spotlight

AFP VIA GETTY

A patrol robot is used to monitor people's temperatures and disinfect wards at a hospital in Shenyang, China.

Mechanical medics to the rescue

Researchers are trying to support China's overburdened medical sector with cutting-edge robots, but progress has been slow. **By Sarah O'Meara**

In the first few months of 2020, the outbreak of COVID-19 in China, where 84,000 people have been infected and 4,600 have died, revealed the country's willingness and readiness to deploy robotic technology as part of a medical emergency. Service robots were used in hospitals and publicly shared spaces to clean, take temperatures and deliver food, to minimize contact between people as part of the fight against the coronavirus.

"I was staying in a hotel under quarantine and had my takeaway food delivered by a white, cylindrical robot on wheels with a screen on top and a digitally lockable hatch for food placed inside," says Guang-Zhong Yang, founding dean of the Institute of Medical Robotics at Shanghai Jiao Tong University – China's first academic establishment dedicated to the study of medical robotics, which opened in 2019.

"I ordered the food from the restaurant by phone, it was delivered and the robot brought it to my room and rang my phone, so I could open the door and take the food," he explains.

"In the United Kingdom, I would have classed that kind of robot activity as a novelty, but in China it's gradually becoming less unusual," says Yang, who moved to Shanghai last year after working as director of the Hamlyn Centre for Robotic Surgery at Imperial College London for 12 years.

This gear change in the use of robotics began in 2012, when China's five-year economic plan, published as a statement of intent by the central government, made it clear that service robots would become a key technology. The idea was to make them capable of performing a range of crucial social functions, from firefighting to minimally invasive surgery.

The use of robots in the medical sector, to help in areas such as nursing, physical rehabilitation and surgery, has been a particular priority, says Yao Li, a biomedical and robotics engineer at Stanford Robotics Laboratory in California and founder of Borns

spotlight

Medical Robotics, based in Chengdu, China, and Silicon Valley, California.

"China's need for skilled clinical staff in areas such as health care has contributed to the government's focus on the robotics industry to help care for citizens in the future," he says.

The country currently has a shortage of health-care workers. In 2017, China had 2 doctors per 1,000 members of its population, whereas the average in countries that are part of the Organisation for Economic Co-operation and Development was 3.5. Evidence shows that increased living standards have sparked a demand for health-care services, and that the country's rapidly ageing population will place more demands on the system in the future (Q. Wu *et al*. *Br. Med. J.* **354**, i4860; 2016).

According to Jian-Kun Hu, director of surgery at the West China Hospital of Sichuan University in Chengdu, one of China's most prestigious medical centres, his hospital began planning the introduction of robotic technology in 2012. The aims were to give patients the benefits of minimally invasive surgery and to reduce some of the heavy workload on staff. For example, during surgery for gastric or colorectal cancer, the robotic system helps surgeons to see small lymphatic vessels, veins and nerves that need to be protected, Hu says. The outbreak of COVID-19 has prompted hospitals to speed up the clinical application of robotic technology, he adds.

"The use of robots in the medical sector, to help in areas such as nursing, has been a particular priority."

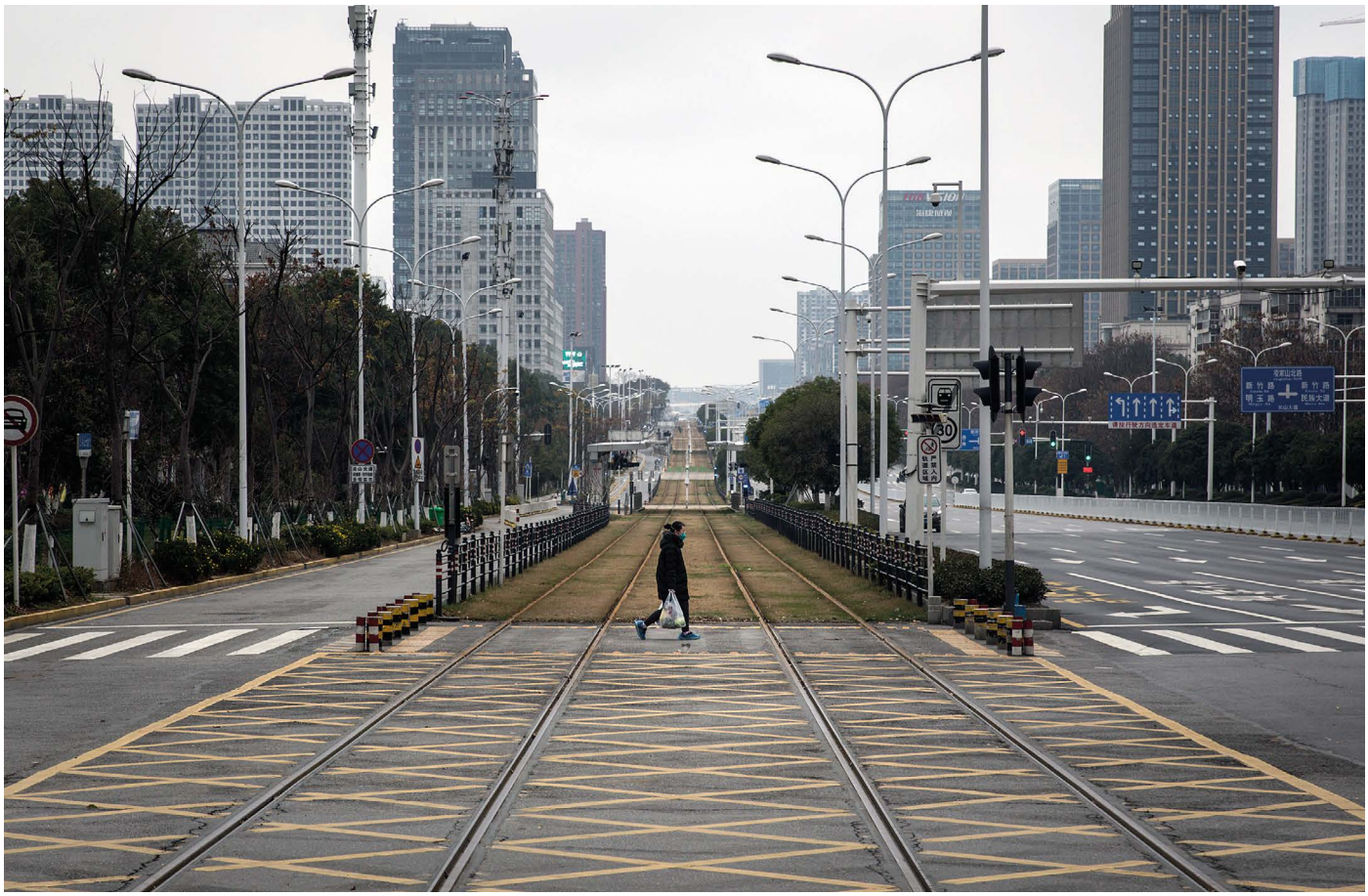
In 2015, the hospital purchased a US-made general-surgical system for minimally invasive surgery called da Vinci – a four-armed, chandelier-like apparatus operated by a surgeon through a computer console. That year, 12 other similar systems were installed in the country (see page S51). In 2018, the hospital installed a ROSA robotic surgical assistant for use in neurosurgery and last September acquired a logistics robot, which has been disinfecting isolation wards during the COVID-19 outbreak. This year, the hospital intends to expand the use of logistics robots, to reduce the burden on and danger to staff, he says.

Home-grown robots

Although hospitals are keen to use more robots, the market for such technology in China is relatively young, says Miao Li, the co-founder of Cobot, a four-year-old company in Wuhan that makes easy-to-use operating systems for multipurpose service and industrial robots.

At present, only service robots that do basic jobs such as delivering drugs and food to people are affordable to businesses and hospitals, he says. "You can now buy these simple service robots for around US$10,000 because these robots are also used in hotels, restaurants and other similar scenarios."

A disinfection robot for use in a hospital, however, will usually cost $30,000–80,000, says Li. The da Vinci technology cost the West China hospital around $3.5 million, according to HuIntuitive Fosun in Shanghai, which supplied the equipment.



GETTY

The streets of Wuhan in China are deserted during lockdown because of COVID-19, which has spurred efforts to use robots in hospitals.

What the Chinese robotics market needs, says Yao Li, is an increased number of home-grown Chinese robotics companies that will stimulate competition and demand, and ultimately lower costs.

China does not make its own equivalent of the da Vinci system, but it is starting to catch up. In 2016, Beijing-based company Tinavi Medical Technologies received fast-tracked approval from the central government to sell the TiRobot, the first robot-assisted surgical product made in China. It has a single arm that can conduct spinal surgery.

Li hopes that his company, which was established in 2016, will soon launch its robotic surgical system. He plans to make an integrated robotic product that runs on a custom-built software platform, comprising robotic hardware — including dexterous multi-jointed arms — and electronics that work with conventional surgical instruments, such as endoscopes, giving them more movability, precision and stability. Unlike other robotic systems, such as the da Vinci, the Borns platform will also act as a data centre and record information about operations that have been performed, says Li.

"We will use the data we collect from surgical procedures to improve the performance of the platform," he adds.

However, he says that the production process has been more challenging than he expected. Li is now working towards gaining the registration his company needs to start production, and predicts it could take a few more steps to bring his robot to the market.

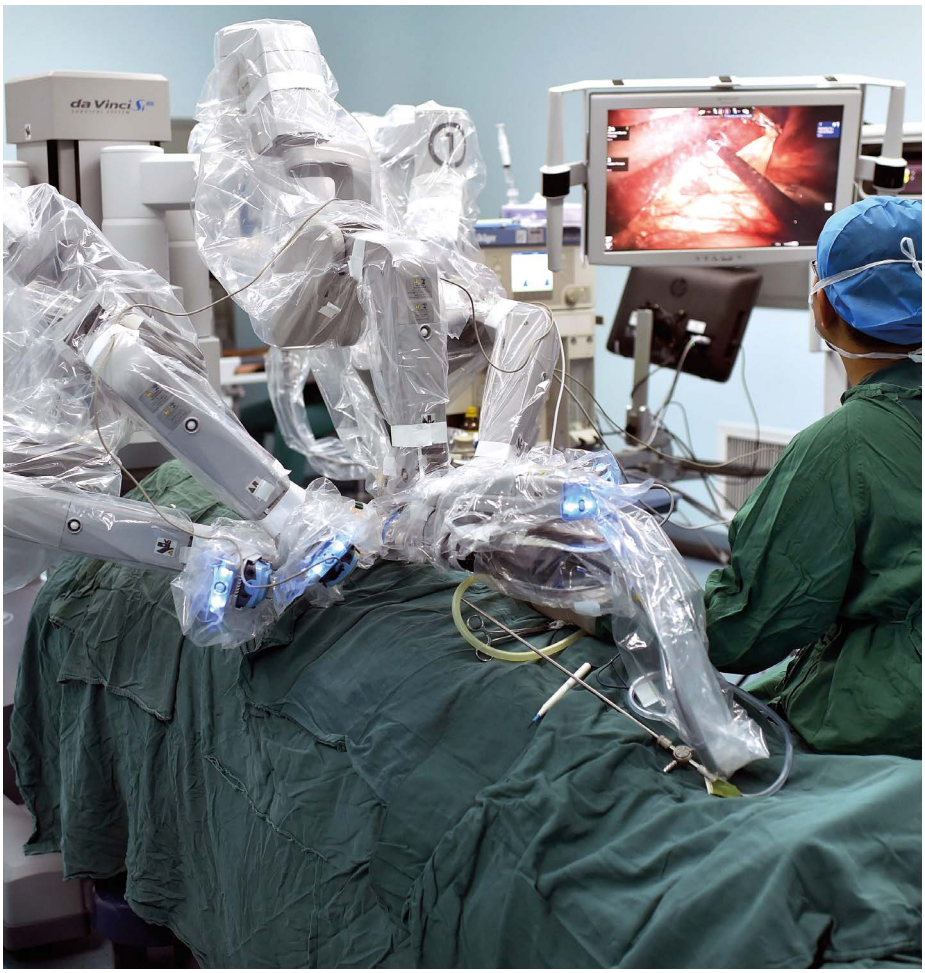
He says developing a product that fully meets the needs of surgeons, hospital staff and patients, while being affordable and also satisfying government regulations and purchasing requirements, is a difficult and lengthy process.

Despite going through a rigorous, three-phase process that includes certification of the technology's functionality, validation of its clinical use and obtaining a licence for its manufacture, Li says he hopes to have the whole process wrapped up within five years.

Li founded his company, which is funded entirely by private and venture-capital funds, with computer-systems engineer William Levine. They met when Li was a doctoral student at the University of Maryland in College Park.

"You have to think about surgeons, hospitals and patients as you're developing your product. If you can keep all those things balanced then you can keep your technology alive," says Li.

Sarah O'Meara is a freelance journalist based in London. Additional reporting by Kevin



SHUTTERSTOCK

A da Vinci surgical robot system performs heart surgery in 2017 at a hospital in Hefei, China.

MEDICAL ROBOTICS ON THE RISE

China's push to get more robots into its hospitals is starting to bear fruit. **By Sarah O'Meara**

In 2006, China highlighted the importance of robotics in its 15-year plan for science and technology. In 2011, the central government fleshed out these ambitions in its 12th five-year plan, specifying that robots should be used to support society in a wide range of roles, from helping emergency services during natural disasters and firefighting, to performing complex surgery and aiding in medical rehabilitation.

Guang-Zhong Yang, head of the Institute of Medical Robotics at Shanghai Jiao Tong University, says that China's robotics research output has been growing steadily for two decades, driven by three major factors: "The clinical utilization of robotics; increased funding levels driven by national planning needs; and advances in engineering in areas such as precision mechatronics, medical imaging, artificial intelligence and new materials for making robots."

Yang points out that funding levels for medical robotics from the National Natural Science Foundation of China and the Ministry of Science and Technology began to increase more sharply in 2011 compared to the previous decade.

spotlight

Update

Mechanical medics to the rescue

This article has been updated to replace Hu's cost estimate for the da Vinci technology with a price from the company that supplied it.

See https://doi.org/10.1038/d41586-020-01793-9