



5G in healthcare

How the new wireless standard can connect a post-COVID healthcare ecosystem



Executive summary

In a hospital ward in Wuhan, China — at the peak of the COVID-19 pandemic in the city that was the epicenter for the global outbreak — 12 robots glided across the floor. Their primary tasks: taking patient temperatures, delivering meals and disinfecting the facility. More than just an advance in automation, these robots were saving lives. Ill patients received much-needed attention, and healthcare workers were afforded distance from the contagion and a safer ward to work in.

Easily lost in the details of the story of this eye-popping, unique healthcare automation is the telecommunications breakthrough that made it possible; namely, a 5G network, the next generation of wireless communication technology. Without the significant speed, reliability and quality of 5G, managing a fleet of robots to do such intricate chores would be out of the question.

But perhaps more important, this innovation hints at the ways 5G networks could transform — and improve — all of the critical components of healthcare, a subject especially meaningful today as the spread of the coronavirus has put unprecedented stress on healthcare systems around the world. 5G's features could prove valuable in many areas of healthcare, including telehealth, remote surgery, transferring large medical files, tracking patient movements inside facilities, using wearable devices for real-time monitoring, and delivering continual treatment information and support to patients. In short, 5G promises to provide essential levels of connectivity to enable a new health ecosystem — one that can meet patient and provider needs accurately, efficiently, conveniently, cost-effectively and at substantial scale.





5G's remote possibilities

The potential of 5G springs from the fact that its technical attributes represent a quantum leap forward from its predecessor, 4G. 5G is capable of achieving speeds approximately 100 times faster than 4G's while also handling vastly more connections. And these advantages are strengthened by ultra-low latency, the time it takes for the network to process a request.

In assessing the impact that 5G could have on healthcare, it's important to keep expectations in check. For one thing, widespread implementation of 5G is still some ways off. Although there are pockets of 5G installations by telecom companies in all of the largest countries, the availability is generally limited to small cell zones in urban areas. Extensive deployment is not expected until about 2025 in many developed markets. In addition, broad consumer acceptance of 5G applications like wearable medical devices and telemedicine is unlikely to occur in the next few years, though the COVID-19 pandemic has probably accelerated this timeline significantly. And with how sensitive and confidential medical data is, concerns about security and privacy are already being raised about healthcare records being transferred across enormous, often global public networks.

In the context of the COVID-19 pandemic, much attention has focused on 5G's potential to support telehealth services, or doctor's visits conducted via computer, which are helpful when physical distancing is required or when patients are located far from healthcare facilities. Basic, one-on-one, low-touch sessions are already feasible over existing 4G and fixed broadband infrastructure. But 5G offers the potential of moving these interactions a big step forward by, for example, adding sensors and virtual

reality to teleconferencing, enabling healthcare workers to remotely monitor vital signs during calls. In addition, because 5G can transmit sizeable data packages, testing patients with conditions for changes in their heartbeat, blood sugar and blood pressure multiple times a day using cloud-linked scanners is also possible. These advances, in turn, would unlock more insights into the day-to-day health of patients.

As in other sectors, including transport, manufacturing and retail, combining and integrating 5G with a wide array of other advanced technologies — AI, the Internet of Things (IoT), the cloud, big data analytics, geolocation sensors, real-time monitors — is essential for healthcare to apply the full potential of 5G.

5G's technology specs far surpass those of other wireless protocols

Feature	Description	Real-time high-capacity, low-latency applications		
		Wi-Fi6	4G	5G
Latency	Delay between the sender and receiver of the data — the lower the latency, the more 'real time' the experience of the event	20 milliseconds (ms)	30–50 ms	1–10 ms
Reliability/availability	How efficient the network is in transporting data between the source and destination without packet loss	99.99%	99.99%	99.99%
Throughput	Theoretical maximum amount of data moved from one place to another in a given period	9.6 Gbps	300 Mbps–1 Gbps	10 Gbps
Speed (project driven)	Expected practical speeds per user or device	1 Gbps	20–50 Mbps	Up to 1 Gbps
Connection density	Number of connected devices per unit area	8 per part	12 per part	100 per part
Energy	Comparative power consumption levels	Medium	High	Medium

Source: PwC



5G's impact on the healthcare value chain

The benefits of 5G will be felt differently by each of the key participants in the healthcare value chain: providers, payers and pharmaceutical companies. But on the whole, 5G networks hold out the promise of major improvements in efficiency and outcomes, positive results that ultimately feed through to patients.

Providers

The onset of the COVID-19 crisis exposed a flaw in the operations of many healthcare providers — including hospitals and local/regional health authorities — who found themselves at the eye of the storm: manual inventories of devices. As the anticipated need for ventilators and other emergency devices grew, hospitals were scrambling to figure out whether they would have sufficient equipment to deal with the expected crush of seriously ill patients. In many cases, device inventories were not electronically tagged, and manually maintained lists were ragged at best. Hospitals have generally resisted sophisticated inventory monitoring systems because their tight profit margins make them loath to earmark expenditures for new computer systems and training that could upgrade efficiency but not generate a tangible return on investment.

But 5G could do much more than just track equipment. 5G-enabled devices could also monitor vital variables such as bed occupancy levels, as well as the movement of people — physicians, nurses, patients — around the hospital. These insights could then be integrated into the hospital's electronic medical records (EMR) system, making it possible to visualise and manage hospital activities with unprecedented clarity and granularity. The resulting visibility would provide the basis for highly effective operational improvement initiatives.

In perhaps a more futuristic vein, 5G technology could change the face of how providers deliver medical care and alter the relationships between patients and doctors. Telehealth, which we are just beginning to

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harness, will in time be routine. And it will be amplified by the use of wearables. Remote monitoring via wearables, 5G networks and cloud analysis and processing has been termed the ‘Internet of the body.’

A further 5G opportunity for providers is so-called remote operations. Although video demonstrations of surgical techniques and broadcasts of operations via fast-speed 5G networks are already viable, the real breakthrough will come with the emergence of the ‘tactile Internet.’ Enabled by the ultra-low latency of 5G, the tactile Internet would enable a physician to perform a procedure on a patient who is in a different location. The surgeon’s movements at one site would be recreated instantaneously by computerised equipment at the other site, an innovation that could particularly benefit patients in rural areas or smaller regions, where surgeons specialising in complex procedures may not be readily available.

Payers

5G-networked wearables can also be a boon for healthcare payers — whether they are a private insurance company or a government. Payers have large financial incentives to keep their individual clients healthy and to catch medical emergencies early so they can be treated before the situation requires outsized and expensive diagnostic tests and treatments. Expanding the use of wearable monitoring equipment to, for instance, more diabetics or patients at risk for cardiac issues could save lives, improve the health of the general population and cut payer outlays significantly. As the price of setting up 5G connectivity declines, it will become feasible for health plans to provide monitoring devices to every policyholder whose health outcomes (and costs) could be improved by such equipment.

Payers will also benefit from the substantially increased speed and bandwidth available on 5G networks, compared to current telecommunications systems, inasmuch as these capabilities enhance the treatments that physicians can employ — leading to better patient outcomes. For instance, in many cases, MRI scans and other critical images must be sent to a specialist for review, a transmission that can take a long time or even fail if the network is not equipped to handle large files the way 5G can. As a result, diagnoses could be slowed and compromised and treatment delayed, ultimately adding significant costs to the physician–patient interaction that will be borne by the payer.

Similarly, 5G can enable advanced technology-assisted treatments that have been shown to improve outcomes and potentially lower costs associated with individual cases. One illustration: augmented reality (AR), virtual reality (VR), AI and robotic equipment linked to large databases and sensors can aid in complex operations by offering surgeons visibility that they may not have otherwise and by recommending procedural steps based on the latest accumulated medical knowledge.

Pharmaceutical companies

Clinical trials greatly depend on a constant flow of data detailing patients’ responses to the therapies under investigation. In some cases, the participants in the trial take their own vital signs every day and self-report them via a website. In others, they go into a doctor’s office or hospital for diagnostics.

5G infrastructure and connectivity may now provide drug manufacturers with the incentive and opportunity to place IoT-connected monitoring devices in the participants’ homes during clinical trials. This would reduce administrative overhead and processing costs, in turn bringing down the price of each trial and enabling pharma companies to trial more drugs each year. And the availability of the data in real time might shorten the cycle time of a trial from, say, eight months to six, meaning the company can get the drugs to market faster or more quickly halt trials that aren’t working.



A new health ecosystem

As use of 5G in healthcare increases, with its applications boosted by advances in robotics, IoT and AI, a new connected healthcare ecosystem will take shape. In our view, this ecosystem will align with a relatively recent idea known as 4P medicine — that is, it will be predictive, preventative, personalised and participatory.

Predictive

Equipped with a constant flow of instantaneous data on patients' vital signs and relevant alerts, blended with information on lifestyle behaviors and social factors, the new health ecosystem will be better able to predict risks to patients. Simultaneously, it will furnish healthcare providers with early warnings of patients' problems. In turn, physicians and nurses can use these insights to intervene or respond effectively before the problem escalates. Although 5G won't be central to the predictive process itself, it will underpin the ubiquitous connectivity and scale of the ecosystem that collects, analyses and shares the data.

Preventative

Being predictive boosts the ability to take preventative action. An apt example — especially relevant in the context of the COVID-19 outbreak — is the ability to track and trace with unprecedented accuracy the location and proximity of vast numbers of people using smartphone apps, as evidenced in South Korea. During a contagion, this geolocation data can be combined with diagnostic profiles and ongoing testing results to pinpoint factors like who is most at risk and who may be unwittingly passing an as-yet asymptomatic illness on to other people. Individualised alerts and interventions to stifle the spread of the outbreak can then be initiated.

Personalised

The combination of constant real-time health monitoring over 5G networks will provide substantial opportunities for personalising people's healthcare experiences and interventions. Care providers can use the tactile Internet, for example, for remote examinations of patients who are unable to get to a large clinical facility that specializes in their condition. In addition, well-being advice can also be tailored and delivered to the individual, confidentially, at a population-wide scale.

Participatory

In the 5G-enabled health ecosystem, patients will become less passive consumers of healthcare and more engaged participants in driving their own outcomes. Currently, the average patient in the US spends about 15 hours a year with a healthcare provider, but has more than 5,000 waking hours to care for themselves. By 'activating' some of those 5,000 hours — that is, taking independent actions to manage their well-being, diagnostics and treatments — patients can improve their quality of life and medical outcomes and, at the same time, reduce overall costs in the healthcare system. One study found that after controlling for demographics and health status, an activated patient costs US\$1,987 less annually than a less activated patient, a 31% difference.



The privacy challenge

To realise the full potential of 5G networks in healthcare settings, network security and data privacy are paramount. Nothing is more sensitive than an individual's medical records. And in order for patients and participants in the healthcare value chain to freely use, without fear of data theft, advanced communications programs for healthcare interactions and activities, the 5G networks that serve as the backbone must be protected from cyber intruders.

In our view, there are three prongs to a robust and effective cybersecurity and privacy strategy for 5G networks used in healthcare:

Zero-trust approach. There should be a robust security posture from end to end for all devices and software on a 5G network. Each device and application must be assessed for cyber risk and allowed access to network resources only if they meet high security standards. Also, all software must be constantly checked for vulnerabilities and malware. Permission to view the most sensitive patient data should be reserved for limited communications nodes, and these connections must be continually and rigorously tested for potential security gaps.

Universal encryption. To minimise the risk of data being compromised or corrupted, telecom operators and other 5G participants should adopt strong encryption methods for traffic between endpoints and services. These methods should be flexible enough to be strengthened progressively over time as standards and risks evolve. And they should be sufficiently agile to thwart 'man in the middle' attacks, in which hackers eavesdrop on communications between two network participants who believe they're communicating directly with each other.

Orchestration by AI. Machine learning and AI should play a big role in identifying and mitigating mutable cyber risks, providing high levels of automated intelligence to manage and root out security intrusions

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across hyper-dense communications and ultra-low latency applications. These technologies can be counted on for traffic analysis, network packet inspections, threat identification and infection isolation.

Government regulators and policymakers must also develop rules and provide oversight to protect patient privacy as 5G in healthcare expands. These measures should be designed to enable interoperability and the expansion of communications networks, programs, applications and devices while ensuring end-to-end security and data privacy for sensitive information. There should be rigid privacy standards for connected medical devices, data processing equipment and activities and always-on networks that give end users control over the data generated, stored and communicated by 5G-driven equipment and networks.

Defined parameters for testing all new equipment and software for cyber threats and privacy vulnerabilities in real-life healthcare use cases should also be established. Moreover, periodic revision of the data-security testing and approval regime for technologies that are still evolving, such as medical applications of the cloud, AI, sensors and the IoT, should be undertaken to guard against privacy gaps arising during the development of new platforms and devices.

ADAPT

Although this paper focuses on advancing telecommunications technology primarily in a post-COVID environment, it's our view that similar transformations are occurring in commercial, economic, fiscal and monetary policy writ large. Broadly speaking, the virus is both accelerating powerful existing trends, such as automation and inequality, and slamming the brakes on trends that had, until very recently, possessed tremendous momentum, such as globalisation. PwC has developed an ADAPT framework — addressing economic asymmetry, technological disruption, population age, political polarisation and trust in institutions — for companies, technologists, government and organisations to deal with this rapidly changing landscape. For more on this, see [*Adapting to a new world: Facing the challenges of the post-COVID-19 landscape.*](#)





Conclusion: The 5G future

5G could help transform healthcare, providing networking reliability, speed and scale that advance medicine, patient services, treatments and wellness programs in significant ways, as we've seen in the examples described above. But with so many new ideas floating around this topic these days, especially as a pandemic reminds us of how impotent and fragile our healthcare systems can be in the face of natural disasters, we believe that healthcare companies and healthcare technology providers should determine the soundness of their proposed 5G applications by testing to see if they would be markedly improved by any of the three primary advantages of these networks: ultra-fast broadband, ultra-low latency and massive machine connectivity.

Overall, the message is clear. By combining 5G with other leading-edge technologies, we can create the opportunity to transform many aspects of patient care, while catalysing the emergence of a new healthcare ecosystem — one that will be more connected, more intelligent and more efficient in its use of resources than the current systems. There are still many hurdles to overcome — institutional, cultural and technological — before 5G networks will be commonplace in healthcare. But the success of 5G-enabled applications will most likely depend upon taking into account what patients (who are really the center of the healthcare ecosystem, new or old) need most and want.

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