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The Use of Zipline Drones Technology for COVID-19 Samples Transportation in Ghana

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Abstract

Drone technology has had many general applications in the military, agriculture, data processing industry, security and the health sector. The emergence the novel coronavirus pandemic has increase its revolution in the healthcare industry. Ghana, a western African country, was the first country to programme and deploy automated drones to shuttle medical supplies and samples of suspected COVID-19 patients. By this approach, Ghana was able to respond timely to the pandemic and quickly saved the lives of the general population. This paper presents a narrative study on the use of Zipline drones for transporting samples of suspected COVID-19 patients, the challenges and potential barriers encountered.

Keywords: Zipline-Drones; COVID-19; Testing Capacity; Ghana.

1. Introduction

The novel COVID-19, first detected in Wuhan China in December 2019, has become a public health emergency of international concern and at least 188 countries worldwide have reported confirmed cases [1]. As of June 11 2020, the John Hopkin University reported that the pandemic has infected over 7.4 million individuals on the globe with 418,203 deaths rate and about 3.5 million recoveries [2]. Previous studies had already labelled certain African countries like Algeria, Egypt and South Africa as high risk for the importation of the virus [3]. Ghana implemented prudent and drastic public health measures in a bid to control the spread and the effects of COVID-19 on the populace since recording her first two cases on 12th March, 2020 [4]. Although the pandemic has undeniably revealed humanity's lack of preparedness to outbreaks, it has also presented the health and science world with one of the most daunting examinations [5].

Ghana is currently using a drone technology approach to reduce the amount of time it takes to get COVID-19 test samples from remote rural areas to labs. Instead of waiting for days for a batch of samples to be transported by truck, tests from rural areas can be delivered for analysis in less than an hour [6]. The government wanted to ensure that testing would have the same level of confidence in rural areas as it does in the city [7]. It is the first time in history that autonomous drones are been used to make regular, long-range deliveries into densely populated urban areas [8]. These innovations, developments and historic turn around in Ghana show that air transport or drone technology can be a reliable and a dependable tool in the fight against coronavirus by speeding up mass testing. This paper aims to highlight the scientific and technological innovation adopted to speed up the COVID-19 testing capacity in Ghana.

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2. A Brief Account of Drones

Drones also known as Unmanned Aerial Vehicles are making advances in this 21st Century. Areas of application include agriculture, data processing, the Military, security and Health. Irrespective of the purpose and use, drones tend to be very fast, flexible and economically cost effective. These air taxes have shown to possess the capability of shipping and distributing packages to their destination when necessary [9]. Drones are eco-sustainable with fewer carbon dioxide emissions because they operate on batteries and ride in the skies without being obstructed by road infrastructures or traffic networks. When drones transport samples or parcels, the approximate time it would take to deliver is extremely predictable. According to Drones for Development, there are more than 2.5 billion people living in developing countries who live in rural and remote areas. Therefore, drones can serve as an alternative, reliable and secure option to transporting samples and distributing medical supplies to such areas [10].

3. Drone Technology in Africa

Unlike developing countries, developing countries have overwhelmingly adopted the drone technology to reduce traffic congestion and pollution. Whether developing African countries have the technical advancements needed to use this method is arguable. However, in recent times, several African countries have enthusiastically accepted this technology due to weak road connectivity and other causes. Africa now serves as the mature location for full deployment and development of drone technology. This drone technology currently supports three sectors of the African economy, namely, the mining, agricultural, and health sectors. In 2016, the Malawian government in partnership with UNICEF implemented a pilot program to speed up the testing of HIV Cases in infants [11]. Drones are also used by Rwanda to transport blood samples and other essential medications to remote clinics [12]. A memorandum of understanding to deploy drone technology for successful healthcare delivery was signed by the government of Ghana via the Ministry of Health and Zipline Health Care Logistics Company [13]. The Ghana Drone Delivery Service was aimed at transporting and distributing healthcare products, blood transfusion sets, vaccines, Personal Protective Equipment (PPE) and other medical supplies across the country within the shortest possible time. The primary goal of this initiative was to ensure timely universal healthcare coverage, regardless of geographical location.

Figure 1. African map showing Ghana, Rwanda, the two African countries currently using drones

4. Zipline Company and Drone

Zipline, the drone-delivery start-up based in California, is one of America's leading autonomous logistics medical organization developing some of the fastest and most reliable drones worldwide [12]. Their products are medical models with different speed, target range and payload capacity that can achieve a speed of up to 128km/h, coverage of

160km (99 miles) while carrying a load of 1.75 kg [14]. The drones are configured with flight computers, engines, communications devices, flight controls, navigation and power systems. The zips of the drone have a wingspan of 3.8 meters (10.8 foot) and carries about 4 pounds of payload within 100 miles while flying at a speed of 90 mph. Although Zipline drones are autonomous, they are still supervised and managed by humans when needed [8]. The company's autonomous drones have flown more than 2 million miles since its launch in October 2016 and shipped more than 60,000 vaccines, units of blood and other medical products to Ghana, Rwanda and India [8, 14].

5. Zipline's Drone Technology for Expedite Haulage of Samples in Ghana

With the initial low testing capacity and substantial number of suspected cases, the government tasked Zipline Healthcare Logistic Company to shuttle medical supplies and COVID-19 suspected samples from rural and deprived areas within the country to the two largest cities, Accra and Kumasi were the main laboratories responsible for COVID-19 testing are located. The Noguchi Memorial Medical Research Institute is headquartered in Accra while Kumasi Collaborative Research Center is located in Kumasi.

The Company has two main distribution centers, the Omenako center which delivers samples from environs of Accra to the Noguchi Memorial Institute for Medical Research and the Mampong center obtain samples from Kumasi environs and deliver to Kumasi Centre for Collaboration Research [6, 8]. The company liaisons and obtains samples taken from suspected persons in health facilities within remote parts of a catchment area and delivers them to the laboratories from for testing.

The project, which launched on Friday, 17th April 2020, gathered 51 test samples from suspected persons in rural health facilities to the company's delivery center at Omenako, about 68 kilometers north of the capital of Accra and delivered to the Noguchi Memorial Institute for Medical Research in Accra for testing and analysis over the course of four separate flights [8]. And on Sunday, April 18, 2020, the first sample transfer to the Kumasi Center for testing took place, 30 miles away from the Distribution Centre. The Zipline Drone has since then carried samples from more than 1000 rural health facilities across country to these two major laboratories [12].

Aside the transportation of COVID-19 test Samples, the zips (drones) are also involved in sending unused test kits, medical supplies, drugs to rural areas where they are most needed [6]. Despite that capacity for the start, Zipline fleets can be equipped to transport up to 15,000 test cases flying 300 time a day all over the country.

Figure 2. Map of Ghana showing Greater Accra and Asante region, the Zipline drone company headquarters

6. Method

Once the samples are obtained from the health facilities, the test swabs are packaged with ice in a well-designed biological container in compliance with the WHO Laboratory Biosafety Guidelines for Handling and Processing COVID-19 Specimen and placed in the bellies of the drones (zips). The Zip is placed on a launcher (like a rope that catapults the zip off a ramp into the skies) and programmed to take off to its destination (The Testing Laboratory). Upon arrival at the testing laboratory premises, the Zip positions itself in a safe and stable an attitude above ground level. The zip opens up its belly to release the load (the COVID-19 samples) by parachute into a prepared drop zone. After dropping off their payloads, the drones then returned to the delivery center. Attendants at the drop zone disinfects the biological container using a spraying device before touching it. Noguchi Memorial Institute for Medical Research or Kumasi Centre for Collaboration Research run the analysis and the test results are then delivered via Short Message Service (SMS). Compared to vehicle transport, the drone saves time, the entire process takes a maximum of 30 minutes [14]. It is worth mentioning that, during this current COVID-19 pandemic, it is the first time drone technology has been reach and make daily long-range deliveries in Africa.

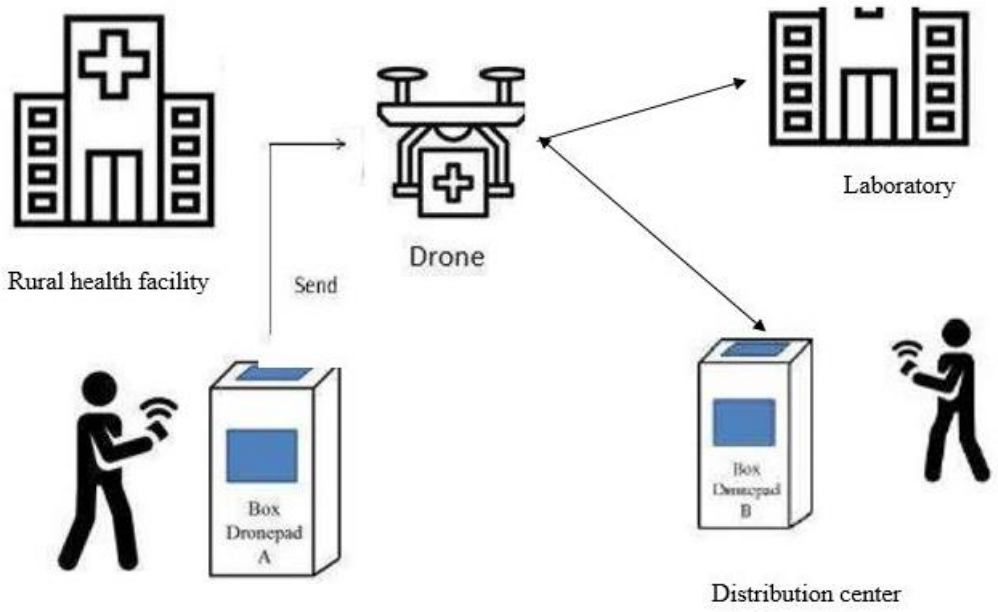

Figure 3. Illustrates the application for the distribution of COVID-19 suspected samples from remote areas to the laboratory

Figure 4. Drone delivery of COVID-19 samples in Ghana (Photo: Zipline)

7. Challenges and Anticipated Barriers Associated with the Drone Technology

Although the world has applauded Ghana for this unique initiative, there are challenges and anticipated downsides associated with this approach. First, the successful operations of the drones depend on weather conditions. Hot and cold weather has also been found to impact drone performance and distance flight. In hot weather, just as in tropical Africa, drone engines do not operate harder to airlift the device, and this may result in shorter flights. High winds and rains impair drone flights, reduce battery life, influence drone stability and in cases of maintaining their stability ends

up flying in the wrong direction. In rainy seasons, drones cannot fly because they are not water resistance. Most of these sometimes result in failed delivery or no flight until the weather conditions are favorable. Thus, all conditions must be balanced or they can impact the Zipline Drones' take-off, move, and landing. However, the aforementioned limitations were unable to undermine the successful running of the operation and this has put Ghana at the forefront of such technological breakthrough.

8. Conclusion

This global challenge demanded a distinctive solution and this is precisely the plan Ghana's government and Zipline's logistics adopted in confronting the coronavirus pandemic. Ghana tackled the COVID-19 pandemic effectively and inspired innovative ways of increasing access to testing and healthcare delivery to everyone including those in remote areas of the country. By this approach, the government of Ghana was able to quickly save the lives of the general populace. Drones are contributing immensely to the revolutionalization of Africa and Ghana is hailed for championing this course and by so doing Ghana achieved the United Nations Global Goals of Universal Health Care.

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10. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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