital access, training, and trust in online consultations.

2. Perceived Convenience – Telemedicine must be designed to be simpler and more user-friendly.

3. Wearable Inclination – Adoption of wearable health tools needs encouragement and awareness.

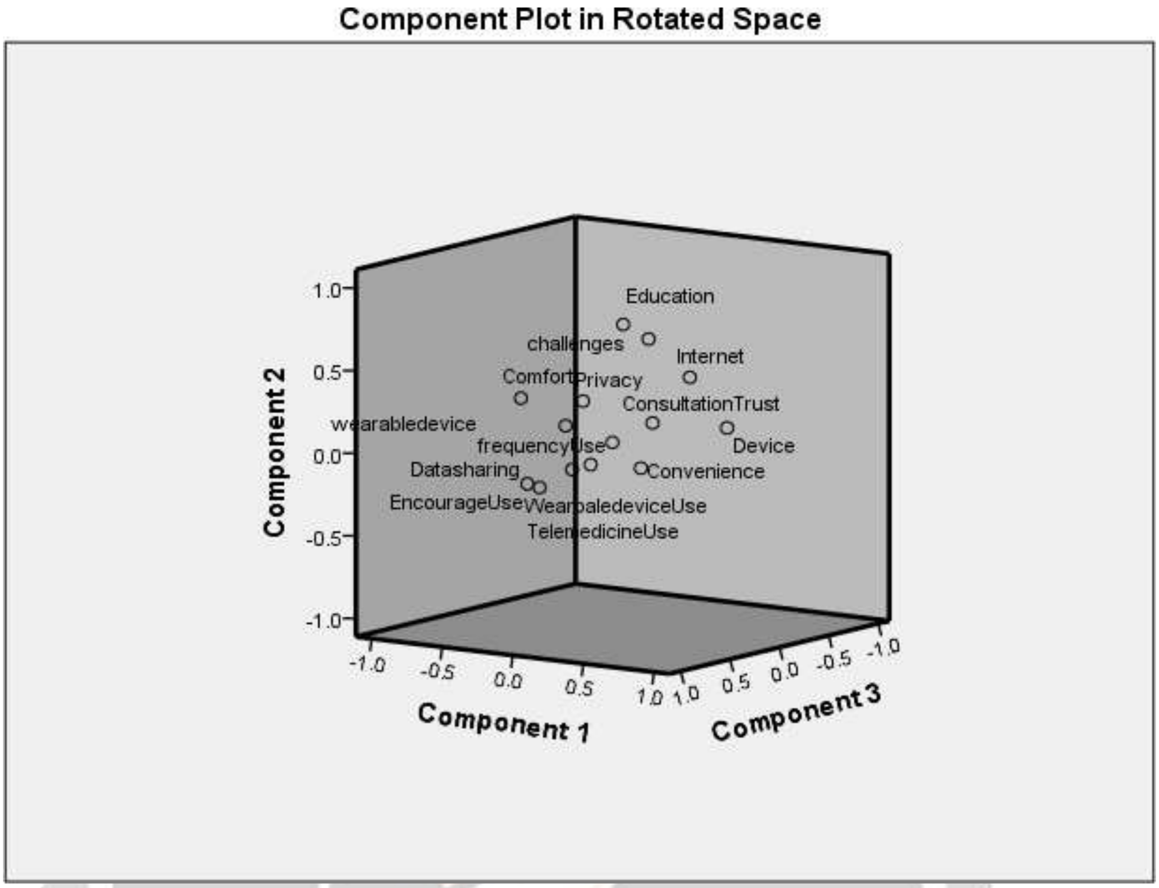
4. Privacy Concerns – Stronger data security, transparency, and regulations are required to build trust.

5. Usage Intention – Policies should focus on encouraging routine use of telemedicine through awareness campaigns and habit formation.

Factor Analysis – Component Plot in Rotated Space

The 3D component plot below visually represents the rotated factor solution from the exploratory factor analysis conducted on the variables influencing telemedicine adoption. Each point in the plot corresponds to a variable, and its position indicates its loading across the three extracted components.

Variable	Component 1	Component 2	Component 3	Component 4	Component 5
Encourage Use	-.753				
Device	.674				
Internet	.591				
Consultation Trust	.544				
Education	.536	.456			
Comfort	-.484	.447			
Wearable device Use		.676			
Data sharing		.642			
Wearable device		.534			
Challenges			.451		
Telemedicine Use					
Convenience			.795		
Privacy		.446		.486	
Frequency Use				.605	



Variables that are close together in the plot tend to load similarly on components and may be conceptually related. The rotation helps simplify interpretation by maximizing high loadings and

- **Component 1 (X-axis)** captures variance related to technology use and access, as seen by variables like "Device," "Internet," and "Consultation."
- **Component 2 (Y-axis)** seems to reflect personal concerns and challenges, including "Privacy," "Comfort," and "Challenges."
- **Component 3 (Z-axis)** may relate to behavioral aspects and usage patterns, as shown by "TelemedicineUse," "EncourageUse," and "frequencyUse."

Conclusion-The alternate hypothesis (H_1) is accepted – the study confirms the presence of significant patient-centric barriers to telemedicine adoption in Hyderabad.

Top 3 Identified Barriers:

1. Technology Access & Digital Literacy – Many patients lack access to stable internet and the skills to use telemedicine platforms effectively.
2. Privacy & Security Concerns – Fear of data breaches and mistrust in confidentiality hinder adoption.
3. Perceived Inconvenience – Patients often perceive telemedicine as less convenient due to usability issues and a lack of personal interaction.

Discussion

Adoption of telemedicine in Hyderabad is shaped by a mix of technological, behavioral, and social factors. While many people own smartphones and a fair share have tried telemedicine, their use is not yet habitual; it is often an occasional, problem-driven choice rather than a routine part of care.

Technology and access form the foundation: without reliable devices and internet, even motivated users struggle. Experience and design matter too—if platforms are confusing or slow, people revert to in-person visits. Privacy worries and reluctance to share wearable data further reduce willingness to adopt remote health monitoring at scale.

Practical implications

- Addressing the digital divide is essential. Even in urban areas, gaps in device ownership and connectivity exclude some users.
- User experience must improve: apps should be simpler, available in local languages, and designed with older or less-literate users in mind.
- Privacy and transparency are non-negotiable: clear consent processes and visible data protections will help build trust.
- To move from episodic to routine use, telemedicine needs to be integrated into care pathways—follow-ups, reminders, and blended care models will help make it part of regular care.

Suggestions for future problem-solving

Infrastructure & access

- Pilot subsidized device or data plans for low-income groups through public–private partnerships.
- Develop low-bandwidth telemedicine options (audio + optimized text, lightweight video) for unreliable networks.
- Create community telehealth kiosks or assisted telemedicine points for those without home devices.

Digital literacy & support

- Run provider-led training and community workshops, focusing on older adults and people with low digital skills.
- Add in-app guided walkthroughs, tooltips, and simple ‘call for help’ options for first-time users.

Usability & service design

- Co-design interfaces with patients (including seniors) to ensure features are intuitive and relevant.
- Provide multilingual support and accessibility options (large text, voice navigation).

Trust, privacy & governance

- Publish clear, plain-language privacy notices and consent forms, practice data minimization for telehealth records.
- Introduce certification or Trustmark schemes for telemedicine platforms to signal compliance with data security standards.

Clinical integration

- Adopt hybrid care protocols that combine remote triage with scheduled in-person visits for cases that need hands-on assessment.
- Implement standardized follow-up workflows so remote consultations link smoothly to in-person care when required.

Wearables & monitoring

- Pilot secure integration of wearable data into clinician dashboards and EMRs with explicit patient consent.
- Educate patients about the benefits and controls around wearable data to reduce reluctance to share.

Research & evaluation

- Run randomized pilots comparing low-bandwidth vs standard platforms, and measure outcomes and user satisfaction.
- Conduct longitudinal studies to track whether UX improvements, training, or subsidized access increases routine telemedicine use.

Limitations

- This online, cross-sectional survey may underrepresent people without internet access, who are precisely those most affected by access barriers.
- Responses are self-reported and can reflect recent experiences or social desirability.
- The factor analysis is exploratory and sample-dependent**;** confirmatory work on a new sample would strengthen these findings.

Conclusion

Telemedicine has real potential, but several clear barriers stand in the way. Improving device and internet access, simplifying user experience, strengthening privacy safeguards, encouraging wearable adoption where useful, and embedding telemedicine into clinical workflows will together make telemedicine a more reliable and equitable option for patients in Hyderabad. Achieving this requires coordinated action from healthcare providers, tech companies, policymakers, and community organizations.

References:

1. Albahri, A. S., Alwan, J. K., Taha, Z. K., Ismail, S. F., Hamid, R. A., Zaidan, A. A., Albahri, O. S., Zaidan, B. B., Alamoodi, A. H., & Alsalem, M. A. (2021). IoT-based telemedicine for disease prevention and health promotion: State-of-the-Art. *Journal of Network and Computer Applications*, *173*, 102873. https://doi.org/10.1016/j.jnca.2020.102873
2. Alenoghena, C. O., Ohize, H. O., Adejo, A. O., Onumanyi, A. J., Ohihoin, E. E., Balarabe, A. I., Okoh, S. A., Kolo, E., & Alenoghena, B. (2023). Telemedicine: A Survey of Telecommunication Technologies, Developments, and Challenges. *Journal of Sensor and Actuator Networks*, *12*(2), 20. https://doi.org/10.3390/jsan12020020
3. Al-Samarraie, H., Ghazal, S., Alzahrani, A. I., & Moody, L. (2020). Telemedicine in Middle Eastern countries: Progress, barriers, and policy recommendations. *International Journal of Medical Informatics*, *141*, 104232. https://doi.org/10.1016/j.ijmedinf.2020.104232
4. Anwar, S., & Prasad, R. (2018). Framework for Future Telemedicine Planning and Infrastructure using 5G Technology. *Wireless Personal Communications*, *100*(1), 193–208. https://doi.org/10.1007/s11277-018-5622-8
5. Bakshi, S., & Tandon, U. (2022). Understanding barriers of telemedicine adoption: A study in North India. *Systems Research and Behavioral Science*, *39*(1), 128–142. https://doi.org/10.1002/sres.2774
6. Bali, S. (2019). Barriers to Development of Telemedicine in Developing Countries. In *Telehealth*. IntechOpen. https://doi.org/10.5772/intechopen.81723
7. Barbosa, W., Zhou, K., Waddell, E., Myers, T., & Dorsey, E. R. (2024). Improving Access to Care: Telemedicine Across Medical Domains. *Public Health*, *19*, 463–481. https://doi.org/10.1146/annurev-publhealth
8. Bastani, P., Mohammadpour, M., Samadbeik, M., Bastani, M., Rossi-Fedele, G., & Balasubramanian, M. (2021). Factors influencing access and utilization of health services among older people during the COVID − 19 pandemic: a scoping review. *Archives of Public Health*, *79*(1). https://doi.org/10.1186/s13690-021-00719-9
9. Berry, C. A., Kwok, L., Massar, R., Chang, J. E., Lindenfeld, Z., Shelley, D. R., & Albert, S. L. (2022). Patients' Perspectives on the Shift to Telemedicine in Primary and Behavioral Health Care during the COVID-19 Pandemic. *Journal of General Internal Medicine*, *37*(16), 4248–4256. https://doi.org/10.1007/s11606-022-07827-4
10. Bokolo Anthony Jnr. (2020). Use of Telemedicine and Virtual Care for Remote Treatment in Response to COVID-19 Pandemic. *Journal of Medical Systems*, *44*(7), 132. https://doi.org/10.1007/s10916-020-01596-5
11. Cegarra-Navarro, J.-G., Sánchez, A. L. G., & Cegarra, J. L. M. (2012). Creating patient e-knowledge for patients through telemedicine technologies. *Knowledge Management Research & Practice*, *10*(2), 153–163. https://doi.org/10.1057/kmrp.2011.47

12. Cegarra-Sánchez, J., Cegarra-Navarro, J.-G., Chinnaswamy, A. K., & Wensley, A. (2020). Exploitation and exploration of knowledge: An ambidextrous context for the successful adoption of telemedicine technologies. *Technological Forecasting and Social Change*, *157*, 120089. https://doi.org/10.1016/j.techfore.2020.120089
13. Chandwani, R. K., & Dwivedi, Y. K. (2023). Telemedicine in India: current state, challenges and opportunities. *Transforming Government: People, Process and Policy*, *9*(4), 393–400. https://doi.org/10.1108/TG-07-2015-0029
14. Chellaiyan, V., Nirupama, A., & Taneja, N. (2019). Telemedicine in India: Where do we stand? *Journal of Family Medicine and Primary Care*, *8*(6), 1872. https://doi.org/10.4103/jfmpc.jfmpc_264_19
15. Coombs, N. C., Campbell, D. G., & Caringi, J. (2022). A qualitative study of rural healthcare providers' views of social, cultural, and programmatic barriers to healthcare access. *BMC Health Services Research*, *22*(1). https://doi.org/10.1186/s12913-022-07829-2
16. *Current Trends in Telemedicine in India*. (n.d.). Retrieved November 28, 2024, from https://www.tifac.org.in/index.php/reports-publications/recent-publications/2-uncategorised/1120-current-trends-in-telemedicine-in-india
17. Ganiem, L. M. (2021). EFEK TELEMEDICINE PADA MASYARAKAT (Kajian Hukum Media McLuhan: Tetrad). *Interaksi: Jurnal Ilmu Komunikasi*, *9*(2), 87–97. https://doi.org/10.14710/interaksi.9.2.87-97
18. Grigsby, J., & Sanders, J. H. (1998). Telemedicine: Where It Is and Where It's Going. In *Ann Intern Med* (Vol. 129). http://www.acponline.org.
19. Haleem, A., Javaid, M., Singh, R. P., & Suman, R. (2021). Telemedicine for healthcare: Capabilities, features, barriers, and applications. *Sensors International*, *2*, 100117. https://doi.org/10.1016/j.sintl.2021.100117
20. Heinzelmann, P. J., Lugn, N. E., & Kvedar, J. C. (n.d.). *" Telemedicine in the future*.
21. Huang, K. T. L., Lu, T. J., Alizadeh, F., & Mostaghimi, A. (2016). Homebound patients' perspectives on technology and telemedicine: A qualitative analysis. *Home Health Care Services Quarterly*, *35*(3–4), 172–181. https://doi.org/10.1080/01621424.2016.1264341
22. Jnr, B. A., Nweke, L. O., & Al-Sharafi, M. A. (2021). Applying software-defined networking to support telemedicine health consultation during and post Covid-19 era. *Health and Technology*, *11*(2), 395–403. https://doi.org/10.1007/s12553-020-00502-w
23. Kaplan, B. (2020). REVISITING HEALTH INFORMATION TECHNOLOGY ETHICAL, LEGAL, and SOCIAL ISSUES and EVALUATION: TELEHEALTH/TELEMEDICINE and COVID-19. *International Journal of Medical Informatics*, *143*, 104239. https://doi.org/10.1016/j.ijmedinf.2020.104239
24. Khemapech, ttipong. (2019). Telemedicine – Meaning, Challenges and Opportunities. *Siriraj Medical Journal*, *71*(3), 246–252. https://doi.org/10.33192/Smj.2019.38
25. Kumar, D., Singh, T., Vaiyam, P., Banjare, P., & Saini, S. (2022). Identifying potential community barriers for accessing health care services in the context to health for all in rural-tribal geographical setting in India: A systematic review. *The Journal of Community Health Management*, *9*(4), 169–177. https://doi.org/10.18231/j.jchm.2022.033
26. Kumar Roy, A., & Dutta, G. (n.d.). *Telehealth in India: Embracing disruption due to Covid-19 pandemic and the growing acceptance towards the next frontier of care delivery*.
27. Lakshmi, V., & Molli, P. (n.d.). *Telemedicine Adoption in Rural Healthcare: Overcoming Barriers and Enhancing Access*.
28. Leite, H., Hodgkinson, I. R., & Gruber, T. (2020). New development: 'Healing at a distance'—telemedicine and COVID-19. *Public Money & Management*, *40*(6), 483–485. https://doi.org/10.1080/09540962.2020.1748855
29. Mackert, M., Mabry-Flynn, A., Champlin, S., Donovan, E. E., & Pounders, K. (2016). Health literacy and health information technology adoption: The potential for a new digital divide. *Journal of Medical Internet Research*, *18*(10). https://doi.org/10.2196/jmir.6349
30. Majid, U., & Wasim, A. (2020). Patient-centric culture and implications for patient engagement during the COVID-19 pandemic. *Patient Experience Journal*, *7*(3), 5–16. https://doi.org/10.35680/2372-0247.1398
31. Mathur, P., Srivastava, S., Lalchandani, A., & Mehta, J. L. (2017). Evolving Role of Telemedicine in Health Care Delivery in India. *Primary Health Care Open Access*, *07*(01). https://doi.org/10.4172/2167-1079.1000260

32. Mishra, S. K., Singh, I. P., & Chand, E. D. (2011). Current Status of Telemedicine Network in India and Future Perspective. *Proceedings of the Asia-Pacific Advanced Network*, *32*(0), 151. https://doi.org/10.7125/apan.32.19
33. Moulaei, K., Sheikhtaheri, A., Fatehi, F., Shanbehzadeh, M., & Bahaadinbeigy, K. (2023). Patients' perspectives and preferences toward telemedicine versus in-person visits: a mixed-methods study on 1226 patients. *BMC Medical Informatics and Decision Making*, *23*(1). https://doi.org/10.1186/s12911-023-02348-4
34. Negredo, E., & Warriner, A. H. (2016). Pharmacologic approaches to the prevention and management of low bone mineral density in HIV-infected patients. *Current Opinion in HIV and AIDS*, *11*(3), 351–357. https://doi.org/10.1097/COH.0000000000000271
35. Niltakan, K. (n.d.). Health Literacy in the Digital Age: Challenges and Opportunities. In *Journal of Buddhist Education and Research* (Vol. 10, Issue 3).
36. Paul, D. L., Pearlson, K. E., & McDaniel, R. R. (1999). Assessing technological barriers to telemedicine: technology-management implications. *IEEE Transactions on Engineering Management*, *46*(3), 279–288. https://doi.org/10.1109/17.775280
37. Prawestiningtyas, E., Hamada, M., Aulia, N., Puspitasari, D., Yusuf, V., & Amar, N. (2023). Potensi Implementasi Telemedicine (Telekonsultasi, Telemonitoring, dan Telenutrisi) pada Penyakit Kronis Pasca Pandemi COVID-19 sebagai Upaya Resiliensi Bangsa Indonesia. *Jurnal Klinik Dan Riset Kesehatan*, *2*(3), 365–373. https://doi.org/10.11594/jk-risk.02.3.6
38. Raju, P. K., & Sistla, P. G. (2022). Challenges in the Implementation of Telemedicine. *Journal of Indian College of Cardiology*, *12*(4), 178–183. https://doi.org/10.4103/jicc.jicc_22_21
39. Ramessur, R., Raja, L., Kilduff, C. L. S., Kang, S., Li, J. P. O., Thomas, P. B. M., & Sim, D. A. (2021). Impact and Challenges of Integrating Artificial Intelligence and Telemedicine into Clinical Ophthalmology. In *Asia-Pacific Journal of Ophthalmology* (Vol. 10, Issue 3, pp. 317–327). Lippincott Williams and Wilkins. https://doi.org/10.1097/APO.0000000000000406
40. Reddy Mallipeddi, S., Reddy Goda, D., Reddy Yerram, S., Varghese, A., & Rama Phanendra Kumar Ande, J. (2017). Navigating the Frontier of Medical Technology. In *Technology & Management Review* (Vol. 2, Issue 1).
41. *Revolutionizing Indian Healthcare: Health Tech Boom | IBEF*. (n.d.). Retrieved November 28, 2024, from https://www.ibef.org/blogs/the-rise-of-health-tech-startups-bridging-gaps-in-indian-healthcare
42. Sathishkumar Chintala. (2023). View of Improving Healthcare Accessibility with AI-Enabled Telemedicine Solutions.
43. Scott Kruse, C., Karem, P., Shifflett, K., Vegi, L., Ravi, K., & Brooks, M. (2018). Evaluating barriers to adopting telemedicine worldwide: A systematic review. Journal of Telemedicine and Telecare, 24(1), 4–12. https://doi.org/10.1177/1357633X16674087
44. Sinsky, C. A., Jerzak, J. T., & Hopkins, K. D. (2021). Telemedicine and Team-Based Care. Mayo Clinic Proceedings, 96(2), 429–437. https://doi.org/10.1016/j.mayocp.2020.11.020
45. Telehealth expected to revolutionise Medical Tourism in India in 2023, ET HealthWorld. (n.d.). Retrieved November 28, 2024, from https://health.economictimes.indiatimes.com/news/health-it/telehealth-expected-to-revolutionise-medical-tourism-in-india-2023/98521284
46. Telemedicine Market Size, Share, Growth | Global Report [2032]. (n.d.). Retrieved November 28, 2024, from https://www.fortunebusinessinsights.com/industry-reports/telemedicine-market-101067
47. The Future of Telemedicine: 7 Telemedicine Trends for 2024. (n.d.). Retrieved November 28, 2024, from https://devabit.com/blog/7telemedicine-trends-that-build-the-future-of-telemedicine/
48. Thenral M l, A. A. (n.d.). Challenges of Building, Deploying, and Using AI-Enabled Telepsychiatry Platforms for Clinical Practice Among Urba
49. VERMA, V., KRISHNAN, V., & VERMA, C. (2023). Telemedicine in India - an investment of technology for a digitized healthcare industry: a systematic review. Revista Română de Informatică Și Automatică, 31(4). https://doi.org/10.33436/v31i4y202103