Rise of the robot in the wake of coronavirus

Steve Eames provides an insight into the role of robotic technologies in preventing infection during outbreaks, such as COVID-19, from disinfection of contaminated areas, to medical support and triage of patients. China has led the way, in terms harnessing innovation and artificial intelligence, but there is increasing potential for medical support automation in the NHS, as the technology arrives in the UK.

Even in normal times, without pandemic, there are unprecedented demands on healthcare systems globally. In the UK, the NHS is balancing workloads and productivity against economic constraints. Ageing population and the associated number of conditions to be treated will continue to be a challenge. Much is already being done by way of devolved funding and management at local level in order to maintain productivity and performance of hospitals, alongside other cost-containing efficiency measures.

Salaries and manpower costs versus patient-facing time needs to be optimised. Furthermore, while manpower and other resources can be stretched, we face a possibility of that being exacerbated further in the aftermath of Brexit. If you add to the mix an epidemic or outbreak, like we are experiencing with Coronavirus globally, it begs the question, how well were we prepared? What other tools or innovation could be deployed in order to combat and even prevent such unanticipated pressures to our healthcare system?

We have seen mixed reports on how China dealt with the recent outbreak, in which there seems to be controversy mainly around the early acceptance of the warning. Nevertheless, China is a country with its own challenges, and since the epidemic, it has taken extraordinary measures in dealing with the outbreak and minimising further impact on its healthcare system. Impressively, a hospital was constructed in a matter of days, for purposes of dealing with Covid-19. Another, lesser known measure, is the use of robotics combined with other technology in achieving tasks necessary in clinical areas.

We have seen reports that in Seattle, US, doctors have used a remote-controlled telepresence robot in treating and monitoring a coronavirus patient in order to minimise risk of infection.[1] What other similar examples of available technology have been used throughout this outbreak?

Infection control robot in a hospital ward

Robotics for Infection Control

Aside from adopting counter-epidemic measures, China has also invested in cutting-edge innovation in hospitals for infection control, logistical tasks and support in treatment of patients. One such innovation is the 'Infection Control Robot'. A technology company in China has commissioned and manufactured additional robots to be deployed across the affected regions. Indeed, the manufacturer has found itself in a position of demand exceeding supply, even providing demonstration models in order to fulfil orders.

Mr Li Maokun, President of Jingzhou Hospital of Traditional Chinese Medicine, stated: "In the wake of the coronavirus outbreak, artificial intelligence robotics technology is currently being used in Chinese hospitals, which automates other medical support roles traditionally undertaken by people, in order to further reduce spreading of the virus."

The robot, which has been developed and produced by the Shanghai TMI Robotics company (and distributed in the UK by British-based company, MedAssyst), moves completely autonomously, fulfilling the task as pre-programmed with the layout and topography of the hospital or department. It will set off systematically disinfecting nearby air and all surfaces in any given area, and even return itself to a docking station when it requires a recharge.

It is equipped with three disinfection methods: ultraviolet, vaporised chemistry and air filtration. Any combination of

these methods can be applied depending on the space or departmental rooms to be disinfected. The robot automatically calculates disinfection time according to the space and fixings and ensures no 'dead spots'. Traditional Ultraviolet Germicidal Irradiation (UVGI) uses short wave ultraviolet light and has been in wide use as an antimicrobial method for many years across other sectors, such as water purification.

It works by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions.[2] UV alone, at the optimal distance, can achieve 99.9999% bacterial kill, including antibiotic-resistant bacteria and viruses. When combined with air-filtration, it forms a highly effective method of disinfecting and cleansing the surrounding air, in addition to achieving surface disinfection of surrounding walls, furniture and fixings. The Infection Control Robot also uses a fine mist chemical as a further disinfection method. In unpopulated spaces this can be a peroxide solution.

However, in public spaces, a hypochlorous acid solution is used. By combining these disinfection methods with smart technology and robotics, it ensures systematic disinfection of any given area, eliminating human factor omissions or errors in traditional disinfection methods by hospital staff. In addition, of course, it minimises human exposure to potentially contaminated areas, ensuring staff safety. The robot is designed to be used and deployed completely autonomously in areas of hospitals or even whole hospitals where infection control is of paramount importance.

Dr. Zeng Guang, Chief Scientist of Epidemiology at the Chinese Centre for Disease control and Prevention (CCDC) commented: "It is a good thing that disinfection robots can participate in the epidemic prevention war. It reduces occupational exposure of medical staff in the affected environment, thus saving patients while protecting medical staff."

Meanwhile, in the epicentre of the COVID-19 outbreak, at Wuhan 6th Hospital, Mr Cui Junkai, Director of No.13 Quarantine Ward Respiratory Department, commented on the robotics measures in place: "Currently, we have 30 patients in No.13 Quarantine Ward and medical staff are working at full capacity. The robot, once set-up, is equivalent to an intelligent automatic moving subject which is fully capable of performing tasks unattended, like disinfection, making way for pedestrians and finding its own charging points to recharge. This save us a lot of time and manpower."

He also emphasises the operational value of the robots: "Before the disinfection robots were put into use, large numbers of medical workers including support staff were deployed to perform disinfection of the overall hospital environment. This workload is immense. Now the disinfection robot has released our medical staff from that, so that they can return to their real responsibility of saving lives and caring for patients, devoting their efforts in fighting against COVID-19."

When weighed against the real financial cost of healthcare-associated infections to healthcare providers, and the tragic human impact of infection, as we have seen recently, an automated robot, which systematically disinfects air and surfaces, seems a common-sense approach, even in the absence of an epidemic crisis.

According to the World Health Organization, the prevalence of healthcare-associated infection (or nosocomial infection) in developed countries varies between 3.5% and 12% at any given time, with an average prevalence of 7.1% in European Countries. According to a European multicentre study, the proportion of infected patients in intensive care units can be as high as 51%; most of these are healthcare-associated. Approximately 30% of patients in ICUs are affected by at least one episode of healthcare-associated infection. The longer patients stay in an ICU, the more at risk they become of acquiring an infection.[3] The economic impact in Europe is estimated at approximately 7 billion Euros in direct costs and reflects 16 million extra days of hospital stay. Therefore, even without the acute threat of an epidemic, it is easy to see the economic and human benefit of adopting automated / artificial intelligent robots for infection control.

In China, where healthcare systems face familiar challenges in addition to population density, the Infection Control Robot has been commercially available for over two years and, in this time, has been acquired by a number of hospitals, with over 60 hospitals in China using robotics from the same company. From April 2020, MedAssyst is making the technology commercially available in the UK. As the authorised European distributor, the company is introducing a series of autonomous robots for numerous aspects of medical support, all designed with the aim of enhancing productivity, efficiency and safety in hospitals.

Robotics for medical support

In a WHO-designated coronavirus hotspot, China's South Eastern province of Guangdong, doctors at the city's Provincial People's Hospital have been using robots to deliver medicine and food to patients. Robots shaped like a small refrigerator on wheels can navigate areas of the hospital autonomously, tackling doors and elevators where necessary to reach infected people in quarantined areas of the hospital.[4]

A robot similar to that described to treat the patient in Seattle is also available commercially in China, and now in Europe, through MedAssyst. However, ▶

AI reception assistant

Medical / surgical supplies robot

this robot goes beyond telepresence and direct human control. The robot has IoT technology, usually associated with domestic 'smart' technology to interact directly with the patient: instructing the patient and explaining courses of treatment. The robot can even access patient information.

It can take patient measurements such as temperature and blood pressure, with the built-in blood pressure monitor and thermometer. It even has a Geiger counter, as it was designed with departmental radiation in mind, such as in PET departments, in order to minimise ongoing staff exposure. This robot has obvious applications in an epidemic outbreak: with all of this capability, it is ideally placed to conduct monitoring ward rounds in quarantined areas.

So, how ready is the Western world to adopt this innovation in medical support roles? On British soil, it seems there is indeed already an appetite for artificial intelligence and robotics in medical support services. Health Secretary Matt Hancock has urged that the NHS must adopt new technology in order to survive, and has pledged a £412 million technology fund, primarily for purposes of automation.

To augment this, a study by the Taxpayers Alliance suggests one tenth of the NHS budget could be saved by the introduction of automation across the health service and could save up to £17 billion annually in public sector costs by 2030. The report states: "embracing technology is crucial" and could lead to more lives saved.

The report also hints at the wider acceptance of IT and technology among the public. The research found that 90% of people prefer to book GP appointments online, with an enthusiasm for replacing GP receptionists with automated systems. The report highlights innovations, such as the use of AI to analyse emergency calls, which were found to detect life-threatening situations more quickly. The study also highlights the need to eliminate concern over employment or job losses, hinting at a diversion of talent. The report highlights the positive effects that such technology and innovation could have on the economy, productivity and jobs.[5] It cites that between 2001 and 2015, new technology made 800,000 jobs obsolete, but created more than 3.5 million.

At hospital level, the adoption of artificial intelligence and robotics is based on a clear rationale: enhanced efficiency, patient and staff safety, and enhanced human-to-human time in treating patients. Pharmaceutical robotics for prescribed medicines and 'robotic porters' for in-hospital logistics have been in use by Greater Glasgow & Clyde, since 2015, and have successfully demonstrated efficiency savings, while placing more clinical staff in front of patients.[6]

Patient monitoring robot

Similarly, in North Bristol NHS Trust, robotics are used in conducting cancer surgery, dispensing pharmacy medicines, transporting supplies, and analysing blood samples. The Trust are also collaborating with a local robotics laboratory on the development of robotics and other healthcare technology to improve patients' health and hospital experience.[7] In the West Midlands an experimental trial of artificial intelligence is to take place which will offer patients the ability to Skype medics via smartphones or receive a diagnosis by chatbots.[8] In 2019 it was reported that an AI system trialled at Moorfields Eye Hospital, London, found it made the correct referral decision for over 50 eye diseases with 94% accuracy, matching the world's best eye experts.[9]

In terms of the technology available from China, there seems to be no limits as to what can be automated via artificial intelligence, with further patient assistance robots available. All of which are soon to be available in the UK. For example, in busy treatment areas there is an 'AI Reception Patient Assistant', which greets patients, can access patient information, direct patients within the hospital and even answer medical questions. This seems only a small step further from the already established automated phone systems for patients.

A further development on the AI Reception Assistant is the AI Robot Patient Assistant which possesses all of the same software but mounted on a robot which can physically escort patients to the relevant department. As a further technological solution, for busy A&E departments, there is an automated Triage Robot, which interacts with patients in a waiting room, runs through their symptoms and conditions and advises and prioritises patients.

In a world where internet bookings and automation are the norm, is it really a stretch too far to offer a robot that is capable of dealing with patients and, importantly, potentially eliminating patient bottlenecks in busy departments? Although these products may seem futuristic, they are available here and now.

Considering the recent epidemic, the economic and operational challenges of healthcare provision, coupled with the will from the Department of Health to harness Artificial Intelligence, what better time is there to consider this level of medical support automation? MedAssyst are welcoming interested hospitals to partake in early pre-launch trials, as a partnership with UK hospitals to help drive and refine this technology in the UK. CSJ

References

1 The Guardian, 'Coronavirus outbreak: doctors use robot to treat first known US patient', 23rd Jan 2020.
2 National Institute for Occupational Safety and Health. Word of the Month: Ultraviolet Germicidal Irradiation (UVGI), April 2008.
3 World Health Organization, Healthcare Associated Infections Fact Sheet.
4 The Telegraph, 'China unleashes robots in its battle to control coronavirus', 10 Feb 2020.
5 Taxpayers Alliance Study, Automate the State: Better & cheaper public services, Jun 2018.
6 The Herald Scotland, New hospital takes delivery of fleet of robot workers, April 2015
7 North Bristol NHS Trust Website, Partnership will explore use of robots to improve patient care, 22 Jan 2020
8 The Telegraph, 'NHS experiment in AI will see whole city offered virtual hospital appointments and diagnosis by chatbot', 23 Jan 2020
9 NHS England, News: NHS aims to be a world leader in artificial intelligence and machine learning within 5 years, June 2019

About the author

Steve Eames is a graduate in the biomedical science of physiology and has worked with hospitals in the medical devices sector for 23 years in various business development, technical product management and leadership roles. He is currently working on a British-based venture introducing medical support robotics and artificial intelligence into UK healthcare. Visit: www.medassyst.com or email: enquiries@medassyst.com for further information.