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UNLEASHING THE POWER OF HEALTHCARE WITH 5G

The 5G use cases that will transform healthcare for patients and providers

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Executive summary

5G will transform all industries, and healthcare is no exception. Citizens, patients, doctors, and healthcare providers all stand to benefit from this innovation. It is, therefore, immensely important to understand its potential applications and associated risks.

This whitepaper will explore the value of 5G technology in healthcare, considering different use cases, from remote monitoring to supporting surgical interventions.

Welcome to the age of 5G

Imagine. It's a lovely summer's day, and you're enjoying the comfort of your garden.

As you've done every month since discovering your heart condition two years ago, you're attending your regular teleconsultation with your cardiologist. The doctor is clearly able to see you and interact with you, enjoying real-time access to the data your wearable devices provide. The AI-powered system notifies her that your heart rate profile has been irregular over the last two weeks, and she recommends that you change your medication. A new therapeutic plan is delivered directly to your medical app, along with recommendations of what to do in an emergency.

That's it. You didn't need to spend an hour in traffic to visit the hospital as you did in the past, so you now have time to take a walk. But, as you walk down the street, you start to feel dizzy. There's a sharp pain in your chest, and you fall unconscious.

Fortunately, your health sensors detected this critical event and automatically called for medical support, sharing both your health status and your precise location. An ambulance is already on its way and an autonomous drone equipped with an automatic external defibrillator and instructions on its use. In less than three minutes, the drone is next to you, and a passer-by is helping you. Meanwhile, the drone supplies the paramedics in the ambulance with real-time information on the status of the situation, so they know what to expect when they arrive.

"Clear!" announces the defibrillator. An electrical shock runs through your body, bringing you back to life. But you're not out of the woods yet.

The ambulance arrives at the scene and quickly takes you to the nearest hospital. Here, emergency doctors have already received information on your health status from sensors in the ambulance. They notice you may have to undergo urgent heart surgery and inform the head of cardiovascular surgery that a new patient is on the way. But today, he's working in another hospital, a hundred miles away.

A real-time connection between the two hospitals means this isn't an issue. With the support of virtual, augmented glasses, the head of surgery can clearly see everything that's happening during your operation and provide valuable insights to the surgeon carrying out the procedure. Everything goes well, and you're now safe.

Later that day, as you lie in your hospital bed recuperating, you think to yourself how grateful you are to be living in an age where technology, driven by people, can save lives in real-time.

Welcome to the age of 5G.

Introduction

Medicine and telecommunications have seen perhaps the fastest technological leap of any industry in recent years. Now, with the rollout of 5G, their paths have converged and connected to improve people's health and wellbeing as never before.

Life expectancy and access to healthcare innovation have improved immensely in recent years; people now live much longer and better lives. This has, however, created pressure on healthcare systems. With more individuals to treat, they must now find new and better ways to increase efficiency and therapeutic success and, at the same time, keep costs down. Information technology is critical to providing tailored care, away from hospitals and closer to home, while increasingly detailed data on patients and centralized healthcare repositories enable efficiency gains in prevention, diagnosis, and treatment.

But the technological innovations expected in healthcare, from wearables and drone-delivered medical supplies to remote surgeries, artificial intelligence (AI), and the internet of medical things (IoMT), need high-performance connectivity and infrastructure. And this can be difficult to maintain. 5G – the next generation of networks – promises to be the answer.

5G impacts the development of healthcare technology and affects every topic related to health. New horizons for smart and telehealth, for example, mean doctors will have access to data on their patients in real-time. They'll interact via imaging systems and share big data among various other parties simultaneously. In parallel, patients and citizens will live more safely; connected wearables and other medical devices will monitor their health status and advise them – and their doctors and caregivers – in times of need. In short, 5G will enable healthcare providers to deliver care to their patients whenever they need it, wherever they are in the world.

A brand new world of possibilities with 5G

5G is designed to connect virtually everyone and every machine, object, and device without impacting the quality of connection or signal. But it's not just about faster wireless connectivity or a quantum leap in bandwidth, latency, and computing power. It's an inclusive synergy of all these components to create an ultra-reliable pervasive network that will transform the world.

The sensors, wearables, and connected devices used in healthcare – and the smart algorithms that underpin them – rely on big data sets. They can't depend on the fragile nature of 4G networks or home broadband bandwidth for support, especially when sharing patient data and making critical healthcare decisions. It's here, then, that the benefits of 5G outlined above will be crucial.

The following six chapters explore how 5G will power change in healthcare by leveraging the stability, reliability, performance, and robustness of 5G networks.

In simple terms, 5G networks will eclipse their predecessors with:

10x Decrease in latency	**100x** Increase in bandwidth	**+100x** Increase in capacity
Low latency will provide users with constant connectivity and the ability to quickly compile and compute data and translate artificial intelligence into real-time decision-making. This will be extremely important in the development of telehealth, especially tele surgeries.	The capacity to exchange high-definition content quickly and securely will further support teleconsultation and multidisciplinary consultations between institutions, as information will be flowing in real-time.	The quantity of devices supported will increase to up to 1.000.000 devices per square kilometer. As the Internet of Medical Things (IoMT) networks monitoring health will generate huge amounts of data from a huge amount of devices, this is vital.
100% Availability	**500km/h** Increase in mobility	**10 years** Increase in battery
The consistency of the service provided will be almost 100%, assuring that communications will happen without interruptions and in real-time.	5G can support seamless transfer between radio nodes by up to 500km/h - this means that no matter where and how fast you are moving, the connection is always intact.	Battery life can be increased by up to 10 years for low power IoT devices. If we consider that 56% of consumers worry about their wearable health patches running out of battery, this seems to be relevant.

Use Case	Lower Latency	Higher Bandwidth	Higher Capacity	Higher Availability	Higher Mobility	Longer Battery
Health Data processing		✓	✓			
Real-time monitoring	✓	✓		✓	✓	✓
Teleconsultations	✓	✓		✓		
Virtual Reality	✓	✓	✓	✓		
Connected Ambulance	✓	✓	✓	✓	✓	✓
Innovative Surgeries	✓	✓	✓	✓		✓

Non-exhaustive analysis of use cases with the advantages of 5G

Huge amounts of health data will flow faster

According to a report from 2018, the healthcare industry generated 30 percent of the world's stored data; a single patient typically generates about 80 MB in Electronic Medical Record (EMR) data each year[1]. With the advent of digital health, these values are expected to increase at a Compound Annual Growth Rate (CAGR) of 36 percent until 2025 [2].

At the same time, 35 percent of consumers say that online access to a central repository of EMRs will help them easily manage the quality and efficiency of their care, while 45 percent of cross-industry experts consider a central repository as a breakthrough in healthcare provisioning [3]. But, to obtain value from all these data, healthcare stakeholders need a fluent and agile infrastructure that allows hospitals, healthcare centers, pharmacies, and patients to capture, analyze, transfer, and manage huge amounts of data in real-time.

Consider the highly complex data imaging systems available in hospitals. The huge files they generate will need to be sent to a specialist for analysis. Network performance is vital. If a network is low on bandwidth, it can take a long time to transmit these files. In some cases, they won't transmit at all. As a result, patients will have to wait longer for treatment, while providers will see fewer patients in the same amount of time. A high-speed 5G network can help quickly and reliably transport huge files of medical imagery data, improving efficiency, access, and quality of care.

With networks powered by 5G, a hospital can truly become a smart hospital, in which data from each patient flows in real-time between multiple healthcare professionals. This puts the patient in control and at the center of their care.

It will increase the ability to create big data-powered smart algorithms, too. 5G infrastructure will make it easier – and more reliable – for healthcare providers to use AI software to analyze real-time patient data sent to cloud platforms. Indeed, as many key healthcare functions begin to use AI systems

to predict and manage diseases and conditions and decide on the best therapeutic path for a specific patient, the fast flow of data will be key. In this sense, 5G will allow doctors, nurses, and other clinical staff to collaborate more efficiently.

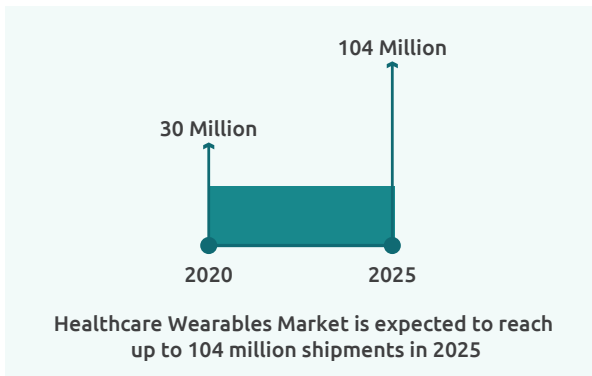## Connected devices will monitor people's health in real-time

One of the greatest possibilities of future healthcare is the ability for anyone to monitor their health quickly, easily, and reliably. The healthcare wearables market continues to grow and innovate. Over 60 percent of the world's consumers are ready to use wearables such as small glucose monitors, wireless blood pressure sensors, or connected scales for healthcare management. Two-thirds say that wearables that can monitor and administer medication are important to manage health better and improve personalized and preventive care [3]. Furthermore, 86 percent of doctors believe wearables will increase patients' engagement with their health and cut hospital costs by about 16 percent in the next five years [4].

The data created by these devices can be combined with data on a patient's lifestyle and other social factors and analyzed to predict changes in their health status. This way, they can often detect medical conditions before a patient feels any relevant change. This information can also be shared automatically with healthcare professionals, who can take preventive and corrective actions before the change becomes an issue.

They can then remotely adjust treatments, give advice, or ask patients to make new appointments. This will not only benefit people in their daily lives, but also help patients as they return from hospital, the elderly, and those with chronic diseases, all of whom will enjoy closer follow-up attention at home. This is good for a patient's health, and it also saves time and resources for both the patient and the broader healthcare ecosystem.

This situation will involve a constant flow of data from and between billions of connected devices, of course, which will put additional pressure on networks. 5G will ease this pressure, ensuring data flows with greater velocity and reliability than other connectivity solutions. The introduction of 5G promises improved service reliability and security, increased capacity on the number of connected devices per square kilometer, and greater mobility than home connectivity solutions such as Wi-Fi. And all of this will enable remote patient monitoring at an unprecedented scale.

104 Million

30 Million

2020   2025

Healthcare Wearables Market is expected to reach up to 104 million shipments in 2025

Teleconsultations will become more realistic

Traditionally, patients in need of medical attention had limited options: to go to a doctor or a hospital. For patients in rural areas, where doctors can be located several miles away, travel can be a challenge, not to mention expensive and time-consuming. If the patient is especially unwell, the challenge can be even worse. Telehealth, however, allows chronically ill patients to receive critical healthcare when they might find it difficult to visit their doctor. This means patients can be treated sooner and even have access to specialists that would otherwise be unavailable to them.

But, although such teleconsultations are available with existing networks, the remote monitoring and sophisticated imaging equipment they involve can put strain on a healthcare provider's network. They can often increase congestion and slow networking speeds, especially if a consultant is interfacing with dozens of patients each day, and this lag can be frustrating for anyone using the service. More importantly, though, a poor-quality connection can delay a patient's care, which can seriously impact their longer-term health outcomes.

Fortunately, the ultra-fast speeds and low latency promised by 5G means telehealth applications will improve dramatically. The virtual interaction between doctor and patient will become almost indistinguishable from the real thing.

Driven by rising demand from remote and urban areas and the ongoing uptake of technologies such as 5G and cloud, the telemedicine market is expected to grow at a CAGR of 17.7 percent until 2026 [5]. By 2025, it is expected to be worth US$756m and deliver savings of up to US$21m per year globally through improvements in efficiency and operations [6]. This growth is reflected in the sentiment of both patients and doctors.

Due to recent lockdown measures, consumers are becoming more amenable to online, rather than face-to-face, consultations. And the greater efficiency and profitability and more inclusive access to healthcare mean practitioners are also increasingly open to the benefits of teleconsultations delivered across a fast, reliable 5G network.

Teleconsultation is expected to save up to 21 million dollars per year in costs globally

New immersive realities will shape healthcare

The healthcare ecosystem uses distinctive digital realities such as augmented reality (AR) and virtual reality (VR) for a number of purposes. But network limitations can impact their performance. However, the new capabilities provided by 5G networks can mitigate these constraints. The lower latency and greater bandwidth can support real-time experiences without the delays, lags, and dropouts that can sometimes make people feel sick. Properly applied, there are several possible use cases for these technologies.

It will be possible, for example, for surgeons to create a comprehensive 3D digital model of a patient's body part, which they can use to virtually simulate an operation and ensure everything needed for the surgery is fully functional in advance. Then, visual guidance can be provided to the surgeon via AR during the surgery itself.

The use of VR and AR can improve the patient experience. Long-term patients can use VR to explore different relaxing environments to improve their mood and alleviate anxiety or depression. And amputee patients can use a VR headset to virtually overlay their lost limb to help relieve phantom limb pain. The technologies can benefit people with low, impaired, or even no vision, too. A 5G-enabled headset can connect visually-impaired individuals to a live advisor, who can guide them through day-to-day tasks.

Furthermore, VR and AR, supported by a 5G network, can play an important role in the education and training of healthcare professionals, who can perform practice procedures remotely in a virtual environment.

Response to medical emergencies will be faster and more efficient

5G capabilities are transforming medical emergency systems. The technology supports great bandwidths, with no latency, even when the sender or receiver moves at speed. This makes it possible to create a "connected ambulance" that will continuously share data with the hospital while the patient is still in transit.

In this type of ambulance, both the vehicle and the medical team act as mechanisms to collect data on the patient and transfer it to the hospital, using wearables, sensors, or streaming high-definition video cameras. Multiple algorithms process all this data in real-time, alerting any sign of deterioration in the patient's condition. This continuous stream of data, combined with the patient's EMR received from the cloud, enables the AI system to identify any changes and notify paramedics to take the appropriate action. At the same time, hospital staff will better understand the patient before they arrive.

In life-threatening situations, clinicians can even remotely guide paramedics through a medical procedure in real-time using a VR or AR headset before the ambulance reaches the hospital. 5G also enables the use of drones in medical emergencies. The emergency services can dispatch a drone via which it's possible to connect health devices such as electrocardiograms or automated external defibrillators to a patient's body with a caregiver's support. Remote paramedics can then use a real-time imaging system to view the scene and issue instructions to the caregiver.

Should there be multiple casualties, the flow of multiple streams of medical data over 5G will enable doctors to assess each patient's health status. They can take remote action on those who need immediate, local support and monitor the status of anyone taken to a hospital facility. They can also use this information to manage which hospital each patient is taken to, given their specific needs.

Surgeries will no longer be limited to those in the room

Robotic surgery is already a reality. Currently, a surgeon must stand next to the robot rather than operate it remotely. But, while full remote surgery might still be some years off, it will soon be possible for a surgeon in one location to advise a colleague in another via a 5G-enabled AR or VR headset.

However, although most patients believe remote robotic surgery to be acceptable, most also consider it too risky. This will change, though. With the addition of haptic feedback and high-definition image streaming to help perform such procedures, the low latency and high throughput communication afforded by 5G means surgeons will be able to operate on patients remotely, anywhere in the world, safely.

In the not-too-distant future, surgeons will likely share their mastery with robots via remote control. The surgeon will use VR gear and haptic gloves to transpose their movements onto a robotic surgeon operating on a patient in a different location. Indeed, such action forms the basis of an Internet of Skills: robots can acquire human skills regardless of physical boundaries, and knowledge is shared globally – more quickly and efficiently than ever before.

Ultimately, the access that 5G allows to advanced visual, audio, and haptic technologies will help humans enjoy sensory experiences as close as possible to those experienced locally. [7]

Step by step
into the future

Recent advancements in medical technology will transform the way healthcare is delivered: a transformation supported by 5G. It's now time to prepare the entire healthcare ecosystem to embrace the benefits of 5G technology.

It is important, for instance, to create an implementation plan. This must involve local IT resources – whether in-house or external consultants – and network providers, who can talk to 5G availability and performance guarantees. The plan should include a detailed analysis of any equipment that must be upgraded to be 5G-compatible. And it should outline a clear flow of information to all stakeholders on 5G innovations and how to employ them for maximum ROI.

Any transformation journey is likely to have its challenges, of course. An organization's 5G implementation roadmap may not be clear, there might not be a sufficient budget available, and it might not fully engage stakeholders. Whatever the challenge,

it's vital for the organization to assure its users that any risks and vulnerabilities are being addressed and that access to its new 5G-powered technologies will be simple. Organizations must make these technologies as trouble-free for their users as possible. Otherwise, their transformation efforts will have been in vain.

Healthcare will garner the greatest benefit from 5G when it eventually becomes pervasive. 5G has the potential to enable all the use cases listed in this paper and more. Its implementation will improve the quality of care and of the patient experience, reduce the cost of care, avoid preventable medical events and emergencies, and democratize access to healthcare – independent of geography. Rather than just reacting to a patient's condition, 5G networks can allow providers to deliver more personalized and preventative care. More than that, when paired with human expertise, 5G-powered technology has the power to elevate public services, relieve resource restraints and crucially, save lives.

Conclusion

5G is going to forever transform the way we experience healthcare. The transformation journey won't be straightforward, though. It's important to manage multiple stakeholders, challenges, expectations, and uncertainties.

No one can be entirely successful on their own. That's why it's vital to explore the different partnerships and collaborations available in the market; to share the investments and mitigate the risks.

We've reached the point of no return with this new network disruption. The time to embrace the future is now.

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