

# A Comprehensive Review on the Impact of 5G Technology and its Application in Healthcare

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**Abstract—** This review highlights the importance of 5G technology in redefining connectivity as it examines the revolutionary effects of the technology on healthcare. With an emphasis on fast data rates, low latency, and broad device connection, it goes over the foundations of 5G, highlighting its salient characteristics and contrasting them with those of previous generations. The study looks at particular uses in the field of healthcare, such as telemedicine, remote patient monitoring, and the fusion of IoT applications with medical sensors. In addition to boosting data transmission efficiency and analytics for healthcare insights, it looks at how 5G might improve virtual and augmented reality applications in the field of medicine. With the use of case studies, the assessment also covers collaborative healthcare platforms and enhanced professional communication made possible by 5G. An overview of the revolutionary impact of 5G in healthcare is provided in brief, including security and privacy concerns in 5G-enabled systems, future advances, and regulatory and ethical implications discussed in the conclusion.

## I. INTRODUCTION

5G stands for fifth generation wireless communication, which is a paradigm shift in mobile network capabilities. With a maximum transmission rate of gigabits per second (Gbps), 5G is intended to offer noticeably faster data rates than its predecessors. Important characteristics like ultra-low latency, spectrum efficiency, and low energy consumption go hand in hand with this speed increase. 5G's architecture integrates novel technologies such as edge computing, software-defined networks (SDN), network function virtualization (NFV), small cells (e.g., femto, pico, and micro), millimeter waves (mmWaves), and device-to-device (D2D) communication. When combined, these technologies help overcome obstacles like ultra-densification of networks and high energy consumption resulting from Internet of Things (IoT) applications. 5G technology's key features include its support for a variety of communication technologies, both short- and wide-range (e.g., Wi-Fi, Bluetooth), which enables 5G to transport data effectively in the context of smart healthcare applications. 5G's architecture for smart healthcare solutions includes small cells, D2D communication, mmWaves, SDN, NFV, and edge computing. This combination of technologies

positions 5G as a catalyst for advanced applications in healthcare, enabling real-time patient monitoring, remote medical assistance, and continuous health monitoring. Hence, 5G's introduction is more than just a generational upgrade; rather, it's a technological leap with immense potential to revolutionize how connectivity is used across many sectors.

The revolutionary potential of 5G to meet the changing needs of contemporary society—particularly in the area of smart hospitals and healthcare—makes it significant for redefining connections. With the arrival of 5G, traditional connectivity constraints will no longer apply, and a new age marked by ultra-low latency, high bandwidth, ultra-high dependability, high density, and energy efficiency will begin. Together, these characteristics position 5G as a critical facilitator for the upcoming wave of intelligent healthcare applications. 5G is expected to be crucial in enabling remote health monitoring, enhancing network coverage, and facilitating improved access to remote locations in the context of smart hospitals. Beyond just providing basic connections, 5G is ready to handle the complex needs of healthcare applications. In order to support real-time health monitoring and diagnostic applications, solid, low-latency connections must be maintained, patient data privacy must be guaranteed, and secured networks are an absolute must. Moreover, 5G is more than just a technical advancement; it is a paradigm change that makes it possible to incorporate cutting-edge technologies into healthcare. Its use is anticipated to improve smart healthcare systems' overall effectiveness and performance. 5G stands out as a revolutionary force that will change how connectivity intersects with healthcare, delivering never-before-seen prospects for innovation and better patient outcomes. This is especially true as the need for seamless connectivity and advanced healthcare services continues to rise [1]-[2].

There is a noticeable transition in the healthcare landscape from a traditional hospital-centric style of treatment to a distributed patient-centric approach. The development of tailored and remote healthcare services made possible by developments in communication technologies has a huge impact on this revolutionary journey. The current dependence on 4G networks and communication technology has been crucial in enabling applications for smart healthcare. However, these technologies are facing difficulties with bandwidth, data rates, and latency as the healthcare industry

tries to satisfy the demands of intelligent healthcare applications. The growing smart healthcare market necessitates more complex communication requirements for a wide range of machinery and gadgets in hospitals that use sensors. To support the growing number of applications connecting to the network, the idea of Massive-Machine Type Communication becomes essential. Furthermore, certain use cases such as Tactile Internet and remote surgeries require Ultra Reliability and Low Latency Communications, which are difficult for current communication technologies to meet. The stage is set for the future inclusion of 5G as a solution in this growing landscape. The integration of 5G and Internet of Things (IoT) devices is anticipated to create a synergistic future for smart healthcare networks. It is projected that this integration will improve network performance, boost cellular coverage, and resolve security-related issues. This represents a significant change in healthcare delivery toward more sophisticated, individualized, and effective healthcare services. As a result, the rollout of 5G in the healthcare industry serves as both a stimulus for a thorough reimagining of healthcare connectivity and services and a response to the industry's changing technical needs [3]-[4].

## II. FUNDAMENTALS OF 5G TECHNOLOGY

To allow high-quality patient services, advanced healthcare practices look for appropriate and connected network facilities. The various facets and key components of 5G technology for medical practices are examined in Fig. 1. The 5G scenario for healthcare practices is supported by a number of characteristics and technologies, including patient data support, virtual and augmented reality, rapid and accurate connected trends, wireless communications, and remote surveillance and tracking. 5G technology further enhances the effectiveness and impact of healthcare operations [5].

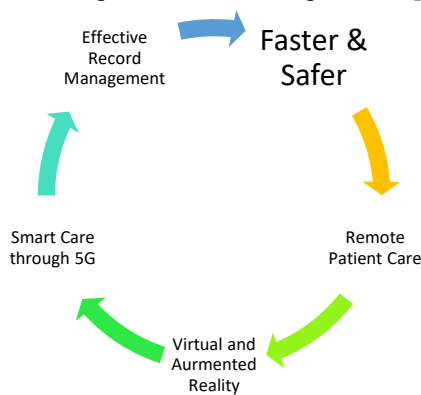


Fig. 1. Features of 5G in healthcare

Using the fastest network available, 5G enables medical providers to provide therapy in real-time to patients who are chronically ill. Reliable, always-on mobile personal emergency response devices help patients with chronic conditions maintain autonomy and improve outcomes. As technology develops, people will have access to more medical gadgets that will let them test and track their health from the comfort of their homes. This medical technology gathers, verifies, and calibrates data from reliable sensors. A variety

of medical and healthcare specialists can then receive this data for study. Clinicians can provide patients with a personalized treatment plan by integrating many Internet of Medical Things (IoMT) devices and sensors to get a complete picture of their health [6]-[7].

The healthcare sector is still adaptable enough to take full advantage of the wave of cutting-edge applications that 5G networks are offering. For hundreds of years, the primary means of interaction between doctors and patients has been at medical offices, hospitals, homes, and care facilities. But today's faster 5G networks and advances in medical technology are changing the face of healthcare. The most noticeable advancement has been the creation of wearable medical devices to track vital signs. In order to treat patients safely and protect the safety of medical staff, health facilities are increasingly implementing telehealth technologies. The conclusion is that the telemedicine market is growing quickly worldwide. Manufacturers of medical devices are rushing to keep up with demand [8].

Significant improvements in latency reduction, network efficiency, and data transfer capacities may be seen in the progression of mobile networks from 3G to 5G. 3G first brought video, audio, and graphics apps to users, making things like video streaming and phone calls possible. But problems like network bottlenecks restricted its possibilities. A 3G service called Universal Mobile Telecommunications Systems (UMTS) standardized worldwide data transmission standards and offered up to 2 Mbps in ideal circumstances. With the transition to 4G, data transmission rates shot up to roughly 20 Mbps, highlighting the importance of quality of service and enabling high-speed streaming of multimedia material. Moreover, 4G supported devices traveling at fast speeds within a network area and improved video conferencing [9].

A revolutionary step forward, the fifth-generation (5G) mobile network is intended to enable a hundred-fold increase in network efficiency and traffic capacity. 5G provides real-time access with rates of up to 15-20 Gbps with much lower latency (down to 1 millisecond). As a result, it has become a universal wireless standard that supports a wide range of applications, such as vast Internet of Things (IoT) deployments and mission-critical communications. 5G's scalability feature makes it possible to connect multiple devices at once, which speeds up data flow. 5G networks, in contrast to 4G, use tiny cells, which use less power and enable quicker installation. This gets around bandwidth restrictions that were present in earlier generations [9],[10].

5G is regarded as a game-changer since it will allow IoT applications in smart homes, cars, cities, and other intelligent systems, opening up new opportunities for the mobile ecosystem. 5G's extraordinary speed, dependability, and minuscule latency offer opportunities for e-healthcare systems as well as many other businesses. It has a significant impact on the placement of sensors in smart cities, covering a large area and making safer transportation, remote healthcare, precision agriculture, digitalized logistics, and other features possible. In conclusion, the transition from 3G to 5G

represents not only small adjustments but a fundamental change in the capabilities of mobile networks, enabling a broad range of services and applications in various industries [9],[11].

The shift in mobile networks from 3G to 5G highlights how important it is to have fast data speeds, minimal latency, and a large number of connected devices. Video, music, and graphic applications were first made possible by 3G, however, it was limited by issues like network bottlenecks. Building on this, 4G enhanced video conferencing while preserving a focus on quality of service, with a data transmission rate of roughly 20 Mbps. The real revolution, however, will come with 5G, which is intended to enable data rates as high as 15-20 Gbps, guaranteeing a massive boost in network efficiency and traffic capacity [9]. 5G's notable feature is its drastically reduced latency, which is now only 1 millisecond. This supports the enormous Internet of Things (IoT) and allows for instantaneous, real-time access as well as mission-critical communications. The key component of 5G is its scalability, which enables multiple devices to connect at once. 5G networks, in contrast to its predecessors, use tiny cells, which allow for quicker installations and lower power consumption. This invention ensures continued efficiency as system use increases up by addressing bandwidth limits observed in previous generations [9]-[10].

5G will have a transformative effect on many different businesses. Its remarkable speed, dependability, and low latency create new opportunities in smart homes, cars, cities, and electronic healthcare (e-healthcare). This also applies to data sharing that is quicker and more dependable, enabling new services and deployment patterns. The potential of 5G to link almost everyone and everything is a prime example of how revolutionary it is; it makes it possible for a wide range of applications, from the Internet of Things to immersive multimedia experiences, to operate seamlessly. The transition to 5G represents, all things considered, a paradigm change, whereby the emphasis on large data rates, minimal latency, and widespread device connectivity redefines the possibilities and capacities of mobile networks [9]-[11].

### III. APPLICATIONS OF 5G IN HEALTHCARE

A 5G network is an important component because of its incredible speed and capacity. By allowing cordless live streaming and providing 360-degree video, this technology improves the watching experience. Having a wealth of experience during their schooling and while treating or operating on patients is beneficial for medical professionals. IoT devices can be used by medical professionals to keep an eye on their patients and gather data that will help to make healthcare more individualized and preventative than it has ever been. A real-time remote health monitoring system can help manage chronic conditions and reduce healthcare expenses [5].

TABLE I  
APPLICATIONS OF 5G IN HEALTHCARE

S.No	Application	Description
1	Digital advancement	Because of its faster data download speeds, lower latency, and more stable connections, 5G can lead to a number of advancements, including digital transformation in all sectors of the economy, including healthcare. By facilitating the interplay of health sensors, algorithms, and smart devices and more effectively and economically supporting remote monitoring, 5G technology can lay the groundwork for innovation. Hospital management systems can be enabled by 5G technology, which can allow a number of applications such as virtual reality and remote surgery. 5G-connected diagnostics equipment is used to thoroughly examine patients using real-time information. As a result, there is less physical contact, which lowers the risk of coronavirus transmission and frees up medical professionals to treat more patients.
2	Transfer of data	Data files are sent between physicians and hospitals more quickly over a 5G network, saving time compared to traditional wired networks that are usually underpowered. In light of the fact that physicians may now send and receive medical data more quickly than ever before, both at work and at home, 5G suggests that diagnoses, opinions, treatment plans, and adjustments will happen more quickly. The move to 5G offers a long-term solution to the continuously rising bandwidth need. With 5G-enabled wearable technology, medical practitioners can remotely monitor patients and gather real-time data for preventative care and other specially designed healthcare solutions.
3	virtual monitoring of patients	5G will improve surgical operations, remote patient monitoring, and home healthcare. The handling of emergencies in smart cities will be enhanced by this technology. Teams will be able to respond more quickly and treat patients more effectively thanks to the near real-time availability of vital information. Accuracy will increase with a greater role for robots, artificial intelligence, and machine learning. 5G has the potential to accelerate the digital transformation of the healthcare sector while mitigating its problems. Patients with chronic illnesses who have undergone multiple medical examinations in the past and find it challenging to travel thousands of miles to see a doctor benefit from it.
4	massive transfers of healthcare imaging files	Enabling a 5G network to supplement a current healthcare infrastructure can help ensure that large medical imaging files are transferred reliably and quickly.

S.No	Application	Description
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			8	Provide rapid delivery	<p>Beyond their physical borders, 5G can provide life-saving, high-speed services to healthcare practitioners. Among them are data benefits like the ability to communicate big digital diagnostic files, like MRI results. With faster tests and diagnostic results, telemedicine, remote monitoring and surgery, robotics, and other applications, 5G is expected to transform the way healthcare professionals interact with each other and their patients. The new 5G wireless network is mostly cloud-based. 5G can be used by healthcare institutions to enable mobile networks to do telemedicine consultations, greatly increasing the reach of these initiatives. It also enables more productive and efficient work from doctors and other staff members.</p>
5	Telemedicine	<p>When chronically ill patients are unable to leave their homes to see their doctors, telehealth provides them with essential medical care. Applications related to telehealth are growing significantly as 5G provides extremely fast bandwidth with lower latency. Year after year, the healthcare industry's network footprint grows, suggesting that more and more healthcare applications and services depend on fast network speeds. 5G technology helps turn outdated hospital healthcare systems into smart hospitals that can offer patients all around the world remote medical care.</p>	9	Support healthcare equipment	<p>5G will work with a range of medical gadgets, including as smart watches, smart scales, smartphones, and other measuring tools. Implanted in our clothing and accessories, biosensors and trackers will provide insightful data and notify us of any changes in health before they become apparent. More bandwidth, lower latency, and the ability to integrate cloud and network-connected devices are all provided by 5G telecommunications. Because of this, the Internet of Things (IoT) will link increasingly intricate networks, while other systems—like driverless cars, robotic surgery, and crucial infrastructure monitoring—need massive amounts of data flow.</p>
6	Enhance performance	<p>Because 5G technologies offer more bandwidth than 4G technologies, large-scale device communication networks and faster Internet connections are possible. More responsiveness is provided by 5G technology, which enables multiple network-connected devices to be reached. Therefore, it is anticipated that 5G would propel the Internet of Things, enabling the construction of complex networks of intelligent medical devices by the healthcare industry. As a result, 5G is a faster network that enables more effective device connectivity and faster data transfers. 5G technology can compute data swiftly and maintain connectivity. This opens up new medical options, such as utilizing cutting-edge technologies and artificial intelligence to make decisions in real time and enhance patient care.</p>	10	remote medical procedures	<p>Additionally, 5G establishes the foundation for advanced uses like doctors doing remote surgery via robotic arms connected by communications networks. In addition, these apps can open up new revenue sources for operators, who are essential in enabling this creative use of modern network technology. Without a doubt, 5G technology will be extensively used in healthcare. Medical care will be more affordable in hospitals and private clinics because of this technology.</p>
7	Procedure for security	<p>Businesses need to prepare to modify their security procedures in order to protect sensitive data while deploying 5G, whether in the healthcare industry or not. 5G is expected to be a major technological development accelerator in the near future. One sector that has been waiting for 5G to start delivering the benefits it is supposed to is healthcare. 5G makes it possible to establish connections that serve the data transmission needs of medical practitioners. Thus, telecom software solutions for the healthcare industry will soon emerge as a desirable growing sector with the potential to actualize</p>	11	Make public safety possible	<p>Public safety organizations will be able to develop realistic crisis scenarios for training and testing thanks to 5G-enabled technologies. The implementation of 5G gives businesses and IT professionals even more amazing choices to strengthen security and combat cyberattacks. Access to 5G wireless technology has expanded. It provides lower latency, more bandwidth and data rates, and the possibility to make IoT useful for a large number of devices. Significant improvements in patient care, outcomes, and experiences are implied by 5G. Consumers monitor their blood pressure, glucose levels,</p>

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They may instantly get the information they need in real-time and provide the right care for their patients. Fast data communication between patients and the 5G network will be possible. In the end, this enables patients to make better use of patient portals, view test results and images, get access to remote treatment and get details about their care plans. 5G will help with this shift to remote care by offering more stable connectivity for the transfer of patient data. This will facilitate remote, data-driven healthcare decision-making for medical professionals [12]-[14].

The introduction of 5G has accelerated the adoption of numerous cutting-edge technologies that demand greater network capacity and result in groundbreaking new medical advancements. In addition to handling a lot of patient data, healthcare professionals also handle sensitive data that needs to be stored securely. In addition to protecting mission-critical communications, 5G will completely transform how devices and networks interact, allowing physicians to deliver medical care remotely. Using 5G technology will have a big impact on the patient experience. The introduction of 5G technology will improve telemedicine and remote monitoring capabilities. There will be major benefits to preventative care from 5G. Thanks to 5G's speed, doctors can send files to experts much more quickly. After that, they might use AI technology to assist them in diagnosing patients using only pictures [14]-[17].

5G will bring benefits and drawbacks in terms of network and data security as the number of connected devices and networks rises. Healthcare organizations need to evaluate the risks and weaknesses related to patient health data availability and access. From finding a hospital room for an arriving patient to moving patients between rooms and diagnostic treatment areas to keeping an eye on a heart monitor, technology is at the heart of both inpatient and outpatient monitoring and tracking. All of that data will be exponentially accelerated by the emergence of 5G, which will also provide completely new communication channels both within and outside of hospitals. It will redefine the way medical professionals communicate with patients and exchange important information [5],[17].

#### IV. SECURITY AND PRIVACY CONCERNS

Every person has the right to privacy, which is safeguarded and improved by a complicated regulatory framework that is always evolving. On the other hand, security in the virtual environment establishes guidelines and measures to protect information and the integrity of the system by ensuring safe access to data and preventing information from being shared

or altered. The upcoming mobile generation, or 5G, is anticipated to offer a plethora of cutting-edge capabilities and an improved user experience. But because they add value to society by combining vertical businesses like e-health, smart grids, banking, manufacturing, and transportation, adequate data and user privacy protection techniques are crucial [18].

Aspects of 5G security are crucial for future wireless networks' robustness and dependability. Current mobile networks' four main security features are secrecy, availability, integrity, and authentication. Numerous hazards present in today's 2G, 3G, and 4G networks have been addressed by the security safeguards created for 5G. It is crucial to consider privacy from the standpoint of the architect, taking into account concepts like observability, unlinkability, anonymity, and pseudonymity, since 5G will bring new and important applications. These restrictions include additional security protocols, improved subscriber identity safety, and new verification tools. The 5G cellular system aims to offer an enhanced security approach in contrast to the security methods of current cellular networks, which are based on protecting end-user privacy and fundamental connectivity. To address the issues of accounting, authorization, and authentication for diverse computer networks, it is deployed throughout the whole network [19]-[20].

For IoT applications, security and privacy are important design considerations in a number of ways. In practical terms, "Secure by Design" refers to a contemporary government initiative that uses mutual verification, an assumed open network, and an admission that all connections could be compromised in order to guarantee a robust and wide-ranging IoT ecosystem for customers. Additionally, 5G offers a multi-layered network architecture that necessitates the implementation of security services at the application, transport, and network layers. Two of the most important elements in safeguarding any Internet of Things network are the device identification process and the deployment procedure. MTC devices could not be able to activate the security features that are now in place on the internet because of their limited processing power caused by resource constraints. However, the unparalleled connectivity and quick speeds of 5G bring with them new threats and challenges. This area of consideration includes data security, user privacy, network infrastructure security, and cyberattack resistance. Robust encryption techniques, secure authentication processes, and effective intrusion detection systems are the most crucial safeguards for confidential data and valuable resources on a network. Furthermore, as IoT devices proliferate on 5G networks, it gets harder to ensure the security of such a large and diverse array of networked devices. Close collaboration between industry players, standardization organizations, and regulatory bodies is necessary to establish best practices and frameworks that can adjust to the changing threat landscape and ensure that 5G networks are secure by design. To build a dependable and robust 5G ecosystem that can deliver on the promises of the upcoming generation of connectivity without jeopardizing users' security and privacy, it is imperative that these fundamental concerns are resolved [18].

User data, individual rights, and communication confidentiality in a linked world are all aspects of privacy in 5G networks. Privacy will be crucial since 5G networks will drive a significant evolution in daily activities and access modalities to digital services. Moreover, unlike previous mobile networks, 5G introduces new structural and service-oriented requirements and necessitates stringent privacy standards and regulations. 5G privacy will be critical for entire ecosystems, including users and other stakeholders. Thus, 5G privacy issues need to be addressed in-depth if universal adoption and acceptance are to be attained. The three main facets of user privacy in a 5G network are identity, data, and location [21]-[22].

5G technology could offer users customized network services by examining the characteristics of particular services. Because of this, different services in the 5G network may have different privacy rules. 5G technology will, however, make service-oriented privacy standards feasible. For instance, certain healthcare applications will require a higher level of privacy due to the users' health information. In relation to the development of upcoming wireless technologies, "location-based services" (LBS) are widely utilized. In such cases, the introduction of 5G will enable smooth and continuous service availability by actively monitoring users' positions. Additionally, this kind of tracking service helps companies create new, user-friendly services and enhance their current ones. But it gives users serious privacy problems [23]

A 5G private network's ability to operate smoothly and effectively depends on a number of variables, including data competency, the capacity to quickly and cheaply explore and iterate, and the availability of complementary assets and knowledge. Even customers with strict security needs can operate their secondary authentication algorithms, protocols, and industry-specific features thanks to the 5G network's flexibility. To avoid privacy threats and hurdles, any business operating in a 5G environment should create a processor and encourage its legal departments to conduct a transfer impact analysis among the available policy options. A hybrid solution that stores less sensitive data in the cloud and private or confidential data locally, close to, and inside a person's national borders (edge cloud) could be a good substitute. Achieving a balance between the transformative potential of 5G technology and the protection of individual privacy rights in the digital age will require industry, regulatory bodies, and technology developers to closely monitor the evolution of 5G networks in a way that upholds and safeguards personal privacy [24]-[25].

## V. CHALLENGES AND FUTURE DIRECTIONS

The main disadvantage of 5G is its spotty global coverage and limited local availability. The 5G network will only have a major impact on urban areas; coverage in rural areas may not extend for several years. Furthermore, compared to other networks, the installation expenses of tower stations are high. Due to the high expense of testing, trialing, and building 5G towers, the introduction and implementation of 5G will take years. 5G will not have the same range as 4G, while operating

at high speeds and with rapidity. Large buildings and trees may also block the 5G network's frequency, which will result in a number of problems. This means that adding more towers to provide coverage takes longer and costs more money. Rain can also cause 5G coverage to be disrupted, therefore extra protection is needed. 5G technology is expected to have a slower upload speed than 4G and 4G LTE, although having the potential for faster download rates [5].

The fact that 5G technology shortens the lifespan and drains the batteries of cellular devices is another disadvantage. The phone's 5G connectivity will result in a large power drain and shorter battery life. It follows that manufacturers need to make investments in cutting-edge battery technology to protect the battery from damage and other problems. The fact that 5G technology increases cybersecurity susceptibility to attacks is another drawback. However, 5G-enabled gadgets are also more vulnerable to cyberattacks and data theft because there is no encryption in place when the device is connected. Since there will be hacking, cybersecurity is one of the problems with 5G. The database can be easily stolen by thieves thanks to the increase in bandwidth. Also, it is vulnerable to attacks due to the software it uses. As 5G links to more devices, attacks are likely to occur. The lack of encryption in 5G would allow hackers to plan their attacks more efficiently, which would be extremely detrimental to enterprises [26]-[29]

In the future, 5G technology will enable high-quality healthcare remotely while reducing patient exposure by doing away with the need for in-person doctor and hospital visits. Patients who are unable to see their doctors in person will be able to communicate with them through 5G telepresence gadgets that feel natural. As a result, a wireless network can provide patients who are bedridden or chronically sick with essential medical treatments. 5G has the ability to dramatically change the Healthcare IT infrastructure. 5G technology will become more practical and bring about a digital transformation in the medical field. In order to remove any obstacles and prepare for a 5G future, healthcare companies need to evaluate their equipment and infrastructure. This technology has the potential to completely change home health care and patient empowerment.

With the help of 5G networks, businesses will be able to track customer behavior, tailor marketing strategies, enhance service quality and delivery, boost operational effectiveness, empower staff members with easily connected devices and accessibility, and ultimately use predictive analytics and better decision-making to ensure a sustainable and prosperous future. Physicians and other medical professionals will be able to accomplish more with 5G technology, increasing the effectiveness of their work and opening up new avenues for their careers. 5G in healthcare will only be successful with the use of AI and machine learning. The network will soon be inundated with enormous amounts of data from wearables, imaging files, electronic health records, and the soon-to-be massively integrated healthcare paradigm. In an emergency, 5G will enhance the control and management of unmanned aerial vehicles (UAVs) and drones operating beyond visual lines of sight, enabling public safety officials to react more quickly and gather more situational information.



## VI. CONCLUSION

Conclusively, this thorough analysis has examined the revolutionary effects of 5G technology on the healthcare industry, emphasizing its importance in transforming connectivity and satisfying the changing technical requirements of the healthcare sector. High data speeds, low latency, and widespread device connectivity have been highlighted as the three main characteristics of 5G, which have also been compared to those of earlier generations (4G and 3G) through an examination of the technology's architecture and essential elements. There are numerous and innovative uses for 5G in the medical field. With continuous health monitoring via wearables and real-time video chats, telemedicine and remote patient monitoring have reached new heights. A paradigm shift in patient care is promised by the integration of linked medical devices, which is fueled by IoT applications and technologies like medical sensors and smart implants. Virtual reality (VR) and augmented reality (AR) have shown promise in improving surgical techniques and transforming medical education and training. Better healthcare insights are also derived from the efficient use of 5G for data transfer as well as the big data and analytics analysis of massive datasets. Although this evaluation acknowledges the transformational potential, it also tackles important privacy and security issues related to 5G-enabled healthcare. The conversation emphasizes how crucial it is to take strong action in order to handle security issues and guarantee patient data privacy inside the networked healthcare environment.

The assessment highlights possible future developments and improvements while acknowledging the difficulties that exist in deploying 5G in the healthcare industry. The deeper 5G technology integration into healthcare procedures, the more important it is to take regulatory and ethical considerations into account.

## REFERENCES

- [1] Arun Kumar, "Future 5G Network Based Smart Hospitals: Hybrid Detection Technique for Latency Improvement" IEEE Access.
- [2] M. H. Alsharif, A. H. Kelechi, M. A. Albream, S. A. Chaudhry, M. S. Zia, and S. Kim, "Sixth generation (6G) wireless networks: Vision, research activities, challenges, and potential solutions," *Symmetry*, vol. 12, no. 4, p. 676, Apr. 2020.
- [3] D. Li, "5G and intelligence medicine—How the next generation of wireless technology will reconstruct healthcare," *Precis. Clin. Med.*, vol. 2, no. 4, pp. 205–208, Dec. 2019, doi: 10.1093/pcmedi/pbz020.
- [4] ABDUL AHAD, "5G-Based Smart Healthcare Network: Architecture, Taxonomy, Challenges, and Future Research Directions", IEEE Access.
- [5] Mohd\_Javaid, "5G Technology for Healthcare: Features, serviceable pillars, and applications, June 2023
- [6] A. Gupta, Y. Hasija, "Next generation 5G wireless technologies in healthcare", *ICT with Intelligent Applications*, Springer, Singapore (2022), pp. 393-402
- [7] A. Ahad, M. Tahir, M.A. Sheikh, K.I. Ahmed, A. Mughees "An intelligent clustering-based routing protocol (CRP-GR) for 5G-based smart healthcare using game theory and reinforcement learning" *Appl Sci*, 11 (21) (2021), p. 9993
- [8] E. Kapassa, M., "An innovative eHealth system powered by 5G network slicing" 2019 Sixth International Conference on Internet Of Things: Systems, Management, And Security (IOTSMS), IEEE (2019, October), pp. 7-12
- [9] Godfred Yaw Koi-Akrofi, "Telecommunications Wireless Generations: Overview, Technological Differences, Evolutional Triggers, and the Future", February 2023.
- [10] C. Ziegler, "Android: A visual history".
- [11] S. C. Yang, "Mobile applications and 4G wireless networks: a framework for analysis".
- [12] G. Li, W. Lian, H. Qu, Z. Li, Q. Zhou, J. Tian, "Improving patient care through the development of a 5G-powered smart hospital", *Nat Med*, 27 (6) (2021), pp. 936-937
- [13] A. Franchi, L. Franchi, T. Franchi, "Digital health, big data and connectivity: 5G and beyond for patient-centered care", *Int J Dent Hyg*, 1 (1) (2021)
- [14] S. Tiwari, N. Sharma, "Idea, architecture and applications of 5G enabled IoMT systems for smart health care system", *SPAST Abstracts*, 1 (1) (2021)
- [15] A.M. Ashleibta, A. Taha, M.A. Khan, *et al* "5g-enabled contactless multi-user presence and activity detection for independent assisted living", *Sci Rep*, 11 (1) (2021), pp. 1-15
- [16] I. Taboada, H. Shee, "Understanding 5G technology for future supply chain management", *Int J Logist Res Appl*, 24 (4) (2021), pp. 392-406
- [17] B. Dzogovic, B. Santos, N. Jacot, B. Feng, T. Van Do, "Secure Healthcare: 5G-enabled network slicing for elderly care", 2020 5th International Conference on Computer And Communication Systems (ICCCS), IEEE (2020, May), pp. 864-868
- [18] Shams Forruque Ahmed, "Toward a Secure 5G-Enabled Internet of Things: A Survey on Requirements, Privacy, Security, Challenges, and Opportunities", *IEEE Access*
- [19] N. A. Anagnostopoulos, S. Ahmad, T. Arul, D. Steinmetz, M. Hollick and S. Katzenbeisser, "Low-cost security for next-generation IoT networks", *ACM Trans. Internet Technol.*, vol. 20, no. 3, pp. 1-31, Aug. 2020.
- [20] X. Ge, R. Zhou and Q. Li, "5G NFV-based tactile internet for mission-critical IoT services", *IEEE Internet Things J.*, vol. 7, no. 7, pp. 6150-6163, Jul. 2020.
- [21] M. Liyanage, J. Salo, A. Braeken, T. Kumar, S. Seneviratne and M. Ylianttila, "5G privacy: Scenarios and solutions", *Proc. IEEE 5G World Forum (5GWF)*.
- [22] T. Kumar, M. Liyanage, I. Ahmad, A. Braeken and M. Ylianttila, "User privacy identity and trust in 5G" in *A Comprehensive Guide to 5G Security*, Hoboken, NJ, USA: Wiley, pp. 267-279.
- [23] 5G and Data Privacy: An Overview for Policymakers, London, U.K., 2020.
- [24] T. W. Nowak, M. Sepczuk, Z. Kotulski, W. Niewolski, R. Artych, K. Bocianiak, et al., "Verticals in 5G MEC-use cases and security challenges", *IEEE Access*, vol. 9, pp. 87251-87298, 2021.
- [25] P. Camps-Aragó, S. Delaere and P. Ballon, "5G business models: Evolving mobile network operator roles in new ecosystems", *Proc. CTTE-FITCE Smart Cities Inf. Commun. Technol. CTTE-FITCE*, pp. 1-6, Sep. 2019.
- [26] Outlook Business Team 5G Technology: What Are its Advantages and Disadvantages (2023) <https://www.outlookindia.com/business/5g-technology-what-are-its-advantages-and-disadvantages-news-214808>.
- [27] R. Mehta, Pros and Cons of 5G Technology (2021) <https://timesofindia.indiatimes.com/blogs/digital-mehta/pros-and-cons-of-5g-technology/>
- [28] M. Javaid, A. Haleem, S. Rab, R.P. Singh, R. Suman, S. Mohan Progressive schema of 5G for Industry 4.0: features, enablers, and services, *Ind Robot: Int J Robot Res Appl*, 49 (3) (2022), pp. 527-543
- [29] H.M. Ali, A.B. Bomgni, S.A.C. Bukhari, T. Hameed, J. Liu Power-Aware fog supported IoT network for healthcare infrastructure using swarm intelligence-based algorithms *Mobile Network Appl* (2023), pp. 1-15.