

Candid conversations

Communicating after adverse events

Positive disruption

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Seasonal trends

PHIN data sheds light on patient choices when it comes to cosmetic procedures

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HIM_{UK}

Healthcare Markets

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In focus

Flying doctors

Can drone technology lift the supply of medicines and equipment to new heights?

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INTELLIGENCE + INSIGHT

Unmanned aerial vehicles are already successfully transporting essential medical supplies in remote parts of the world, but could they also be used to help tackle the healthcare workforce shortage? Candesic's **Dr Joe Taylor** and **Dr Michelle Tempest** explore the potential for drone technology in the delivery of everyday healthcare



Do doctors dream of electric sheep?

Drones can provide more than casual fun or cinematic spectacle. They have the potential to become central to the delivery of healthcare equipment and services.

The value of in-person consultations in medicine can't be underestimated, but there is also a lot of 'physical stuff' that must be moved around to deliver healthcare, from cutting-edge monitoring equipment to urine samples.

Drone technologies will enable us to leverage the healthcare workforce to get more care delivered face-to-face by freeing these staff to do what they are best at – brilliant, compassionate, and highly skilled support for those who need it most.

What is a drone and what is it not?

In this discussion, we don't consider a 'drone' to be a stingless male bee.

There is much debate around classification, but here we're going with the straight forward definition that a drone is a useful device that can move around at a macroscale without a human on board.

Drones may have varying degrees of autonomy, with a move towards full autonomy (Level 5) being made possible by advances in ML/AI (see Figure One). In this discussion we'll be focusing on Levels 3 to 5.

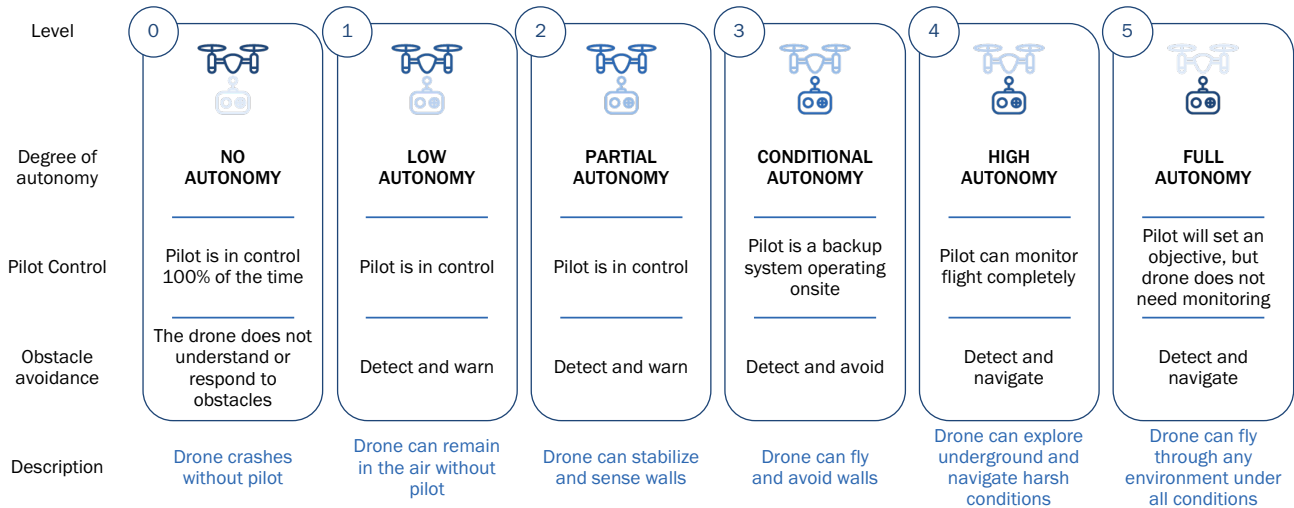
How can we best get emergency equipment to people in immediate need?

Patients are experiencing increasing times for paramedics to arrive on the scene in an emergency (see Figure Two). Rising demand, delayed handovers, staffing challenges and our ever more congested cities are all contributors to ambulance delays.

Providing defibrillators in the community has proven a great success, with an Australian study from 2014 finding that those treated with public defibrillators have a 45% survival rate compared to those who waited for emergency medical

FIGURE ONE
DRONE AUTONOMY LEVELS RANGE FROM 0 TO 5 AND ARE DEPENDENT ON THE AMOUNT OF PILOT CONTROL AND A DRONE'S ABILITY TO AVOID OBSTACLES

LEVELS OF DRONE AUTONOMY



SOURCE CANDESIC RESEARCH AND ANALYSIS

services. However, it's impractical to have one on every street corner or at the top of each hill. The use of drones to quickly deliver such devices to their point of need would be a game changer in immediate management of cardiac arrest (see Figure Three).

There are places which are difficult to access quickly enough to provide lifesaving emergency care, such as defibrillation. Getting this equipment out to a boat or a rural area quickly would save many lives.

How do you get expert help to people quickly?

If Superman is busy battling Lex Luthor, there are some new options on how healthcare professions can reach those in remote locations.

Trials of jet backpacks for mountain rescue teams in the Lake District proved to cut the time for paramedics to reach a simulated casualty from 25 minutes to just 90 seconds. This impressive feat was a result of a collaboration between Gravity Industries and the Great North Air Ambulance Service.

Jet backpacks are limited by the weight and volume of the equipment that can be transported. However, if accompanied by equipment-carrying UAVs, paramedics could have all the kit they need to undertake advanced care onto the

mountainside.

We can also use drones to get communication capabilities to those in remote areas, enabling for communication with clinicians who can guide emergency interventions. The University of Cincinnati has invented a new telehealth drone to improve access to medical services regardless of location. The drone has cameras and a display screen so patients can talk to health care professionals from the comfort of their home. The prototype carries a waterproof box the size of a small first-aid kit to deliver medical supplies or collect self-administered lab tests.

What are drones already doing to support care and safety?

Fleetlight's drone concept is effectively for autonomous mobile streetlights. When walking home late at night, a fleet of overhead drone spot lights can be summoned to guide you on your way. This was successfully trialled in a poorly lit area in Petworth. Working with Direct Line, Fleetlight has also been deployed to support search and rescue by the Caizer Lifeboat Association.

Drone manufacturer Flirtey recently completed the first ship-to-shore drone delivery in the US. The experiment, held in conjunction with the Johns Hopkins,

demonstrated how an aerial drone can ferry aid such as medical supplies and water during a disaster situation. During the demo the drones carried medical samples for emergency testing, flying them between an onshore medical relief camp at Cape May, New Jersey, and a test facility on a vessel off the coast. The drones also transported medical supplies from the vessel to the onshore medical camp.

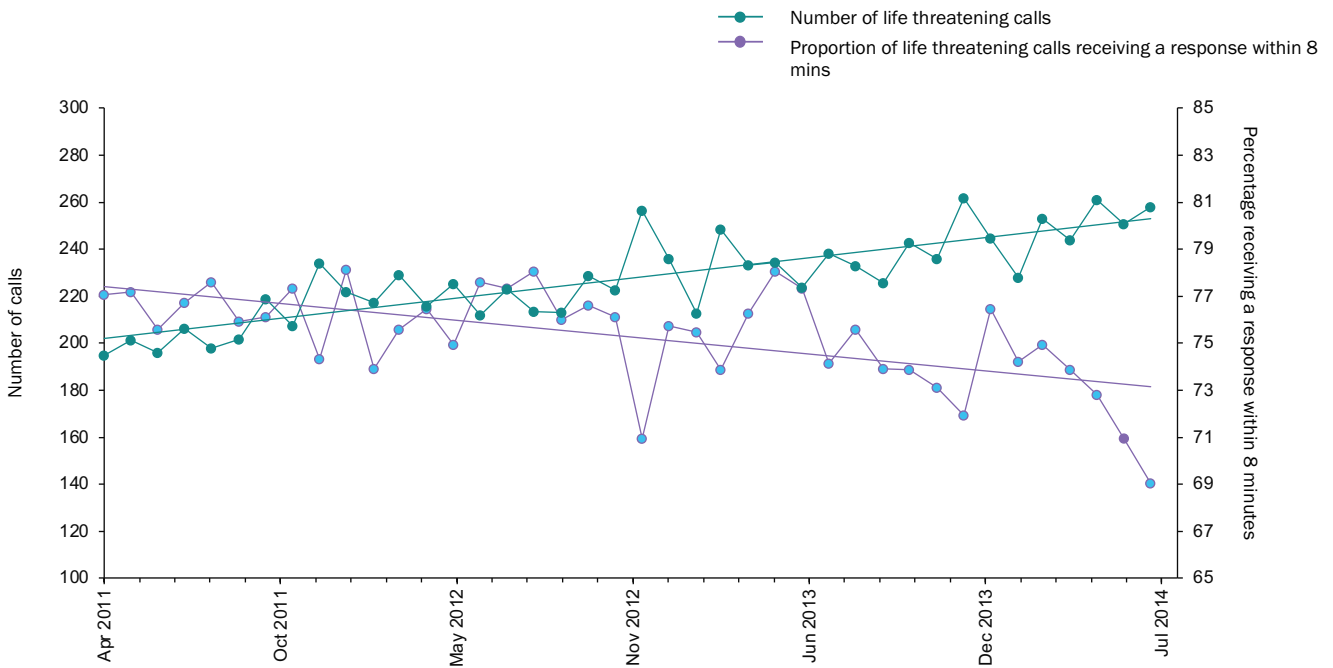
During Covid, the Indian Council of Medical Research's Drone Response and Outreach in North East (i-Drone) delivered 900 doses of Covid-19 vaccine from Manipur to Karang Primary Health Centre (PHC), which is on an Island in Loktak Lake. These doses were used to vaccinate 25 people at Karang PHC on the first day of the initiative on 4 October 2021.

Drones in your home?

Of course, in the bleak mid-winter we'd all like to be brought our morning brew in bed by a drone. However, we can envisage a near future when home drones can support healthcare as part of the 'Internet of Things'.

There are lots of ways already common drones can support independent living for those with mobility and cognitive problems and the list seems to be constantly expanding – lawn mowers, vacuum cleaners, mops to name a few endless

FIGURE TWO
NUMBER OF CALLS FOR AMBULANCE SERVICES HAS BEEN RISING WHILE THE NUMBER OF CALLS RECEIVING A PROMPT RESPONSE IS DECLINING



SOURCE NUFFIELD TRUST; CANDESIC RESEARCH AND ANALYSIS

sources of interest for your pets. Not quite C-3PO so you'll still have to empty your dishwasher.

Amazon's much anticipated security drone – 'Always Home Cam' – is designed to take off from its base, fly around several user-determined pathways recording a video stream as it does, before landing for a recharge. Although considered a way of checking on intruders or giving you peace of mind you didn't leave your oven on, it could also be used to check on vulnerable relatives. For example, somebody who has fallen and can't get up to call for help. One day, in-home drones may be able to bring you medications when you are incapacitated such as your EpiPen. With that last idea we're still not there as we can attest to given the number of rotor blades we've had to replace attempting to fly our drones inside!

What is the role of drones in hospitals?

Already, there is a long history of drone's being used in the bowels of hospitals to move items other than medicine. The Cleveland Clinic's main campus workforce is the size of a small town. In

an operation of this scale huge numbers of bandages and gloves and gauze pads need to be disposed of daily, and to support this Cleveland has an army of more than 100 drones.

After an operation, recyclables and trash are tossed down separate chutes to the basement of the hospital. That's where the drones take over. The lower levels of the Cleveland Clinic are crawling with automated guided vehicles (AGVs), self-driving buggies used to move materials and supplies all around the Clinic's labyrinthine basement. It's common to see the AGVs carry linens and hospital gowns, plated meals and yes, rubbish, recyclables and regulated medical waste.

One potential use of drones within clinical areas in hospitals is to transport blood samples and medications from floor to floor or building to building, rather than making such deliveries by foot or through the pneumatic tube systems hospitals typically use. Will Stavanja, founder of Wilstair, noted: 'As the technology continues to advance, a small drone can be scheduled to deliver medicine at 3 in the afternoon to room X. As long as each of the waypoints are programmed for the drone's trajectory, the drone can complete operations a pneumatic tube can't.'

One constant problem in hospitals is locating equipment, ward staff tend to horde items that should be shared while much disappears into a mysterious abyss. From wheelchairs to ECG monitors a worrying amount of clinical time is spent in search of such items. It's an issue that can potentially be solved by using Real Time Location Services (RTLS) to identify the location of equipment using active RFID. In the future, it is likely many pieces of equipment will themselves be drones and it will be possible to call them to where they are needed, for them to return to their place of storage, and report to maintenance locations as required.

Will drones replace or augment existing services?

The search for efficiencies in healthcare is a continual task – more people, more chronic ill-health, higher expectations and squeezed budgets. One key question for a drone-supported healthcare system is are we going to use drones to replace, support or expand existing provision?

We can look to the evolution of drone use outside of healthcare to understand

how their use might change operational models in care. One estimate suggests drones could replace \$127bn worth of human labour and services across several industries. For example, grocery delivery is already expected to significantly erode demand for delivery drivers.

This year in Cambridge and Greater Manchester, a partnership between the Co-Op and self-driving logistics company Starship Technologies has brought its six-wheeled bots to over seven British cities. The robots, which are the size of a mini-fridge, use pavements to navigate at walking speed around their local areas, waiting to cross the road at the lights and sitting outside customers' homes until they come outside and use the app to unlock them. They achieve Level 4 (complete) autonomy 99% of the time. We've used them and they work!

In the Starship example delivery drivers are certainly being replaced. What would be the implications for healthcare if the drones were delivering medicines, collecting biological samples from patients for analysis, and even monitoring equipment? If they can take some of the pressure of community care then this would be very welcome for these under-appreciated services.

Naturally, if you are able to deploy equipment more efficiently it follows that you need less of it. That is, the required geographic density of equipment is lower when you can cover a greater area within time-critical windows. That may well concern some equipment manufacturers, but the flipside for the innovators is that those who can adapt their equipment for drone cargo constraints will see sales increase; ambulance appropriate kit will have to be replaced with drone-suitable new devices.

Are there significant challenges to drone adoption?

Regulatory hurdles remain for those dreaming of electric sheep. The UK could take a lead from UNICEF's work in Malawi to support the creation of the first 'Drone corridor', which is already delivering medical supplies to remote clinics. The corridor provides a regulated airspace in which new drone technologies can be tested over long distances.

UNICEF's Venture Fund will bring entrepreneurs from other countries to Malawi to test their early-stage projects. This Fund is the first Venture Fund within

ONE CONSTANT PROBLEM IN HOSPITALS IS LOCATING EQUIPMENT, WARD STAFF TEND TO HORDE ITEMS THAT SHOULD BE SHARED WHILE MUCH DISAPPEARS INTO A MYSTERIOUS ABYSS

the UN and allows for \$50–100,000 of investment in early-stage technology companies.

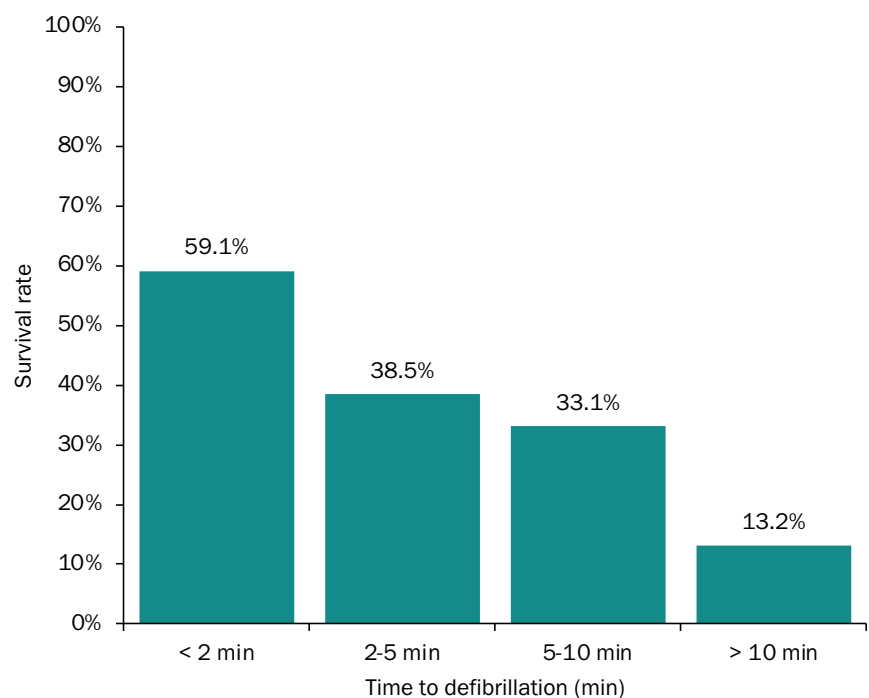
Delivering your groceries or latest Amazon order may be easily palatable. However, what about when you are depending on drones for delivery of essential medicines or key lifesaving kit? The jury is still out on whether populations will be more or less willing to embrace drones in healthcare, but we might think of the general support for ambulances exceeding the speed limit against the likely opposition of a UPS driver doing so to make a delivery slot.

Conclusions

Drones are certain to become a central theme in healthcare, as in so many sectors, over the next few years.

Far from a topic for futurology, drones are already making a tangible difference to the way we deliver care. As we have put so much work into point of care devices over the last couple of decades, we are realising that you need to get those devices to the patients and drones will have a critical role to play.

FIGURE THREE
DEFIBRILLATION SURVIVAL RATES ARE DEPENDENT ON THE AMOUNT OF TIME FROM CARDIAC ARREST TO DEFIBRILLATION



SOURCE CANDESIC RESEARCH AND ANALYSIS