JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

"UNLOCKING THE POTENTIAL OF AI AND MACHINE LEARNING IN HEALTHCARE: PIONEERING THE DIGITAL HEALTH AND TELEMEDICINE REVOLUTION"

Utkarsh Venaik[1], Rinki Kumari[2], Anita venaik[3*]

[1]Researcher, Department of Engineering, Computer Science & Artificial Intelligence, IIIT Delhi
[2]Assistant Professor, Dr. M.C. Saxena College of Engineering & Technology Lucknow
[3*]Professor IT Department, Amity Business School, Amity University Noida UP, India

Corresponding Email: [3*]avenaik@amity.edu

Abstract:

Artificial intelligence (AI) and machine learning (ML) hold significant promise for transforming healthcare, offering innovative approaches to patient diagnosis, treatment, monitoring, and counseling. These technologies excel in processing and analyzing vast and valuable patient data, collected from a diverse and expansive population.While AI has already contributed to advanced diagnostic and treatment tools, its full potential in healthcare is still emerging. Recent studies have showcased its ability to enhance diagnostic accuracy across various medical specialties, such as radiology, pathology, and dermatology.Telemedicine technology is gaining popularity globally, offering enhanced access to care, resource efficiency, and cost-effectiveness compared to traditional office visits. It has demonstrated positive impacts on clinical outcomes, patient satisfaction, and healthcare system efficiency.During the COVID-19 pandemic, telehealth has proven to be a vital tool for safe and effective patient care, allowing interaction between healthcare professionals and patients while adhering to social distancing guidelines. This present research underscores the significant impact of AI and ML technologies in the healthcare sector, with a particular focus on how telemedicine has played a crucial role in tackling present-day healthcare obstacles, notably in the context of the COVID-19 pandemic."

Keywords: Tele-medicine, digital, health-care experts,covid-19, pandemic

1. INTRODUCTION

The utilization of Artificial Intelligence (AI) and Machine Learning (ML) within the healthcare sector possesses the potential to revolutionize patient diagnosis, treatment, and monitoring. Nevertheless, lingering questions persist regarding the potential impacts of these technologies on patient outcomes.Tele-medicine, also referred to as tele-health/TCC (tele-medicine consultation center)/TSC (tele-medicine specialty center)/telemedicine system, offers an avenue to gather precise patient information and insights into their health concerns. This information assists healthcare professionals in determining the necessity for patient intervention or treatment.

Currently, AI and machine learning find application in various medical domains encompassing medical imaging, drug discovery, and patient monitoring. In the realm of medical imaging, Artificial Intelligence (AI) and Machine Learning (ML) algorithms excel in automating the interpretation of medical images such as X-rays, CT (Computed Tomography) scans, and MRI. These algorithms can analyze images and pinpoint specific features, such as tumors or abnormal tissue (Yang, 2018). This automation holds the potential to enhance diagnostic accuracy and alleviate the workload of radiologists (Schüffler, 2016).

In the realm of drug discovery, AI and machine learning algorithms facilitate the analysis of copious data from preclinical and clinical trials. These algorithms discern patterns within the data, potentially identifying drug targets or predicting the efficacy of new drugs (Thrall, 2018). By streamlining data analysis in preclinical and clinical trials, AI and machine learning algorithms hold the promise of expediting the drug discovery process and augmenting success rates.

Worldwide, numerous healthcare institutions have adopted telemedicine technology, experiencing the advantages it offers. Telemedicine, encompassing both screening and diagnostic methodologies, has garnered significant attention in recent literature, paralleling the increased adoption and expansion of digital healthcare (digi-health). In essence, telemedicine functions as a virtual care provider platform, enabling remote clinical and healthcare services through electronic audio and video interactions between patients and healthcare experts.
Tele-medicine has been a rapidly expanding digital method in different departments' healthcare systems since its inception in the early 1950s [7-8]. The availability of automated tools in clinical settings has expanded

significantly, largely attributed to the proliferation and widespread adoption of technological devices like personal computers (PCs) and smartphones" [9-11].

Several literate have shown its variety of digital tools or software apps that enable or assist clinicians or healthcare providers in reaching [1] and periodically monitoring patients who have difficulty attending specialist appointments, especially those with chronic diseases that require ongoing monitoring [12]. Furthermore, in a first-hand appointment, counseling could be evaluated regularly by submitting the data recorded on the digital tools to a health care provider [13-15].

Many healthcare providers have acknowledged the cost-effectiveness of telemedicine services [1], which not only enhance physician treatment delivery [16] but also streamline the utilization of clinical resources, reducing expenses associated with conventional clinic visits. Telemedicine finds applications across diverse medical domains [15-17], with more than half of acute care hospitals adopting its capabilities [17-18]. The estimated value of the telemedicine system reached approximately $30 billion by 2019, experiencing a notable annual growth rate of 20–50 percent, with its practical clinical uses continually expanding [19]."

In a broad context, telemedicine provides advantages for primary care, handling non-urgent health concerns or situations that do not require in-person visits, typically carried out through telephone calls or mobile devices [16-20].While it complements face-to-face consultations and outpatient departments (OPD) when required, it doesn't fully replace them [21]. Telemedicine systems can offer immediate connections to healthcare facilities when clinicians' physical clinics are closed [22]. For instance, patients with non-urgent medical concerns requiring assistance with medication adjustments, lifestyle routines, prescription refills [16], or community support, find convenience in telemedicine [20-22].

Telemedicine extends its reach across various clinical domains, encompassing cardiovascular and diabetes care [23]. Additionally, it plays a crucial role in the surgical department, assisting in preoperative and post-operative patient care through digital tools [22-25]. Post-operative care, specifically, has experienced significant advantages, including improved patient recovery, higher satisfaction rates, reduced waiting times [1], and cost savings for both patients and healthcare institutions [26-29].

As a result, ongoing technological advancements in clinical settings are laser-focused on delivering standard clinical care (both urgent and non-urgent) while prioritizing patient and healthcare provider satisfaction [1]. This emphasis on providing optimal access to care has led to widespread acceptance and utilization of telemedicine by healthcare professionals, owing to its myriad advantages [27-30].
This article explores the field of telemedicine and its present state, placing special emphasis on its significance during the pandemic, especially in the context of disease control. "Certainly, owing to the obligatory social distancing measures implemented to contain the spread of infection during the COVID-19 pandemic, the potential value of telemedicine in healthcare monitoring has witnessed remarkable expansion

"History of Tele-medicine"
Telemedicine, once a modern digital technology emerging over 30 years ago, has solidified its presence significantly within the past 5 to 6 years, encompassing a wide array of scientific and biomedical domains, effectively spanning nearly all areas [31]. At the forefront of the implementation and advancement of telemedicine is the National Aeronautics and Space Administration (NASA) [1]. NASA's involvement in telemedicine traces back to the early 1960s, coinciding with the initial human ventures into space. In the course of these space missions, physiological data and functional parameters were transmitted from both the spacecraft and the spacesuit [3]. Although data collection took place during this era, real-time communication with crew members was not yet established [32-33].

In a pivotal development, NASA launched the first "Applied Technology Satellites," known as ATS-1, in 1966 [5]. This initiative aimed to explore the use of satellite and digital video consultations to enhance the quality of healthcare facilities in rural Alaska [34-35]. Subsequently, the Lister Hill National Center of the National Library of Medicine selected 26 sites in Alaska in 1971 for biomedical communication, significantly improving clinical care services for villagers [36]. NASA's telemedicine initiatives served a dual role: delivering medical care to astronauts in space and extending healthcare services to the Papago Reservation [5,7]. This initiative led to the inception of the "Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC)" project, which ran from 1972 to 1975, enabling healthcare provision to the Papago Indian Reservation in Arizona [33-37].
The advancement of telemedicine technology continued its upward trajectory. In 1977 [3], the telemedicine center at Memorial University of Newfoundland pioneered interactive audio networks for educational programs

and the transmission of digital health data [39-40]. In 1984, the Australian government initiated telemedicine technology testing through the "North-West Telemedicine Project," launching a pilot test of a satellite-based communications network known as "The Q-Network" [3,41-42]. The project aimed to provide healthcare services to residents in five remote towns in the Gulf of Carpentaria region.
In a notable instance of international collaboration, NASA introduced the "Space Bridge to Armenia/Ufa" in 1989, marking the first foreign telemedicine service. Telemedicine consultations involving experts were conducted using one-way cameras, speech, and likeness technologies between a healthcare center in Yerevan, Armenia, and four medical centers in the United States. This initiative was conducted under the auspices of the US/USSR Joint Working Group on Space Biology [15,42-43]."

Tele-Medicine Adoption
Telemedicine, once a groundbreaking digital concept, has rapidly evolved, gaining widespread acceptance in both patient and healthcare communities [1]. Over the past two decades, the United States Department of Veterans Affairs (VA) has been a pioneer in telemedicine [42-43]. In 2014 alone, nearly 700,000 veterans received 1.2 million telemedicine services from 44 different healthcare experts [44]. The VA has prioritized telemedicine as a means to improve veteran care, setting ambitious healthcare goals for the fiscal years 2014-2020. This commitment is reflected in the allocation of $1.2 billion in the 2016 VA budget dedicated to telemedicine activities [1,45-46].

Status of Telemedicine in India:
In a perfect world, every person would have instant access to the appropriate specialist for clinical guidance. However, in India, delivering even basic primary medical care in rural villages remains a challenge [47]. This disparity extends to suburban and urban areas, where secondary and tertiary medical care is not universally accessible. Attempts to incentivize healthcare professionals to practice in underserved areas have yielded limited success [47-48].

Approximately 68 percent of India's population still resides in rural regions, where healthcare facilities and delivery face numerous challenges, including a shortage of healthcare experts, medical equipment, electricity, clean drinking water, and inadequate planning and funding [10,49-50]. Nonetheless, India's expertise in information and communication technology (ICT) presents a promising avenue for addressing healthcare disparities. The extensive incorporation of Information and Communication Technology (ICT) in the field of medicine has unveiled new opportunities for enhancing healthcare in India[10].
Computer literacy in India is on the rise, and telemedicine is emerging as a transformative solution for healthcare specialists [53]. Building a robust telecommunications system in suburban and rural India is theoretically easier than deploying hundreds of medical specialists. Satellite-based technologies and fiber optic cables are the future of telecommunications [53].

Recent developments in India include the "Centre for Development of Advanced Computing (C-DAC)" developing telemedicine software to support various clinical departments such as Tele-Cardiology, Tele-Radiology, and Tele-Pathology. Prominent government institutions such as the "All India Institute of Medical Sciences (AIIMS)" in New Delhi, "the Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS)" in Lucknow, and "the Post Graduate Institute of Medical Education and Research (PGIMER)" in Chandigarh have established connectivity through ISDN, VSAT, and POTS, linking medical centers in Rohtak, Shimla, and Cuttack [21,52-53].

In Andhra Pradesh, the "Apollo group of hospitals" initiated a pilot project in Aragonda, a village near Chittoor. Local hospitals in this region now have access to advanced healthcare facilities through video-conferencing technology. The AVSAT (Very Small Aperture Terminal) satellite, established by ISRO (Indian Space Research Organization), played a pivotal role in this initiative, initially employing simple webcams and ISDN telephone lines. Additionally, "the Sriharikota Space Center project" (located 130 kilometers from Chennai) served as a significant launchpad for ISRO in the field of telemedicine [3,21].

ISRO's telemedicine network has expanded significantly, connecting 45 remote and rural hospitals and 15 super-specialty hospitals in the past three years [17,7]. These nodes encompass offshore islands in Andaman & Nicobar and Lakshadweep, mountainous districts in Jammu and Kashmir (including Kargil and Leh), medical college hospitals in Orissa, and various rural and district hospitals in mainland states.
A telemedicine pilot project in Karnataka has facilitated over 10,000 teleconsultations in the past two years [3]. "The Karnataka Telemedicine Project" aims to deliver multi-specialty healthcare services to a substantial portion of Karnataka's rural population through a range of technical tools. This network serves as a potential model for "HEALTHSAT," scheduled to launch in the near future [3].

Presently, the Indian government actively supports various telemedicine programs by the mentioned organizations, as illustrated in figure-1.

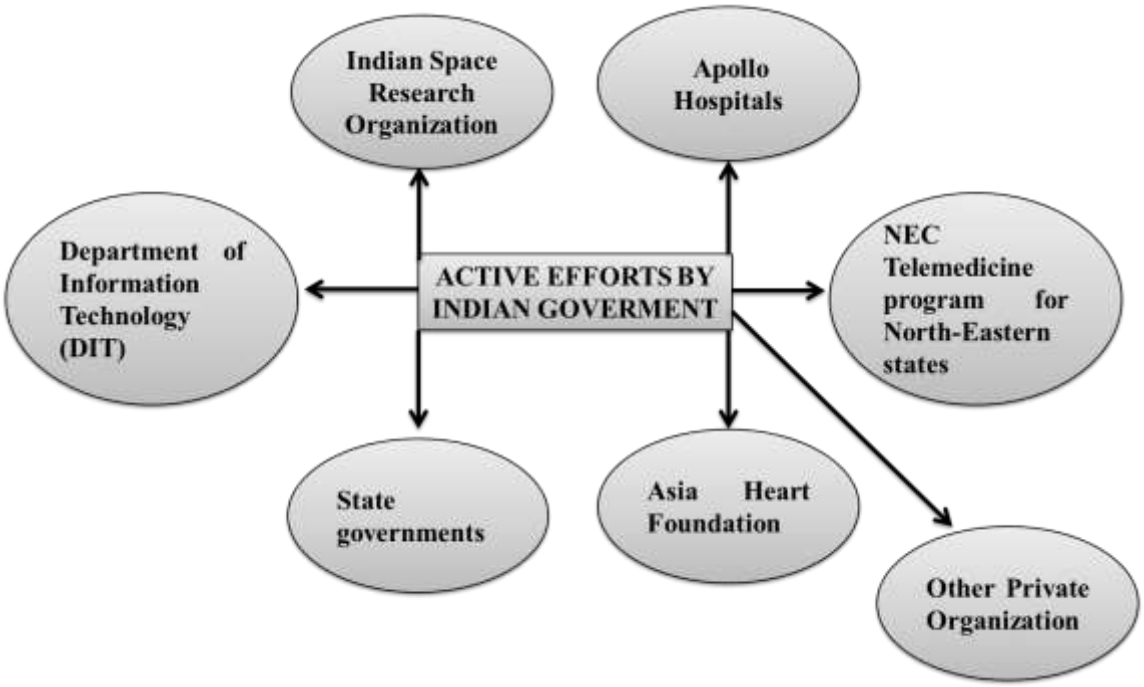

Figure 1: Active Sponsorship of Telemedicine Activities in India

India's commitment to telemedicine extends beyond its borders, as it seeks to share its expertise with African nations grappling with inadequate healthcare infrastructure. The "Pan African e-network Project" establishes connections between hospitals in 53 African countries and 11 specialized tertiary care hospitals in India.

Building on the achievements of various telemedicine initiatives within India, there are plans to create a regional telemedicine network that connects Southeast Asian SAARC countries through the e-Network of the South Asian Association for Regional Cooperation. This initiative by the Government of India aims to enhance healthcare accessibility for all SAARC nations, providing specialized healthcare facilities and supporting the ongoing medical education of healthcare professionals. Memoranda of understanding have already been inked with countries like Bhutan, Nepal, and Afghanistan, and several projects are already in progress [60-62].

In 2007, the Indian government approved the project with a total cost of Rs. 542.90 crores (US$ 125 million). The main objective of this project is to offer telemedicine services to patients, ensuring their proper care, while also promoting continuing medical education for healthcare professionals. The project has already initiated regular continuing medical education sessions, with 654 sessions successfully completed.

Telemedicine Modalities

The healthcare landscape has undergone a revolutionary transformation with the advent of telemedicine technology, aimed at enhancing patient treatment. This technology relies on stable and secure broadband connections to provide effective long-distance healthcare services. The robust broadband signal transmission system, often referred to as a "line," comprises a complex infrastructure that facilitates data flow at high speeds. Recent global advancements in healthcare infrastructure have made cost-effective access to broader bandwidths possible, facilitating faster document transfer speeds.

In the contemporary healthcare landscape, telemedicine technology employs various modalities, including "Short Message Service (SMS)" through text messaging (a long-standing essential modality), smartphone applications, automated calls, and digital wearable gadgets. While SMS messaging has been in use for over a decade, mobile health apps and fitness trackers have emerged as the fastest-growing segments driving telemedicine modalities. These diverse telemedicine modalities or applications now facilitate the provision of potential medical care services through the sharing of images, videos, and audio. However, it's worth noting that some physicians argue that app-based modalities may pose a barrier to remote healthcare delivery, as not all patients have access to smartphones and computers, which are required for these apps [1,72].

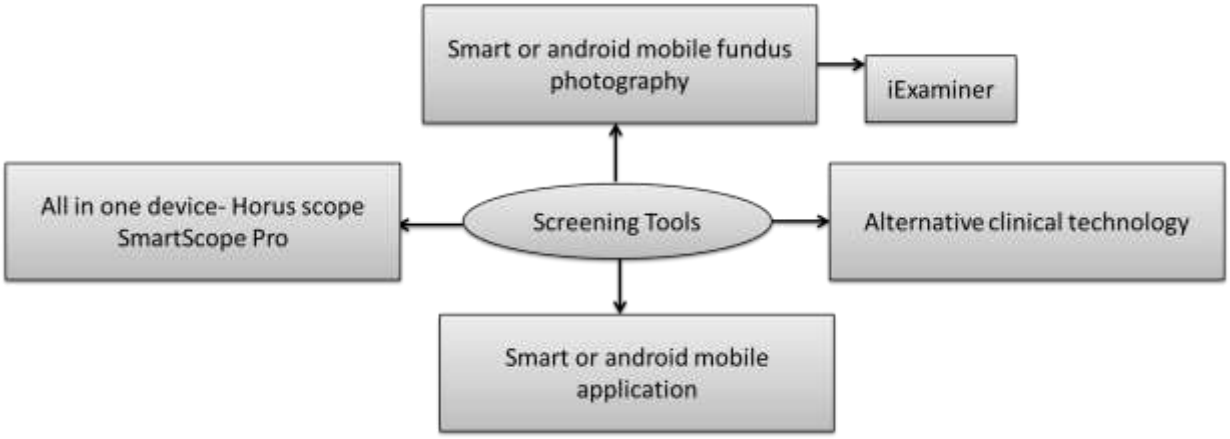

Figure-2- Telemedicine approaches for the screening or the diagnosis of disease

While concerns persist about the limited use of mobile phones and m-Health apps among specific populations, such as the elderly and those with lower socioeconomic backgrounds, numerous studies have highlighted the potential benefits of these technologies for both young and elderly patients. SMS messaging and m-Health apps have proven effective in reducing hospital stays, improving patient care by detecting complications earlier, and subsequently reducing 30-day readmissions. They also contribute to enhanced recovery and reduced healthcare costs in patient treatment.

Despite the various advantages of telemedicine technology, there are certain drawbacks to consider. One significant concern is the presence of legal issues. The integration of telemedicine into various healthcare capacities necessitates the implementation of laws, regulations, and ethical guidelines, which may take time to develop. As telemedicine becomes more widespread, issues related to provider compensation may also need to be addressed, posing complex challenges. Furthermore, an overreliance on telemedicine carries clinical risks, as excessive dependence on this technology can become problematic without uniform policies and procedures to guide its use.

Telemedicine technology has not yet reached a stage where it can be used continuously or flexibly. While its potential contributions to healthcare are vast, further planning and development are required before it can be confidently and effectively utilized.

Current Application of Telemedicine:

The COVID-19 pandemic has presented a significant global public health crisis, impacting people worldwide and posing substantial challenges in delivering primary healthcare [2,6,80]. COVID-19, caused by SARS-CoV-2, is a highly contagious disease declared a pandemic by the World Health Organization (WHO) [2,11].

Many low-resource or developing countries face limitations in their healthcare systems, lacking necessary resources such as ventilators, ICU beds, and medical staff. Additionally, personal protective equipment (PPE) for healthcare workers may be insufficient or unavailable. Fears of exposure to the virus have led to hesitancy among hospitals and clinics to provide healthcare services, even for non-COVID illnesses.

Numerous acute and chronic conditions, including diabetes, pregnancy, obesity, malnutrition, chronic respiratory diseases, cardiovascular diseases, cancer, and mental health conditions, require regular medical attention. Meeting these primary healthcare needs during the pandemic has proven challenging within hospital settings. Therefore, telemedicine and telehealth have emerged as critical tools in ensuring access to primary healthcare for individuals with both acute and chronic illnesses in developing countries.

Telemedicine enables healthcare professionals to consult remotely with patients, establishing a two-way communication channel between the patient and healthcare expert, utilizing information and communication technology (ICT). The healthcare expert, located remotely from the patient, provides health advice and prescriptions based on their conversation. This interaction can occur through video conferencing on smartphones, tablets, or desktop computers, creating an audiovisual consultation experience that mimics an in-person visit.

Additionally, consultations can be conducted through audio and/or text messaging on mobile phones. The utility of telemedicine during the COVID-19 pandemic in developing countries has been recognized as an effective

means of addressing healthcare challenges. Restrictions on human mobility, such as lockdowns, play a significant role in curbing the spread of new coronavirus strains.
The World Health Organization (WHO) has encouraged countries to implement necessary measures to prevent infection and maintain the progress achieved in reducing cases and slowing the spread of COVID-19. Approximately 4 billion people have been affected by the pandemic, with half of the world's population receiving government directives to stay at home to curb the spread of this deadly virus [2,6].

Lockdowns and mobility restrictions have posed significant challenges for patients suffering from various acute and chronic illnesses, preventing them from physically visiting healthcare facilities. The inability to access medical assistance for an extended period can jeopardize their health, as early intervention is crucial in preventing complications. Therefore, telemedicine consultations can prove highly beneficial to such patients, enabling them to maintain a healthy lifestyle during this challenging period.

During the COVID-19 outbreaks, visiting hospitals and clinics increases the risk of infection for patients with non-coronavirus diseases [13]. Testing kits for COVID-19, such as RT-PCR kits, are in short supply in developing countries, limiting diagnostic capabilities. Many COVID-19-positive patients remain untested, including asymptomatic, presymptomatic, or those with mild symptoms [2]. Additionally, healthcare professionals who are asymptomatic and untested may unknowingly risk infecting patients seeking their care [2]. Patients with non-coronavirus illnesses visiting healthcare facilities face an elevated risk of contracting the virus [2]. Consequently, utilizing telemedicine to treat non-coronavirus-affected patients can significantly reduce the risk of infection transmission to both patients and healthcare providers. Furthermore, the majority of COVID-19-positive patients do not require hospitalization due to mild symptoms [2]."

Future Prospects of Telemedicine Technology:
Telemedicine technology holds the potential to emerge as a compelling alternative to traditional medical care, encompassing acute, chronic, and preventive healthcare, all while enhancing clinical outcomes [4,22]. It is anticipated to continue reshaping healthcare delivery, transitioning from hospitals or healthcare systems to patients' homes in developed countries [4]. However, the future of telemedicine technology is influenced by human factors, economics, and technology, all of which play pivotal roles [20]. Technological behaviors impact individual, organizational, and societal changes [4,20,22].

Within the healthcare sector, shortages in personnel and declining third-party reimbursement rates are significant drivers for technology-enabled healthcare, particularly in fields such as home care and self-care [4]. Various digital tools like smartphones, sensor devices, and nanotechnology are poised to reshape the landscape of healthcare delivery [4]. Undoubtedly, in the future healthcare system, the integration of information and communication technology into healthcare delivery will offer substantial benefits to patients, providers, and payers alike [4].

Furthermore, the global telemedicine market is projected to experience a Compound Annual Growth Rate (CAGR) of 16.9% [18], surging from USD 25.4 billion in 2020 to USD 55.6 billion by 2025. Several factors are influencing the telemedicine market's growth, with the COVID-19 pandemic standing out as one of the most significant drivers [14]. The years 2020-2021 have witnessed a remarkable transformation in the history of telehealth due to COVID-19, witnessing a dramatic surge in telemedicine adoption. Telemedicine technology has demonstrated its vital role in healthcare settings [4].

In recent years, the telemedicine market has experienced explosive growth, enabling healthcare practitioners to assess, diagnose, and treat patients virtually through telecommunications. According to Statista, North America leads the global telemedicine market, with revenues projected to reach $35 billion by 2025. Additionally, a McKinsey survey reveals a substantial increase in the number of people interested in using telehealth services, surging from 11 percent to 76 percent. The question of when telemedicine will become a standard part of care remains challenging to answer but is a topic of significant interest [4].

2. CONCLUSION

1. In summary, telemedicine has rapidly become a prominent part of the healthcare landscape, offering various benefits such as improved clinical outcomes, high patient satisfaction, reduced travel and wait times, and cost savings for both patients and healthcare systems.
2. Based on the methodologies and analyses detailed in the literature review research paper, it is clear that the integration of AI and machine learning into healthcare can significantly enhance patient outcomes. These technologies can identify high-risk patients and create personalized treatment plans. AI and machine

learning also extend to predicting disease risks, like cancer, and devising tailored treatment strategies based on individual patient characteristics and medical histories. Moreover, they empower healthcare professionals to predict treatment responses, monitor patient progress, and adjust treatment plans as needed.

3. However, it's essential to emphasize the research's focus on addressing the ethical, legal, and societal implications of implementing AI and machine learning in healthcare. These technologies raise concerns about data privacy and security, given the vast amount of personal and sensitive patient data involved. To address these concerns, transparent, explainable, and accountable development and implementation of AI and machine learning systems are crucial. Additionally, the needs and concerns of all stakeholders, including patients, healthcare providers, and ethicists, must be carefully considered.
4. Based on the literature review and analysis presented in this research paper, which focused on "The use of AI and machine learning in healthcare and its potential to improve patient outcomes," several avenues for further research have been identified.Long-term Outcomes: Despite the positive results reported in many of the studies reviewed, further research is warranted to assess the long-term outcomes and overall effectiveness of AI and machine learning systems in enhancing patient outcomes. (Suresh et al., 2020)
5. Generalizability: The studies included in this literature review were conducted within specific geographic regions and healthcare systems. Therefore, it is essential to conduct additional research to ascertain the generalizability of these findings to diverse settings and populations. (Chen et al., 2020)
6. Ethical Considerations: Given the rapid advancement of AI and machine learning, there is a pressing need for further research to comprehensively explore the ethical considerations. Ensuring transparency, explainability, and accountability in the development and deployment of these systems is of paramount importance. (Henderson et al., 2019)
7. Limited Sample Size: It is worth noting that the literature search for this review was confined to English-language articles published between 2010 and 2021. This limitation may have resulted in a relatively small sample size and could have potentially missed pertinent literature on the subject. (Klein et al., 2018)

Conflict of interest

The authors declare that they have no conflicts of interest to disclose in relation to this manuscript.

Acknowledgment

We would like to express my sincere gratitude to my co-authors, research advisor, reviewers, friends, family, funding agencies, and institutions for their invaluable contributions and support in the creation of this manuscript. Your involvement has been instrumental in shaping the final product."

3. REFERENCES

1. Hashmi, Shah Rukh. "Artificial Intelligence in Healthcare: Past, Present, and Future." Journal of Medical Systems, vol. 41, no. 8, 2017, pp. 1-12.
2. Schüffler, Peter J. "Machine Learning in Healthcare." Health and Technology, vol. 6, no. 2, 2016, pp. 105-117.
3. Yang, Jie. "Deep Learning in Medical Image Analysis." Physics in Medicine and Biology, vol. 63, no. 17, 2018, pp. 170001.
4. Thrall, James. "The impact of artificial intelligence on the future of medical imaging." The British Journal of Radiology, vol. 91, no. 1087, 2018, pp. 1-7.
5. Murphy, James D. " Artificial Intelligence in Radiology: Past, Present, and Future." Radiology: Artificial Intelligence, vol. 2, no. 1, 2020, pp. e190005.
6. Chen, Y., Lu, J., Chen, H., & Wang, Y. (2020). Machine learning in healthcare: Past, present and future. Journal of medical systems, 44(6), 168.
7. Brown N. A brief history of telemedicine. Telemedicine Information Exchange. 1995;105:833–5. [Google Scholar]
8. Ganapathy K. Neurosurgeon, Apollo Hospitals, Chennai, Telemedicine in India-the Apollo experience, Neurosurgery on the Web. 2001.
9. Bashshur RL, Armstrong PA, Youssef ZI. Telemedicine: Explorations in the use of telecommunications in health care. Springfield, IL: Charles C Thomas; 1975. [Google Scholar]
10. Bashshur R, Lovett J. Assessment of telemedicine: Results of the initial experience. Aviation Space Environ Med. 1977;48:65–70. [PubMed] [Google Scholar]
11. Bashshur R. Superintendent of Documents. Washington DC: US Government Printing Office; 1980. Technology serves the people: The story of a cooperative telemedicine project by NASA, the Indian Health Service and the Papago people. [Google Scholar]
12. Chen, Y., Lu, J., Chen, H., & Wang, Y. (2020). Machine learning in healthcare: Past, present and future. Journal of medical systems, 44(6), 168.

13. Watson DS. Telemedicine. Med J Aust. 1989;151:62–66. 8,71. [PubMed] [Google Scholar]
14. Foote D, Hudson H, Parker EB. National Technical Information Service (NTIS) Springfield, VA: US Department of Commerce; 1976. Telemedicine in Alaska: The ATS-6 satellite biomedical demonstration. [Google Scholar]
15. Allen A, Allen D. Telemedicine programs: 2nd annual review reveals doubling of programs in a year. Telemedicine Today. 1995;3(1):10–4. [Google Scholar]
16. Report of the Technical Working Group on Telemedicine Standardization, Technical working group for Telemedicine Standardization Department of Information Technology (DIT), Ministry of Communications and Information Technology (MCIT), May 2003.
17. Houtchens BA, Allen A, Clemmer TP, Lindberg DA, Pedersen S. Telemedicine protocols and standards: Development and implementation. J Med Sys. 1995;9(2):93–119. [PubMed] [Google Scholar]
18. Balas EA, Jaffery F, Pinciroli F. Patient care from a distance: Analysis of evidence. Annu Meet Int Soc Technol Assess Health Care. 1996;12:17. [Google Scholar]
19. Grigsby J, Schlenker RE, Kaehny MM, et al. Analytic framework for evaluation of telemedicine. Telemedicine J. 1995;1(1):31–39. [PubMed] [Google Scholar]
20. Bedi BS. Telemedicine in India: Initiatives and Perspective, eHealth 2003: Addressing the Digital Divide-17th Oct. 2003.
21. Mexrich RS, DeMarco JK, Negin S, et al. Radiology on the information superhighway. Radiology. 1995;195(1):73–81. [PubMed] [Google Scholar]
22. Brown N. Telemedicine coming of age. TIE. 1996 Sep 28; [Google Scholar]
23. Wachter GW. Telecommunication, linking providers and patients. Telemedicine Information Exchange. 2000 Jun 30; [Google Scholar]
24. Kopp S, Schuchman R, Stretcher V, Gueye M, Ledlow J, Philip T, et al. Telemedicine. Telemedicine J E-health. 2002;8:18. [Google Scholar]
25. Grigsby B, Brown N. ATSP Report on US Telemedicine Activity: Portland; 1999 or Association of Telehealth Service Providers.
26. Saxena G, Singh JP. E-medicine in India: Hurdles and future prospects, paper presentation at an International seminar organized at The International Institute of Professional Studies. Devi Ahilya University; [Google Scholar]
27. Schüffler, Peter J. "Machine Learning in Healthcare." Health and Technology, vol. 6, no. 2, 2016, pp. 105-117.
28. Stamm BH. Clinical applications of telehealth in mental health care. J Am Psychol Assoc. 1998;29:536–42. [Google Scholar]
29. C. Cook, I. Murdoch, C. Kennedy, P. Taylor, K. Johnson, and R. Godoumov, "Teleophthalmology and vision 2020 in South Africa," South African Medical Journal, vol. 94, no. 9,pp. 750-751, 2004.
30. M. Ng, N. Nathoo, C. J. Rudnisky, and M. T. Tennant, "Improving access to eye care: teleophthalmology in Alberta, Canada," Journal of Diabetes Science and Technology, vol. 3,
31. no. 2, pp. 289–296, 2009.
32. F. Gomez-Ulla, F. Alonso, B. Aibar, and F. Gonzalez, "A comparative cost analysis of digital fundus imaging and direct fundus examination for assessment of diabetic retinopathy,"Telemedicine Journal and E-Health, vol. 14, no. 9, pp. 912–918, 2008.
33. R. Minutolo, F. C. Sasso, P. Chiodini et al., "Management of cardiovascular risk factors in advanced type 2 diabetic nephropathy: a comparative analysis in nephrology, diabetol ogy and primary care settings," Journal of Hypertension,vol. 24, no. 8, pp. 1655–1661, 2006.
34. . Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coron avirus from patients with pneumonia in China, 2019. New England JMed. 2020. doi: 10.1056/NEJMoa2001017.
35. 2. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China.Lancet. 2020;395(10223):497–506. doi: 10.1016/S0140-6736(20)30183-5.[PubMed: 31986264].
36. Worldometer. COVID-19 coronavirus pandemic. 2020, [up dated 2020 Mar 21; cited 2020 Mar 22]. Available from:https://www.worldometers.info/coronavirus/.
37. McKibbin WJ, Fernando R. The global macroeconomic impacts of COVID-19: Seven scenarios. SSRN Elec J. 2020. doi: 10.2139/ssrn.3547729.
38. Lucey DR, Gostin LO. The emerging zika pandemic: Enhancing preparedness. JAMA 2016;315(9):865–6. doi: 10.1001/jama.2016.0904.
39. [PubMed: 26818622].
40. Williams AM, Bhatti UF, Alam HB, Nikolian VC. The role of telemedicine in postoperative care. Mhealth. 2018;4:11. doi: 10.21037/mhealth.2018.04.03. [PubMed: 29963556]. [PubMed Cen tral: PMC5994447].

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

41. Hollander JE, Carr BG. Virtually perfect? Telemedicine for Covid-19. N Engl J Med. 2020. doi: 10.1056/NEJMp2003539. [PubMed: 32160451].
42. Medical Economics. Coronavirus and telemedicine: How it can help practices and patients with communicable diseases. 2020, [cited 2020 Mar 22]. Available from: https://www.medicaleconomics.com/news/ coronavirus-and-telemedicine-how-it-can-help-practices-and patients-communicable-diseases.
43. Wu Z, McGoogan JM. Characteristics of and important lessons from the Coronavirus Disease 2019 (COVID-19) outbreak in China: Sum mary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020. doi: 10.1001/jama.2020.2648. [PubMed: 32091533].
44. : a possible reality in rural India. Int J Dermatol 54: 375-376. 42. Boyers LN, Schultz A, Baceviciene R, Blaney S, Marvi N, et al. (2015) Teledermatology as an educational tool for teaching dermatology to residents and medical students. Telemed J E Health 21: 312-314.
45. Bai VT, Murali V, Kim R, Srivatsa SK (2007) Teleophthalmology-based rural eye care in India. Telemed J E Health 13: 313-321.
46. Prathiba V, Rema M (2011) Teleophthalmology: A model for eye care delivery in rural and underserved areas of India. Int J Family Med: 683267.
47. John S, Sengupta S, Reddy SJ, Prabhu P, Kirubanandan K, et al. (2012) The Sankara Nethralaya mobile teleophthalmology model for comprehensive eye care delivery in rural India. Telemed J E Health 18: 382-387.
48. Gupta A, Raman R, Sharma T (2014) Evaluation of the effectiveness of diagnostic & management decision by teleophthalmology for retinal diseases. Indian J Med Res 139: 954-955.
49. Kumar A, Unnikrishnan B, Mithra P, Kumar N (2015) Awareness and attitude regarding breastfeeding and immunization practices among primigravida attending a tertiary care hospital in southern India. J Clin Diagn Res 9: LC01- 05.
50. Gargano LM, Thacker N, Choudhury P, Weiss PS, Pazol K, et al. (2012) Attitudes of pediatricians and primary health center physicians in India concerning routine immunization, barriers to vaccination, and missed opportunities to vaccinate. Pediatr Infect Dis J 31: e37-42.