

Ghana Go Digital Agenda: The Impact of Zipline Drone Technology on Digital Emergency Health Delivery in Ghana

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Abstract

Ghana has deployed high-speed technology and digital initiatives for the daily management of all the sectors of the country under the theme "Ghana Go Digital Agenda" policy initiative. These digital governance initiatives include the electronic or digital-health care systems, e-justice system paperless clearing of goods at port-banking, and other online services. Paramount among the many digital initiatives is the introduction of drones for emergency digital health delivery. Access to medical supplies in Ghana has been hindered by the difficulty of getting the supplies from the central points to other areas that are remotely located to enable the patients who need the services to get them. To overcome this challenge and deliver affordable and accessible health care services to the Ghanaian populace, the Government of Ghana engaged a US-based company Zipline Technology to use Drones in the supply of medical supplies for emergencies and hard-to-reach areas of the country. Since the introduction of this initiative in 2019, it has attracted mix-reactions from various stakeholders on the relevance of the drone technology project on health delivery in Ghana. This study used the Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM) as a theoretical framework to assess drone technology's impact on Ghana's emergency health delivery system. The study utilized an online survey questionnaire to solicit data from participants. From the hundred (100) health facilities, located within the operational zone of the drone, twenty (20) were purposively sampled. Out of 550 questionnaires distributed, a total of 533 health workers (participants) validly responded to the online questionnaire. One key finding of our study indicates that the introduction of drone technology for medical supplies in Ghana has significantly impacted positively on the emergency health delivery system in Ghana.

Keywords: Ghana Go Digital, Zipline Drone Technology, Emergency digital health delivery, Medical supplies for emergencies

Introduction

The Ghanaian Government, through the Ministry of communication, is working hard to come up with a robust framework that is aimed at supporting the digitization of the economy in a way that can reach out to all its citizens (National Communications Authority, 2018). As part of the Digital Ghana Agenda, the government of Ghana embarked on one of the prosperous infrastructural development programs within the ICT sector, in conjunction with National Broadband Infrastructure to facilitate internet connectivity in areas that were undeserved before. The government has started implementing a biometric National Identity Card, facilitated by the new technology such as tactile elements for the blind and chip-embedding technology according to the Ministry Communication, 2019 report on an identity card for all Ghanaians.

The National Digital Property Addressing System that is managed by the "Asaaase" GPS App, which was locally developed, has provided the locals with an exclusive digital address that are well linked to the postcodes. Consequently, a well-integrated paperless port operation and an e-immigration system that is fast and efficient.

Services such as procurement, the justice system, among others, have also been digitized. The projects are now at various stages of implementation, and the aim is to have a well-integrated government database. They all point to the milestones that the government of Ghana has made towards digitization (African Development Bank, 2019; Ministry Communication Ghana, 2019).

These laudable digital initiatives in Ghana have also been extended to the health sector. In 2019, the Ghanaian government signed a contract with American Drone Company, Zipline Technology International to initiate a drone medical delivery service from different distribution points within the country, and would make on-demand supply and delivery of medical equipment to various facilities within the Ministry of Health and Ghana Health Service (Ministry of Health Ghana, 2019, Ghana Health Service, 2020). According to the Ministry of Health of Ghana, Ghana's purpose was to be part of the journey that other digital countries are part of, thus the use of drone technology to supply medical health services and provide a rare opportunity for Ghanaian citizens to receive essential healthcare products and services.

The processes enable more natural delivery of the products and services to hospitals and health centers across the country, especially during emergencies. Since, 2019 the drone project in Ghana has increased access to medical supplies for close to 15 million people in Ghana, with the main focus being the hard-to-reach rural areas. (African Development Bank, 2019; Ghana Health Service, 2020).

As cited by (Ackerman, 2019; Sigal, 2019) before the COVID-19 pandemic outbreak, the Zipline drone technology in Ghana, transported about 200 various types of medical products such as blood, protective types of equipment, vaccines, and antivenins to several health facilities. This would not be easy through the long and dangerous road journey, which would have caused lives to be lost due to the associated delays. Currently, small deliveries can be done through the use of drones, and there is minimal human contact and virus transmission. However, instead of delivering blood products and medicines as initially anticipated, Zipline Ghana mainly focuses on the distribution of scarce resources like protective

gear and testing kits. Further down the line, plans are that the drone technology would soon be used to supply routine medication and keep the vulnerable patients that are hard-hit with the disease away from the hospitals where they risk exposure to the virus.

Literature Review

Usage of Digital Technology in Health Context

For the past few decades, the resources that most countries have been using for health information are changing. The Internet and digitization have become significant sources of health information and double up as one of the main channels of health-related deliveries. Additionally, several digital technologies, including drones and mobile phone applications, are widely used to examine, maintain, and improve people's health status within a country. The outcome of the Health Information National Trends Survey found out that the Internet and digital technologies were the first sources of information that are mainly related to health in the USA (Šmahel et al., 2018; Atkinson & Mabey, 2019).

Over half of the population in both the US and Europe uses the digital internet technology for health-related services according to Eurostat, 2017 report. The progress made in technology and digitalization has also enhanced the delivery of essential medicines and other services between health facilities. In this regard, technology (such as drones for healthcare) is paramount (Sims & Carr, 2017; Scott & Scott 2020). Digital Technologies have enhanced service delivery and improved interaction between the patients and the caregivers. Access to health facilities and products has also been greatly enhanced. For example, a drone delivering medications for health facilities and patients in rural areas (Menvielle et al., 2017 p. 33; Konert, et al., 2019; Hii, et al., 2019).

“Ghana Go Digital” Campaign

Digitization is a virtually niche topic studied under ICT. However, the demand for digitization in the field of development and health communication has grown tremendously over the years, mainly on the African continent. Digitization is the process that involves the transformation of data and information from its physical state to the digital state (Segal, 2016; Kimura, 2015; Ranger et al., 2015).

According to the digital transformation agenda report of the Ministry of Communication 2019, the Public services of Ghana are going through an explosive transformation digitally in a way that had never been experienced before. Through its agenda of digitizing the economy, Ghana's government has put in a lot of resources to upscale aging public services and make them align themselves with the current 21st century. This has been achieved through investing in the simplest forms of technology and software, as well as some of the most sophisticated technology like blockchain. The current President has also pledged a minimum of 1% of the country's GDP to be channeled research work in science, technology, and innovation to be improved to 2.5% in the long term.

A 2019 report by the International Finance Corporation of the World Bank Group, on "Digital skills in Sub-Saharan Africa" cited that Ghana's economy has greatly benefited from the processes of digitization, which has not just improved the level of life of the citizens but has also controlled the level of corruption in the country significantly. The knowledge and skills of the public servants have also improved (National Communication Authority, Ghana's Digital Agenda Report, 2018).

Some of the most impressive digitization projects in Ghana include:

- Ghana Digital Card – It is a unique identity card, for both Ghanaians and non-Ghanaian. It is the first e-ID of its kind in West Africa.
- Mobile money interoperability system – Allows users to send and receive money directly and seamlessly from one mobile to another through the networks.
- Ghana's drone service - This is a service that provides on-demand emergency deliveries of vaccines, blood products, among other life-saving medications to health facilities across the country.
- Paperless port system - This is a system that speeds up clearing and forwarding, especially at the ports.
- Ghana Electronic Procurement System – This system aims to enhance the processes of procuring public goods, disposal of assets, and consultancy services, among others.

According to a 2019 report by the African Development Bank, the Ghanaian government entered into a partnership with IBM to look for ways to leverage their blockchain's capabilities to modernize some of the key functions of land administration. The new technology is supposed to reduce corruption levels, increase investment opportunities, and enhance capital access. Together with Bitland, Ghana is working in conjunction with the Lands Commission to blockchain land registration in Kumasi, the second-largest city in Ghana after Accra. An open larger platform was chosen to be used as a basis for the blockchain.

The initiatives in the digital sector have also changed the state of the public health system, which has received a significant upgrade after the implementation of the new e-Health technology, which together with other things, has led to the establishment of new National Healthcare Data Centre (Ghana Health Service, 2019, and National Communication Authority, 2018). As part of the strategy, the Ghanaian government has started a phased rollout of the Lightwave Health Information System. The focus is to digitize and modernize the public health system. Rolling out of the system is currently taking place in the central region of Ghana, with plans for a wide rollout throughout the country on the way.

The World Bank has promised to support Ghana's digitization agenda because it is well aware of its significance in the citizens' daily lives. Mobile Money is a clear example of how the introduction of modern technology is likely to transform how to successfully interact with other parts of Ghana daily (The World Bank Group, 2019). There has been tremendous improvement in the level of quality services courtesy of digital technology. The country has also been placed strategically to benefit from the growth of the economy.

The IMF predicted a growth rate of 8.8% in the year 2019 in the World Economic Outlook. This was expected to make Ghana one of the fastest-growing economies in the world. The initiatives that have been put in place have opened doors to several private companies to collaborate with the government. It should be noted that there are several untapped lucrative sectors in the Ghanaian economy, such as

finance, health, agriculture. These sectors have more significant potential for digital breakthroughs, what is needed is an enabling environment. Technology will enable private companies to partner with the government to bring about economic prosperity (Solberg, 2014; United Nations Conference on Trade and Development, 2019).

As argued by (Larsson & Teigland, 2020, P.17), digitization will provide the necessary ground for the stakeholders to put together data from various arms of national projects to transform some of the formally unstructured material into useful items. Some of the methods will also be optimized to eliminate wasteful tendencies. The modern methods can save time and give out quality output. Government salaries are paid mostly every month; therefore, when the processes are digitized, more work is done within the given time, thus saving resources.

Drones Delivering Medical Supplies in Ghana

To a more considerable extent, poor accessibility to essential healthcare products has been hampered due to inadequate means of transport to remotely located areas. The company was launched in Rwanda in 2016 to deliver blood products as well as other important medicine to rural clinics. By 2019, the services were extended to Ghana. Zipline is currently able to provide 170 different vaccines, blood products, and other forms of medicine to over 2000 health facilities and close to 22 million people (de Leon, 2020; Ackerman, 2019; Sigal, 2019). A drone is used to delivering products required in emergency cases such as blood and vaccines and other life-saving medications (Ackerman, 2019; Sigal, 2019). The service in Ghana operates 24/7, from four (4) distribution centers, each having 30 drones and makeup to 600 on-demand delivery flights (Ghana Health Service, 2019; Ackerman, 2019; Sigal, 2019).

In Ghana, the health systems are characterized by high medicine waste; in rural areas, patients are forced to make trips during emergency instances to hospitals that are found several kilometers. In such situations, it means that patients who require life-saving care do not get the required medicine and treatment they need to be able to survive. Until the introduction of the medical drones in Ghana, if the necessary medicine is not available, it means that

the patients are likely to succumb to the sicknesses (Ghana Health Service, 2019 and Ackerman, 2019).

Ghana has an estimated population of 30.8 million people. According to data from the World Bank (2019), about 45% of Ghana's people are found in rural areas. World Health Organization estimated that earlier on that by the year 2017, there would be 270 cases of malaria per 1000 people. Though the disease can be prevented and curable, in 2019, the country piloted a new vaccine for children in rural areas that mainly lack timely access to the treatment that could save their lives. The introduction of the drone program was a great inspiration to a considerable number of people in Ghana. Making use of the technology to provide quality healthcare services to people was regarded as a noble idea and highly commendable. The revolutionary model of healthcare delivery has saved many people's lives and is also an inspiration to most people (Van Velthoven et al., 2019; Pathak et al., 2019). The drone technology did also promoted efficiency, leading to a considerable reduction in the wastage of the supply chain system. It is presumed by many scholars this intervention will also help the country to achieve a Universal Healthcare delivery system.

Drones Delivering COVID-19 Tests in Ghana

The fight against COVID-19 in the African continent is better compared to Europe and the United States. Though Africa hosts about 17% of the world's population, the continent has only recorded less than 100,000 cases of infection, which is just 1.4% of the world's total disease. The continent has also recorded less than 3000 deaths, which are 0.7% of the total fatalities across the globe, according to the African Centre for Disease Control.

The Ministry of Health and Ghana's Health Service is well equipped to carry out up to 15,000 tests in a single day. The drones can do 300 flights from their two collection points, but it is hoped that demand would not reach that point. Zipline's fleet has two other drone ports, which can be brought online to serve at least 2000 health clinics in rural areas with about 10-15 million residents. According to the Ghana Health Service and the World Health Organization, as of mid-May, 2020, Ghana conducted 233, 7340 COVID-19 tests, and

the country has one of the highest testing capacity on the continent. Compared to the US, where swabs and the chemical reagent that are required to complete the tests are running out, Ghana has a different form of backlog, the rural clinics in far-flung areas with only nine testing points in the entire country are providing the services required. It is the first time that self-sufficient drones are being used to enable long-range deliveries in areas that are densely populated, especially in urban areas, to give room to drone technology to fight against COVID-19.

Theoretical Framework

For this study, the researcher adopted the Diffusion of innovation and Technology Acceptance Model as the underpinning theoretical framework.

Diffusion of Innovation and Technology Acceptance Model

The most regularly adopted theory for the study of why countries and individuals adopt new innovative technology in their everyday activities is the Diffusion of Innovation (DOI) (Rogers, 1983, cited by Ahadzadeh et al., 2015). The diffusion of innovation is regarded as a valid and authentic model to explain why individuals as well as countries utilize new technologies (Taherdoost, 2018). According to Rogers 1983, the five attributes of DOI theory include observability, complexity, trainability, compatibility, and comparative advantage. The attributes help individuals to get used to innovative technology. Nevertheless, some studies point out that relative advantage, compatibility, and complexity are the only ones closely related to the adoption of innovation (Kang et al., 2015). Relative advantage entails to the level in which innovation is alleged as being better compared to its precursor. Compatibility, on the other hand, is the level upon which innovation is considered consistent with the present values, needs, and past experiences (Ahadzadeh et al., 2015).

Most of the dissemination of the innovations based on research has mainly focused on the nature of adaptation of institutions, and the people are influenced by the nature of innovation. Many researchers and innovators apply the Technology Acceptance Model (TAM) which was proposed by

Davis, 1989. TAM can explain the level of perception of the existing technology (Lsi, 2017 and Ahadzadeh et al., 2015). Some of the essential factors in TAM that influence attitudes and behavioral interaction towards the system's use are considered useful and are easy to use (Lai, 2017). The perceived usefulness is referred to as the level upon which a person believes that making use of a given system is likely to facilitate their job performance (Davis, 1989, cited by Ahadzadeh et al., 2015).

Dissemination of innovation and TAM can easily complement each other because they have the same constructs. Perceived usefulness and the ease of use in TAM are similar to the relative advantage and complexity in both diffusion and innovation (Chamata & Winterton, 2018). Therefore, several researchers took note of the attributes of innovation and determinants of attitude and intention regarding the acceptance of technology while applying ODI and TAM (Taherdoost, 2018; Lai, 2017; Chamata & Winterton, 2018; Ahadzadeh et al., 2015). This research, therefore, aims to determine the factors that influence the perception of health workers on the impact of drone's medical supplies and why the Technology Acceptance Model is the most enhanced model that can be used to explore various variables.

Research Questions (RQ)

- RQ1. What is frontline healthcare workers' opinion on the sustainability of Ghana's digital campaign on the use of drones for medical supplies?
- RQ2. Name some of the positive impacts of using drone technology in providing healthcare services to the people of Ghana.
- RQ3. What is the perception of medical staff on the use of drones for delivering the COVID-19 test?
- RQ4. What challenges do frontline healthcare workers encounter in relying on drone technology for emergency medical supplies?

Materials and Methods

The health facilities for this study were purposively sampled after a pre-study. Purposive sampling was used because the participants were purposively chosen with an experiential fit and willingness to

participate in the study (Klar and Leeper, 2019, p. 428). According to (Roller and Lavrakas, 2015 p.152) informal interviews could be conducted in generating the research idea and designing the survey questionnaire, therefore, informal interviews were conducted with the administrative staff and frontline health workers of the 20 health facilities to discuss their use of drones' technology to assist in health delivery. These informal interviews, in combination with the review Literature and theoretical framework in the previous section, were used to design an online questionnaire (hosted by Questions- Pro software).

The health workers (population for the study) were homogeneous; hence, the participants had similar experiences with requesting for medical supplies via the drone technology. Also, the sampled health facilities were of the same characteristics, and the participants included Nurse Practitioners, Nurse Midwives, and Physician Assistants, Hospital Pharmacist, Medical Doctors, and other health workers who regularly request for medical supplies via drone technology. Since all the over 100 health facilities within the operational zone of the drone for emergency medical supplies could not be covered under this study, the researcher employed the quota sampling to identify 20 health facilities thus 5 each from the four operational areas (Zipline Omenako, Air Jays Canopy Zipline, Zipline SefwiWiawso and Zipline Mpanya) of the Zipline medical drone.

The survey comprised 25 questions exploring the general impacts of the drone technology for medical supplies and the technology's effectiveness in terms of time and cost (as well as collecting demographic information). The key challenges frontline health workers face with the utilization of drone technology for emergency medical supplies. The questions used 5 point Likert-scales to get the respondents' responses to determine their acknowledgment with the statement. Nevertheless, they were presented by two open-ended questions on how and the average time spent on each requisition via drone technology for medical supplies.

The data for this study was gathered using an online survey of 550 health workers in 20 out of the 100 healthcare facilities in the operational areas of the Zipline Drone technology for medical supplies (located in Omenako, 68 kilometers north

of Accra, the capital); thus the four operational zones in the Western North and Eastern Regions of Ghana between March and mid-May 2020. The survey was put into the test and shared through the WhatsApp group page of the sampled 20 hospitals and Clinics. (These particular WhatsApp groups were created purposely by the administrators of the sampled hospitals for those health workers who were interested and willing in participating in the survey). Out of 550 questionnaires distributed via the WhatsApp group platforms of the 20 health facilities, 533 valid responses were received, which translates to a response rate of 96.9%.

The data received from the survey questionnaire were downloaded to excel and hand-coded. All the information acquired, apart from the responses of the open-ended questions, were well exported in a condensed form and analyzed through the use of SPSS. The final analysis of the data was done using Mean scores, percentages, Standard Deviation, and Cronbach's Alpha to measure the validity of the two main variables in this study.

Findings and Discussions

This section analyses the data of the study and discusses the result. The areas discussed in the section are the demographic characteristics of respondents, The Opinions of front line healthcare workers on the sustainability of Ghana's digital campaign on the use of drones for medical supplies, the positive impacts of using drone technology in delivering health care in Ghana. The medical staff's perception of the use of drones for delivering the COVID-19 test, the challenges frontline healthcare workers encounter in relying on drone technology for emergency medical supplies.

Demographic Characteristics of the Respondents

In this part of the study, the description and distribution of the respondents' demographic backgrounds are discussed. The participant's characteristics discussed were sex or gender, age group of the respondents, current job title, and years of working experience. The result related to the demographic background of respondents is presented in Table 1.

Participants are 52.7% female (n=281), 45.8% male (n=151). 45.4% (n=244) and 1.5% others (n=8). Respondents are of age 21-30, 12.8 % (n=68), 31-40 years 37.0% (n=197), 41-50 years 34.5 % (n=184) and 51-60 years 15.8% (n=84). The study sought to find out the job title of the interviewees because their titles would well determine how they responded to the questions that were asked. And from the responses obtained, it was discovered that a majority of them (49.1%) were Nurse Practitioners, (49.1%) were Nurse-Midwives, 20.3% were Physician Assistants, 14.3% were Hospital Pharmacist, 7.1% were Medical Doctors and 4.5% were another category of health workers. The study also describes the years of working experience of respondents such as '1 to 5 years' n= 97 (18.2%), '6 to 10 years' 272 (51.0%), "11 to 15 years" n=108(20.3%), and "16 to 20 years" n= 56 (10.5%) (See Table 1).

Table 1: Demographic Characteristics of Respondents

Variables	Category	Frequency	%
Age	21-30	68	12.8
	31-40	197	37.0
	41-50	184	34.5
	51-60	84	15.8
Gender	Male	244	45.8
	Female	281	52.7
	Others	8	1.5
Current Job title	Nurse Practitioner	120	22.5
	Nurse Midwife	120	22.5
	Physician Assistant	108	20.3

Current Job title	Hospital pharmacist	76	14.3
	Medical Doctor	85	15.9
	Others	24	4.5
Years of working experience	Less than 1 year		
	1 to 5 years	97	18.2
	6 to 10 years	272	51.0
	11 to 15 years	108	20.3
	16 to 20 years	56	10.5

The Opinions of Front Line Healthcare Workers on the sustainability of Ghana's Digital Campaign on the Use of Drones for Medical Supplies

In this study, the opinions of front line healthcare workers on the sustainability of Ghana's digital campaign on the use of drones for medical supplies were sought. Some of the responses and scores are as follows: "Am satisfied with the government's campaign for the digitization of the health and other sectors in the country" with an average score of 4.17 and (SD=.79), "So far, am satisfied with the implementation of the medical drone technology in the health sector in Ghana" with an average of 4.37 and (SD=.69), "I will encourage the government to expand the coverage of the use of drone medical technology for medical supplies to other parts of the country" with an average of 4.18 and (SD=.87), "I Will support the idea of cancellation of the drone medical supplies project when there a change of government soon" with an average of 1.95 and (SD=1.12), and "I support the use of digital drone technology to improve health delivery in my health facility" with an average of 4.19 and (SD=.71).

Table 2: Sustainability of Ghana's Digital Campaign on the Use of Drones for Medical Supplies

Measurement Items	Mean	SD
Am satisfied with the government's campaign for the digitization of the health and other sectors in the country	4.17	.79
So far, I am satisfied with the implementation of the medical drone technology in the health sector in Ghana	4.37	.69
I will encourage the government to expand the coverage of drone medical technology for medical supplies to other parts of the country	4.18	.87
I Will support the idea of cancellation of the drone medical supplies project when there a change of government in the near future	1.95	1.12
I support the use of digital drone technology to improve health delivery in my health facility	4.19	.71

Note: 1=(strongly disagree), 2=(somewhat disagree), 3=(neither agree), 4=(somewhat agree), 5=(Strongly agree)

The Positive Impacts of Using Drone Technology in Healthcare Delivery in Ghana

The positive impacts of using drone technology in providing healthcare services in Ghana were also examined. There exists a considerable difference in the average scores of concerns on the positive impacts for using drone technology in providing health care services in Ghana, these include, “The drone medical technology in delivering healthcare is very impactful and have saved a lot of lives” (M=4.59, SD=.63), “The drone technology in delivering medical supplies to our Hospital/Clinic is saving us a lot of time and

made us efficient” (M=4.38, SD=.74); “The drone technology in delivering health care in our hospital/ Clinic is cost-effective in terms of transportation for medical supplies” (M=4.43, SD=.75); “The drone technology in delivering medical supplies to our hospital/Clinic able us to save the lives of many emergency cases and patients who visit this health facility” (M=4.43, SD=.74); and “I ordered medical supplies via the drone technology, and it was delivered to our hospital right on time” (M=4.41, SD=.73).

Table 3: Positive Impacts of Using Drone Technology in Delivering Health Care in Ghana

Measurement Items	Mean	SD
The drone medical technology in providing healthcare is very impactful and have saved a lot of lives	4.59	.63
The drone technology in delivering medical supplies to our Hospital / Clinic saves us a lot of time and makes us efficient	4.38	.74
The drone technology in delivering health care in our hospital/Clinic is cost-effective in terms of transportation for medical supplies	4.43	.75
The drone technology in delivering medical supplies to our hospital/Clinic able us to save the lives of many emergency cases and patients who visit this health facility	4.43	.74
I ordered medical supplies via the drone technology, and it was delivered to our hospital right on time	4.41	.73

Note: 1=(strongly disagree), 2=(somewhat disagree), 3=(neither agree), 4=(somewhat agree), 5=(Strongly agree)

The Perception of Medical Staff on the Use of Drones for Delivering the COVID-19 Test

The perception of medical staff on the use of drones for delivering the COVID-19 test is discussed. This include, Using drone technology in delivering COVID-19 test in Ghana is the best idea in times of pandemics situations, Using the drone technology in delivering COVID-19 test in Ghana enable us to

speed up the testing of COVID-19 suspected cases, The use of the drone technology has helped us prevent the person- to- person spread of COVID-19 pandemic, Overall my impression of the using drone technology in delivering COVID-19 test in Ghana is the most favorable innovation for improving health care delivery in Ghana. (Table 4)

Table 4: Perception of Medical Staff on the Use of Drones for Delivering the COVID-19 Test

Variables	Sample	
	Mean	CV
Using drone technology in delivering the COVID-19 test in Ghana is the best idea in times of pandemics situations.	4.41	.53
Using the drone technology in delivering COVID-19 test in Ghana enable us to speed up the testing of COVID-19 suspected cases	4.41	.53
The use of drone technology has helped us prevent the person- to- person spread of COVID-19 pandemic	4.43	.62
Overall my impression of the using drone technology in delivering COVID-19 test in Ghana is the most favourable innovation for improving health care delivery in Ghana	4.49	.45

Note: 1=(strongly disagree), 2=(somewhat disagree), 3=(neither agree), 4=(somewhat agree), 5=(Strongly agree)

Table 4 contains the mean of each instrument and the cumulative variance of each instrument. "Using drone technology in delivering COVID-19 test in Ghana is the best idea in times of pandemics situations" (M=4.41, CV=.53), "Using the drone technology in delivering COVID-19 test in Ghana enable us to speed up the testing of COVID-19 suspected cases" (M=4.41, CV=.53), "The use of the drone technology has helped us prevent the person- to- person spread of COVID-19 pandemic" (M=4.43, CV=.62), "Overall my impression of the using drone technology in delivering COVID-19 test in Ghana is the most favorable innovation for improving health care delivery in Ghana" (M=4.49, CV=.45).

The Challenges Frontline Healthcare Workers Encounter in Relying on Drone Technology for Emergency Medical Supplies

This section of the study discusses the challenges frontline healthcare workers encounter in relying on drone technology for emergency medical supplies and this includes; "Sometimes the medical supplies take too much time to arrive" (M=4.30, CV=.74), "High or strong winds, like those that occur during a natural disaster, could make using a drone ineffective if it cannot arrive on-site safely" (M=4.27, CV=.73), "The amount of weight a drone can affect the payload or quantity of medical supplies we can order at a time" (M=4.32, CV=.87), "Sometimes both blood and the vaccines do not get the right temperature during

transportation by the drones to our health facilities" (M=4.34, CV=.90), "Due to the facts, some of those operating the drones are not medical professionals, they sometimes do not supply the right prescriptions of medical supplies" (M=4.39, CV=.69).

Table 5: Challenges Frontline Healthcare Workers Encounter in Relying on Drone Technology for Emergency Medical Supplies

Variables	Sample	
	Mean	CV
Sometimes the medical supplies take too much time to arrive	4.30	.74
High or strong winds, like those that occur during a natural disaster, could make using a drone ineffective if it cannot arrive on-site safely	4.27	.73
The amount of weight a drone can affects the payload or quantity of medical supplies we can order at a time	4.32	.87
Sometimes both blood and the vaccines do not get the right temperature during transportation by the drones to our health facilities	4.34	.90
Due to the facts, some of those operating the drones are not medical professionals; they sometimes do not supply the right prescriptions of medical supplies (drugs).	4.39	.69

Note: 1=(strongly disagree), 2=(somewhat disagree), 3=(neither agree), 4=(somewhat agree), 5=(Strongly agree)

Table 6: Opinions on the Requisition of Medical Supplies and the Average time for Medical Supplies

Variables	Items	Reliability
How is the requisition of medical supplies done?	1	0.923
On average time how does it take to receive medical supplies when a requisition is made?	1	.060
Completed instrument	2	0.983

In table 6, there were 2 dimensions and the 2 items in the questionnaires. Cronbach's Alpha recorded the reliability for all the questionnaires that were provided with each ranging from 0.814 to 0.923. The overall reliability was 0.98, a clear indication that the instruments gave consistent reliability, which is well accepted even when Cronbach's Alpha is greater than 0.70. This shows that one can rely on the results of this instrument.

Conclusion

Ghana and other countries deliberately use different types of digital technologies, especially, drones to improve the health systems for economic growth and development. Moreover, health authorities in Ghana are adopting the use of drones to facilitate healthcare product delivery that, according to this study, has improved emergency health delivery in the country.

This study on the adaptation of digital technology, especially drones, for emergency health delivery in Ghana is yielding a tremendous positive impact within the health sector in Ghana. Since 2010 various governments have adopted and implemented different strategies to digitize all sectors of the Ghanaian economy, including the health sector. The debate on the viability and the value for money of these interventions in the health sector, especially the introduction of drones for medical supplies, have drawn so much public discourse as well. This study aimed to assess the impact of the “Ghana go digital” intervention of the introduction of drone technology for emergency health care in Ghana. However, the findings for this study indicated that the drone technology intervention for medical supplies in Ghana had improved on the management of emergency cases within the 20 sampled health facilities.

Another finding of this study, again reported that an average time of 45 minutes to 60 minutes, is spent by health workers in making requisition from the drones supplies. Another finding from this study shows that WhatsApp is the main social media platform used by health workers in requesting drugs via drone delivery.

The study also found out that drone technology in Ghana has tremendously helped in the fight against COVID-19 and the majority of the respondents indicated they will support the idea of future governments to continue with the drone medical delivery program. The general public is, therefore, greatly embracing technology due to associated benefits. The combination of direct and indirect effects of digital drone technology has been dramatically emphasized. In the same way, the impact created by drone technology on health is mainly dependent on both direct and indirect effects.

One other essential aspect of the impact of digital drone technology on matters of health is in the area of Electronic health or E-Health literacy. E-Health literacy refers to seeking, finding, comprehending, and appraising information regarding health from electronic sources. The knowledge gained is then applied in addressing problems related to health (Hii, et al., 2019). A high level of e-health literacy can easily lead to the negative influence of technology

(Farid, 2019). Despite the few challenges identified by this study, the overall findings of this research suggest that the introduction of drone technology for health delivery in Ghana has impacted them positively on emergency health delivery in Ghana.

Limitations and Future Research

This study has the following limitations that suggest directions for future research. First, the researcher cannot claim to have fully comprehended drones for medical delivery related debates within the respective period. High-level information density in the specified field of the investigation did not permit the researcher to cover a whole range of articles related to the various topics of interest. The researcher recommends that future research should be able to address the areas and also expand the scope and focus of the analysis based on the levels that have been established in this study.

Another limitation is the scope of this current study. Out of over 2,000 health facilities and over 1000 frontline health workers benefiting from the drone technology for medical delivery in Ghana, the researcher was only able to sample 533 workers and 20 health facilities. The researcher proposed that future studies on this subject matter should be on a large scale. Regardless, the researcher believes this study is the first to be conducted about the use of drones in health care delivery in Ghana.

Conflict of Interest

None declared.

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