TATA ELXSI

5G in Healthcare

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ABSTRACT

The much-awaited fifth-generation of cellular wireless technology has the ability to revolutionize healthcare with its high speed and massive connection power. Along with its many primary advantages, it will also empower medical innovations via extended reality (augmented/virtual/mixed reality), artificial intelligence, remote medical learning, patient care, and monitoring, to name a few.

The healthcare domain's critical and time-sensitive nature makes it all the more essential to have continuous access to near real-time data to support and derive full use of the advanced technologies today. The applications of 5G in healthcare paint a promising picture of better and effective communications, efficient and quick transmission of large amounts of data for early diagnosis of life-threatening diseases, coupled with low latency and high computing power to enhance and accelerate the growth of diagnosis and therapy exponentially. Such applications of 5G technology would also be of great assistance when dealing with the unprecedented impact of the COVID-19 on healthcare systems worldwide.

INTRODUCTION

It is the beginning of the high-tech era in the healthcare technology sector. New-age technologies such as artificial intelligence, cloud computing, IoT, and big data have become a common topic of discussion amongst healthcare professionals to cater to patients with high-quality services while lowering the costs substantially.

One of the factors set to contribute majorly to patient value is the introduction of 5G in healthcare. 5G or fifth-generation cellular wireless technology would not only come with significantly increased bandwidth, it would also be incredibly responsive due to low latency. It can essentially deliver absolute digital connectivity as it would integrate and connect multiple devices connected to the network. This upcoming fifth-generation technology is going to have a significant impact on the healthcare industry.

Many technology companies in the healthcare sector, hospitals, and healthcare professionals are already experimenting with the potential 5G applications. One of the major challenges in the healthcare system today is the quick transmission of huge amounts of patient data such as images, videos, patient/device records, or simply the data recorded through wearable devices. It can be overwhelming for the currently available networks, e.g., 4G or 3G, to handle and transfer such large data sets. 5G, on the other hand, has the greater capacity to support the near-instantaneous transmission of huge amounts of data, and this could soon be a reality for the hospitals and healthcare providers that have the 5G network wired-up in their facilities.

Overview of 5G in Healthcare

What is 5G?

5G is the fifth-generation of wireless network technology. The central theme of 5G, just like the previous fourth-generation, is speed. Every new generation of wireless networks is significantly faster and more capable than the last. The first-generation of the cellular network, i.e., 1G, was focusing primarily on improving the voice quality on the phone; second-generation or 2G was launched to enhance the voice quality further and introduced the concept of sending and receiving text messages. 3G, in addition to improved call and texting experience, also brought the internet to our cell phones, and fourth-generation or 4G took data sharing to another level with significantly faster wireless internet connectivity. 5G represents another step forward with super-fast connectivity, ultra-low latency, and widespread coverage. The global 5G technology market is expected to reach $667.90 billion by 2026, with a CAGR of 122.3% from 2021 to 2026.

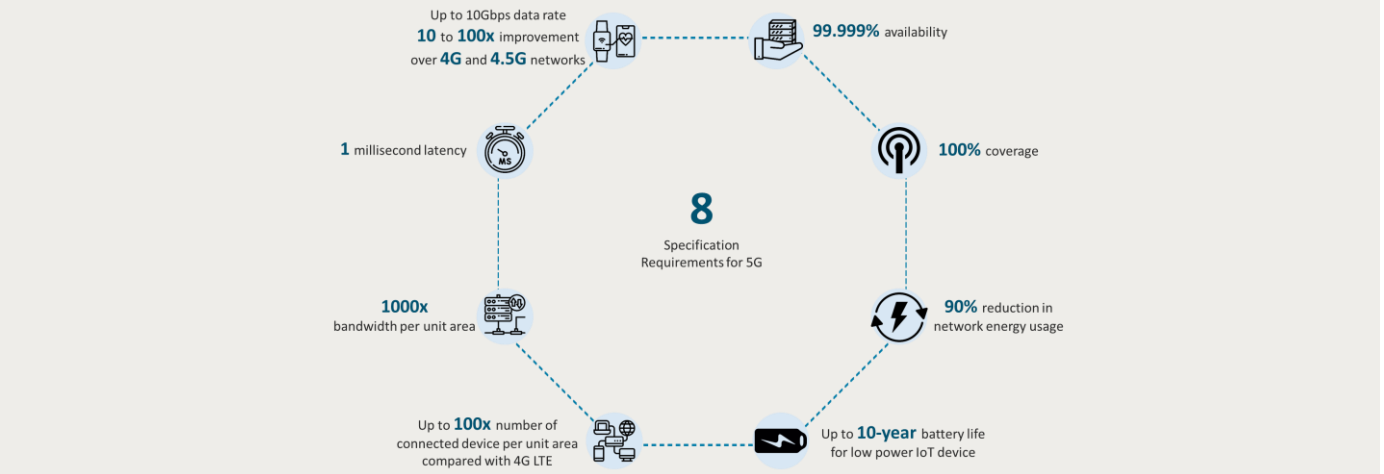


Figure 1: 5G Requirements

Relevance of 5G in Healthcare

Patient value (patient-relevant outcomes divided by costs per patient to achieve the results) has been continuously decreasing, giving rise to soaring costs of healthcare. Moreover, there is a growing concern regarding the imbalance of medical resources, inefficient healthcare system administration, and inconvenient medical experiences. To overcome these prevalent challenges, technologies such as IoT, cloud computing, big data, and artificial intelligence are being developed to improve the patient experience and healthcare service quality while cutting the total cost attributable to healthcare. For example, telehealth and remote patient monitoring ease up the communication delay between the care provider and the patient; however, problems like network congestion and slow internet speeds pose a serious problem, especially for the healthcare providers that might interact with dozens of patients every day. Moreover, the mass adoption of technology like IoT will add to the existing burden.

5G as technology is bound to have the most impact on the healthcare landscape. Owing to the high bandwidth, low latency, and low-power-low-cost of 5G, the healthcare industry is expected to experience the most changes.

Many connected-care use cases were explored and implemented by the healthcare functionaries, but widespread implementation suffered from the limitations of existing communication technology. As healthcare systems transition to a cloud-native architecture, high-speed and reliable connectivity will be essential.

5G technology has the potential to help resolve these challenges by offering some unique features of most value to healthcare, such as high-speed data transfer rate, super-low latency (delay in the data transmission-response system), connectivity and capacity, high bandwidth, and durability per unit area.

5G offers immense possibilities for healthcare stakeholders to restructure, move to holistic data-driven personalized care, optimize medical resource utilization, offer care delivery convenience, and achieve increased patient value.

Healthcare industry trends driving the adoption of 5G

Shift in demographics

The 2019 revision of the United Nation's World Population Prospects estimated the global population of 7.7 billion. It is expected to rise to 8.5 billion by 2030 and 9.7 billion by 2050. As life expectancy is increasing year on year, the world population is bound to grow older. For the first time in history, in 2018, persons aged 65 and above outnumbered children under 5 years of age. The rise in the aging population and the prevalence of chronic or lifestyle diseases boost RPM systems' demand for home care.

Shift to value-based and patient-centric care

The healthcare service provider industry moves towards value-based care by shifting the focus from financial incentives to rewards based on how patients fare rather than by the number of visits. 85% of the health system and hospitals have invested or are planning to invest in remote patient monitoring technology to contribute to value-based care significantly. For example, the collection of patient's vital data via Bluetooth enabled glucose meter or blood pressure monitor connected to a mobile app for sharing information securely with the care provider. The transition to value-based care can potentially help patients with chronic disease avert the risk of hospital admission.

Big data analytics

Big data has made a remarkable impact on the healthcare industry in oncology, neurology, cardiology, and other specialties. The extensive use of wearable devices and smartphones has helped to accumulate a large volume of patient-specific data.

Big data enables healthcare professionals to utilize population data for new research and personalized treatment opportunities. The remote monitoring system can help collect this information and play a crucial role in making the advanced healthcare-associated analysis with big data.

Internet of Medical Things (IoMT)

IoMT is at the core of remote patient monitoring. IoMT for remote patient monitoring enables patients and healthcare providers to work together for more effective and faster tracking of chronic disease management. This adds more value to care service provided to elderly patients, those who need constant supervision or urgent medical attention. There is growing popularity in using IoMT driven healthcare devices such as wearable medical devices that allow patient data to be continuously monitored and transmitted through cloud-based platforms.

Advances in wearable medical technology

Wearable devices are used to monitor a patient's physiological parameters remotely. During the COVID-19 pandemic, the wearable devices have become a critical component of the healthcare system. Wearable devices and sensors provide many data and insights that help doctors improve treatment methods and understand the patients' body behavior. This will help to compare the impact of the treatment in the clinic and remote monitoring conditions. Pharmaceutical companies are incorporating the use of wearable devices in their clinical trials for improved drug discovery cycle.

Remote monitoring systems in hospitals and eHealth

Many Hospitals have an electronic patient data management system to manage admitted patients' data, including prescriptions, diagnostics, analytical test results, medical reports, etc. Technically well-equipped hospitals also have modern PDMS, which helps collect data in real-time such as cardiac monitors, pulse oximetry, blood pressure, etc. This allows doctors to fully optimize patient care, eventually leading to a significant amount of time-saving and reduced unnecessary readmissions. Many modern hospitals plan to implement the concept of "ICU without walls," where the patient is admitted to a hospital close to their family that provides physiological comfort using remote monitoring to treat patients as if they are in ICU.

Impact of 5G on Global Healthcare Market

5G is going to be the major driving force to accelerate the adoption of digital healthcare. Countries such as the US, UK, Germany, Japan, South Korea, China etc. which are leading the 5G race would scale their adoption of Digital health technologies.

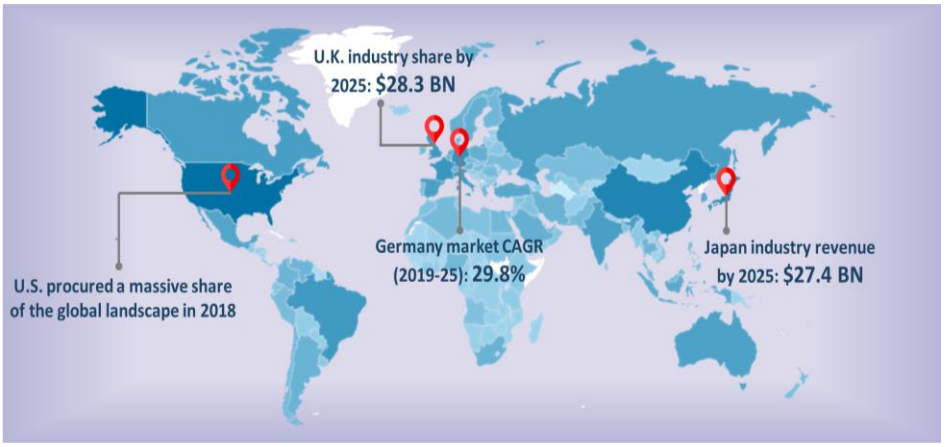


Figure 2: Global Digital Health Market, 2019

Figure 3 determines various digital healthcare applications that can significantly reduce the cost of intervention through an increased focus on preventive patient care.

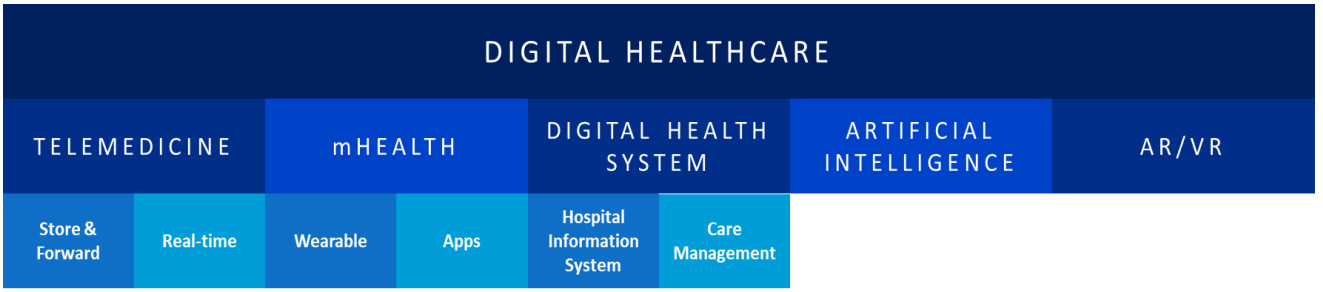


Figure 3: Digital Healthcare Applications

Figure 4, on the other hand, outlines the various functions of MedTech & healthcare IT operations that would focus on making the hospitals more efficient through proactive maintenance of the IT infrastructure in the hospitals and intelligent asset tracking and allocation.

Figure 4: Healthcare IT Operations Applications

Telemedicine

Telemedicine is a clinical service that allows patients to consult doctors or healthcare professionals using telecommunications technology remotely. It can be as simple as telephone consultation, but it has increasingly evolved over the years with the technologies. Telemedicine is a good alternative, beneficial during times like the COVID-19 pandemic when regular doctor visits or routine medical treatment at a hospital or clinic is not an option.

It is commonly used for follow-up visits, treatment of chronic conditions, management of medications, and several clinical services that can be provided remotely. Telemedicine can be further categorized into various segments in terms of their clinical and medical applications, as defined in figure 5 below.

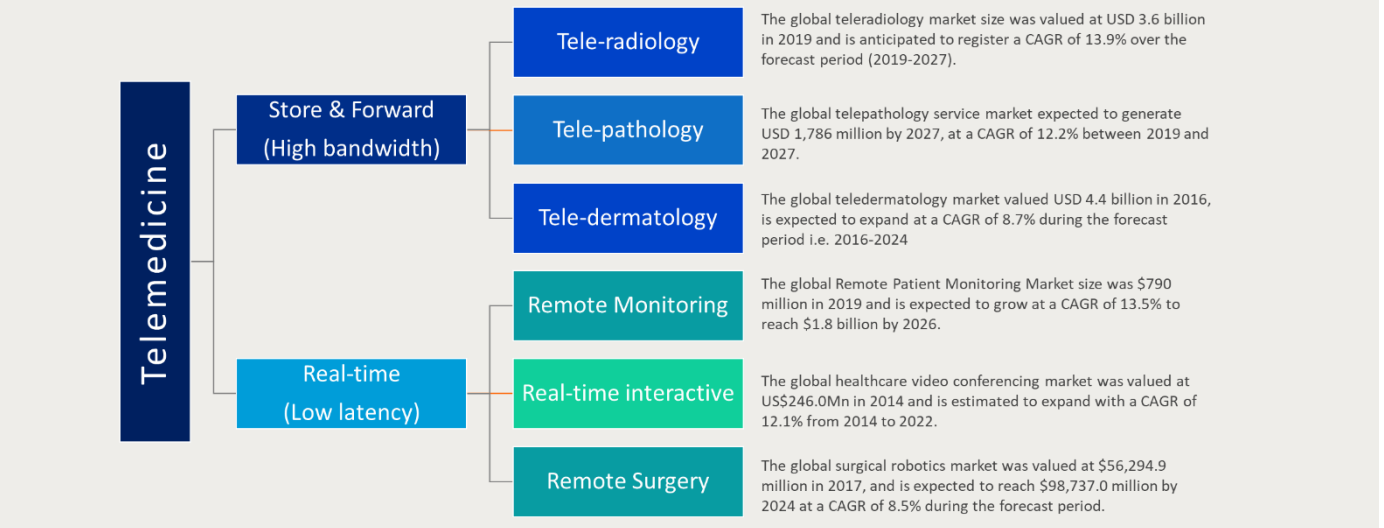
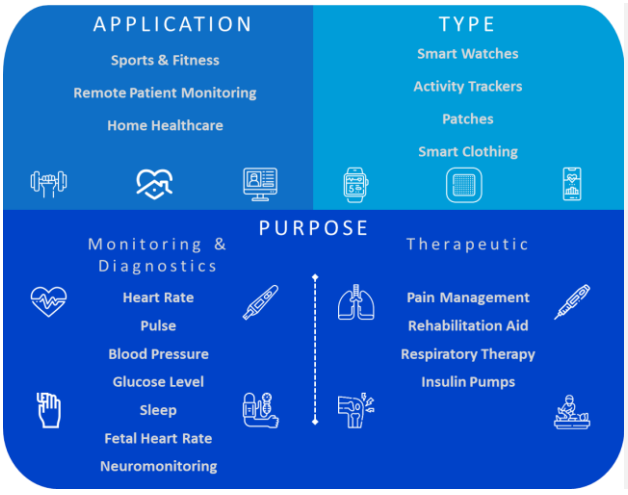


Figure 5: Telemedicine Market

Wearable & mHealth

Healthcare consumers are increasingly using wearable connected devices and mobile applications to manage their health. The global wearable medical devices market is expected to surpass $29 billion by 2026, expanding at a projected CAGR of more than 17% between 2019-2026. Today, many wearable devices are available and can be classified based on their applications, types, and purpose, as shown in figure 6. Subsequently, as most medical wearable devices are heavily dependent on mobile applications, the global mHealth app market is projected to be valued at US$28.320 billion in 2018. It is expected to reach up to US$102.35 billion by 2023. These mHealth apps help users monitor or track their daily routine, diet, general health and assist in prescription adherence. mHealth applications can extensively be grouped into many categories, as shown in figure 6.



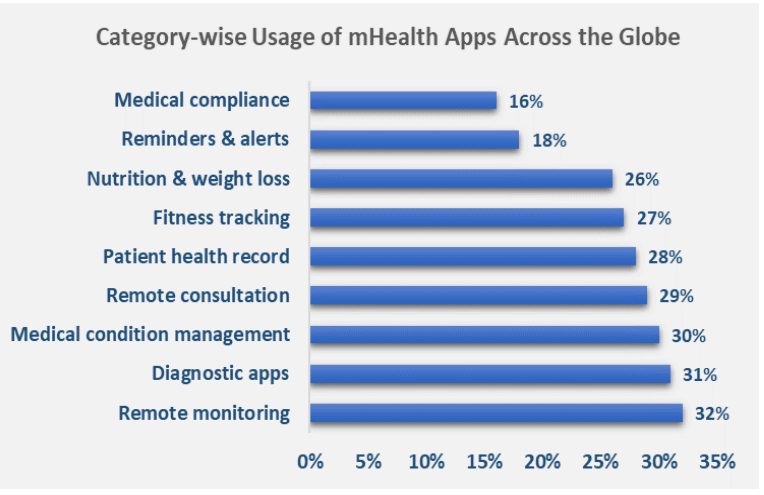


Figure 6: Wearable & mHealth Market

Digital Health Systems

The global healthcare information system market is valued at USD 95.46 Billion in 2018 and is expected to reach USD 158.89 Billion by 2025, with a CAGR of 7.55% between 2019 to 2025. The different types of healthcare information systems are:

- Practice Management / HIS
- Electronic Medical Record (EMR)
- Electronic Health record (EHRs)
- Laboratory Info System
- Pharmacy benefit
- Medication Adherence

The global care management system market is projected to grow at a CAGR of 17.4% to reach USD 37.94 billion from USD 14.12 billion between 2019-2027 time period. The global care management systems are differentiated as:

- Care Management & Care Coordination
- Population Health Management
- Reporting & Visualization
- Revenue Management

AI in Healthcare

Artificial intelligence in the healthcare market was valued at USD 2.10 billion in 2018 and is expected to grow at a CAGR of 50.2% to reach USD 36.15 billion by 2025. AI technology has a vast potential for transforming healthcare as the infrastructure, as the available tools and computational technologies are increasingly becoming more sophisticated.

AR/VR in Healthcare

The AR/VR in the healthcare market is estimated to grow at a CAGR of 28.3% to reach USD 7.05 billion by 2026 from USD 0.95 billion in 2018. The various applications of mixed reality in healthcare will enable interaction of the digital with the physical environment in a multi-dimensional way that will help prevent, manage, and cure a wide array of ailments. Although several challenges lie ahead for the large-scale adoption of AR technologies in healthcare, nevertheless, new approaches will continue to emerge to overcome these obstacles. The applications of mixed reality technology in healthcare would be in areas such as:

Simulation & diagnostics

- Surgeries
- Patient care management
- Medical education & training

Healthcare IT Operations

In addition to digital healthcare, 5G is also going to impact the MedTech and Healthcare IT operations significantly. As already indicated in figure 4, the healthcare IT operations can be further divided into two categories, that are:

•Predictive maintenance of medical equipment

•Hospital asset management

The preventive and predictive maintenance of the medical equipment and healthcare infrastructure will generate immense cost savings for both public and private healthcare organizations. The predictive maintenance service category will witness the fastest growth. It will be USD 15 billion (60%) of the overall medical device maintenance market by 2024 (period 2019-2024), driven by the adoption of IoT, AI, and AR/VR.

The inventory and asset management solutions allow the hospitals to track the assets in real-time, better manage the medical supplies and assets, and plan the preventive maintenance of the medical equipment, thus increasing the efficiency, avoiding the downtime due to malfunctioning or misplaced assets, and reducing the inventory levels in the hospitals. The global hospital asset management market is expected to grow at a CAGR of 31.2% between 2019-2025. It is predicted to reach USD 53.17 billion by 2025.

Healthcare Use Cases Powered by 5G

The new era of 5G will bring together higher bandwidth with ultra-low latency and ultra-reliability, increased adoption of cloud-based storage, and various connected devices. Advanced digital networks will intelligently distribute resources between various applications to enable seamless connectivity and user experience.

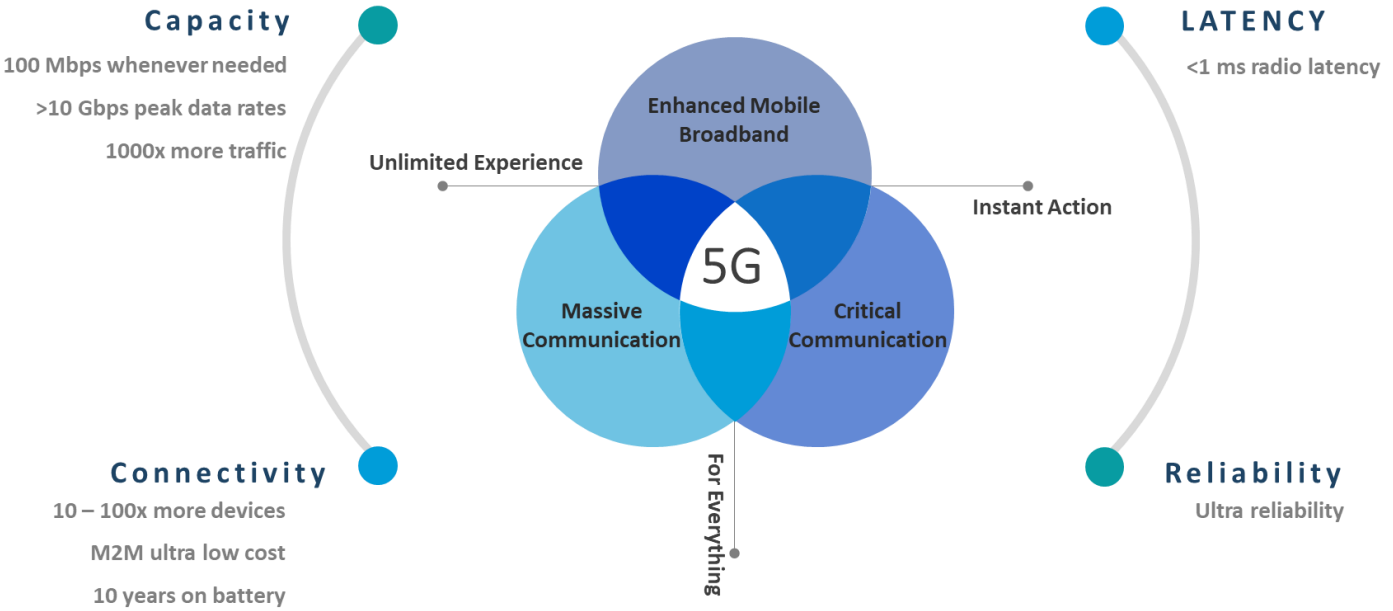


Figure 6: 5G Features

Enhanced Mobile Broadband

5G and broader network coverage would make it easier for healthcare workers to operate more flexibly. Physicians will use 5G mobile devices to perform real-time virtual ward rounds or remote medical consultation anywhere with the same effectiveness as personal interactions. Medical data, such as digital medical records and visual content, will be transmitted over much faster and stable fifth-generation networks.

Healthcare outcomes will be further improved as second opinions, or specialist consultations would be accessible to both patients and care providers. Test results such as pathology tests, medical imaging, or vital monitoring data can be transmitted almost in real-time to make specialist diagnoses more convenient.

5G will also transform emergency or ambulatory services significantly. Paramedics can seamlessly access the patient's past medical records and perform interventions while being frequently in touch with emergency room doctors. Such an ambulatory system enables hospital staff to deal with trauma and life-threatening emergencies even before the patient reaches the hospital.

Massive Communication

With 5G network's 100x more capacity than 4G to connect with IoT devices, healthcare service providers can rely on remote patient monitoring or wearable devices to continuously collect, report, and transmit vital information to a remote monitoring center. Remote monitoring devices will be more integrated into the healthcare ecosystem as massive communication capability of 5G can allow physicians to gather and process rich near real-time data to make informed decisions for better clinical outcomes. Pharmaceutical or medical device companies can use remote monitoring devices to track the safety and efficacy of drugs or devices in patients during clinical studies. Medical device manufacturers can leverage 5G to monitor medical devices' performance in real-time to provide proactive and predictive maintenance support and avoid adverse events caused by malfunctioning devices.

Critical Communication

Specific critical healthcare applications require highly reliable bandwidth with ultra-low latency. 5G network's ultra-reliable bandwidth and ultra-low latency can seamlessly enable applications as essential as remote surgery or surgery guidance. 5G will help specialist surgeons provide surgical guidance to primary hospitals thousands of miles away and make remote robotic surgery widespread and accessible to the masses. Moreover, the advanced digital network can guarantee that the required bandwidth is allocated to such applications through network slicing.

Challenges

As with most innovations, some industry experts are skeptical about the global adoption of 5G technology in healthcare, as indicated by the critical challenges discussed below:

- **Privacy & Security Concerns** – As 5G starts to make its first rounds in the healthcare industry, more and more devices in hospitals, clinics, and similar healthcare facilities would soon rely heavily on the network. 5G would also further facilitate the extensive usage of Electronic Medical Records (EMR) and Patient Care Management Systems (PCMS). Though revolutionary, these advancements raise serious concerns about the security and confidentiality of patient records and data. Therefore, to realize the full potential of 5G in healthcare space, the government and policymakers need to strengthen the patient privacy laws such as Health Insurance Portability and Accountability Act (HIPPA compliance) and further develop new regulation as per 5G standards to address patient privacy concerns and data security issues. Additionally, the network providers need to meet the healthcare industry's strict privacy standards and ensure end-to-end security of data across mobile, IoT devices, and networks.
- **Device Compatibility** – The current 4G/LTE smartphones and devices are not compatible with the new generation of 5G networks. Therefore OEMs have already started rolling out 5G-enabled smartphones and similar devices. However, since 5G introduces new frequencies in the microwave range, it requires exceptionally complex device-based testing to understand or predict the device's performance and its interaction with the network. The high frequency of the 5G network also creates device performance and heating issues. Consequently, the widespread availability and the subsequent distribution of 5G devices still hinges on the manufacturers' ability to overcome the challenges mentioned earlier.
- **Deployment and Coverage** – The current 4G network employs particular frequencies on the radio frequency spectrum, typically under 6 GHz. However, the 5G network operates on shorter millimeter waves that fall between 30 and 300 GHz. Although this opens up a considerable bandwidth for the plethora of connected devices available now and in the future, the millimeters wave cannot travel well through buildings and other obstacles and tend to be absorbed by plants, rains, etc. A new technology called the small cell networks has been developed to broadcast high-frequency millimeter waves. Nevertheless, such networks' availability is currently only limited to few countries within their metro/ urban areas, and the telecom providers need to build an extensive infrastructure to overcome this challenge.

- **Infrastructure –** The currently available wireless networks rely on large, high-powered cell towers to broadcast 4G/LTE signals over long distances. However, the 5G signals (high frequency millimeter waves) would be broadcasted through small cell networks that use thousands of low power mini base stations. These base stations, being much closer together than the traditional towers, would facilitate the signal transmission around obstacles. The telecom providers and the government will have to build a widespread network of 5G small cells or similar hardware to enable seamless and uninterrupted 5G connections. On the other hand, hospitals, clinics, and other healthcare providers/organizations would also need to upgrade and update their infrastructure, applications, technology, and devices as per the 5G network requirements.

CONCLUSION

5G can transform healthcare as we know it. As we witnessed during the latest pandemic, the healthcare industry needs technologies that cater to the population across the socio-economic classes. 5G promises network reliability, speed, and scale for telemedicine and catalyzes mass adoption of leading-edge technologies such as artificial intelligence, big data, extended reality (augmented/virtual/mixed reality), and the internet of things for improved clinical outcomes. Healthcare companies must build, test, and deploy applications that exploit critical features of 5G that are ultra-fast bandwidth, ultra-reliability, ultra-low latency, and massive machine connectivity. Although there are challenges in terms of privacy and security, infrastructure, device compatibility, and limited coverage, healthcare companies must invest in applications considering what patients/users need most.

REFERENCES

1. https://www.pwc.com/gx/en/industries/tmt/5g/pwc-5g-in-healthcare.pdf
2. https://www.researchgate.net/publication/334641135_5G-Based_Smart_Healthcare_Network_Architecture_Taxonomy_Challenges_and_Future_Research_Directions
3. https://bridgera.com/iot-and-5g-driving-health-care-transformations/
4. https://www.thalesgroup.com/en/markets/digital-identity-and-security/mobile/inspired/5G
5. https://www.alliedmarketresearch.com/5g-technology-market
6. https://www.prnewswire.com/news-releases/worldwide-digital-health-market-to-hit-504-4-billion-by-2025-global-market-insights-inc-300807027.html
7. https://ec.europa.eu/health/sites/health/files/ehealth/docs/ev_20171128_co09_en.pdf
8. https://www.credenceresearch.com/press/global-video-conferencing-in-healthcare-market
9. https://www.grandviewresearch.com/industry-analysis/teleradiology-market
10. https://www.alliedmarketresearch.com/surgical-robotics-market
11. https://www.grandviewresearch.com/press-release/global-remote-patient-monitoring-devices-market
12. https://www.globenewswire.com/news-release/2019/04/05/1797517/0/en/Global-Telepathology-Service-Market-Will-Grow-USD-1-786-Million-By-2027-Zion-Market-Research.html
13. https://www.businessinsider.in/science/latest-trends-in-medical-monitoring-devices-and-wearable-health-technology/articleshow/70295772.cms
14. https://liquid-state.com/mhealth-apps-market-snapshot/
15. https://www.grandviewresearch.com/press-release/global-mHealth-market
16. https://www.sam-solutions.com/blog/wearable-technology-in-healthcare-how-devices-will-influence-our-health/
17. https://www.appventurez.com/blog/mobile-applications-in-healthcare/
18. https://www.marketsandmarkets.com/PressReleases/care-management-solutions.asp
19. https://www.medgadget.com/2019/09/healthcare-information-system-market-2019-size-share-analysis-upcoming-trends-latest-innovations-growth-key-players-and-competitive-strategies-forecast-to-2025.html
20. https://www.mordorintelligence.com/industry-reports/hospital-information-system-market
21. https://www.marketsandmarkets.com/Market-Reports/healthcare-it-252.html
22. https://www.newson6.com/story/41635892/healthcare-information-software-market-2020-global-trends-size-share-outlook-by-leading-manufacturers-cagr-projection-by-2024-ndash-industry
23. https://www.accenture.com/sg-en/insight-artificial-intelligence-healthcare
24. https://www.marketsandmarkets.com/Market-Reports/artificial-intelligence-healthcare-market-54679303.html
25. https://www.reportsanddata.com/report-detail/ar-vr-in-healthcare-market
26. https://www.globenewswire.com/news-release/2019/05/15/1825476/0/en/AR-VR-in-Healthcare-Market-To-Reach-USD-7-05-Billion-By-2026-Reports-And-Data.html
27. https://www.slideshare.net/Eurotechchannel/eth-io-tm2mmedicalhealthcare20150502
28. https://www.psmarketresearch.com/market-analysis/medical-equipment-maintenance-market
29. https://www.zionmarketresearch.com/market-analysis/hospital-asset-management-market
30. https://www.infovista.com/blog/5g-network-deployment-challenges
31. https://www.iot-now.com/2019/04/05/94717-top-five-challenges-5g/
32. https://www.futurithmic.com/2020/07/02/five-biggest-challenges-facing-5g/
33. https://www.verizon.com/about/news/5g-and-future-wearables
34. https://www.brookings.edu/wp-content/uploads/2016/07/How-5G-tech-enables-health-iot-west.pdf
35. https://www.tataelxsi.com/Perspectives/WhitePapers/Remote-Patient-Monitoring-business-whitepaper.pdf
36. https://brandessenceresearch.com/healthcare/healthcare-information-system-market
37. https://www.globenewswire.com/news-release/2019/01/21/1703010/0/en/Artificial-Intelligence-in-Healthcare-Machine-Learning-NLP-Context-Aware-Computing-Computer-Vision-Market-Global-Forecast-to-2025.html
38. https://www.globenewswire.com/news-release/2019/06/14/1868818/0/en/Global-Hospital-Asset-Management-Market-Will-Reach-USD-53-17-Billion-By-2025-Zion-Market-Research.html
39. https://blockdelta.io/5g-the-next-wave-of-wireless/

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Tata Elxsi also provides solutions and services for emerging technologies such as IoT (Internet of Things), Big Data Analytics, Cloud, Mobility, Virtual Reality, Cognitive Computing, and Artificial Intelligence (AI). Tata Elxsi has a global presence and is supported by a talent pool of over 6,500 employees, a network of ISO 13485 certified design and development centers, and a robust ecosystem of technology, manufacturing, and internationally accredited testing partners.

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