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THE ROLE OF 5G IN PROMOTING PATIENT-CENTRIC CARE IN SMART HEALTHCARE SYSTEMS

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Purpose: This publication seeks to present the potential benefits of fifth generation (5G) wireless technology in smart healthcare systems, especially in enhancing patient-centric care.
Design/methodology/approach: Analysis of international and local literature.
Findings: The healthcare sector is transforming and changing from a dispersed disease-centric to a more personalized patient-centric model. This has been accelerated by the integration of wireless communication technologies used in administrative functions and smart healthcare applications. 5G technology is a game-changer in smart healthcare systems and promotes patient-centered service delivery. The growing use of wearable technology has had a massive impact on personalized and round-the-clock health monitoring, especially in remote settings and this requires a stable and reliable network. The high-speed wireless technology has advanced emergency response, making it quicker and more effective, allowing healthcare providers to make timely life-saving decisions. Its high performance and reliability have led to an increase in patient experience and performance, physically and virtually. This has led to better healthcare service delivery that is more personalized and efficient as medical professionals use personalized approaches that suit the specific health needs and preferences of patients.
Originality/value: Originality/value: This article offers an analysis of the role 5G plays in supporting a patient-centered care in smart healthcare systems. The value of this research is based on outlining the interdisciplinary nature of 5G and how it can promote care services and technological advancements in healthcare.
Keywords: 5G, healthcare, patient-centric.
Category of the paper: literature review.

1. Introduction

Smart healthcare systems are increasingly becoming necessities in the delivery of medical services. However, current systems are facing immense efficiency strains due to the rise in viral infections, chronic illnesses, and a growing elderly population (Ahad, Tahir, Yau, 2019). To reduce the burden on healthcare systems and improve the quality of care, organizations are

turning to modern technological solutions. Even though the integration of smart technology into the healthcare system has been gradual and started to pick up in the early 2000s, the onset of commercial deployments of 5G technology only started in around 2019.

Healthcare facilities are turning to focus on providing individuals with patient-centered medical services rather than disease-focused (Bojhour et al., 2018). This approach puts the patient in the "driver's seat" as clinicians have found that when patients take an active role in their care, then the results are better. A customized patient-centered approach improves patient outcomes, leads to better engagement and decision-making, and consequentially a higher satisfaction. Furthermore, a modern patient-centric approach focuses on preventive care, especially after the Covid-19 pandemic which highlighted the vulnerability of disease-focused healthcare systems.

Technology advancements have played an important role in promoting the patient-centric approach, with mobile health applications, telemedicine, and electronic health recordings catalyzing the development of highly advanced, reliable, and well-coordinated patient care. 5G wireless network has become one of the important technologies in unifying smart healthcare systems and patient-centric medical approaches. With it, patients, clinicians, and other administrators can coordinate and provide the necessary medical care. This network makes accessing patient data, collaborating amongst medical personnel, training new professionals, handling emergencies, and monitoring the patient's progress more efficient. This research introduces 5G technology and the potential outcomes of using it in healthcare, especially in an era where patients are centered.

2. 5G wireless technology

The fifth-generation wireless technology is powering the current fourth industrial revolution. Unlike its predecessors, it is connectivity is faster, more stable, and more secure. This makes the wireless network. It's driven by the following specification requirements and advantages such as: (Ansari et al., 2022; Attar et al., 2022; Martinez-Alpiste et al., 2020):

- 100% coverage.
- 99.999% availability.
- 1-millisecond latency.
- Up to 10 Gbps data rate.
- 1000x bandwidth per unit area.
- 90% reduction in the network energy use.
- Up to 10-year battery life for low-powered IoT devices.
- Up to 100x more connected devices per unit area compared to 4G LTE.

- Fixed wireless access: a better alternative to wired broadband and suitable for markets without fiber optics.
- Mission-critical control: higher resiliency and lower latency suitable for high demand and emergency healthcare situations that require absolute reliability.
- Superior mobile broadband enables clinicians and medical trainees to access ultra-high-definition videos and use virtual reality.
- Internet of Things (IoT): enabling exponentially high connections while using lower power.

3. eHealth monitoring of chronically ill patients

Chronically ill patients need centered care due to the complex nature of their complications and their progressive changes. The multifaceted characteristic of chronic conditions requires personalized patient-centered care as they are difficult to address. They need individualized treatment plans, constant monitoring, routine checkups, adjustments in the administration of treatment, and long-term management.

Medical personnel have to continuously change how they handle such cases as they progress or regress and look for the emergence of new complications hence it is important to know how to track them. This basic nature of chronic illness requires the involvement of different participants including the patient, clinicians, and caregivers. The use of 5G technology comes in handy in this case, helping in communication, constant monitoring, and administration of care.

It allows high data transmission from monitoring devices which healthcare providers can use to make important and timely decisions e.g. changing therapy. Smart medication dispensers can integrate this technology and be used in secure monitoring and adherence tracking (Liang et al., 2021). This makes it possible to manage the timely dispensation of prescriptions in the right doses and refilling of medicine and nutritional supplements which most of these patients need. It ensures that patients can take their treatment when required and eliminates the likelihood of negative drug interactions (Choi, 2019) and if there is a lack of adherence or depletion in the prescription, then caregivers can get notified on time (Kumar et al., 2023). Movement for most chronically ill patients can be challenging so 5G eliminates the need for physical hospital visits by promoting telemedicine and encouraging virtual consultations. The high resolution offers high visual clarity for better assessment, improving the telemedicine experience. This means clinicians can attend to patients in rural and remote areas, ensuring even those in marginalized communities receive quality healthcare (Saeki et al., 2022; Mwangama et al., 2020).

This wireless communication network offers faster data transmission with low latency, leading to a more engaging telehealth experience. As a result, it fosters a healthcare environment that is more engaging, immersive, and patient-centered. 5G's ability to quickly, securely, and reliably transmit data makes it suitable for emergency responses and managing fall detection. With a wearable device connected to 5G, a sudden change in patient activity means that caregivers can quickly get an emergency alert and respond. The network in addition to wearables can be fine-tuned to offer advanced location-based services, including real-time locations, and in the event of a fall or slip, the device can transmit the emergency alert alongside the precise location (Bartoletti et al., 2021; Ersoy, Alemdar, 2010; Usman, Philip, Politis, 2019).

4. Data-driven insights for predictive analytics

One of the main objectives of using 5G in healthcare is for it to be integrated with wearable health monitors and used to perform local data analysis i.e. without the need to connect to the cloud. For instance, a heart rate monitor can be used as a stand-alone data analysis device to monitor heart health data and provide immediate response by alerting caregivers if there are alarming changes (Devi et al., 2023).

Its ultra-low latency makes it ideal for intensive care unit monitoring with real-time analysis of the continuous stream of data from connected devices. This way, healthcare professionals can monitor the patient's vitals and respond quickly in case of anomaly. The high-speed data transmission capabilities can empower the healthcare sector to harness big data for disease monitoring, design personalized treatment plans, and conduct predictive analytics (Prakash et al., 2022). Big data, in this case, refers to the information collected from various medical devices i.e. clinical, and wearables found in the form of data reports and biometric text (Jain et al., 2021). This data can be swiftly processed in near real-time to extract information for doctors and clinicians. AI can be used to power biometric patterns and provide accurate diagnoses or predict the best possible treatment in care areas related to medical imaging and precision medicine.

5. Data privacy and security

Data is a crucial component of patient-centered care as it is used in tailoring services based on specific individual needs. This includes diagnosis and personalized treatment plans based on symptoms, gender, age, medical history, lifestyle, and genetics. Traditional security

mechanisms used in legacy systems such as data encryption and isolation cannot effectively provide sufficient data protection in a distributed healthcare system (Chen et al., 2020).

The successful use and storage of digital data in patient-centered care requires investing in cybersecurity. As the healthcare system becomes more digitized, it raises questions regarding data privacy and security, thus, safeguarding patient information becomes important. 5G is an important tool that can accelerate the rate at which cyber threats can be established and handled. It allows faster and more timely data analysis, download of data, and communication across different parts of organizations (Mohanta, Das, Patnaik, 2019) .

Advancements in 5G's network slicing will support enhanced patient privacy through multiple dedicated networks within a common shared physical infrastructure. This means that organizations can apply different instances of cybersecurity measures across various inner networks as patient data is not shared across isolated slices, minimizing the risk of data violations and unauthorized access (Sylla et al., 2022).

The technology allows the implementation of Zero Trust Security Architecture (ZT) (Ramezanpou, Jagannath, 2022) which, unlike the traditional security models, assumes that security and privacy threats are found inside and outside the network. When used with 5G, the identity-centric ZT promotes comprehensive monitoring and authentication to verify user identity, give access controls to users, and continuously assess the security of users, devices, and applications within the network.

The technology's ability to allow real-time monitoring and evaluation of network traffic can also be ideal for mitigating threats. Through continuous monitoring, organizations can quickly identify abnormal patterns and act on them promptly. 5G uses edge computing for data processing which means that data is processed closer to the source i.e. at the edge of the network, and as a result, it helps to reduce the risk of transmitting sensitive health data over long distances for processing. Furthermore, edge computing in 5G enables the use of "virtual" hardware which means data can be sent through virtual hubs and switches and be modified/relocated quickly instead of specialized hardware that can easily get compromised. overall, this localized data processing technique improves the healthcare system's overall security (Chan, Jain, Gupta, 2016).

6. 5G in emerging healthcare technologies

In emerging healthcare, 5G has been crucial in supporting the use of Virtual Reality (VR) and Augmented Reality (AR). The high-speed network offers a seamless integration between virtual and real elements by delivering large data sets at ultra-fast speeds and providing real-time responsiveness (Rahmati, Hazarika, 2023).

VR can allow medical students to simulate surgical procedures (Reid et al., 2017), dissect the human anatomy, or diagnose and monitor patients in a risk-free virtual setting without loss of human life. 5G mobile network presents an opportunity to accelerate the adoption of VR/AR in healthcare as it guarantees better visualization and increases medical precision. BioFlightVR startup, for instance, offers VR/AR training that medical professionals and new joiners can use to refine their skills using realistic simulations (Virtual reality medical training, 2022). A high-speed and reliable mobile network such as 5G can enhance the use of this technology, allowing more users to utilize it.

Using a 5G-powered AR can facilitate better communication and engagement between doctors and patients, leading to better visualization of symptoms. For instance, AccuVein AR startup has handheld scanners that medical staff can use to easily locate veins. 5G technology blends with the growing adoption of VR and AR in healthcare, allowing real-time interpretation leading to enhanced diagnosis, decision-making, and more patient-centric service delivery. The combination of AR/VR and a low latency network that allows seamless multiple-device connection offers an opportunity for implementing remote and active training where both the trainee and trainer can engage without limitations of physical barriers or scheduling limitations for high-demand experts (Vega et al., 2020).

7. The future of 5G in healthcare

5G technology is expected to promote better accessibility to healthcare services, especially concerning remote support. Thus, in-person hospital visits are bound to reduce, with more focus shifting to telemedicine. As a result, it is bound to enhance care delivery to confined and chronically ill patients (Javaid et al., 2023). The use of robots to deliver assistance and conduct remote surgeries with high precision will reduce the understaffed surgical sector and overworked personnel. For instance, the 5G network by Huawei and the Kangduo robot surgery system used a porcine model to perform remote hepatectomy (Tewari et al., 2022) so more refined human applications are on the way. In patient-centric healthcare systems, the 5G network will facilitate the development of collaborative environments. This is through the use of interlinked care providers and devices that allow the sharing of patient data with ease and the delivery of well-coordinated, holistic care with universal quality (Georgio, Georgiou, Satava, 2021) in different locations and areas of specialties.

5G's future in patient-focused healthcare is closely linked to the advancement of IoT and AI. Its high-latency feature makes it suitable for driving the growth of AI-based diagnostics and the use of IoT in patient care, resulting in better predictive and personalized healthcare. Home healthcare is becoming popular as the population continues to age. Most people are choosing to stay at home as it is cheaper and more convenient. 5Gs technological elements such

as real-time patient monitoring (Peralta-Ochoa et al., 2023), real team updates of vital signs, and smart dispensation of medicine means that homecare, especially for the elderly and those chronically ill will continue to grow in the future as patients choose to manage or recover chronic conditions from the comfort of their homes. This communication network will lay the groundwork for other industry players in the healthcare sector such as pharmaceutical brands. They can keep track of disease and patient behavior, improve their research efficiency, and provide better products and services via the seamless connection of devices and better accessibility. Consequentially, this can be used in predictive analytics, resulting in better research outcomes and decision-making for a more sustainable future.

8. Conclusion

The use of 5G network technology in the era of smart healthcare is bound to transform the patient-centered medical approach by changing how care services are delivered and how patients experience them. 5G enhances seamless and reliable connectivity, allowing professionals to interact with patients and collaborate with their colleagues regardless of location barriers. Thus, it opens new opportunities for medical dispensation and training by promoting virtual access. The technology provides ultra-fast data transfer speeds with low latency making it possible to manage and attend to chronically ill patients who require continuous and remote monitoring. It's real-time data analytics and swift data transmission provide clinicians with an opportunity to access critical information and promptly make life-changing decisions. Furthermore, it makes it possible for clinicians to attend to individuals in remote and underserved communities through telemedicine. The future of 5G is expected to enhance how surgical procedures are done, especially in medical traineeship through virtual reality simulation and high-clarity images without the use of human subjects (Pérez-Martínez, Yanez, 2023). Overall, 5G wireless technology will propel healthcare in a new dimension and it is expected to enhance the growth of homecare health services, telemedicine and robotic surgery support, remote patient monitoring, and an overall improvement in the smart city infrastructure.

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