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USE OF DRONES FOR DELIVERY OF MEDICINE AND BLOOD IN REMOTE AREAS

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Abstract

The use of drone technology for the delivery of medicines and blood in remote areas has emerged as an innovative solution to some of the logistical challenges in healthcare. The study aims to evaluate the effectiveness, viability, and impact of the use of drones in improving access to essential medicines and blood supplies in hard-to-reach locations. Research methods carried out through the study of literature. Research results show that drones can not only significantly reduce delivery times and ensure reliability in delivering medical aid, but also offer a cost-effective solution compared to traditional transport methods. The study underscores the importance of a multidisciplinary approach in addressing barriers to delivery of health services in remote areas and exploring the future of drones as a major tool in medical follow-up response and health logistics delivery.

Keywords: Drones, Medicines, Remote Areas.

Introduction

In an era of globalization and rapid technological development, efforts to improve the quality of healthcare are one of the priorities that cannot be neglected. (Free et al., 2013). One of the biggest challenges in healthcare is to ensure the distribution of medicines and medical needs, such as blood, to remote and hard-to-reach areas. The need to reach these areas quickly and efficiently is becoming increasingly critical, especially in emergencies or pandemic situations that require a quick and timely response. (Joyce, K., & Loe, M. 2010).

Traditionally, the distribution of drugs and blood to remote areas is often faced with a number of obstacles such as inadequate infrastructure, long delivery times, and high costs. This often leads to potentially life-threatening delays or even the loss of a chance to rescue patients due to delays in the delivery of the necessary medicines and blood. (Li et al., 2018).

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So with that, health services in remote areas are a crucial issue that requires serious attention from all sides. (Aslan, 2019). The difficulty of accessibility is one of the biggest challenges in the effort to provide adequate health care at the location. Remote areas are often isolated due to restricted transportation infrastructure, such as poor roads, inadequate bridges, or disconnected access during the rainy season. (Wakerman, J., & Humphreys, J. S. 2011). This has a significant impact on the ability to provide timely and effective medical services, including access to medicines, medical equipment, and health professionals. Without an innovative solution to this problem, residents in remote areas are at risk of facing much lower levels of health than those living in urban areas. (Parsons et al., 2021).

On the other hand, the urgency of health care in remote areas is also crucial because these communities often face unique health conditions that require specific and immediate intervention. (Fitts et al., 2020). For example, in some cases, remote areas may be more susceptible to certain disease outbreaks due to lack of access to health information and vaccinations. In addition, the lack of preventive health care and regular medical supervision can lead to the inability to identify and treat health problems at an early stage, which will ultimately increase the cost of treatment and decrease the quality of life. Innovative and creative solutions, such as the use of drones for the delivery of medicines and blood, are becoming crucial in reducing the gaps in access to health services between urban and remote areas, ensuring that every individual has an equal opportunity to access quality health services. (Ajuebor et al., 2020).

Unmanned Aerial Vehicles (UAV) technology has demonstrated its potential as an innovative solution to address distribution challenges in remote areas. Drones, with automatic flight capabilities and accurate navigation, offer a fast and flexible alternative to direct delivery to targeted locations with minimal risk and obstacles. (Mohsan et al., 2022).

Using drones to deliver medicines and blood to remote areas not only helps in solving access and efficiency issues, but also paves the way for further innovation in delivery of health services. With the continuous development of technology and infrastructure, this implementation is expected to be even wider, touching more needy communities around the world. (Wulfovich et al., 2018).

Drone technology has great potential as an innovative solution to address the challenges of providing health care to remote areas. With its ability to fly over geographical obstacles and insufficient infrastructure, the drone can shorten the time it takes to deliver medicines, blood samples, and essential medical equipment to hard-to-reach locations. This speed and flexibility is crucial in medical emergencies, where time is often directly linked to the patient's chances of survival. (Oigbochie et al., 2021). Drones also open up opportunities for remote health surveillance through delivery and collection of medical samples, allowing diagnosis and consultation without requiring remote residents to travel far to the nearest health facility. (Yigit et al., 2023).

In addition, the use of drone technology in the health sector also offers significant cost-efficiency potential. By reducing the need to build expensive transportation infrastructure in remote areas and eliminating inactive time associated with logistical constraints, delivery systems using drones can substantially reduce operating costs in the provision of health services. (Hiebert et al., 2020). It encourages more innovation and investment in the health sector, especially in regions that were previously considered economically inadequate for adequate access to health services. In the end, the integration of drone technology into the global health system has the potential not only to improve the accessibility and efficiency of health services, but also to promote equality and improvement of health standards for people in remote areas around the world. (Balasingam, M. 2017).

Thus, this research is to identify the effectiveness of the use of drones in the delivery of medicines and blood and to assess the impact of the drones on the acceleration and efficiency of delivery in remote areas.

Research Method

The method of research carried out on this study is literature. Literature research method is an approach carried on through the collection, analysis, and synthesis of data from published text sources, such as books, journals, and scientific articles related to research issues (Ratislavová & Ratislav, 2014; Richardson, 2018). This technique is carried out by researchers to gain a thorough understanding of the subject researched through previous works. A method that can be done to conduct a study of literature, among other things through keyword search, which involves searching for other research references from various reliable sources. (Antin et al., 2015; Punch, 2013). In addition, research into literature studies is also considered an important step in building the theoretical foundations of research, presenting the background of the problem, and validating the methods of research chosen based on existing evidence and theory. (Champe & Kleist, 2003; Zed, 2004).

Result and Discussion

Understanding and development of drone technology

Drones, also known as Unmanned Aerial Vehicles (UAVs), are unmanned aircraft that can be controlled remotely or fly automatically through programmed flight control systems. The beginnings of drone technology began with military purposes, where drones were used for missions that were considered too dangerous to humans, such as spying enemy territory and targeting strategic locations. (Chan et al., 2018). However, technological advances over time have extended drone functions to a variety of fields, including photography, surveys, mapping, agriculture, and healthcare. With a wide range of size options from the very small to the size of traditional aircraft, drones offer unparalleled flexibility in achieving air access. (Vergouw et al., 2016).

The development of drone technology has experienced a significant leap in the last decade. Innovations in battery technology, lightweight materials, advanced GPS navigation systems, and flight automation software have enabled drones to be more efficient, reliable, and affordable. The commercialization of drones has opened up new opportunities in a wide range of industries, ranging from rapid delivery of shipments, rapid emergency response, to forest and wildlife conservation monitoring. (Kitonsa, H., & Kruglikov, S. V. 2018). Drones are growing not only in operational capability, but also in safety aspects, with the implementation of regulations and standards set by civil aviation authorities in many countries to regulate the use of UAVs in crowded airspace. (Kim, H. W. 2017).

Looking ahead, drone technology is expected to continue to evolve, affecting the way we interact with the world around us. The development of artificial intelligence (AI) and machine learning technology is expected to enrich the ability of drones to perform complex operations independently, reducing the need for human operators. (Yunus, A. M., & Azmi, F. A. M. 2020). Integration of drone technology with the expanding 5G network can provide faster controls and real-time data streaming that will open up new opportunities for applications that require instant response, such as traffic monitoring and disaster management. The future of drone technology seems to be full of endless possibilities, pushing the limits of what can be achieved, and bringing positive change to various industrial sectors around the world. (Yunus, A. M., & Azmi, F. A. M. 2020).

Thus, the development of drone technology has gone from its military origins to a multifunctional existence that has a broad impact on a wide range of industries and sectors of society. Advances in battery technology, materials, navigation systems, and software have made drones more efficient, reliable, and affordable for commercial and personal use. With continuous adaptation and innovation, drones have found new applications in shipment delivery, emergency response, environmental surveys, and more. Moreover, with the emergence of artificial intelligence and 5G networks, the future potential for drones is increasing, promising improvements in automation, efficiency, and the ability to perform more complex tasks. Therefore, drones not only reshape the way we access and monitor our environment, but also offer a path for unprecedented innovation and socio-economic transformation.

Logistical models in medical delivery

The logistical model in medical delivery has undergone a significant transformation with the integration of state-of-the-art technology, including the use of drones and geographic information systems. (GIS). These processes are designed to improve the efficiency, speed, and reliability of delivery of medical materials, such as medicines, equipment, and laboratory samples, especially to locations that are difficult to reach or require rapid response. (Lucchese et al., 2020). Medical drones, for example, have become innovative solutions to address geographical challenges and

insufficient infrastructure, enabling direct delivery to desired locations without being hampered by traffic jams or land transport restrictions. (Ghelichi et al., 2021).

Integrated logistics systems, which combine AI and analytics, play an important role in improving medical supply chain management. Through real-time data analysis, the system can optimize delivery routes, predict supply needs, and ensure compliance with strict storage and transportation standards (He, Y., & Liu, N. 2015). It not only improves operational efficiency but also ensures the quality and safety of medical products shipped. GIS mapping, on the other hand, provides important geographical information that helps in effective route planning and identifying locations requiring urgent medical supplies. (Costantino et al., 2005).

With increasing awareness of the importance of public health and continuous advances in technology, the medical delivery logistics model is expected to continue to evolve. In the future, further integration of technologies such as the Internet of Things (IoT) and blockchain could provide greater transparency, traceability, and security in the medical supply chain. It will not only improve the effectiveness of medical delivery but also provide stronger support for a responsive and adaptive health system in the presence of both emergency and routine operational situations. This transformation promises improved accessibility and quality of health services for the general public.

Effectiveness of Drones in Drug and Blood Delivery

Delivery speed

Drones have revolutionized delivery speed in the medical world, especially in the distribution of drugs and blood products to hard-to-reach areas. Previously, deliveries to remote or disaster-affected areas often faced significant constraints due to damaged or inadequate infrastructure, resulting in life-threatening delays. (Hii et al., 2019). The use of drones in medical delivery removes geographical barriers by flying directly to targeted locations, allowing drugs and blood to reach the hands of those in need in minutes or hours, not days. It's vital in an emergency, where every second is precious and can determine the safety of the patient. (Sharma et al., 2021).

In addition, drones provide additional benefits in terms of reducing the risk of contamination and ensuring product integrity during transportation. With its ability to store medical products in ideal condition during flight, the drone ensures that the drugs and blood products remain in prime condition to reach their destination. The reliability and speed offered by the drone delivery not only improves logistical efficiency in the health sector but also increases the chances of saving lives and patient recovery (Jackson, A., & Srinivas, S. 2021).

Thus, the use of drones in the delivery of drugs and blood has brought radical updates to the speed and reliability of medical distribution. By enabling fast and secure delivery to locations previously considered difficult or even inaccessible, this technology paves the way for improved access to critical health care. As technology continues to evolve, the potential for further improvements in the efficiency of medical

delivery promises significant advances in health care and our ability to respond quickly to urgent medical needs worldwide.

Time and location accuracy

Time and location accuracy are crucial factors in medical delivery, especially when ensuring that critical supplies such as medicines and blood products are available to patients in need. Logistical challenges, such as traffic jams, bad weather conditions, and limited access to remote areas, have historically hampered the ability to meet these needs. (Hui et al., 2021). However, with the emergence of advanced delivery technology, including the use of drones, we can now overcome many of these obstacles, enabling delivery not only fast but also very accurate. Drones can use advanced navigation systems accompanied by detailed geographical information, ensuring that they can reach very specific locations with high accuracy. (Duffy et al., 2019). It is essential not only to ship to remote or difficult-to-reach locations but also to meet strict delivery times, which are often critical in medical emergencies. (Pulver, A., & Wei, R. 2018).

Furthermore, location accuracy in the delivery of drones plays an important role in improving the efficiency and effectiveness of health services. With the ability to accurately place medical supplies in specified locations, health facilities can reduce waiting times and speed up the process of distribution to patients. (Famili et al., 2024). It carries broad implications not only for the delivery of emergency care but also forining a routine supply in challenging conditions or at times when the health system faces extra stress. The accuracy of time and location in medical delivery ensures that aid is given at the right place and time, increasing the chances of healing and saving lives. (Caillouet et al., 2019).

In other words, the importance of timing and location accuracy in medical delivery cannot be underestimated. It increases not only the possibility of positive outcomes for patients but also the overall efficiency and effectiveness of the health system. As advances in delivery technology, such as drones, continue to evolve, we can expect further improvements in our ability to meet medical needs accurately and quickly around the world.

Impact on medication and blood condition

The use of drones in medical delivery not only improves the speed and accuracy of delivery but also has a significant impact on the condition and integrity of medicines as well as blood products during transit. Many medicines, vaccines, and blood products require specific storage conditions, including strictly controlled temperatures, to maintain their effectiveness and safety. (Shaw et al., 2022). Traditionally,ining these

conditions during transportation to remote or disaster-affected areas can be a challenge. However, with the drone's payload capabilities specially designed to support temperature control and other controlled conditions, medical delivery by drone ensures that the medical product arrives in optimal condition. This minimizes the risk of product damage or degradation that may reduce the effectiveness of treatment or blood transfusion given to the patient. (Vijayaratnam et al., 2015).

Furthermore, the delivery of drones also helps inining the safety of the drug and blood supply chain from contamination or interference. By routing directly to the destination without the need for repeated transfers or temporary storage that may be less ideal, drones reduce the number of contact points where medical products are potentially exposed to inappropriate conditions or undue human intervention. (Teleanu et al., 2019). This is crucial in the context of public health, where the integrity of medical products must be safeguarded at the highest level to guarantee the safety and effectiveness of their use. Thus, drone delivery offers innovative solutions to strengthen the medical supply chain, especially in critical and emergency situations. (Parta et al., 2010).

Thus, the impact of the use of drones in medical delivery includes significant improvements inining optimal condition of medicines and blood products during transportation, as well as improved security and integrity of the supply chain. Through the use of this advanced technology, we can ensure that critical medical supplies are not only delivered quickly and accurately to the location in need but also in conditions that allow for maximum use. This opens the door to major advances in the delivery of health care, in responding to emergency needs and supporting populations in remote and hard-to-reach areas.

The impact of drones on the acceleration and efficiency of delivery in remote areas

The use of drones in logistics and delivery to remote areas has provided significant breakthroughs in how aid and medical supplies can be delivered. In hard-to-reach locations, where road access is limited or none and geographical conditions are challenging, drones provide an effective and efficient solution. (Nisingizwe et al., 2022). Drone speeds in overcoming various geographical obstacles, such as mountains, forests, and large rivers, enable much faster deliveries than traditional transport methods. With the ability to fly directly to the destination without having to follow a land route, the time it takes to deliver medicines, vaccines, and other vital medical supplies can be significantly reduced. (Dukkanci et al., 2021).

In addition, drones improve operational efficiency by reducing the need for physical transport infrastructure such as roads or bridges, which are often difficult and expensive to build in remote areas. (Benarbia, T., & Kyamakya, K. 2021). By eliminating dependence on this conventional infrastructure, drones enable the establishment of a delivery system that is more focused on technology and less on environmental

modification. This means that even the most isolated communities are accessible, and the provision of health services is no longer hampered by geographical or economic constraints. With this increased efficiency, aid can be channeled to areas in need in a more predictive and sustainable way. (Tamke, F., & Buscher, U. 2023).

The impact on efficiency and delivery speed has also led to an improvement in the fulfilment of urgent health needs. (Rashidzadeh et al., 2021). In an emergency, like after a natural disaster or a disease outbreak, the speed of delivery of vaccines, medicines, and other medical materials can mean the difference between life and death. (Meng et al., 2023). Drones, with their ability to quickly cross physical obstacles and deliver aid directly to points in need, enable handling emergencies in a much more dynamic and effective way. This quick response not only saves lives but also reduces the long-term impact of the health crisis on the community. (Macias et al., 2020).

Finally, the implementation of drones in shipping to remote areas offers a more sustainable and responsive model for global health logistics. By reducing delivery time and costs, resources can be allocated more effectively, enabling the optimization of aid distribution to different areas more equitably. Through increased access to medical supplies, remote communities have a better chance of coping with health challenges, strengthening their resilience to future emergencies. (Bhatt et al., 2018).

Thus, it can be concluded that the impact of the use of drones on the acceleration and efficiency of delivery in remote areas is very significant. Their ability to overcome physical obstacles quickly, reduce dependence on conventional transport infrastructure, and provide rapid response in emergencies, offers a major improvement in the delivery of global health services. Drones have not only revolutionized the way we send aid to remote areas but also how we view the possibilities of future health logistics, paving the way for more inclusive, efficient, and responsive systems.

Conclusion

Drones, as advanced technology, have a huge impact on the delivery of medicines and blood to remote areas, where they offer a faster, more efficient, and more reliable way to distribute these vital health supplies. With the ability to fly over geographical obstacles and limited infrastructure, drones simplify the process of shipping these vital goods to locations that are difficult to reach. The impact includes improved access to health services for isolated populations and improved response to medical emergencies. Drones play an important role in turning health logistics delivery systems into more sustainable and effective, especially in places where conventional delivery methods cannot properly serve.

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