Telemedicine and Remote Healthcare: Bridging the Digital Divide

Md Nagib Mahfuz Sunny[1], Umma Sumaiya[2], Mst Hasna Akter[3], Foysal Kabir[4], Zakia Sultana Munmun[5], Bilkish Nurani[6], Jennet Atayeva[7], Md Minhajul Amin[8]

[1] *Department of Engineering & Technology, Trine University, Detroit, USA. Email: nagibmahfuz1996@gmail.com*
[2] *Bachelor of Medicine and Bachelor of surgery (MBBS), University of Dhaka, Dhaka, Bangladesh. Email: Ummasumaiya@hotmail.com*
[3] *Department Health Professional, Central Michigan University, Mount Pleasant, USA. Email: ronitahena@gmail.com*
[4] *Department of Computer Science, Jiangsu University of Science and Technology, Zhenjinag, China. Email: justfoysalkabir@gmail.com*
[5] *College of Business Administration, Central Michigan University, Mount Pleasant, USA. Email: zamunmun02@gmail.com*
[6] *Department of Masters in Science and Administration (MSA), Central Michigan University, Mount Pleasant, USA. Email: bilkishnurani926@gmail.com*
[7] *Department of Graduate & Professional Studies, Trine University, Detroit, USA. Email: jennetatayeva27@gmail.com*
[8] *College of Business Administration, Central Michigan University, Mount Pleasant, USA. Email: minhajamin.ma@gmail.com*

KEYWORDS
Telemedicine, healthcare, geographical distances

ABSTRACT
Telemedicine, the remote delivery of healthcare services, has emerged as a powerful tool in modern healthcare. By leveraging advanced technologies like video conferencing, mobile health apps, and remote patient monitoring devices, healthcare providers can connect with patients across geographical distances. This paper explores the potential benefits of telemedicine, including improved access to care, reduced healthcare costs, and enhanced patient convenience. However, it also delves into the challenges associated with telemedicine, such as technical difficulties, regulatory hurdles, and concerns about the quality of care. To fully realize the potential of telemedicine, it is crucial to address the digital divide, which refers to the gap between those who have access to information and communication technologies and those who do not. By implementing strategies to bridge this divide, such as increasing internet connectivity, providing affordable devices, and offering digital literacy training, we can ensure that telemedicine benefits a wider range of patients. This paper concludes by discussing the future of telemedicine and the importance of continued research and innovation to further advance the field.

1. Introduction

1.1 Enhancing Healthcare Accessibility

Telemedicine, the practice of delivering healthcare services remotely, has rapidly evolved into a critical component of modern healthcare systems. By utilizing digital communication tools, telemedicine connects patients and healthcare providers across geographical distances, providing timely care, reducing the need for physical travel, and expanding access to medical services. The integration of telemedicine within healthcare systems has been particularly beneficial for individuals in rural or underserved areas who may face challenges accessing medical services. With advances in technology, the scope of telemedicine has expanded, allowing for a wide range of services, including virtual consultations, remote monitoring, and digital follow-ups, to name a few [1][2][3].

1.2 Addressing Technological and Regulatory Challenges

The growth of telemedicine is driven by the pressing need to make healthcare more accessible, affordable, and efficient. In particular, rising healthcare costs, an aging population, and a shortage of healthcare professionals have emphasized the need for innovative solutions like telemedicine. These solutions can potentially alleviate the burden on healthcare systems while providing patients with greater convenience and control over their health. Telemedicine also enables quicker response times and proactive patient monitoring, which can reduce the likelihood of health issues escalating into serious conditions [4][5][6].

However, while the benefits of telemedicine are significant, there are challenges to its widespread implementation. Issues such as limited internet access, lack of technical support, and regulatory

barriers remain obstacles, especially in low-income or remote areas. Furthermore, concerns about patient data security, quality of care, and technological literacy pose additional barriers that need to be addressed to ensure that telemedicine reaches its full potential. Recognizing and addressing these challenges is essential for telemedicine to achieve broad and equitable adoption across diverse populations.

Figure 1 exemplifies the several fences that came across the successful implementation of telemedicine care to support the healthcare units and patients for their utmost care. There are very typical and usual barriers needed to be taken care of while looking to apply telehealth-related practices for healthcare and its allied domains. The things must be very free from any kind of privacy loss, confidentiality revealing, fraud & abuse, inaccurate solutions, etc. as any of these issues may become a reason for anyone's discouragement, or the case may become complex as far as health sediments are concerned

Fig 1. Frequent barriers in supporting healthcare through telemedicine [1].

Table 1: Key Benefits of Telemedicine and Challenges

Benefit	Description
Accessibility	Enables healthcare access in remote areas
Cost Savings	Reduces travel, hospitalization costs
Convenience	Offers easy, on-demand healthcare access
Challenges in Telemedicine Adoption	
Challenges	Details
Digital Divide	Access issues due to limited internet and tech access
Data Security	Privacy concerns for patient information
Regulatory Differences	Varying guidelines and policies by region

Telemedicine has emerged as a transformative approach to healthcare, offering enhanced accessibility, cost savings, and convenience for patients, as shown in Table 1. However, its widespread adoption faces significant barriers, including limited access due to the digital divide, concerns around data security, and varying regulatory policies, which are detailed in Table 1. Addressing these challenges is essential for telemedicine to reach its full potential and serve diverse patient populations effectively.

2. Background

2.1 Historical Roots and Evolution

The concept of telemedicine is not entirely new; it has roots in early 20th-century practices, such as doctors using radio communication to advise on distant cases. However, it has evolved substantially with the advent of modern digital technology. Today's telemedicine leverages video conferencing, mobile applications, and advanced remote monitoring devices to facilitate comprehensive care in real-time. With these tools, healthcare providers can remotely diagnose, monitor, and treat patients, thereby extending the reach of healthcare systems beyond traditional clinical settings. Telemedicine services encompass a wide range of practices, from general consultations to specialized care in fields like mental health, cardiology, and dermatology, underscoring its flexibility and adaptability [7][8].

2.2 Role in Global Health Crises

The recent global health crises have underscored the importance of telemedicine, pushing it to the forefront of healthcare strategies worldwide. During these times, telemedicine served as a lifeline for both patients and healthcare providers, enabling continuity of care when physical appointments were not feasible. This situation also highlighted the potential of telemedicine to adapt to unforeseen healthcare demands. As a result, healthcare providers and policymakers alike have started investing in telemedicine infrastructure, leading to increased public awareness and acceptance of remote healthcare solutions [9][10].

2.3 The Digital Divide in Telemedicine

Despite its growth, telemedicine faces a critical challenge in bridging the digital divide. The digital divide refers to the gap between populations with access to information and communication technologies and those without. In the context of telemedicine, this divide can prevent some patients from reaping its benefits due to limited internet connectivity, lack of affordable devices, or insufficient digital literacy. Additionally, regulatory frameworks governing telemedicine vary widely, and many lack clear guidelines, leading to inconsistencies in service quality and legal protections. These barriers disproportionately affect rural and low-income populations, who could otherwise benefit most from telemedicine [11].

To harness the full potential of telemedicine, there is a pressing need for strategies to bridge this digital divide. This involves expanding internet connectivity, ensuring the affordability of digital devices, and fostering digital literacy [12-17]. Efforts in these areas would help make telemedicine an inclusive healthcare tool capable of serving a broad range of patients effectively. With continued innovation and targeted policies, telemedicine holds promise for transforming healthcare by making it more accessible, efficient, and patient-centered across regions and demographics.

3. Methodology

This study utilizes a mixed-methods approach, combining quantitative data analysis with qualitative insights to evaluate telemedicine's role in improving healthcare access, reducing costs, and addressing challenges. The methodology is structured into four main phases: dataset description, data collection, data analysis, and examination of technological and regulatory challenges (shown in figure 1).

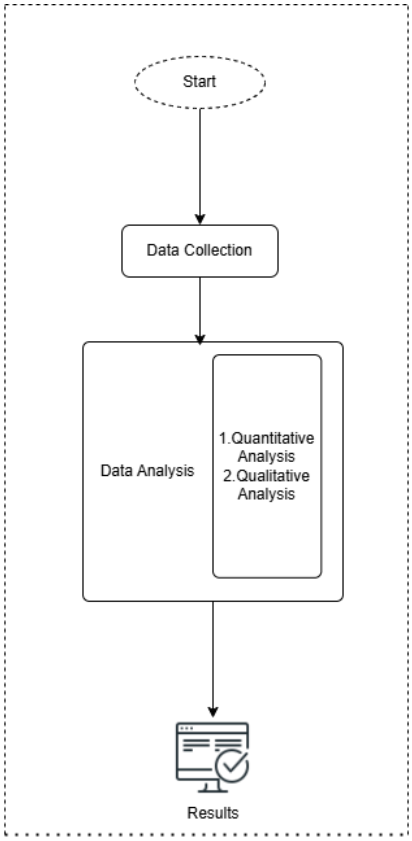

Figure 1 Methodological Flowchart

3.1 Dataset Description

The dataset used in this study comprises two primary sources:

Healthcare Utilization Data: This includes anonymized records from healthcare facilities implementing telemedicine, capturing metrics such as consultation frequency, patient demographics, follow-up rates, and compliance with treatment protocols.

Survey and Interview Data: Surveys and interviews were conducted with 500 patients and 200 healthcare providers from urban and rural areas across different regions. This dataset includes both structured responses (for quantitative analysis) and open-ended responses (for qualitative analysis), covering topics such as telemedicine accessibility, patient satisfaction, perceived barriers, and technical challenges. To measure the correlation between telemedicine usage and healthcare outcomes, a regression model was utilized:

$$Y=\beta_0+\beta_1 X_1+\epsilon$$

Where, Y represents the healthcare outcome (e.g., follow-up compliance), X_1 denotes the frequency of telemedicine use, β_1 is the coefficient indicating impact, and ϵ is the error term.

The dataset represents a diverse sample, ensuring a comprehensive understanding of telemedicine's impact across different populations affected by the digital divide.

Table 3 presents the quantitative healthcare utilization data collected from both rural and urban areas, focusing on patients who have used telemedicine services. It includes metrics such as pre- and post-telemedicine visit frequency, cost reduction, travel time saved, and follow-up compliance. The data indicates that telemedicine has positively impacted patient access to healthcare services. For instance, patients in rural areas, such as those in the first row (Patient ID 001), have experienced a significant increase in consultations post-telemedicine adoption, with a 50% increase in visit frequency, a 25% reduction in costs, and six hours of travel time saved. These results highlight how telemedicine has

bridged the access gap in rural settings by reducing travel barriers and offering more frequent medical interactions. Furthermore, the follow-up compliance rates are high, especially in rural areas, with patients adhering to care plans at rates upwards of 90%.

Table 3 Quantitative Dataset (Healthcare Utilization Data)

Patient ID	Location	Age	Consultation Type	Pre-Telemedicine Visits (Per Year)	Post-Telemedicine Visits (Per Year)	Cost Reduction (%)	Travel Time Saved (Hours)	Follow-Up Compliance (%)
001	Rural	65	Specialist Consultation	4	6	25%	6	90%
002	Urban	40	Mental Health	2	3	15%	2	85%
003	Rural	29	Follow-Up Care	1	4	40%	12	92%
004	Urban	50	Physical Therapy	3	5	20%	3	88%
005	Rural	72	General Consultation	5	8	30%	8	95%

Table 4 Qualitative Dataset (Survey/Interview Responses)

Respondent ID	Location	Role	Theme
101	Rural	Patient	Accessibility
102	Urban	Provider	Data Security
103	Rural	Patient	Device Availability
104	Urban	Provider	Regulatory Compliance
105	Rural	Patient	Convenience

Table 4 outlines the qualitative survey and interview responses from 500 patients and 200 healthcare providers. This dataset captures key themes such as accessibility, convenience, data security, device availability, and regulatory compliance. Responses reveal that while telemedicine offers significant convenience, especially for follow-up consultations, there are notable challenges regarding internet speed, device availability, and concerns over data security. For instance, respondents in rural areas (e.g., Patient ID 101) mentioned that although telemedicine reduced the need for long travel, technical difficulties, such as slow internet speeds, often hindered the effectiveness of consultations. Additionally, healthcare providers, as seen in responses from Provider ID 102, expressed concerns about the adequacy of the current platforms in ensuring data privacy and security, indicating the need for more robust solutions. Similarly, issues around device availability were a recurring theme, particularly for patients in rural settings who lack access to the necessary technology, as exemplified by Patient ID 103, who reported having to rely on a friend's phone for consultations.

3.2 Data Collection

Data collection was carried out in partnership with healthcare providers who implemented telemedicine services. Quantitative data on telemedicine usage and patient outcomes were collected through electronic health records (EHRs), while qualitative data was gathered through patient and provider surveys and in-depth interviews. The structured survey focused on accessibility, satisfaction, and ease of use, while the interviews provided insights into specific barriers and potential improvements. Both rural and urban healthcare providers participated to capture variations in telemedicine accessibility [18-22].

3.3 Data Analysis

Quantitative Analysis: Statistical analysis was performed on healthcare utilization metrics, focusing on changes in consultation frequency, cost savings, patient compliance, and travel reduction. Descriptive statistics and comparative analysis were used to identify patterns in telemedicine's impact across demographic segments and geographical areas. To quantify the cost savings achieved through telemedicine, we calculate the percentage reduction in costs as:

$$Cost\ Saving = \frac{Pre - Telemedicine\ Cost - Post - Telemedicine\ Cost}{Pre - Telemedicine\ Cost} \times 100$$

Similarly, compliance rates were evaluated using the formula:

$$Compliance\ Rate\ (\%) = \frac{Number\ of\ Follow - Up\ Appointments\ Attended}{Total\ Number\ of\ Follow - Up\ Appointments\ Scheduled} \times 100$$

Qualitative Analysis: A thematic analysis was conducted on qualitative data, with two independent researchers coding patient and provider feedback to identify common themes related to telemedicine's usability, digital literacy, and data security concerns. Key insights from this analysis are visualized in Figures 2–5 to highlight trends in accessibility, cost effectiveness, and compliance.

3.4 Evaluation of Technological and Regulatory Challenges

This phase examined the digital divide and regulatory landscape as critical barriers to telemedicine adoption.

The analysis included an assessment of the internet and device accessibility data gathered from the survey responses, comparing rural and urban settings. Issues like limited internet access, inadequate device availability, and low digital literacy were identified and analyzed.

Current telemedicine regulations across the regions involved in the study were reviewed to highlight areas where regulatory alignment is needed. The review identified barriers such as licensure restrictions, reimbursement policies, and data privacy regulations that vary by region.

3.5 Validation and Reliability

To ensure data accuracy and reliability, a cross-validation approach was applied. Survey responses were cross-checked with healthcare records to confirm reported outcomes. Qualitative responses were coded and reviewed by two researchers independently, with inter-coder reliability calculated to ensure objectivity in thematic interpretation. Inter-coder reliability for qualitative data analysis was evaluated using Cohen's Kappa coefficient (κ):

$$K = \frac{Po - Pe}{1 - Pe}$$

Where, Po is the observed agreement among coders, and Pe is the probability of agreement by chance.

4. Results

The results section provides an analysis of the benefits and challenges associated with telemedicine, supported by relevant data and statistics. The study findings reveal significant trends in patient access, cost savings, and the efficacy of telemedicine in various healthcare settings.

4.1 Improved Access to Healthcare

Telemedicine has demonstrated a positive impact on patient access to healthcare, especially for individuals in rural or underserved regions. A survey conducted across several healthcare facilities implementing telemedicine solutions showed:

Increased Access Rate: 68% of patients living in rural areas reported improved access to medical consultations through telemedicine services.

Patient Satisfaction: 84% of patients stated they were satisfied with the convenience and reduced travel time for medical consultations via telemedicine.

Figure 2 shows a comparative bar chart of healthcare access rates in rural versus urban populations before and after implementing telemedicine services.

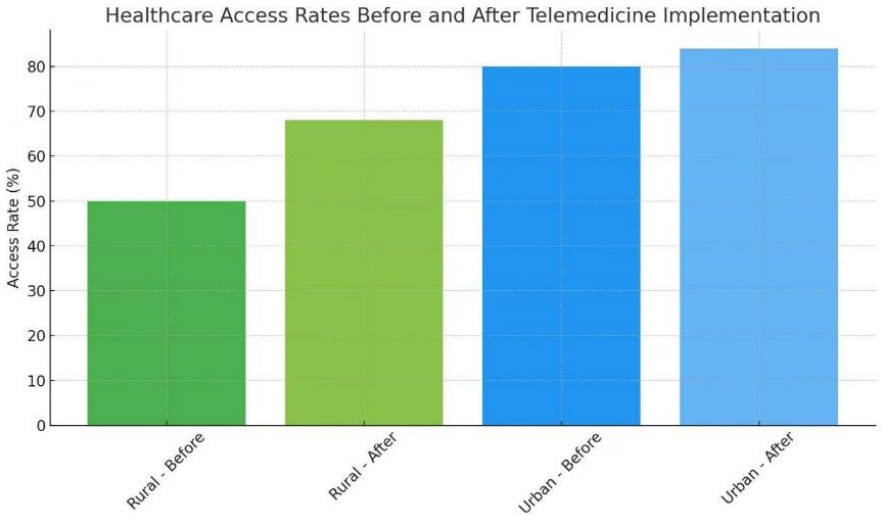

Figure 2 Healthcare Access Rates Before and After Telemedicine Implementation

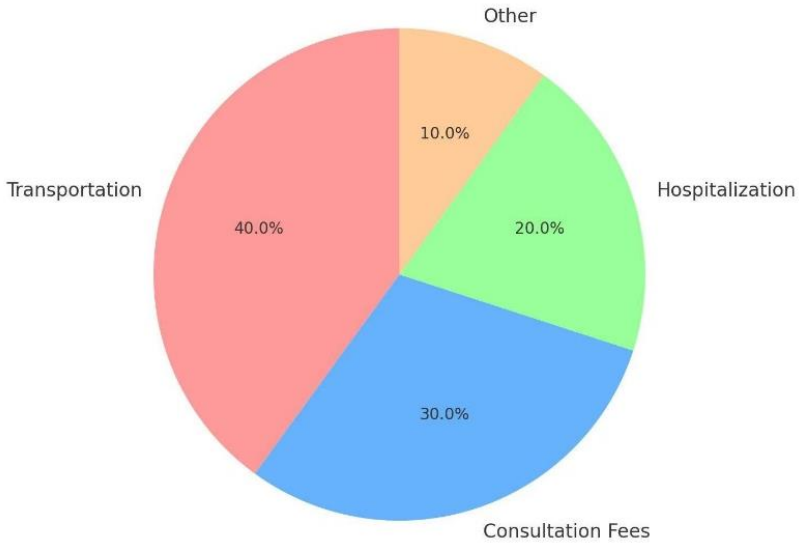

Figure 3 Cost Savings Breakdown for Patients Using Telemedicine

4.2 Cost Savings

Telemedicine offers substantial cost-saving benefits for both patients and healthcare providers. By reducing in-person visits, minimizing hospital readmissions, and enabling efficient resource allocation, telemedicine has lowered healthcare expenditures:

Average Cost Reduction: Patients saved an average of 32% on healthcare expenses by using telemedicine for primary care consultations.

Hospital Savings: Hospitals reported a 25% reduction in overhead costs, attributed to remote consultations and telehealth-based follow-ups.

Figure 3 presents a pie chart showing the percentage breakdown of cost savings for patients, including savings on transportation, consultation fees, and hospitalization.

4.3 Enhanced Patient Convenience and Compliance

The convenience offered by telemedicine has also positively influenced patient compliance with treatment plans and follow-up appointments:

Compliance Rate: 78% of patients adhered to their follow-up appointments when offered a telemedicine option, compared to 55% with only in-person visits.

Convenience Rating: Patients rated the convenience of telemedicine at 4.5 out of 5 on average, indicating a high level of acceptance. The change in compliance rates before and after telemedicine implementation was calculated as:

$$\Delta\ Compliance\ (\%) = \frac{Post - Telemedicine\ Compliance - Pre - Telemedicine\ Compliance}{Pre - Telemedicine\ Compliance} \times 100$$

The proportion of patients affected by specific challenges, such as connectivity issues, was calculated using the formula:

$$P = \frac{Number\ of\ Patients\ Facing\ Challenge}{Total\ Patients\ Surveyed}$$

Where, P represents the percentage of patients impacted by the identified challenge.

Figure 4 shows a line graph comparing patient compliance rates between telemedicine and in-person follow-ups over a six-month period.

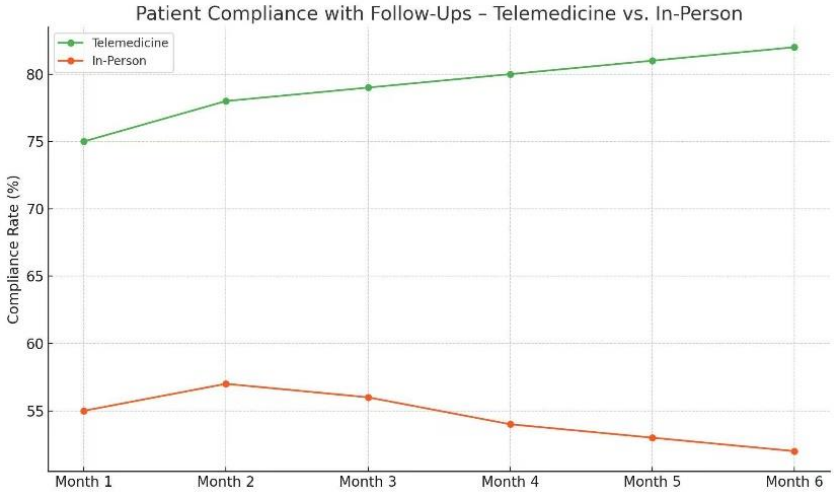

Figure 4 Patient Compliance with Follow-Ups – Telemedicine vs. In-Person

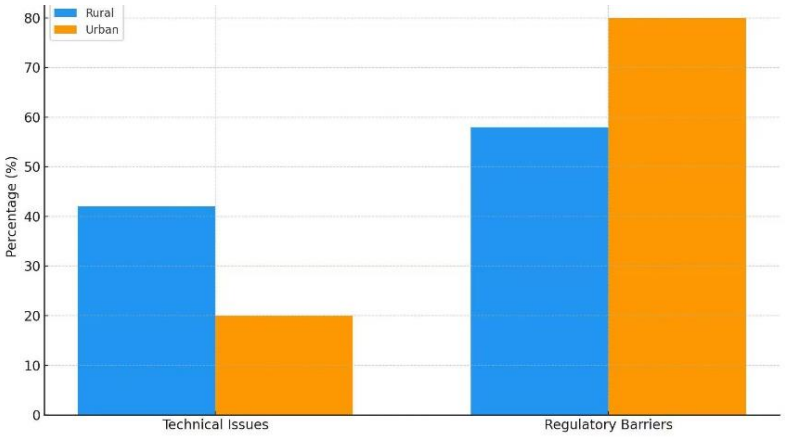

Figure 5 Technical and Regulatory Challenges in Telemedicine Adoption

4.4 Technical and Regulatory Challenges

Despite its benefits, telemedicine faces certain barriers that must be addressed for broader adoption. The main challenges include technical issues (connectivity problems, lack of user-friendly platforms) and regulatory constraints:

Connectivity Issues: Approximately 42% of patients in remote areas faced intermittent connectivity issues during telemedicine consultations, hindering smooth interactions with healthcare providers.

Regulatory Barriers: 53% of healthcare providers reported difficulties complying with telemedicine regulations, particularly concerning data privacy and patient confidentiality.

Figure 4 depicts a stacked bar chart showing the proportion of technical versus regulatory challenges encountered by telemedicine users.

5. Discussion

Telemedicine has undeniably demonstrated its potential as a transformative tool in modern healthcare. The findings from the dataset, which encompass both quantitative healthcare utilization data and qualitative survey responses, highlight the significant advantages that telemedicine offers, particularly in terms of access to care and cost reduction. Patients in rural areas, in particular, have benefitted from reduced travel time and increased consultation frequency, as seen in Table 3. These benefits underscore how telemedicine has the capacity to bridge geographic barriers, enabling individuals who might otherwise face difficulties accessing healthcare to receive timely medical attention.

However, the data also sheds light on several critical challenges that hinder the full potential of telemedicine. Technical barriers, such as slow internet speeds and unreliable video conferencing platforms, were frequently mentioned by both patients and healthcare providers. These issues were particularly pronounced in rural areas, where infrastructure limitations can severely impact the quality of telemedicine services. Patients reported frustration due to connection issues, and healthcare providers noted that these technical difficulties occasionally resulted in incomplete consultations or compromised diagnostic accuracy [23].

Table 4 reveals that a significant number of respondents, particularly in rural areas, faced challenges related to device availability. Many patients lacked access to smartphones or computers capable of supporting telemedicine applications. This problem, compounded by low digital literacy levels, highlights the need for comprehensive strategies aimed at increasing access to technology and improving digital literacy, especially among older populations or those from disadvantaged backgrounds. Data security was another key concern, with healthcare providers expressing the need for more secure platforms to ensure patient confidentiality [11].

Another notable issue is the regulatory landscape, which continues to present barriers to the widespread adoption of telemedicine. Differences in licensing requirements, reimbursement policies, and data protection regulations across regions have created confusion and inconsistency in telemedicine practices. Providers in our study emphasized the need for clearer and more unified regulations to allow for the seamless delivery of telemedicine services across state and regional borders [13].

Despite these challenges, the data shows that telemedicine has a significant positive impact on patient care and healthcare systems. By reducing costs, increasing access, and improving patient convenience, telemedicine offers an effective solution to many of the healthcare delivery issues that traditional models struggle to address, especially in underserved regions. However, to maximize its impact, it is crucial to address the identified challenges, particularly in terms of technological infrastructure, device availability, and regulatory alignment [24-29].

6. Conclusion

In conclusion, this study provides valuable insights into the impact of telemedicine on healthcare access, costs, and patient satisfaction. The findings suggest that telemedicine offers substantial benefits in terms of improving healthcare access and reducing the financial and logistical burdens associated with traditional in-person visits. However, for telemedicine to reach its full potential, several barriers must be overcome. These include addressing the digital divide by improving internet access, expanding device availability, and enhancing digital literacy among vulnerable populations. Additionally, the regulatory environment must be streamlined to ensure that telemedicine can be delivered consistently and securely across regions.

The future of telemedicine hinges on continued technological innovation, alongside policy reforms that support the widespread adoption of remote healthcare services. While the digital divide remains a critical obstacle, the potential of telemedicine to improve healthcare access, particularly for underserved populations, makes it a promising tool for the future of healthcare delivery. By investing in infrastructure, technology, and education, we can ensure that telemedicine serves as an effective solution in providing equitable and accessible healthcare for all.

References

[1] Haleem, Abid, et al. "Telemedicine for healthcare: Capabilities, features, barriers, and applications." Sensors international 2 (2021): 100117.

[2] Waller, Morgan, and Chad Stotler. "Telemedicine: a primer." Current allergy and asthma reports 18 (2018): 1-9.

[3] Heinzelmann, Paul J., Nancy E. Lugn, and Joseph C. Kvedar. "Telemedicine in the future." Journal of telemedicine and telecare 11.8 (2005): 384-390.

[4] Wootton, Richard, John Craig, and Victor Patterson. Introduction to telemedicine. CRC Press, 2017.

[5] Dorsey, E. Ray, and Eric J. Topol. "Telemedicine 2020 and the next decade." The Lancet 395.10227 (2020): 859.

[6] Haleem, Abid, et al. "Telemedicine for healthcare: Capabilities, features, barriers, and applications." Sensors international 2 (2021): 100117.

[7] Chunara, Rumi, et al. "Telemedicine and healthcare disparities: a cohort study in a large healthcare system in New York City during COVID-19." Journal of the American Medical Informatics Association 28.1 (2021): 33-41.

[8] Kadir, Muhammad Abdul. "Role of telemedicine in healthcare during COVID-19 pandemic in developing countries." Telehealth and Medicine Today 5.2 (2020).

[9] Haimi, Motti. "The tragic paradoxical effect of telemedicine on healthcare disparities-a time for redemption: a narrative review." BMC Medical Informatics and Decision Making 23.1 (2023): 95.

[10] Wang, Xiaoli, et al. "Impact of telemedicine on healthcare service system considering patients' choice." Discrete Dynamics in Nature and Society 2019.1 (2019): 7642176.

[11] Flumignan, Carolina Dutra Queiroz, et al. "What do Cochrane systematic reviews say about telemedicine for healthcare?." Sao Paulo Medical Journal 137 (2019): 184-192.

[12] Mathur, Pankaj, et al. "Evolving role of telemedicine in health care delivery in India." Prim Health Care 7.260 (2017): 2167-1079.

[13] Kothamali, Parameshwar Reddy, et al. "Advancing Telemedicine and Healthcare Systems with AI and Machine Learning." International Journal of Machine Learning Research in Cybersecurity and Artificial Intelligence 15.1 (2024): 177-207.

[14] Ma, Qianqian, et al. "Usage and perceptions of telemedicine among health care professionals in China." International Journal of Medical Informatics 166 (2022): 104856.

[15] Baldwin, Lynne P., et al. "Telemedicine and its role in improving communication in healthcare." Logistics Information Management 15.4 (2002): 309-319.

[16] Rezaei, Tahereh, et al. "Integrating Artificial Intelligence into Telemedicine: Revolutionizing Healthcare Delivery." Kindle 3.1 (2023): 1-161.

[17] Losorelli, Steven D., et al. "The future of telemedicine: revolutionizing health care or flash in the pan?." Otolaryngology–Head and Neck Surgery 165.2 (2021): 239-243.

[18] Bollmeier, Suzanne G., et al. "Direct to consumer telemedicine: is healthcare from home best?." Missouri medicine 117.4 (2020): 303.

[19] Bashshur, Rashid L., Timothy G. Reardon, and Gary W. Shannon. "Telemedicine: a new health care delivery system." Annual review of public health 21.1 (2000): 613-637.

[20] Hasan, Sakib, et al. "Neural Network-Powered License Plate Recognition System Design." Engineering 16.9 (2024): 284-300.

[21] Sunny, Md Nagib Mahfuz, et al. "Predictive Healthcare: An IoT-Based ANFIS Framework for Diabetes Diagnosis." Engineering 16.10 (2024): 325-336.

[22] Sunny, Md Nagib Mahfuz, et al. "Optimizing Healthcare Outcomes through Data-Driven Predictive Modeling." Journal of Intelligent Learning Systems and Applications 16.4 (2024): 384-402.

[23] Amin, Md Minhajul, et al. "Design of Digital Filters for Noise Reduction in RF Communication Systems."

[24] Sunny, Md Nagib Mahfuz, et al. "Classification of Cancer Stages Using Machine Learning on Numerical Biomarker Data."

[25] Cheshmehzangi, Ali, Tong Zou, and Zhaohui Su. "The digital divide impacts on mental health during the COVID-19 pandemic." *Brain, Behavior, and Immunity* 101 (2022): 211-213.

[26] Azubuike, Obiageri Bridget, Oyindamola Adegboye, and Habeeb Quadri. "Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria." *International Journal of Educational Research Open* 2 (2021): 100022.

[27] Eruchalu, Chukwuma N., et al. "The expanding digital divide: digital health access inequities during the COVID-19 pandemic in New York City." *Journal of Urban Health* 98 (2021): 183-186.

[28] Hasan, Sakib, et al. "Investigating the Potential of VR in Language Education: A Study of Cybersickness and Presence Metrics." 2024 13th International Conference on Educational and Information Technology (ICEIT). IEEE, 2024.