# The age of drones: what might it mean for health?

**Drones can destroy lives in conflict settings where they are used for surveillance and bombings. But can they save them too? Dinsa Sachan reports on the use of drones in the health sector.**

Peace activist Leah Bolger has heard several gut-wrenching stories from survivors of drone strikes. One in particular stands out to her. A man had been a few miles away in the field when he heard a drone strike near his house. He rushed back to check on his wife. His house had been reduced to rubble. A scrap of red fabric clung to a fence—it was the only evidence that was left of his wife's existence. She had worn a red dress that day. "I have a picture of him holding this red cloth", said Bolger. She cannot tell his story without crying, she told *The Lancet*.

Although drone strikes are aimed at terrorists or combatants, civilians continue to be hit by them in regions such as Pakistan, Afghanistan, Yemen, and the Gaza Strip. Because governments are secretive about the data, knowledge about casualties from drone strikes comes from news reports and independent sources. The Bureau of Investigative Journalism found that 393–561 people were reported to have been killed in American drone strikes in Afghanistan, including 14–42 civilians, from January to September, 2015. In Pakistan, 2471–3983 people, including 423–965 non-militants, died from US drone strikes from June, 2004, to August, 2015.

## Undocumented trauma

Although the literature is sparse on the subject, drone strikes are also believed to cause mental health problems for people in war zones. Alli McCracken, an activist with CODEPINK, a women-led group that rallies against war, said the symptoms described by survivors in drone-hit areas are comparable to post-traumatic stress disorder (PTSD) and similar disorders. "When they have these death machines flying over their heads 24 hours a day, making this horrific buzzing noise, it is extremely traumatising", McCracken told *The Lancet*. "They never know when a bomb is going to drop and hit their homes, or the homes in the neighbourhood."

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When Bolger visited Pakistan in 2012, survivors told her delegation that suicide had become common among people living in the Waziristan area, which is routinely targeted by drones. "It was absolutely unheard of in this culture before", she said. "The emotional stress is too much." Bolger said that antidepressant use has also risen in this population.

Peter Schaapveld, a psychologist based in the UK, who extensively interviewed drone attack survivors in Yemen as part of a campaign by the human rights group Reprieve, said there was a "psychological emergency" in the country. "What I saw in Yemen was deeply disturbing", Schaapveld said during a press conference in 2013. "Entire communities—including young children who are the next generation of Yemenis—are being traumatised and re-traumatised by drones."

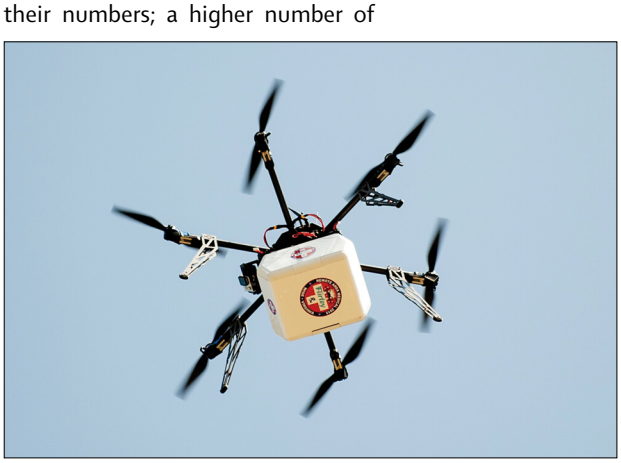
Although drone pilots operate these unmanned objects from afar, they are not immune to the adverse impacts of drones. A 2013 US Department of Defense study found that drone operators are just as susceptible to mental health problems such as anxiety, depression, and PTSD, as their counterparts who pilot aircraft in conflict zones.

## Drones to improve health

Undoubtedly, drones have developed a bad reputation because of their use in wars. However, this technology is now increasingly being used for constructive purposes across several sectors, including health.

Research on infectious diseases is one area where scientists are making use of drones. Chris Drakeley, a professor of infection and immunity at the London School of Hygiene & Tropical Medicine, UK, and his team have been tracking an emerging problem with *Plasmodium knowlesi* malaria in parts of Malaysia using drones. This type of malaria has been known to occur in human beings, but its natural hosts are long-tailed and pig-tailed macaques. The Sabah region in Malaysia has seen a mysterious upsurge in human infections from this illness.

The researchers have been flying two types of drones. The first is a fixed-wing drone, which is flown over an area once every 2 months to look at changes in landscape and environment. "These drones generate very high resolution images of the ground and help us observe changes in vegetation cover", says Drakeley. The second type—a copter drone—follows macaques around to help the team to determine their numbers; a higher number of



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animals (almost all of them infected) indicates a potentially larger risk of infection to human beings.

Drones offer many advantages for researchers like Drakeley. Satellite imagery is expensive and infrequent. Camera traps, which are widely used in wildlife research, do not always generate images and sometimes interfere with macaque behaviour. The drone set-up is expensive initially, but can be easily repeated in other settings to track infectious diseases. "If Amazon is going to deliver my parcel by a drone in the future, why can't I use it for my work?" Drakeley noted.

Matternet, a company based in Silicon Valley, CA, USA, has been paving the way for the use of drones in health care. In August, 2014, the firm partnered with Bhutan's health ministry and WHO for a unique project. Bhutan has a very low ratio of doctors to people—only 0·3 per 1000 people. It is predominantly mountainous and getting patients to hospitals can be challenging.

Bhutan deals with this problem with the help of a telemedicine system. But even that has room for improvement. "Sometimes, doctors need blood samples to make a complete diagnosis", explains Andreas Raptopoulos, founder and CEO of Matternet. "It can take several days to transport the samples by road." This problem might be helped with the use of drones. During 2 weeks, the company flew three drones carrying dummy blood samples from a hospital in the city of Thimphu to a remote clinic 15 km away. Raptopoulos said that Matternet was able to validate the concept that drones can be useful in health-care delivery in Bhutan. He is working with the government to find funding for a large-scale project in the country.

In March this year, Matternet partnered with UNICEF to do a similar trial in infants in Malawi. The country has a high HIV prevalence, and every year 10 000 children die of HIV/AIDS. A drone flew dry blood samples from a remote clinic to a central laboratory in the capital Lilongwe. The test flight was considered successful. UNICEF will now do a cost comparison with road transport. If the drone method comes out cheaper, they will do more test flights from remote parts of the country.

International agencies have begun looking at the potential of drones in delivering medical aid. The UN Population Fund (UNFPA) is undertaking a pilot project in remote parts of Ghana that involves delivering contraceptives and life-saving medicines to women. "Drones

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can not only overcome infrastructural challenges of poor roads, heavily forested areas, or deserts, but can also slash the time needed to wait for life-saving medicines and other supplies", says Renee Van de Weerdt, a senior technical adviser at the UNFPA. The organisation tested a drone called Dr One for the project in November last year. The results will help UNFPA determine whether drones are a cost-effective solution for addressing health problems in this part of the world. If successful, it could be scaled up in Ghana and expanded to other countries.

Although companies are excited at the prospect of using drones for medical purposes, some researchers are proceeding with caution. For Timothy Amukele, assistant professor of pathology at the Johns Hopkins University School of Medicine, MD, USA, it's important to observe what happens to biological samples during drone flights. "Transporting blood or other biological samples is not like transporting a book or a shoe", says Amukele. "They are much more fragile."

In one set of tests, Amukele assessed blood samples. Hundreds of samples were taken from healthy people. Each sample was paired. Half the samples were flown for up to 40 minutes, at a location that was an hour away from Johns Hopkins. They were then examined in the laboratory. The flown-in samples were compared to the samples that were not flown in. For most of the tests, the results of the paired samples were the same.

## The future for health drones

Amukele says drones will likely have different effects in different places. They could improve cost in richer countries and access in the poorer ones. For example, hospitals in western countries generally use cars for transportation—and that is expensive. "It's a reasonable way to move something that requires a car, like a human being", says Amukele. "But it's not a very effective way to move a single test tube at 3 am in the morning."

For organisations willing to invest in drones in health care, regulation will always be a hurdle considering the bad reputation of drones. "We've been asked questions about what we're doing with drones—are we spying?" said Drakeley. "It's difficult to convince people we're not."

Several countries allow hobbyists to fly drones within a limited range, while maintaining a ban on commercial use. In the UK, small drones are now used widely for commercial purposes, whereas their use in India, including by civilians, is illegal.

Public perception of drones might be improved by knowledge of their use in health. "It makes sense to use this technology for purposes that are meaningful", says Raptopoulos. "Most people wouldn't object to seeing a drone in the sky transporting something that could be life-saving."

Even though drones are becoming commonplace, they still have a long way to go to win over the public. "People will become accepting of them", says Drakeley. "But you can never destroy the concept that drones are used for dropping bombs. Because they are."

*Dinsa Sachan*