Combating COVID-19 with 5G

Opportunities to improve public health systems

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Abstract

Since the COVID-19 outbreak started, it has put tremendous pressure on public healthcare systems and epidemic response mechanisms across the world. In China, telecommunications operators collaborated with Huawei to rapidly set up a specific 5G network dedicated to COVID-19 treatment hospitals. In tandem with innovative applications, 5G is driving the transformation of emergency response mechanisms to become digital, accurate and smart.

In collaboration with Huawei, Deloitte has analysed examples of COVID-19 control and treatment in China to ascertain the data demands of different stakeholders during major public emergencies. As well as presenting these findings, this report discusses how key features of 5G, such as high speed connection, large arrays of connection points, low latency and expansive data bandwidth can synergize with big data, AI, and the Cloud. Together, these technologies can enhance the effectiveness of pandemic prevention and treatment, and drive the digital transformation of healthcare systems in response to major public emergencies.

COVID-19 Outbreak Recap

The COVID-19 outbreak started in China at the start of 2020. Following the first confirmed case in early January, the virus spread rapidly across the country, soon reaching a daily average of 1,500 new confirmed cases. During the height of the outbreak, more than 3,000 new cases were confirmed each day[1]. As of midnight of 16 March, China has recorded 81,116 cases nationally.

Since mid-February, the outbreak in China has been contained, yet the virus is now spreading outside the country. As of 16 March, more than 113 countries and regions have reported confirmed cases with more than 98,780 patients infected by the virus. Italy and Iran have the most cases outside China, with 27,980 and 14,991 confirmed cases respectively[2].

The outbreak was initially concentrated and escalated rapidly, putting enormous pressure on local healthcare systems
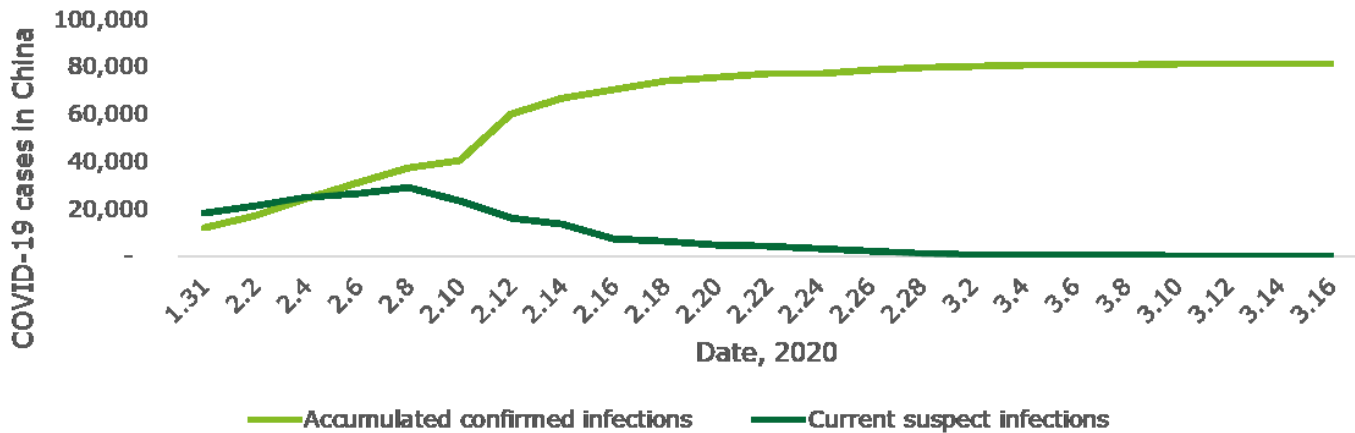
Source: National Health Commission of the People's Republic of China

Compared to SARS, another illness caused by a coronavirus, the symptoms of COVID-19 are less obvious, yet the virus is highly contagious and infected individuals can rapidly develop serious health conditions. These characteristics have made the outbreak difficult to control, shocking both public health and economic activity across the globe.

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[1] 15,153 new cases were confirmed in a single day - 12 February. With all the efforts and technologies, the COVID-19 crisis is under control in China now. Source: National Health Commission of the People's Republic of China, Deloitte analysis

[2] Source: National Health Commission of the People's Republic of China, Deloitte analysis

Data Challenges in Epidemic Control

Fighting COVID 19 will be a battle for everyone in the community. In each country, the government is responsible for the quick control of the illness, allocating sufficient resources for patients and providing effective medical care. In addition, the government needs to engage local communities in the process, supplementing treatment as the virus spreads among them. When necessary, suspected cases will have to be quarantined and an individual's movements restricted. The Chinese Government was tasked with monitoring the spread of the virus, and supporting those in need to control the outbreak and stabilize society. In China, due to its vast landscape, large, highly mobile population and their complicated demand for resources, the effectiveness of communication and data exchange have been essential in screening for infected individuals and controlling the outbreak.

The data requirements of different population groups

	Thermal imaging	Movement tracking	Teleconferencing	Real-time data	Case sharing
Healthy	High	Medium	/	/	/
Suspected case	High	High	Medium	/	/
Confirmed case	/	Low	Medium	High	High
Critical	/	/	High	High	High

Demand for data: =Low =Medium =High

Source: Deloitte analysis

These data requirements vary in different scenarios:

- **Monitoring**: An HD thermal camera and real-time movement tracking system can improve screening accuracy and efficiency. It can also reduce the amount of manual work required, but needs a robust network to transfer and store large amounts of generated data.

- **Quarantine:** Once a suspected case is identified, it is critical to perform accurate testing quickly, as an individual will need to be relocated and immediately treated if an infection is confirmed. This means data networks need to provide fast, stable connections for devices to perform remote testing without delay.

- **Treatment:** Front-line medical care operations always face the challenge of limited resources and an increasing number of patients. Remote medicine can address these constraints as it enables medical experts, to get real-time data, perform livestreamed HD diagnosis, development treatment plans and share their experience of cases with fellow professionals – without having to be in close proximity to patients. To do this, and maximize utilization of available medical resources, a supporting network needs to be reliable and fast with minimum delay, and have extensive bandwidth for data transmission.

Epidemic control scenarios
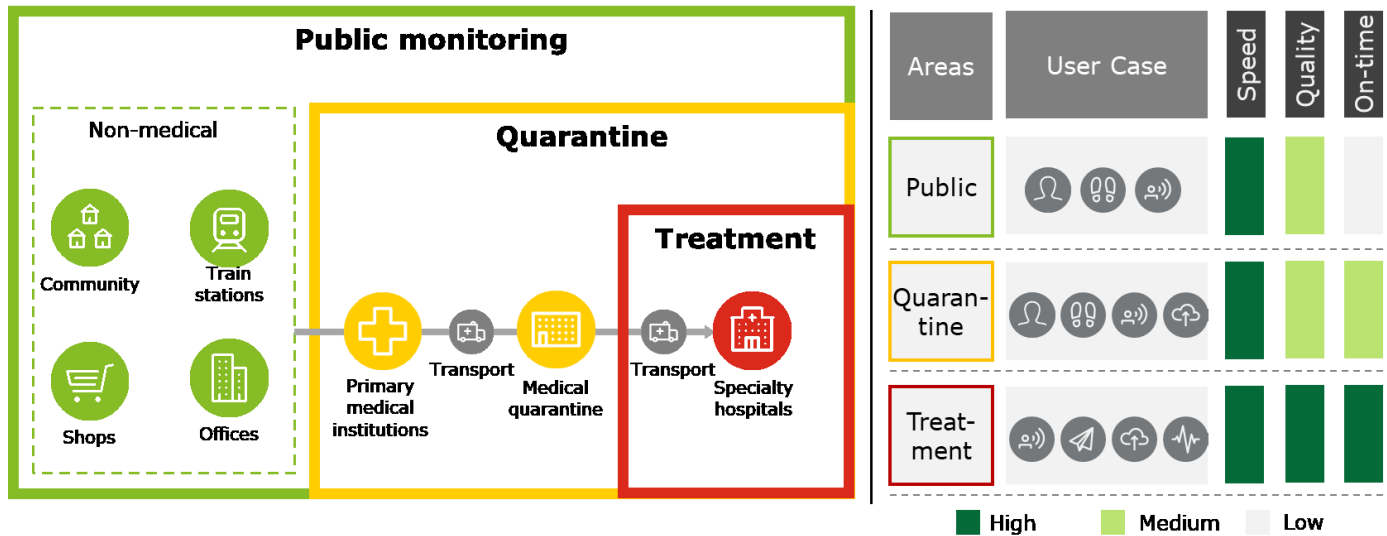
Source: Deloitte analysis

The epidemic has also highlighted the need to build and upgrade public health emergency response mechanism, requiring the government to make quick decisions and allocate resources more effectively.

5G's Impact on Epidemic Control

5G has advantages over 4G in speed, latency, number of connection points and range making it more adaptable. These features can address data transmission challenges during an epidemic, as well as open up possibilities for fresh ideas and new treatment methods.

4G and 5G network comparison

	Speed	Range	Latency	Connection points
4G	0.05 – 0.1 Gbps	Max 350 km/	10-100 milliseconds	10,000/km²
5G	0.01 – 1 Gbps	500 km/h +	Less than 1 milliseconds	10,000,000/km²
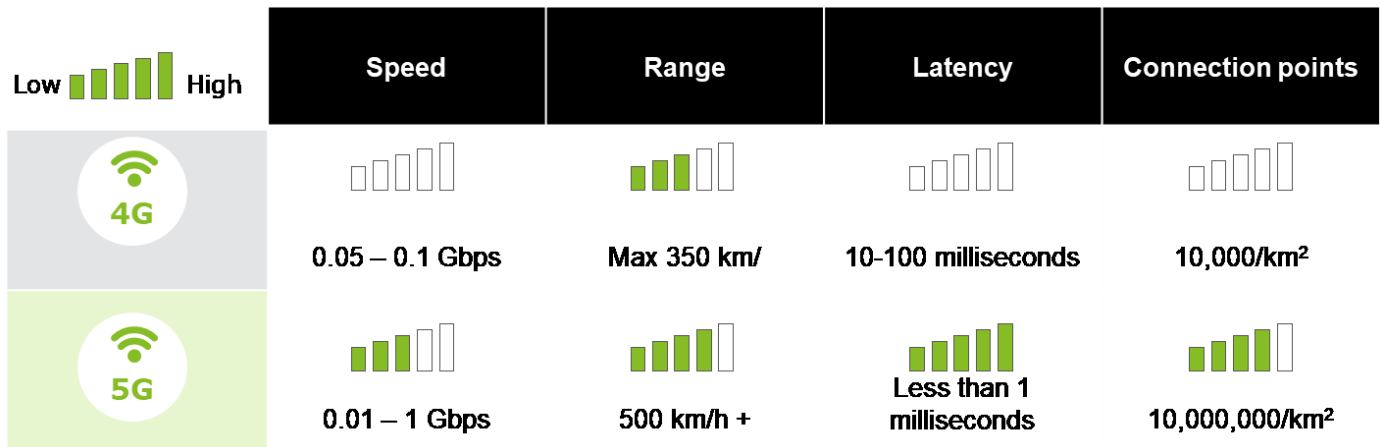
Source: Deloitte analysis

Accurate monitoring in public areas

The key steps in outbreak monitoring include identifying virus carriers who are interacting with the public, quarantining suspected patients, providing immediate medical care and ascertaining people's travel history to identify potential infections, adopting the digital technology like the public health management tool, which people can generate a "Health QR Code" on their mobile phones. Collecting data on public health (e.g. body temperatures) and movement (e.g. travel histories and close personal connections) is also important for virus control. However, 4G networks do not have the capacity to fully support large volumes of HD images, such as the transmission and storage of files, and dynamic personal movement tracking inputs including thermal imaging, travel history and close connections. 5G can better address these requirements.

- **5G+ thermal imaging supports contagion monitoring**
  A 5G+ thermal imaging temperature monitoring system consists of an Infrared Radiation (IR) camera, body temperature measuring unit and 5G network module. It can accurately monitor a moving object's temperatures in real-time without contact and, issue abnormal temperature alerts. Through 5G networks, the data collected by terminals can be sent to central monitoring units and shared to the Cloud in real time with no lag. This enables 24-7 online public temperature monitoring, imaging and travel and contact history tracking when needed.

5G thermal temperature monitoring system
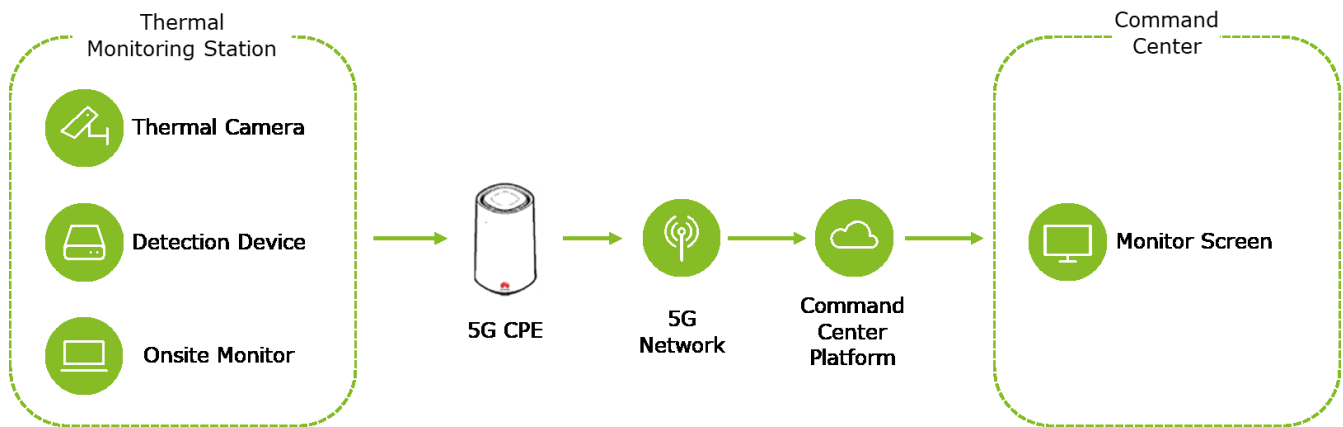
Source: Deloitte analysis

Since the COVID-19 outbreak began, 5G+ thermal imaging temperature monitoring systems have been widely deployed across China, especially in crowded places like airports, train stations and other transport hubs. They have significantly increased the efficiency of monitoring body temperature across a moving crowd to reduce the risk of virus exposure. As a wave of people returned to work, large volumes of travel were expected, and 5G+ thermal imaging could be promoted to drive the digitalization of virus outbreak control.

Communication support during patient transfer

HD remote diagnosis and other medical monitoring systems are required when infected people are being transferred to hospital. 5G networks can provide the bandwidth, speed, and mobility needed to stably transmit large data sets in real time.

- **5G enables continuous remote monitoring and diagnosis during patient transfer**
  Once an individual is identified as a suspected or confirmed infection, treatment becomes a race against time. In China, the peak of the outbreak was concentrated into a short period and, medical emergency systems were tested by a large volume of cases. According to media reports, the average number of ambulance dispatches in Wuhan was about 400 a day in January 2019, but jumped to 600 during the coronavirus outbreak, with some days recording more than 800 dispatches. Some SMART ambulances carry emergency care communication and diagnostics kits, serving a unique role in the healthcare system. Apart from transporting patients safely, they provide emergency treatment remotely, as well as collecting and transmitting information to hospitals so they can develop treatment and quarantine plans. To achieve this, the network needs to provide fast, stable data transmission that can support these rapidly moving objects such.

  Benefiting from 5G networks' fast data load speeds of over 100Mbps, SMART ambulances with 4K HD monitoring systems can send videos and transmit medical data to command centres in real time, allowing support staff to communicate with ambulance crews. If necessary, a command centre can initiate diagnosis conferences with experts and ambulance crews for emergency response, ensuring a patient's smooth transition from the ambulance to hospital. This combination of 5G network and 4K SMART ambulances transforms the medical emergency response model: it digitalizes its operation, from mobilizing treatment to data collection and real time communication, improving treatment efficiency and effectiveness.

5G + 4K SMART ambulance network
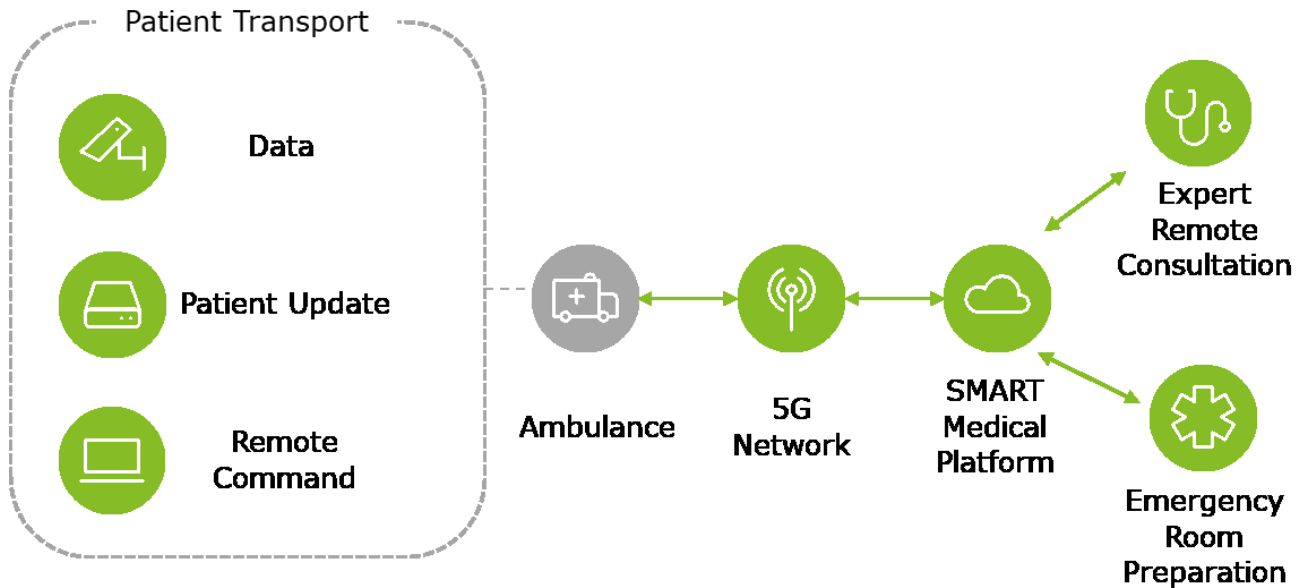
Synergetic collaboration during treatment

Big data is at the core of SMART medical care, covering stages such as consultation, diagnosis and treatment. While treating patients, hospitals need to stay closely connected with one another and maintain effective communication. Case studies and medical data should also be consolidated and shared promptly, providing valuable reference for other hospitals and scientific research institutions. 4G can meet basic data transmission needs, but with rapid increases in data volume and mounting demand for remote, HD-video based treatment, there is a substantial need for upgraded networks with faster connections and more bandwidth.

- **5G remote platforms to improve consultation effectiveness and efficiency**
  Traditionally, consultation teleconferencing is hosted via wired networks. This requires large infrastructure investment and high maintenance costs, yet has low mobility, limiting its use to a single space and preventing movement to different locations such as patients' rooms and ambulances. In addition, remote medical consultation requires real time video conferencing and image transmission. 5G is an ideal technology to meet teleconferencing requirements, it can support 4k/8K ultra HD conferencing and data transmission, which requires network speeds of at least 50 Mbps to 100 Mbps. This enables medical experts to treat patients without constraints on their physical location, and can substantially improve the accuracy and efficiency of consultations.

5G remote medical consultation platform
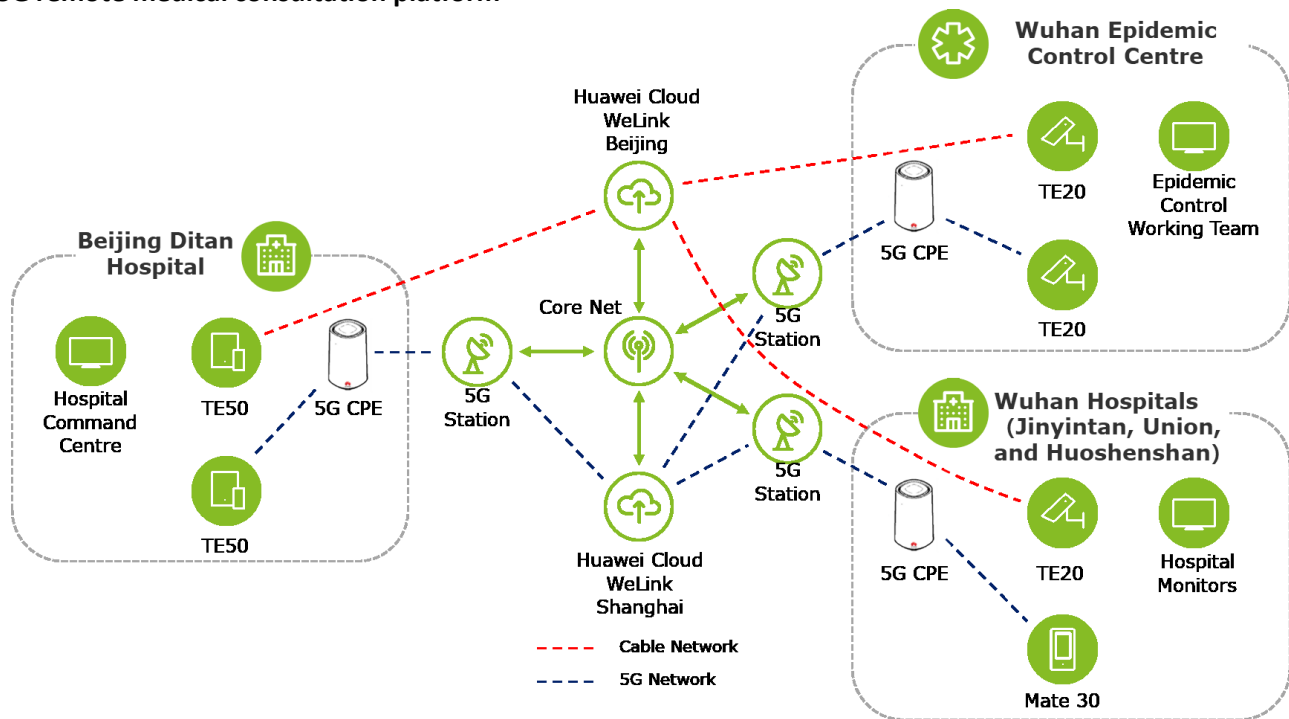
Throughout the coronavirus outbreak began, 5G remote consultation has had clinical trials in multiple locations. At Wuhan Union Hospital, a 5G remote consultation platform is hosting daily appointments with patients in different campuses, enabling them to connect with experts at leading medical institutions such as Beijing Union, Beijing Chao-Yang and Wuhan Oncology hospitals. In Wuhan's Huoshenshan (Fire God Mountain) Hospital, a temporary facility built exclusively to battle the coronavirus, medical staff can seek support from experts in Beijing via a 5G consultation platform, providing access to all available resources. This has improved the efficiency and effectiveness of diagnosis and treatment, reduced the workloads of overstretched medical staff, and reduced the risk of experts being exposed to the virus.

- **5G remote imaging diagnosis platforms enhance collaboration**
  With advances in technology, medical imaging has become an important method of diagnosis. Picture Archiving and Communication Systems (PACS) are at the core of the 5G SMART healthcare ecosystem. When combined with 5G networks, advanced big data analytics and AI, they can automate analysis models and machine learning, greatly reducing the time required and manual work involved. In the battle against COVID-19 in China, remote imaging proved effective in a pilot program at Wuhan Leishenshan (Thunder God Mountain) Hospital, another temporary facility built exclusively for virus patients. Doctors from Chinese PLA General Hospital have performed B-scans of quarantined patients in Wuhan via 5G platforms, achieving real time feedback and diagnosis and reducing the burden of front-line workers.

- **5G SMART medical robots to help care for quarantined patient**
  In additional to technical support during treatment, 5G also provides innovative patient support and care solutions for front-line medical staff. Medical robots developed for the 5G environment could undertake routine tasks like floor checkups, cleaning and sanitation and medicine delivery, to improve efficiency and safety in quarantine areas. More importantly, they can free up valuable human resources from repetitive work so they can be deployed to value-added tasks including complex care for critical cases.

5G Inspiring New Business Models

During the most critical period of the COVID-19 outbreak, all of major cities in China were mobilized to follow the mobile hospital - "Xiaotangshan" model, rapidly building multiple emergency facilities such as Huoshenshan and Leishenshan hospitals in Wuhan. Huawei and other telecommunications suppliers collaborated with the Big Three telecommunications operators in China to quickly set up a 5G network to cover the new hospitals. It took only three days to build, test, and run 5G networks for Huoshenshan Hospital in Wuhan and Xiaotangshan Hospital in Beijing. In Heilongjiang Province, the 4G and 5G networks for an emergency response centre were built within 32 hours. All these outstanding achievements were made possible by the dedication of the community, and showcased the easy setup and fast operation features of 5G networks. For example, a 5G Active Antenna Unit (AAU) can significantly improve network performance and reduce the number of cable connections required, while innovative "mini post stations" can be set up by street lampposts with minimum effort. These designs enable rapid network set up and quick 5G connection, and could inspire "5G speed" deployment across the country.

As a result of 5G features such as high speed connection, high reliability and low latency, the healthcare system has benefited from improved response times, patient monitoring, data collection and analytics, remote collaboration and resource allocation. It also sets an example for digitalized, data driven and Cloud-based innovative major public emergency response platforms. The success of 5G applications in the public health domain could also inspire businesses in other sectors to leverage 5G's popularity and explore new applications of the technology.

Innovative public emergency response platform design
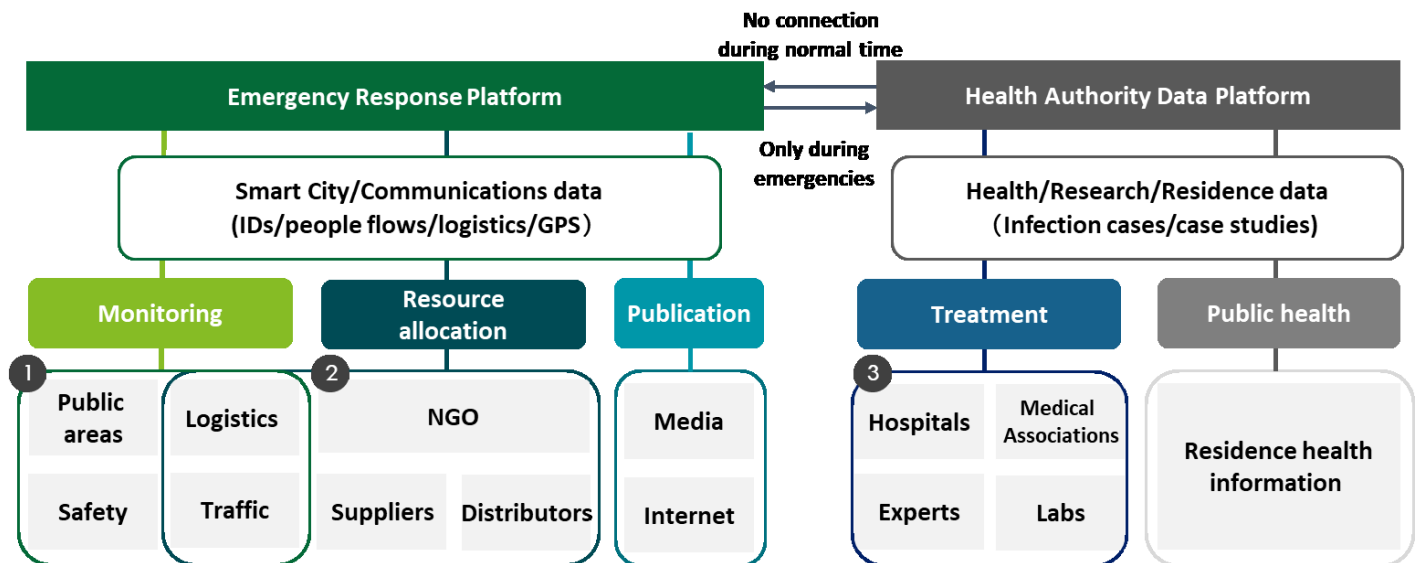
Source: Deloitte analysis

1. **Epidemic monitoring platform**
    5G technology's high-speed data transmission and advanced data analytics can consolidate large amounts of fragmented information (such as thermal image, facial recognition, identity, cargo tracking and crowd movement tracking data) from multiple sources, and enables AI and big data to identify potentially infected individuals interacting with the public. It can improve monitoring accuracy and efficiency, and reduce heavy manual work involved in the process. With 5G, innovative tools and solutions for epidemic control are available to improve efficiency.
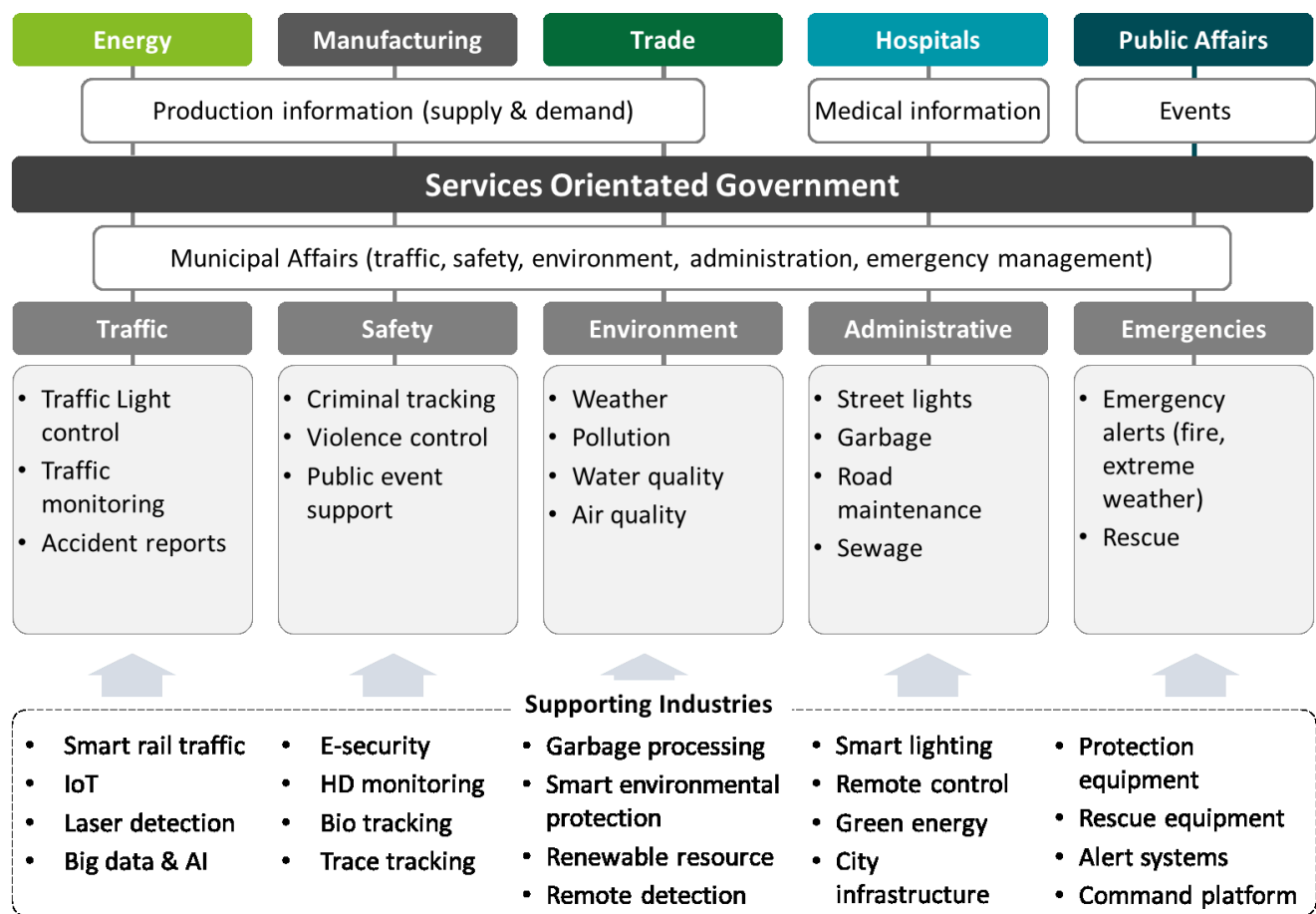
a. 5G epidemic prevention patrol drone

5G drones can patrol and monitor designated areas, it can send images back to a control centre, making public announcements and warning individuals against necessary prevention behaviour such as not wearing a face mask.

b. 5G smart robots

In public areas such as airports, train and subway stations, hospitals, shopping malls and office buildings, 5G smart robots can monitor crowd movements in real time, identifying individuals with higher than normal body temperatures and those not wearing masks, sanitizing areas where there are infections and broadcasting important announcements

5G applications used in epidemic control could also drive the development of a more efficient smart city management model. 5G's data transmission capability can be used in various areas of urban planning management, including traffic planning, smart public safety and smart environmental protection, as well as inspire municipal governments to explore new models of city management. With support from 5G and big data, local governments can break through barriers to information and communication, improve the efficiency of decision making and enhance collaboration in resource allocation to address the demands of citizens and enterprises. We expect supporting industries including network infrastructure manufacturing and development, smart data collection devices, HD image recording systems, municipal service platform development, multiple source data analytics and remote control and testing systems to have potential for further development.

Smart City connected platform model

Energy	Manufacturing	Trade	Hospitals	Public Affairs
Production information (supply & demand)			Medical information	Events

Services Orientated Government

Municipal Affairs (traffic, safety, environment, administration, emergency management)

Traffic	Safety	Environment	Administrative	Emergencies
• Traffic Light control • Traffic monitoring • Accident reports	• Criminal tracking • Violence control • Public event support	• Weather • Pollution • Water quality • Air quality	• Street lights • Garbage • Road maintenance • Sewage	• Emergency alerts (fire, extreme weather) • Rescue

Supporting Industries

• Smart rail traffic • IoT • Laser detection • Big data & AI	• E-security • HD monitoring • Bio tracking • Trace tracking	• Garbage processing • Smart environmental protection • Renewable resource • Remote detection	• Smart lighting • Remote control • Green energy • City infrastructure	• Protection equipment • Rescue equipment • Alert systems • Command platform

Source: Deloitte analysis

2. **Natural disaster command centers**

Resource allocation platforms for natural disaster response can be equipped with 5G and Internet of Things (IoT) networks, enabling deep analysis of supply chains and providing real time information on front-line supply consumption, resource inventory levels, production capability, supply capability and logistics support decisions to balance supply and demand. In addition, smart resource distribution, such as autonomous driving logistics carts equipped with 5G and AI, can deliver cargo to clients in infected areas using preset routes, cutting physical interaction and reducing the risk of contagion.

Such resource allocation platforms could also direct the transformation of supply chains. The combination of 5G and IoT can accelerate the upgrade to SMART supply chains. Manufacturers could use 5G, IoT and advanced robots to achieve fully automated production, AI-based production adjustments, automated default detection and trouble shooting. In addition, being able to take a deep dive into big data could improve the efficiency and cost effectiveness of production. As 5G is a wireless technology, it reduces the complexity and cost of upgraded production lines. On the supply chain side, 5G can have a substantial impact on resource allocation in cargo shipments, express package delivery and consolidated services platforms. Innovations like SMART delivery route planning, real-time cargo tracking, big data-based supply chain network design, remote inventory management, and fully automated inventory management could be the next wave of development opportunities.

3. **Remote medical consultation**

5G networks can extend medical consultation into the community and even to individual households, enabling interaction between patients and doctors. For people under quarantine, mobility and seeking medical support are always challenging. 5G networks could integrate community and households with the hospital system so patients can consult medical staff and receive preliminary treatment through teleconferencing and image sharing. In addition, 5G's low latency makes remote surgical operations possible, reducing the risk of healthcare workers being infected onsite and maximizing resource utilization. 5G Multi-Edge Computing (MEC) can provide powerful processing via Cloud-based medical services. Remote medical care has multiple use cases, including consultation, B-scans, operations and monitoring. In the near future, SMART medical care solutions could be widely adopted through the implantation of 5G networks.

Remote medical care platform model
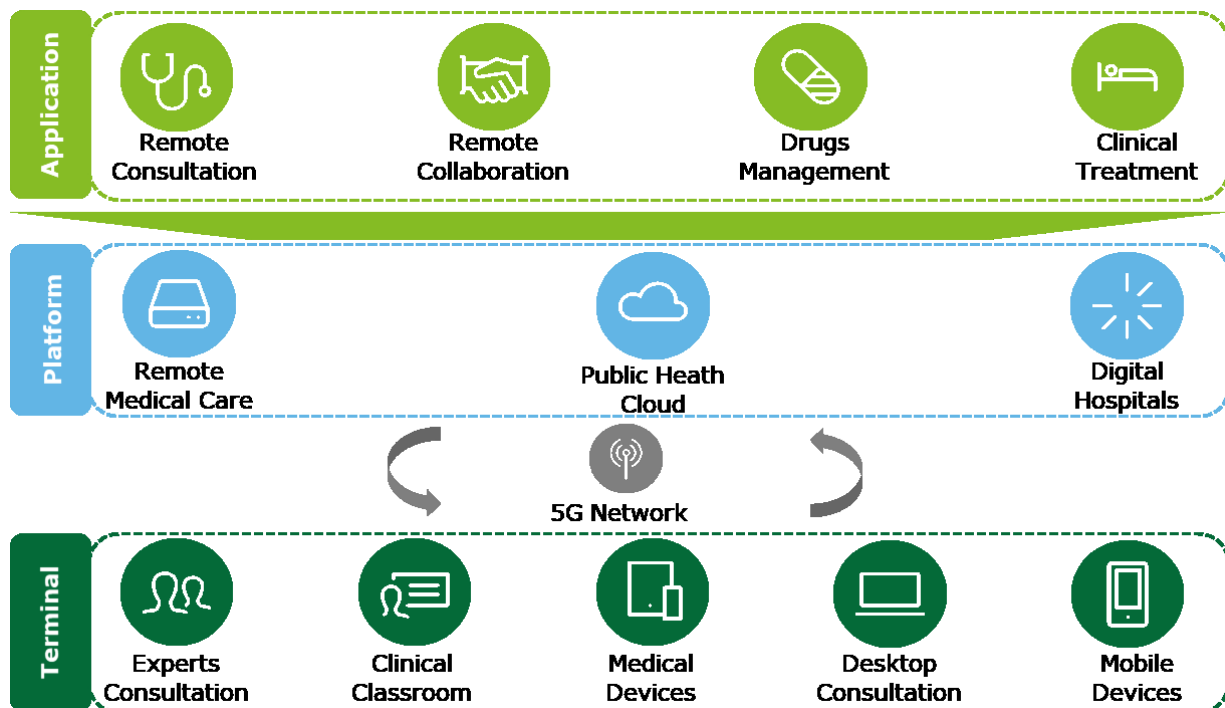
Source: Deloitte analysis

If you are interested in exploring more about technological transformation in healthcare and other sectors, or business model and operational transformation through 5G, please contact:

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