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REVIEW ARTICLE

Secure and Reliable Healthcare Network: The Role of Wireless Communication in Improving Patient Health and Security Outcomes

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ABSTRACT

Wireless communication technologies are revolutionizing healthcare by enabling remote patient monitoring, telemedicine and real time data exchange. This paper explores the potentials of wireless networks in enhancing patient health and security outcomes. We address the critical importance of robust security measures to safeguard sensitive patient data and protect against cyber threats. This study investigates a wide range of issues such as patient-centric communication technology, 6G based applications using smart technologies, real-time communication protocols, implementation of artificial intelligence (AI) and blockchain technology in healthcare. This paper concludes by highlighting the promising future of wireless communication in healthcare, emphasizing the need for continued research and development to further optimize its impact on patient care and wellbeing.

KEYWORDS

6G Wireless Communication; Healthcare Network; Security; Reliability; Internet of Healthcare Things (IoHTs); IOMT; NOMA (Non-Orthogonal Multiple Access); AI; Blockchain

1. Introduction

Human civilization has prolonged relied significantly on communication. In the past interpersonal interactions predominantly occurred between people. Despite this technological advancement has enhanced human interaction with computers, tablets and a wide array of electronic devices. The researchers have successfully developed intelligent smart cameras that enable interaction without involving human assistance. This conceptual framework includes an extensive network of interconnected nodes that communicate effortlessly in a dense network. The quality of human assisted living conditions can be improved through the integration of Internet of Things (IoT) into the medical field. As a result, the field of medical technology (MT) has broadened considerably, encompassing several industries focused on monitoring patient's health and delivering real time healthcare medical support. Modern medical technology has made it possible for the patients to stay in the

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hospital for shorter period of time. These advancements are characterized by easier operability and require less efforts [1]. Patient perceive a overall improvement and transformation in their health. Consequently, this is feasible to conduct standard analysis of patient data in the context of digital era of medicine [2]. MT boost the digital infrastructure by collecting data and rendering this easier for the public to acquire the health information. This aims to support service providers and patients in acquiring the necessary information for subsequent analysis. Because of the growing number of elderly and disabled individuals, real-time health surveillance facilities are necessary to treat patient's health in order to prevent preventable death [3]. The internet of healthcare things (IoHT) comprises a comprehensive framework of interconnected smart devices designed to monitor, track and archive patient health data for continued medical treatment.

Intelligent gadgets provide superior, faster and cost-effective advances in healthcare consumption driven by client needs. The faster evolving practices for healthcare services are supported by wearable IoT devices that are cloud based [4]. The IoT-based healthcare devices are intended for diagnostic testing, monitoring, and remote surgical procedures through internet. Healthcare professionals collect the data input from the sensors and evaluate the data using programs by smartphones, wearable devices and specific devices [5]. IoHT can assist with various health related concerns encompassing chronic illness management for older patients and the growth of organization. Consequently, IoHT will surely serve as a contemporary intelligent rehabilitation system, addressing the challenges posed by aging populations and a shortage of healthcare workers [6]. As an instance IoHTs systems have potential in this dynamic environment since they facilitate the customization of medical services, significantly reducing costs while improving outcomes through enhanced responsiveness, usability and effective data utilization [7]. Similarly, the advantage of IoHTs may expedite the diagnostic process, provide reliable, high-quality care that reduces costs, and potentially reduce the possibility of disease recurrence. The IoHTs offer a solution to discuss the factors and the prevention of disease. This can be assumed that it would be useful in supporting and improving life in the future. The Internet of High-Things, which combines high-altitude platforms (HAPs) and IoT, is a groundbreaking concept in wireless communication [8] [9].

HAPs possess the capability to transform healthcare by delivering dependable and cost-effective connectivity to remote and underserved regions. By functioning in the stratosphere, HAPs can offer extensive coverage, rendering them suitable for accessing populations which currently do not possess fundamental healthcare services. HAPs facilitate telemedicine services by providing the necessary bandwidth and latency for real time video consultations between patients and physicians. HAPs facilitate the collection and transmission of real time patient data, including vital signs and medical device measurements. HAPs can establish a vital communication channel during emergencies, enabling first responders to interact and synchronize their actions. HAPs help disseminate health education and information to underserved groups. HAPs can be utilized to gather data on several health-related subjects, including illness prevalence, risk factors and treatment outcomes [10]. The application of HAPs in healthcare is still developing, however the potential advantages are substantial. With ongoing technological advancements HAPs are anticipated to improve a progressively significant part in enhancing access to decent healthcare for all the individuals. HAPs offer enhanced security measures, protecting sensitive patient information from cyber threats. This ensures data privacy and integrity, building trust between healthcare providers and patients. As HAP technology continues to advance, it has the potential to transform healthcare delivery, making it more accessible, efficient, and secure [11].

Simultaneously, wireless communication technologies such as Wi-Fi, Bluetooth, and cellular networks have significantly contributed to establishing a smooth link between IoT devices and the internet by encompassing cellular networks. Research in this domain has focused on enhancing wireless communication protocols, addressing security challenges, and devising energy-efficient solutions to accommodate the growing proliferation of IoT devices [12].

This paper aims to configure the Internet of Things (IoTs) and analyses the fundamental prerequisites of fields that use this technology. In addition, it will investigate the advantages and security considerations related to IoTs and wireless communication, while also considering future prospects.

2. Wireless Techniques for IoHT Applications

Wireless channels of communication are essential for the implementation of the IoHT paradigm. These solutions facilitate reliable and effective data transmission between HAPs and terrestrial IOT devices. To address the specific issue faced by the individuals with hearing impairments, numerous wireless communication methods have been implemented in real world scenarios [13] [14].

2.1 Noval approach of NOMA in Healthcare

The expansion of IoT connected devices poses substantial challenges for the advancements of future wireless networks. NOMA has been proposed as a feasible way to effectively address the several demands of such networks. These requirements encompass enhancing wireless network performance and efficiency, ensuring ultra reliable communication, achieving low latency and extensive accessibility, and maximizing spectrum efficiency [15]. The primary benefit of NOMA is the enhancement of the capacity and efficiency of wireless networks. NOMA facilitates concurrent communication among multiple users, hence augmenting the number of users engaged in simultaneous communication while concurrently diminishing the spectrum required to accommodate those users [16]. This results in faster and more reliable transmissions, which is especially advantageous in densely populated regions with limited spectrum availability. This approach is beneficial for applications where information is obtained from sensors amongst impulsive disturbance [17]. Examples of these applications include smart grids, smart homes and IOHT applications.

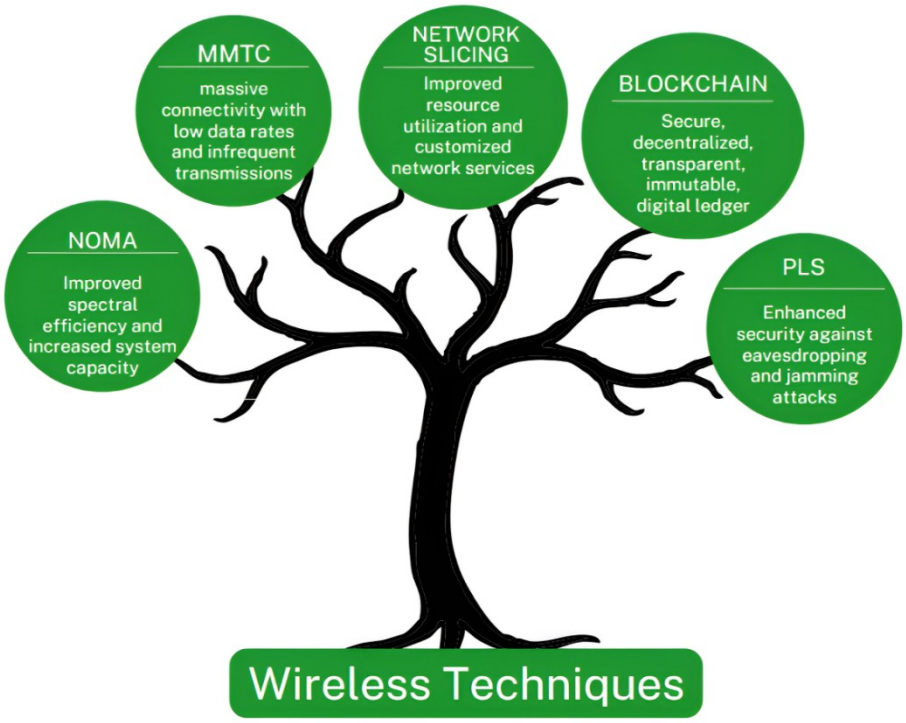


Figure 1. This section delves into the critical role of wireless communication technologies, such as (NOMA, mMTC, network slicing, blockchain and PLS) in enabling the seamless and secure transmission of data within IoHT environments. This section investigates the security and reliability considerations crucial for ensuring the integrity and confidentiality of patient data, focusing on their suitability for various healthcare applications.

2.1.1 Comparison of Exploration in NOMA and Healthcare

Purpose

Surveys in healthcare focuses on wireless communication which aim to examine the utilization of wireless technologies and their impact on healthcare delivery. They assess various elements, including the execution of telemedicine, mhealth applications and remote patient monitoring. The objective is to comprehend how these

technologies affect healthcare accessibility, patient outcomes, provider efficiency and overall patient satisfaction. NOMA surveys assess factors including user equity, resource distribution, interference regulation, and power management, along with the system's overall performance and get insights regarding the use, performance, and optimization of NOMA techniques in wireless communication systems.

Target Population

Healthcare surveys are performed within the field of wireless communication that may focus on several stakeholders, caregivers or specific user groups with an objective of assessing the impact of wireless technology on patient involvement, healthcare accessibility, or the workflow of healthcare professionals. NOMA surveys primarily target academics, engineers, and other professionals involved in the design, optimization, and standardization of wireless communication networks with aim to improve the development and implementation of NOMA techniques.

Survey Instruments

Healthcare and wireless communication surveys may employ several survey instruments, contingent upon the target audience and the objectives pursued which may include elements such as patient satisfaction surveys, usability evaluation metrics, technical acceptance frameworks, or qualitative interviews. NOMA frequently use questionnaires or structured interviews in its surveys to get information from experts in wireless communication. Inquiries regarding user experiences, preferences, and interactions with NOMA procedures, system parameters, performance metrics, and interference management strategies may be incorporated.

Data Analysis and Utilization of NOMA in IoHT Perspective

The outcomes of healthcare surveys utilizing wireless communication are examined to enhance comprehension of the impact of wireless technologies on healthcare results, patient experiences, and provider efficiency. The analysis of data from NOMA surveys often aims to assess the efficacy of NOMA techniques, identify challenges, propose enhancements, and guide future research and development in wireless communication systems. The results enhance the advancement of superior NOMA algorithms, interference management strategies, and resource distribution techniques.

2.2 Massive Machine Type Communication (mMTC)

Massive Machine-Type Communication (mMTC) is an indispensable component of the 6G and IoHT architecture, facilitating an exceptionally high density of connections among online devices by enabling extensive device connectivity in IoT applications. IoHT functions as a network that facilitates the seamless connection and communication of numerous devices, hence significantly improving healthcare services. The integration of mMTC into IoHT presents several opportunities to enhance patient care, streamline organizational processes, and transform healthcare delivery [18]. The utilization of mHealth technology empowers healthcare personnel to augment their capabilities, promotes proactive care management, and fosters active patient participation. This is accomplished through the use of diverse applications, including remote patient monitoring, intelligent healthcare infrastructure, telemedicine, and health wellbeing monitoring [19]. To fully utilize the potential of mMTC in IoHT, it is essential to tackle issues related to scalability, network congestion, power consumption, and data security. The healthcare sector can use a connected and patient-centered approach by utilizing advancements created by mMTC. The concept of mMTC has evolved as a vital communication paradigm within IoHT, enabling the connecting of several devices that require occasional and infrequent data transmission. The significance of this lies in IoHTs objective to establish connections among various entities. The establishment of connectivity and data sharing will facilitate a transformative shift in healthcare delivery, alongside the advancement of preventative care initiatives and the enhancement of patient outcomes.

2.3 Network Slicing and Virtualization

Network slicing is a virtualized networking framework that is essential to the 6G healthcare system design. Network slicing denotes the process of dividing a single physical network into several logical networks, typically

termed "slices". This division facilitates the implementation of 6G-enabled services with distinct network characteristics, allowing for the distribution of vital resources and the satisfaction of networking requirements for Internet of Highly-Connected Things applications [20]. It facilitates the creation of specialized, efficient, and adaptive end-to-end logical networks that function on a shared network infrastructure. These networks are meticulously designed to accommodate a wide array of services with differing requirements, rendering them very beneficial for the healthcare sector. The architecture of Network Slicing enables operators to generate customized network slices for their clients as a demand-driven service, aimed at supporting healthcare applications [21].

2.4 Blockchain for Secure and Transparent Healthcare Data

The rapid advancement of blockchain technology has resulted in its adoption as a transformative solution for safe data sharing in the healthcare sector. Blockchain technology is seen suitable for tackling the difficulties related to data exchange in the healthcare sector. Consequently, it provides features of decentralization and transparency. These features confer numerous advantages regarding data integrity, privacy, and security [25]. Blockchains can enable the creation of distributed ledgers that subsequently function as a method for recording and monitoring transactions. A primary benefit of blockchain technology in the healthcare business is its capacity to maintain data integrity. Each transaction or data exchange is carefully recorded as a block and connected to prior blocks, creating an unalterable chain [26]. The foundational framework of blockchain relies on a distributed ledger system. Blockchain technology improves the confidentiality and security of patient data in the healthcare sector. In a blockchain network, each participant is allocated a distinct cryptographic identity and associated access rights. This facilitates the establishment of stringent authentication and permission protocols, ensuring that only individuals with appropriate authority can access and share specific data.

The development of a strong level of trust and faith in the integrity of disseminated information is essential for the viability and success of cryptocurrencies [27]. Maintaining the integrity and consistency of patient records, medical research data, and clinical trial information is paramount in the healthcare sector. Blockchain technology in the healthcare sector allows organizations to verify the integrity of received data, ensuring its accuracy and avoiding unauthorized alterations. Blockchain technology in the healthcare sector has the potential to improve data interchange and foster interoperability [28]. Interoperability is essential in the healthcare sector as it improves treatment coordination, reduces the likelihood of medical errors, and ultimately enhances patient outcomes. Blockchain technology enables the creation of interoperable healthcare systems by providing a systematic framework for the secure and standardized exchange of data [29].

2.5 Physical Layer Security for Healthcare Networks

Physical layer security (PLS) is a promising approach to improving the security and reliability of communication in the IoHT. PLS techniques exploit the physical properties of the wireless channel to protect data from eavesdropping and jamming. One of the key challenges in developing PLS techniques for IoHT is the resource-constrained nature of IoHT devices. IoHT devices often have limited processing power, memory, and energy resources. This makes it difficult to implement traditional PLS techniques, which can be computationally expensive. Another challenge is the unreliability of wireless channels. IoHT devices often communicate over wireless channels that are subject to noise and interference. This can make it difficult to reliably implement PLS techniques. Despite these challenges, there has been significant progress in developing PLS techniques for IoHT.

3. Wireless Communication in Healthcare Networks

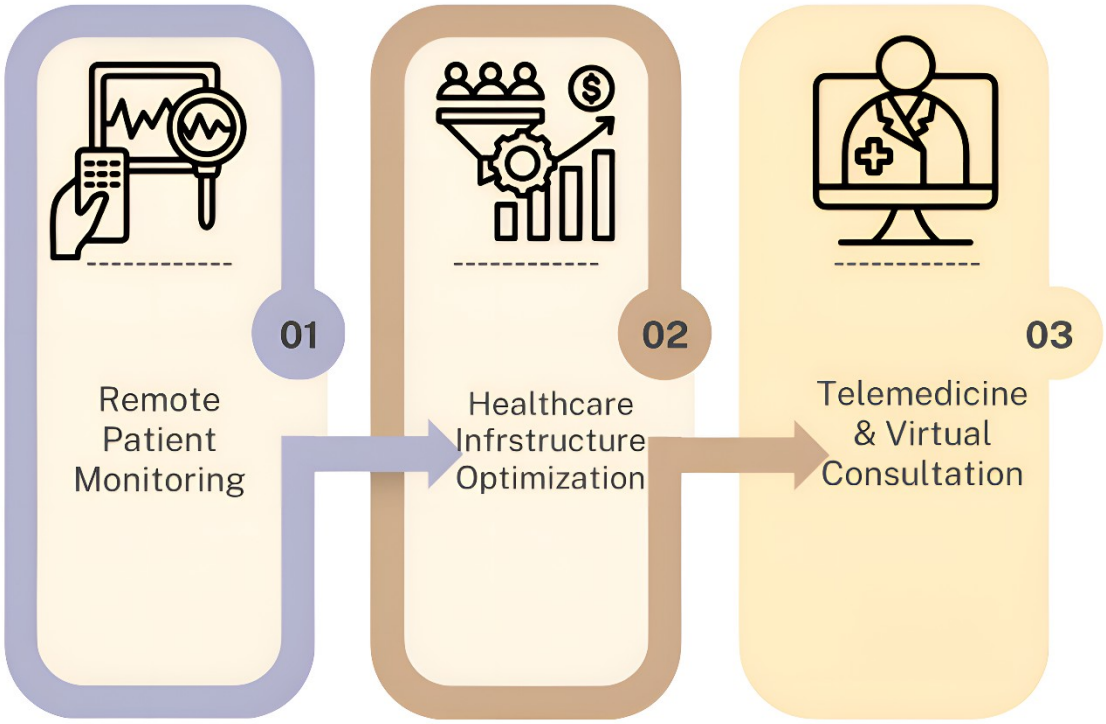


Figure 2. Depiction of a wireless healthcare network, showcasing interconnected devices and communication pathways for enhanced patient care and data security with a schematic representation of how wireless communication empowers patients with remote access to healthcare services, facilitating timely interventions and improved health outcomes.

3.1 Remote Patient Monitoring

RPM is a revolutionary development in healthcare that enables healthcare practitioners to remotely check their patient's physical condition while they are not present in the hospital [30]. This innovative system uses wireless communication technologies to seamlessly transmit medical data between patients and healthcare experts. The utilization of wireless communication for RPM is a significant development in medical technology. This capability offers continuous monitoring, early intervention, improved patient convenience and higher engagement [31]. Because of its dependability and efficiency, wireless communication is critical for data transmission. The usage of secure networks allows for the seamless transmission of patient data, such as vital signs, medical history, and even video consultations. The usage of wireless connectivity ensures that healthcare personnel have easy access to timely and precise information, allowing them to formulate informed decisions about patient care. Wireless communication has enabled RPM, resulting in significant breakthroughs in healthcare systems. To begin, RPM encourages a proactive and preventive approach to healthcare by allowing healthcare providers to monitor their patients' health trends and identify potential problems at an early stage [32]. RPM allows people to accurately measure their important physiological indicators, physical activity levels, and other pertinent health data by integrating wearable devices such as smart watch and sensors. These gadgets can securely communicate data to healthcare providers in real time, minimizing the need for patients to choose frequent hospital visits [33]. This allows for continual monitoring of the patient's health problems.

3.2 Healthcare Infrastructure Optimization

Healthcare Infrastructure Optimization signifies a deliberate and systematic approach to improving the overall functionality of healthcare systems. This process comprises conducting an analysis, developing a strategic plan, and implementing changes to the physical and technological infrastructure with the goal of addressing the ever-changing demands of patients, healthcare professionals and the overall healthcare systems [34]. This optimization method aims to enhance patient outcomes, streamline procedures, and provide high quality care to

each individual patient. The optimization of healthcare infrastructure is a comprehensive approach that includes resource management, technological integration, workflow optimization, infrastructure resilience, patient engagement and continuous improvement. The integration and interoperability of technology systems inside healthcare providers have the potential to enhance operational efficiency, reduce errors, and enhance patient outcomes [35]. Moreover, the use of technology facilitates the ability to carry out consultations from a distance, promotes the exchange of information between patients and healthcare professionals, and streamlines the retrieval of up-to-date data. These advancements together contribute to the enhancement of decision-making processes [36]. The enhancement of healthcare operations quality and productivity relies on the optimization of workflow. Enhancements in the provision of care, reduction in wait times, and elimination of unnecessary steps may be achieved via the analysis and streamlining of processes, identification of bottlenecks, and implementation of standard operating procedures [37]. The streamlining of workflow not only enhances the overall patient experience but also ensures the delivery of consistent and evidence-based therapy.

3.3 Telemedicine and Virtual Consultation

The Healthcare Industry has seen a transformation due to the use of telemedicine and virtual consultations, enabling individuals to conveniently obtain medical care from their residences in a timely manner. Telemedicine encompasses the utilization of technology to deliver medical treatments to patients who are geographically distant from medical professionals. The improved accessibility of healthcare is a significant benefit provided by telemedicine and virtual consultations. Patients, irrespective of their geographical location, can obtain medical advice, receive diagnoses, and acquire treatment recommendations [38]. This is especially beneficial for individuals living in underserved or rural regions, as it increases their likelihood of accessing healthcare services. Telemedicine has improved healthcare accessibility and reduced treatment obstacles by removing the necessity for considerable travel [39]. The patient has the capacity to get medical care without the limitations imposed by traditional face-to-face visits, hence resulting in time and effort savings.

The use of telemedicine and virtual consultation enables the provision of uninterrupted healthcare services. The capacity to remotely observe patients, evaluate their advancements, and modify treatment protocols as deemed appropriate is a useful asset for healthcare professionals. This has great importance in regards to the treatment of chronic diseases or the delivery of postoperative care subsequent to hospitalization. Frequent in-person visits for patients to maintain regular connection with their healthcare team, get timely guidance, or address their issues are not deemed required. Patients have the ability to engage in all of these activities. This process enhances the seamless transition of treatment and enhances the overall outcomes for patients [40].

4. Future Prospects and Emerging Technologies

Widespread changes in the delivery of medical services coupled with interconnectivity are likely to be achieved through the integration of modern healthcare and wireless communication technologies. The plan to improve health care provision by virtue of this technology is putting in place mechanisms that enhances high quality treatment recommendations and better patient output. Directed to the spread of the covid-19 virus, telemedicine has earned the respect of all in the health care sector. This makes it possible for patients to receive care without going to the hospital, hence minimizing the risk of getting the disease [41]. More so, for people, monitoring devices and sensors that assess the health condition has also boosted the capability for individuals to measure their performance and movements in real time. Technology enabled practice aim at providing timely healthcare by preventing the onset of diseases [42]. Besides such technologies, AI and ML are being incorporated into the healthcare sector to analyze the large amount of data to enhance the precision of diagnosis, treatment selection, and prediction of outcomes [43]. In the future, with 5G technology, healthcare will be transformed with advanced communication capabilities due to faster data transfer speeds and lower latency.

These improvements will enable the enhancement of telemedicine services including video consultations and remote operations. Due to its dependable low latency communication structure, the 5G network will allow for the performance of complex medical operations despite geographical location [44]. Moreover, 5G technology will speed up the expansion of the Internet of Medical Things (IoMT), making it possible for devices and sensors to

connect and monitor the patient in real time without any interruptions. In addition, the combination of 5G with the IoMT technology will allow remote health monitoring, real-time response and updates, thus enhancing health service all the more so for poorly served or distant regions [45]. However, it becomes imperative to handle the technological trends' challenges such as ensuring that patients' rights and confidentiality are protected and that people have a fair access to health care. Where these objectives contradict, innovation has to happen more thoughtfully and responsibly [46]. Apart from 5G, the introduction of 6G technology is expected to be even more revolutionary as it is anticipated to include terahertz communications that would make data transmission faster and edge computing that allows data to be processed on location. These advancements will not only increase the speed and security of the transmission of healthcare data but also facilitate the implementation of AI models that would enable more accurate diagnosis and medication in real-time [47]. Another sub-sector that promises ample possibilities for growth is the deployment of augmented reality (AR) and virtual reality (VR) in healthcare. Such technologies may facilitate training for physicians, improve the quality of the patients' interactions, and offer alternative rehabilitation strategies. The future of providing medical assistance using wireless technologies will rely on these trends with the prospect of delivering faster, better, and easier services. But to make sure that these innovations will work for people and society as a whole, more critical since security, privacy, and ethical consequences will center on issues to address [48].

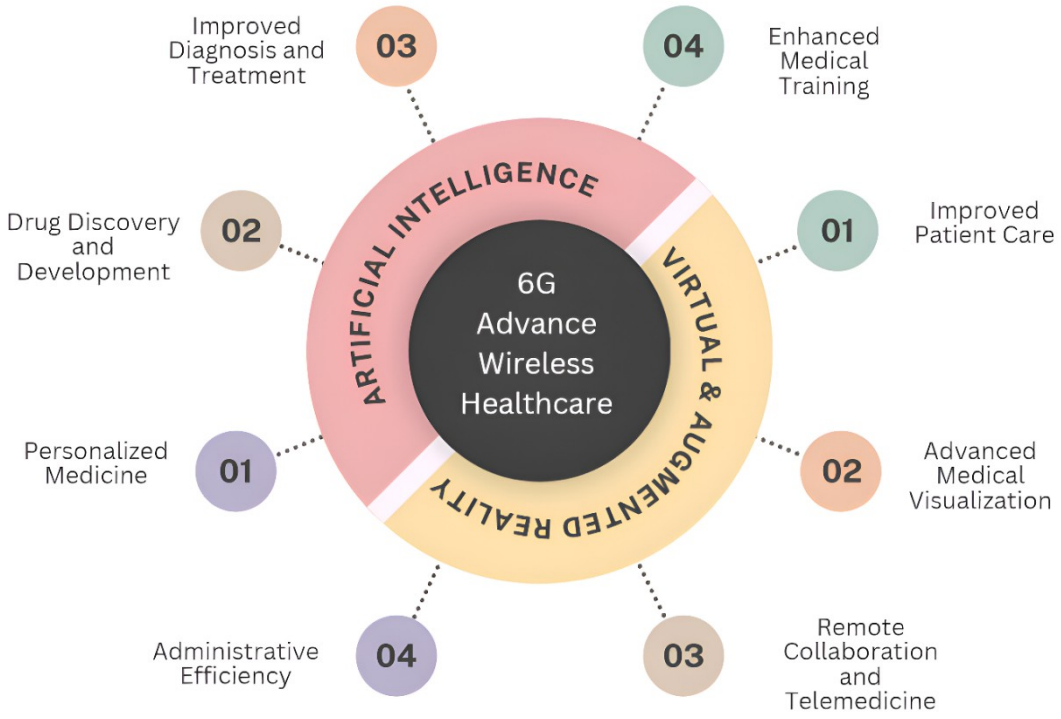


Figure 3. This diagram illustrates the convergence of promising technologies, including 5G/6G, AI/ML, AR/VR to create a secure and reliable healthcare network. These advancements will facilitate real-time data exchange, improve diagnostic accuracy, and enhance patient care delivery.

4.1 5G and Beyond: Advancing Wireless Healthcare

The transition from 5G to 6G technology propels an indisputable force in the health domain leading to numerous applications. from wireless communication of the past, with much faster propagation speed, low latency, and greater capacity, 5G is seen as a significant step forward in the telecommunication industry. These are the critical enablers for the daily life-changing applications of the 5G technology such as real-time telemedicine services. The 5G data link transmissions at high speed over remote consultations and remote surgeries with increased precision that at times are not even possible in physical operations, the rapid transfer of large medical data such as images of diagnostics on which shared work of medical experts are based [49].

With 5G power multiple devices, IoMT's become more and more popular, which means that they are capable to monitor patients' vitals, physical activity, and adherence without interruptions. Such a live feed of information enables the medical staff to acknowledge the beginning of health issues in their patients and, therefore, give more-time-on solutions, cut health care expenses [50]. Besides that, the potential breakthrough in 6G technology by the inclusion of ultra-fast data transmission, low latency, and stronger data processing could be the turning point from the traditional ways of such applications as real-time AI analysis of medical data. 6G network is expected to further transform healthcare by giving rise to innovations such as terahertz communication for high-speed data transmission rates and edge computing for decentralized data processing [51]. These advancements will enhance the capabilities of telemedicine and remote patient monitoring, enabling seamless communication and collaboration between healthcare professionals across distances. Additionally, support of 6G for AR and VR could revolutionize medical training and remote surgeries, improving precision and collaboration in complex procedures [52][53]. Dealing with security, privacy, and ethics issues is very important considering the ever-growing trend of 5G and 6G technologies. This will indeed help in preserving sensitive medical information and maintaining patient's faith by the virtue of security policies and privacy policies that are implemented outside and around the organization [54].

4.2 The Role of AI and ML

AI and ML are becoming integral to healthcare, particularly in eHealth applications. These technologies enhance the connectivity of medical devices and improve the efficiency of healthcare systems by enabling automation and intelligent decision-making. For instance, deep learning models are being used to assist in the diagnosis and treatment of patients, such as those with paralysis, by analyzing their behaviors and predicting medical needs [55]. AI is also making significant strides in medical imaging, with deep learning models improving the accuracy of image processing in X-rays, CT scans, and MRIs [56] . Moreover, AI and ML are being employed in assistive technologies, including physiotherapy and rehabilitation. For example, deep learning models are used in yoga therapy to guide practitioners, correct their poses, and provide feedback through text or voice features [57]. As healthcare continues to evolve, AI and ML will play an increasingly pivotal role in enhancing medical diagnostics, improving patient care, and optimizing healthcare workflows.

4.3 AR and VR in Healthcare

AR and VR technologies are rapidly transforming the healthcare industry, particularly in medical education, patient care, and research. AR allows healthcare professionals to overlay digital patient data, such as CT scans or X-rays, onto a real-world environment, improving accuracy and precision during surgeries. On the other hand, VR provides immersive, simulated environments for medical training, enabling students and professionals to practice complex procedures in a safe, controlled setting [58]. In patient care, AR and VR can be used to manage pain and anxiety, providing patients with engaging virtual experiences during surgery or rehabilitation. These technologies have also proven effective in enhancing rehabilitation sessions, offering interactive exercises that motivate patients and promote recovery [59]. Additionally, AR and VR facilitate research by enabling researchers to visualize complex medical data and simulate biological processes, accelerating scientific discovery and improving medical imaging techniques. Furthermore, AR and VR technologies are set to enhance remote medical collaboration [60]. AR can assist in remote consultations by overlaying real-time information on the condition of the patient, while VR enables virtual collaboration among medical professionals, providing opportunities for training and expert consultations regardless of location.

5. Conclusion

Patients, medical doctors, hospitals staff, and insurance providers all profit from IoT applications in healthcare industries. The medical officials monitor the patients that they need urgent medical treatment or not. IoT allows healthcare practitioners to be more vigilant and proactive in their interactions with patients. While the IoMT has unquestionably enhance the healthcare and delivering new advancements such as glucose monitoring, anxiety, mood tracking, Parkinson's disease tracking, linked inhalers, eyeglasses, and computerized insulin

distribution etc. The development of healthcare IoT will undoubtedly offer even more breakthroughs that will make the medical community easier for both practitioners and patients. When considered in the context of 6G, these three concepts—IOHT, IOMT, and IoT—will merge to build an ecosystem that is both highly networked and extremely intelligent. This ecosystem will make it possible to provide cutting-edge medical care, to practice personalized medicine, and to develop game-changing applications for a wide range of businesses. Real-time data analysis, secure communication, and stable connection for a wide variety of devices will be made possible by using the capabilities of 6G's ultra-high bandwidth, ultra-low latency, and intelligent networking. The environment of 6G wireless communications will provide chances for innovation and cooperation in the healthcare industry that have never been seen before. These prospects will make it possible to build new medical devices, efficient models for the delivery of healthcare, and better patient outcomes. However, in order to guarantee the deployment of these technologies in a responsible and ethical manner in the future, it is vital to address the issues that are connected with them. These challenges include data privacy, security, and ethical concerns. Foster collaboration among healthcare teams and technology experts to effectively integrate IoHT solutions into healthcare workflows and improve patient care. Evaluate and Share insights: Continuously evaluate the effectiveness of IoHT applications in improving patient outcomes and share insights and best practices with peers and stakeholders.

References

[1] M. Yassine and T. Issam, “Securing the future of e-health: Challenges and key management strategies in smart healthcare sensor networks,” in Secure Health. CRC Press, 2025, pp. 19–57.

[2] J. S. Alkasassbeh, F. M. Al-Taweel, T. A. Alawneh, A. Al-Qaisi, Y. F. Makableh, and T. El-Mezieni, “Advancements in wireless communication technology: A comprehensive analysis of 4g to 7g systems,” Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications (JoWUA. 15 (3): 73–91.

[3] M. Rajeevan, V. Anoop, and D. Narayana, “The global trends and hotspots of medical internet of things research: A bibliometric analysis during 2004 to 2023,” in Navigating Cyber-Physical Systems with Cutting-Edge Technologies. IGI Global Scientific Publishing, 2025, pp. 343–372.

[4] E. Hanada and T. Kudou, “Wireless communication system use in medical hospitals and management of the electromagnetic environment,” in 2024 IEEE Joint International Symposium on Electromagnetic compatibility, Signal & Power Integrity: EMC Japan/Asia-Pacific International Symposium on Electromagnetic Compatibility (EMC Japan/APEMC Okinawa). IEEE, 2024, pp. 130–133.

[5] K. Madhura, R. Yadav, Y. Parmar, T. Michael, K. S. Degan, and P. Kapoor, “Iot based wireless networks in hospitals: Ensuring seamless communication in critical situations.” Journal of Intelligent Systems & Internet of Things, vol. 14, no. 1, 2025.

[6] W. Leong and J. Zhang, “Engineer 5g to transform healthcare industrials Science Journal, vol. 18, p. 2023, 2023.

[7] K. Longhurst and V. Wittenberg, “6g waves magazine: spring 2024,” 2024.

[8] I. Al Khatib, A. Shamayleh, and M. Ndiaye, “Healthcare and the internet of medical things: applications, trends, key challenges, and proposed resolutions,” in Informatics, vol. 11, no. 3. MDPI, 2024, p. 47.

[9] M. Singh, K. Chand, and M. Singh, “Navigating challenges and innovations in global healthcare,” in Driving Global Health and Sustainable Development Goals with Smart Technology. IGI Global Scientific Publishing, 2025, pp. 303–338.

[10] S. H. Alsamhi and N. Rajput, “An intelligent hap for broadband wireless communications: developments, qos and applications,” International Journal of Electronics and Electrical Engineering, vol. 3, no. 2, pp. 134–143, 2015.

[11] D. Wang, Y. He, K. Yu, G. Srivastava, L. Nie, and R. Zhang, “Delay sensitive secure Noma transmission for hierarchical hap–lap medical-care iot networks,” IEEE Transactions on Industrial Informatics, vol. 18, no. 8, pp. 5561–5572, 2021.

[12] G. K. Kurt, M. G. Khoshkholgh, S. Alfattani, A. Ibrahim, T. S. Darwish,M. S. Alam, H. Yanikomeroglu, and A. Yongacoglu, “A vision and framework for the high altitude platform station (haps) networks of the future,” IEEE Communications Surveys & Tutorials, vol. 23, no. 2, pp.729–779, 2021.

[13] P. Jayadharshini, G. Kamalam, and T. Abirami, “Future 6g approaches: Integrating intelligent security, sensing, and communication into a green network’s architecture,” in Intelligent Wireless Sensor Networks and the Internet of Things. CRC Press, 2024, pp. 86–106.

[14] K. Kalaiselvi, R. Sankar, S. Supriya, G. Kaushik, H. Swamy, and M. Devika, “Towards seamless connectivity: Implementing 6g communication technologies in next-generation networks,” in 2024 3rd International Conference for Advancement in Technology (ICONAT). IEEE, 2024, pp. 1–6.

[15] L. Bing, Y. Gu, L. Hu, Y. Yin, and J. Wang, “Mimo-noma aided healthcare iot networking: Automated massive connectivity protocol,” IEEE Transactions on Consumer Electronics, 2023.

[16] X. Liu, Y. Liu, Z. Yang, X. Yue, C. Wang, and Y. Chen, “Integrated in Noma-enabled remote-e-health systems,” IEEE Wireless Communications, vol. 28, no. 3, pp. 62–68, 2021.

[17] U. Ghafoor, M. Ali, H. Z. Khan, A. M. Siddiqui, and M. Naeem, “Noma and future 5g & b5g wireless networks: A paradigm,” Journal of Network and Computer Applications, vol. 204, p. 103413, 2022.

[18] U. Chaudhary, M. F. Ali, S. Rajkumar, and D. N. K. Jayakody, “Sensing and secure Noma-assisted mMTC wireless networks,” Electronics, vol. 12, no. 10, p. 2322, 2023.

[19] S. Q. Aeni, R. P. Astuti, and B. S. Nugroho, “Study of mMTC (massive machine type communication) modeling in the automation industry to accelerate the implementation of 5g technology,” in 2024 12th Inter- national Conference on Information and Communication Technology (ICoICT). IEEE, 2024, pp. 341–346.

[20] S. Wijethilaka and M. Liyanage, “Survey on network slicing for internet of things realization in 5g networks,” IEEE Communications Surveys & Tutorials, vol. 23, no. 2, pp. 957–994, 2021.

[21] B. Dzogovic, T. Mahmood, B. Santos, B. Feng, V. T. Do, N. Jacot, and T. Van Do, “Advanced 5g network slicing isolation using enhanced vpn+ for healthcare verticals,” in Smart Objects and Technologies for Social Good: 7th EAI International Conference, GOODTECHS 2021, Virtual Event, September 15–17, 2021, Proceedings 7. Springer, 2021, pp. 121–135.

[22] O. Sabuncu and B. Bilgehan, “Revolutionizing healthcare 5.0: Blockchain-driven optimization of drone-to-everything communication using 5g network for enhanced medical services,” Technology in Society, vol. 77, p. 102552, 2024.

[23] A. M. B. Giridi, L. Jhansi, D. T. Sharon, and B. H. Goud, “Novel methods in utilizing wireless sensor networks with blockchain technology: A review,” in MATEC Web of Conferences, vol. 392. EDP Sciences, 2024, p. 01148.

[24] P. Singh and S. Sagar, “Healthcare monitoring system with blockchain technology encompassing energy harvesting and delays in a wideband network,” Journal of Integrated Science and Technology, vol. 12, no. 4, pp. 794–794, 2024.

[25] W. A. Al-Nbhany, A. T. Zahary, and A. A. Al-Shargabi, “Blockchain-iot healthcare applications and trends: a review,” IEEE Access, 2024.

[26] M. Durgarao, D. Valluru, S. Saraswathi, P. Malathi, K. Thilagam,and S. Loganathan, “A security framework for 5g-enabled wireless sensor networks based on blockchain technology,” in 2024 international Conference on Knowledge Engineering and Communication Systems (ICKECS), vol. 1. IEEE, 2024, pp. 1–6.

[27] A. S. Abdalla*, B. Tang, and V. Marojevic, “Ai at the physical layer for wireless network security and privacy,” Artificial Intelligence for Future Networks, pp. 341–380, 2025.

[28] M. Letafati, E. Jorswieck, and B. Khalaj, “Securing the future e-health: Context-aware physical-layer security,” Physical-Layer Security for 6G, pp. 239–273, 2024.

[29] K. Ramalakshmi, L. K. Kumari, R. Rajalakshmi, and G. Theivanathan, “Enhancing healthcare through remote patient monitoring using internet of things,” in Technologies for Sustainable Healthcare Development. IGI Global, 2024, pp. 133–146.

[30] B. E. Holtz, F. A. Urban, J. Oesterle, R. Blake, and A. Henry, “The promise of remote patient monitoring,” Telemedicine and e-Health, vol. 30, no. 12, pp. 2776–2781, 2024.

[31] R. Uddin and I. Koo, “Real-time remote patient monitoring: A review of biosensors integrated with multi-hop iot systems via cloud connectivity, “Applied Sciences, vol. 14, no. 5, p. 1876, 2024.

[32] J. Malathi, K. Kusha, S. Isaac, A. Ramesh, M. Rajendiran, and S. Boopathi, “Iot-enabled remote patient monitoring for chronic disease management and cost savings: Transforming healthcare,” in Advances in Explainable AI Applications for Smart Cities. IGI Global, 2024, pp.371–388.

[33] D. Muramatsu, “Next-generation healthcare infrastructure based on cross-layer optimization of bio signal sensing and communication,” Impact, vol. 2024, no. 1, pp. 25–27, 2024.

[34] M. Dairoku “Next-generation healthcare infrastructure based on cross-layer optimization of bio signal sensing and communication,” Impact, vol.2024, no. 1, pp. 25–27, 2024.

[35] H. M. Ali, J. Liu, S. A. C. Bukhari, and H. T. Rauf, “Planning a secure and reliable iot-enabled fog-assisted computing infrastructure for healthcare,” Cluster Computing, vol. 25, no. 3, pp. 2143–2161, 2022.

[36] Z. A. Jaaz, M. D. Ansari, P. S. JosephNg, and H. M. Gheni, "Optimization technique based on cluster head selection algorithm for 5g-enabled IoMTs smart healthcare framework for industry," Paladyn, Journal of Behavioral Robotics, vol. 13, no. 1, pp. 99–109, 2022.

[37] A. Haleem, M. Javaid, R. P. Singh, and R. Suman, "Telemedicine for healthcare: Capabilities, features, barriers, and applications," Sensors international, vol. 2, p. 100117, 2021.

[38] S. Omboni, R. S. Padwal, T. Alessa, B. Benczur, B. B. Green, I. Hubbard, K. Kario, N. A. Khan, A. Konradi, A. G. Logan et al., "The worldwide impact of telemedicine during covid-19: current evidence and recommendations for the future," Connected health, vol. 1, p. 7, 2022.

[39] C. O. Alenoghena, H. O. Ohize, A. O. Adejo, A. J. Onumanyi, E. E. Ohihoin, A. I. Balarabe, S. A. Okoh, E. Kolo, and B. Alenoghena, "Telemedicine: A survey of telecommunication technologies, developments, and challenges," Journal of Sensor and Actuator Networks, vol. 12, no. 2, p. 20, 2023.

[40] S. Daousis, N. Peladarinos, V. Cheimaras, P. Papageorgas, D. D. Piromalis, and R. A. Munteanu, "Overview of protocols and standards for wireless sensor networks in critical infrastructures," Future Internet, Vol. 16, no. 1, p. 33, 2024.

[41] P. C. Paul, "A risk management framework for data security and privacy of wireless body area network-based healthcare applications," Ph.D. Dissertation, Dundalk Institute of Technology, 2024.

[42] M. Mrabet and M. Sliti, "Climate change mitigation and adaptation through optical-wireless communication networks: applications, challenges, and opportunities," Frontiers in Climate, vol. 6, p. 1480190, 2024.

[43] S. Ullah, J. Li, J. Chen, I. ALI, S. Khan, A. Ahad, F. Ullah, and V. Leung,"A survey on emerging trends and applications of 5g and 6g to healthcare environments," ACM Computing Surveys, 2024.

[44] S. Kharche and J. Kharche, "6g intelligent healthcare framework: A review on role of technologies, challenges and future directions." Mobile Multimedia, vol. 19, no. 3, pp. 603–644, 2023.

[45] L. Mucchi, S. Jayousi, S. Caputo, E. Paoletti, P. Zoppi, S. Geli,and P. Dioniso, "How 6g technology can change the future wireless healthcare," in 2020 2nd 6G wireless summit (6G SUMMIT). IEEE, 2020, pp. 1–6.

[46] I. F. Akyildiz, A. Kak, and S. Nie, "6g and beyond: The future of wireless communications systems," IEEE access, vol. 8, pp. 133 995–134 030, 2020.

[47] A. Ahad, Z. Jiangbina, M. Tahir, I. Shayea, M. A. Sheikh, and F. Rasheed, "6g and intelligent healthcare: Taxonomy, technologies, open issues and future research directions," Internet of Things, p. 101068, 2024.

[48] R. Satheeshkumar, K. Saini, A. Daniel, and M. Khari, "5g—communication in healthcare applications," in Advances in Computers. Elsevier, 2022, vol. 127, pp. 485–506.

[49] K. Hoque, M. B. Hossain, A. Sami, D. Das, A. Kadir, M. A. Rahman et al., "Technological trends in 5g networks for iot-enabled smart healthcare: A review," International Journal of Science and Research Archive, vol. 12, no. 2, pp. 1399–1410, 2024.

[50] A. Ahad, M. Tahir, and K.-L. A. Yau, "5g-based smart healthcare network: architecture, taxonomy, challenges and future research directions," IEEE access, vol. 7, pp. 100 747–100 762, 2019.

[51] L. K. Sagar, D. Goel, S. Gupta, M. Saraswat, and A. Sharma, "A comprehensive analysis of 5g communication and its health care management models," in 2024 2nd International Conference on Disruptive Technologies (ICDT). IEEE, 2024, pp. 1241–1246.

[52] D. H. Devi, K. Duraisamy, A. Armghan, M. Alsharari, K. Aliqab, V. Sorathiya, S. Das, and N. Rashid, "5g technology in healthcare and wearable devices: A review," Sensors, vol. 23, no. 5, p. 2519, 2023.

[53] M. Nuriev, A. Kalyashina, Y. Smirnov, G. Gumerova, and G. Gadzhieva, "The 5g revolution transforming connectivity and powering innovations," in E3S Web of Conferences, vol. 515. EDP Sciences, 2024, p. 04008.

[54] V. Ponnusamy, A. Vasuki, J. C. Clement, and P. Eswaran, "Ai-driven information and communication technologies, services, and applications for next-generation healthcare system," Smart Systems for Industrial Applications, pp. 1–32, 2022.

[55] R. Kanthavel, K. Anathajothi, S. Balamurugan, and R. K. Ganesh, Artificial Intelligent Techniques for Wireless Communication and Networking. John Wiley & Sons, 2022.

[56] M. Alshamrani, "Iot and artificial intelligence implementations for remote healthcare monitoring systems: A survey," Journal of King Saud University-Computer and Information Sciences, vol. 34, no. 8, pp. 4687–4701, 2022.

[57] B. A. Salau, A. Rawal, and D. B. Rawat, "Recent advances in artificial intelligence for wireless internet of things and cyber–physical systems: A comprehensive survey," IEEE Internet of Things Journal, vol. 9, no. 15, pp. 12 916–12 930, 2022.

[58] M. Nasr, M. M. Islam, S. Shehata, F. Karray, and Y. Quintana, "Smart healthcare in the age of ai: recent advances, challenges, and future prospects," IEEE Access, vol. 9, pp. 145 248–145 270, 2021.

[59] V. Lakshminarayanan, A. Ravikumar, H. Sriraman, S. Alla, and V. K. Chattu, "Health care equity through intelligent edge computing and augmented reality/virtual reality: a systematic review," Journal of Mul- ti disciplinary Healthcare, pp. 2839–2859, 2023.

[60] D. S. Nayak and R. Shivarudraswamy, "A review on augmented reality and virtual reality technologies in the field of healthcare," Smart Hospitals: 5G, 6G and Moving Beyond Connectivity, pp. 45–60, 2024.

[61] M. Venkatesan, H. Mohan, J. R. Ryan, C. M. Schurch, G. P. Nolan, D. H. Frakes, and A. F. Coskun, "Virtual and augmented reality for biomedical applications," Cell reports medicine, vol. 2, no. 7, 2021.

[62] M. B. Janjua, A. E. Duranay, and H. Arslan, "Role of wireless communication in healthcare system to cater disaster situations under 6g vision," Frontiers in Communications and Networks, vol. 1, p. 610879,2020.

[63] R. R. Bruno, G. Wolff, B. Wernly, M. Masyuk, K. Piayda, S. Leaver, R. Erkens, D. Oehler, S. Afzal, H. Heidari et al., "Virtual and augmented reality in critical care medicine: the patient's, clinician's, and researcher's perspective," Critical Care, vol. 26, no. 1, p. 326, 2022.

[64] A. Hazarika and M. Rahmati, "Towards an evolved immersive experience: Exploring 5g-and beyond-enabled ultra-low-latency communications for augmented and virtual reality," Sensors, vol. 23, no. 7, p. 3682, 2023.

[65] A. Gasmi and R. Benlamri, "Augmented reality, virtual reality and new age technologies demand escalates amid covid-19," in Novel AI and data science advancements for sustainability in the era of COVID-19. Elsevier, 2022, pp. 89–111.