Drones for healthcare in developing countries

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What do you do when the human brain has reached its limit in a project? Even though there are a lot of good projects that are trying to improve health care in developing countries, human capacity only has a limited scope. This is where technology can take over. Using artificial intelligence, solutions can be created for problems that are hard to solve for humans alone. One such complex problem is the sustainable development goal of the United Nations to increase health and well-being in developing countries (1). Life expectancy is one of many measures for health and well-being and unfortunately, the life expectancy in developing countries is significantly lower than in developed countries. For example, in 2002, the life expectancy at birth in developed countries was 78 years, whereas this was only 46 years for sub-Saharan Africa. This means that on average, people in developed countries live 1.7 times as long as those in developing countries (9). One of the main reasons for this is the lack of health care and the bad accessibility to it. In some developing countries, it is as bad as 1 available doctor per 100.000 persons (8). There are several causes for this. For example, bad quality of health care education and the lack of education as a whole. Many developing countries do not have sufficient education, causing the few people that start working as a doctor or surgeon to have minimal knowledge and experience (8). This causes insufficient quality of health care for people in need of it. Another cause is bad accessibility of rural areas of countries. Often the remote, rural areas are in need of health care the most. Unfortunately, these areas are hard to reach for doctors from expert clinics and medicines are often too expensive for people. Additionally, people in remote areas may have less knowledge of diseases and its symptoms, causing later diagnosis and higher morbidity and mortality.

A solution for the lack of medicines and medical equipment in remote areas are drones. Drones are unmanned aerial vehicles (UAVs) which can either navigate on their own or be controlled from a distance (6). These drones can be used in delivering medicines or other medical supplies. This way, even the most remote areas have access to medication. On the other hand, drones can also be used to transport laboratory samples, such as blood or microbiological samples to expert clinics. It has been shown that aerial transport by the means of a drone transports samples in approximately 25% of the time that transport by land would take (6). This improves diagnosis time, which can be extremely helpful in stopping diseases from spreading. For example, by using drones to transport biomedical samples to specialized centres, HIV spread can be halted in rural areas much quicker than it normally would (2).

Delivering and transporting medication, medical equipment, and laboratory samples are not the only applications for drones in developing countries. Drones can also serve to establish a connection between a doctor or surgeon in a larger hospital and a robot in a clinic in a remote area (7). This robot could be used to perform emergency surgery on people in remote areas where no specialized surgeon is present. However, for this kind of goals, surgeons and their patients cannot rely on a local connection. Therefore, drones can also be used to establish an Instant Telecommunication Infrastructure (ITI) that can then only be used for this telemedicine purpose and thus not be disturbed by commercial calls and

connections (7). This ITI can be used to perform surgery, but also to assist local doctors and nurses in diagnosing patients and decide on a suitable treatment. This is called telementoring. In 1998, an early application of telementoring was the Early Detection and Prevention System was developed in India for rural clinics (5). This system was able to instruct and advice nurses and paramedical personnel. The consistency between the Early Detection and Prevention System and actual physicians was 94% (5).

Next to making diagnosing patients easier and making expert care accessible for even the most remote areas, drones can also be used to predict disease outbreaks. They can be equipped with technology to acquire high-resolution temporal and spatial information (6). This information can in turn be used for epidemiological research by using characteristics of the environment that may cause a disease outbreak. For example, Fornace et al. (2014) used drones to follow patterns of deforestation and changes in landscape in Malaysia. These patterns and changes influence the spread of malaria parasites and thus the chance of an outbreak of a malaria epidemic in that area. Another example is the use of drones with nucleic acid analysis modules in order to detect the Ebola virus (4). Using this kind of information to predict possible disease outbreaks can be useful in both developed and developing areas to prevent outbreaks or combat them in an early stage. This would improve the quality of life in the remote areas in question, such as rural areas of African countries.

From the examples described above, we can conclude that ICT in the form of drones can be very useful in improving healthcare in developing countries. Equipping drones with the necessities in order to provide better healthcare for people in remote rural areas in developing countries. This links back to sustainable development goal number 3: Good health and well-being (3). A part of that is to end the epidemics of AIDS, malaria and tuberculosis by 2030. Drones could be used to predict these epidemics and thus make it easier to prevent them. These same drones could also be used to deliver medication to remote areas in order to combat and contain these diseases. Additionally, part of SDG number 3 is to reduce the global maternal mortality ratio and to reduce the number of preventable deaths of newborns and children under 5 years (3). Better access to healthcare and medicine would facilitate this. Medicine delivery by drones and telementoring could make a great impact by improving accessibility of medication and expert opinions and skills.

Even though there are a lot of advantages to using drones in providing and facilitating healthcare in remote rural areas of developing countries, there are also some downsides. The biggest challenge in the implementation of aforementioned ideas is the funding. Even though governments imply that they want to improve the healthcare system in their countries, often there is too little budget for such technological additions to the system. The initial costs are higher, but total costs decline over time after implementing initiatives such as drones to deliver medication or telementoring. Many good causes try to help developing countries by raising money in developed countries. However, even if they were to fund an initial drone start-up, this funding would not continue forever and thus the financial sustainability might not be sufficient. Another challenge is training people to become acquainted with the technology. Even though few people are needed to manage and service the equipment, finding suitable candidates is not always easy in remote areas. Without skilled people to service the devices, usage will not be sustainable in the long run. Another

issue with drones is aerospace regulation. Drones are unmanned and subjected to technical flaws. This implies that if another aerospace vehicle were to cross paths with the drones, a collision might occur, endangering many people. This should be taken into careful consideration if a country were to implement drones for healthcare purposes. Lastly, the drones should be equipped with an excellent safety mechanism in order to prevent people taking advantage of the medication or equipment that is being transported. Blood and laboratory samples should be transported in a safe manner in order to deliver the samples to expert clinics safely for the results to be reliable and the diagnosis to be correct.

All in all, drones can have a very positive impact on healthcare services in rural areas in developing countries. However, it is a delicate issue that should be evaluated carefully before implementing such techniques. For each country separately, aerospace regulations, safety measures, and possible applications of the drones should be thoroughly explored before even starting trials. Additionally, many developing countries have to deal with high criminality rates and terrorism. Governments and researchers should take great caution in deploying drones for healthcare purposes, since criminals and terrorists could easily use them for their attacks, completely backfiring at the intention of doing good. The drones could also be used for substance abuse if people were to be able to confiscate the medication they are transporting, or be used for the transport of forbidden substances.

Conclusively, I personally think that drones could be very efficient in striving for sustainable development goal number 3, better health and well-being. Not only can we reach people in the most remote areas, we can also educate and help the available nurses and medics in those areas to provide better care for the people living there. Using drones for medical purposes can be a great start, but with the rapid developments in the artificial intelligence, they may soon be able to be used to address the other sixteen goals as well to increase the development of the less fortunate parts of the world.

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