

# Drone a technological leap in health care delivery in distant and remote inaccessible areas: A narrative review

## ABSTRACT

In developing countries, last-mile delivery of medical products is a challenge, especially in hilly and rural areas where there is no road connectivity. As helicopters or other air services are not affordable all the time, drones can be used for the supply of medical products. They are cost-effective as compared to other air or road transport. However, the carrying capacity of drone is less, it is not able to carry heavier payloads. Also, operating drones requires trained operators, and it is a new venture in a developing country so possibilities of confusion and lack of clarity on operating procedures are there. Drones are becoming increasingly reliable for the health care delivery. This narrative review explores the use of drones in healthcare delivery globally.

**Key words:** Delivery of health care, drones, equipment and supplies, health services accessibility, unmanned aerial devices (UAD)

## Introduction

Medical delivery refers to the delivery of medical products, vaccines, blood samples, testing kits and various medical equipment.<sup>[1]</sup> Recently technology like drones or Unmanned Aerial Vehicles (UAVs) has come into light which is playing a vital role for the supply of medical products in challenging areas.<sup>[2]</sup> The health care delivery system can improve its cost-effectiveness and also improve the efficiency of health care delivery system by using drone technology.<sup>[3-5]</sup> Drone can safely fly longer distances which is enabled by beyond visual line of site technology.<sup>[6]</sup> Often known as –leaf-frog technology,<sup>[7,8]</sup> drone applications can be used to improve health care equity in challenging areas.<sup>[2,4]</sup>

The COVID-19 crisis highlighted the challenges for medical supplies.<sup>[2,9,10]</sup> Drones can play a very essential role in health care delivery and are affordable as compared to any other means in the areas where transport via roads is a challenge.<sup>[3,11,12]</sup> Clinics in rural Virginia, received medical supplies from the Wise Country regional airport. The time taken to deliver was 30 minutes, which was 60 minutes less than the time taken by traveling through road.<sup>[9]</sup> Small drones are also used for monitoring weather and traffic.<sup>[13]</sup> This technology can also be used during disaster management.<sup>[14]</sup> Medical supplies were delivered in Nepal,<sup>[15]</sup> Canada,<sup>[2]</sup> at the time of disaster.

Use of drones for medical supplies is a new technology for developing countries.<sup>[13]</sup> The operators of drones have so many

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concerns including the directions of their arrival, how exact locations can be traced, and the time management.<sup>[10,16-18]</sup> To overcome all these issues drones should have sensors that can act as warning alert, headlights for attracting attention while their arrival.<sup>[16-18]</sup>

In India, first drone was used in remote areas in Meghalaya’s West Khasi Hills for the delivery of medicines. Drone AQUILA X2 was used for the delivery. It covered a distance of 25 km in less than 25 minutes.<sup>[19]</sup> The partnership between Apollo Hospital and Niti Ayog, known as the "Medicine from the Sky" initiative, effectively facilitated the delivery of healthcare supplies to remote regions of Telangana. This demonstration highlighted the transformative potential of drones in ensuring universal access to primary healthcare services.<sup>[19,20]</sup>

Indian Council of Medical Research (ICMR) has issued a guidance document for the use of drones in health care delivery, where drone operators will get to know about requirements for obtaining approvals for regulating drones.<sup>[21]</sup> In developing countries like India, for the improvement of health care equity in challenging areas, public and private sectors should collaborate with drone technology.<sup>[21]</sup>

**Opportunities**

In difficult terrains where transportation through road is a challenge, drones can be a cost-effective alternative.<sup>[22]</sup> Drones can help in mapping infectious disease landscapes and rescue and search mission in hilly or snow-covered areas.<sup>[23,24]</sup> As there is no need of pilot it is safe to use, it can be deployed quickly, beyond visual line sight technology (BVLOS) enables drone to safely cover longer distance.<sup>[19,20]</sup>

**Challenges**

Heavy items cannot be carried out in drones like helicopters can do. Drones’ payload is 2 to 4 kg.<sup>[9]</sup> Also, the major issues are safety, security, and privacy.<sup>[19,20]</sup> It may be the reason for loss of jobs for those who are involved in the transportation of medical products.<sup>[3]</sup>

**Use of drones in health care delivery around the world**

Drones, also known as unmanned aerial vehicles (UAVs),

have gained significant attention and are being utilized in various sectors, including healthcare delivery. Here are some examples of how drones are being used in healthcare around the world [Table 1 and Figure 1].

**Use of drones in health care delivery in India**

1. “Medicines from the Sky” Project of Telangana State: The Government of Telangana collaborated with Apollo Hospitals and the World Economic Forum to launch a pilot project called “Medicines from the Sky” in 2020. Drones were used to deliver vaccines, blood units, and other essential medical supplies to remote areas.<sup>[25]</sup>
2. ICMR’s Drone Response and Outreach in Northeast (I-Drone): The i-Drone project, launched in September 2021, aimed to utilize drones for improving healthcare services and emergency response in the geographically challenging terrain of the North East region. It was a collaborative effort between the ICMR, the North Eastern Space Applications Centre (NESAC), and the Indian Institute of Technology, Guwahati (IIT-G).<sup>[26]</sup> The primary objectives of the i-Drone project were to establish a network of drones for delivering medical supplies, vaccines, and diagnostic samples to remote and inaccessible areas, to enhance the transportation of emergency medical aid and facilitate timely response during disasters and emergencies and to facilitate telemedicine services and aerial surveillance for disease surveillance and monitoring.<sup>[26]</sup>
3. Drone for medicines delivery in Uttarakhand hills by AIIMS-Rishikesh: The state of Uttarakhand implemented a drone delivery system for emergency medical supplies in 2019. These drones can cover 36 km in 30 minutes. The initiative aimed to provide quick medical aid to people residing in remote and hilly regions, especially during emergencies and natural disasters.<sup>[27]</sup>
4. Govt of Maharashtra, Zipline, and Serum Institute of India (SII) autonomous instant drone delivery service: The Maharashtra government partnered with Zipline to establish a drone delivery network for medical supplies in 2020. The project aimed to provide timely access to critical healthcare products, especially during emergencies and natural disasters.<sup>[28]</sup>

**Table 1: Use of drones in health care delivery in certain parts of the world**

| Author and year                               | Article Title   | Country       | Samples Delivered  |
|---|---|---------------|--|
| Amukele TK <i>et al.</i> 2017 <sup>[12]</sup> | Drone Transport of Chemistry and Hematology Samples over Long Distances                                 | United States | Supply of Bio medical product.                                       |
| Braun J <i>et al.</i> 2019 <sup>[29]</sup>    | The promising future of drone in pre-hospital medical care and its application to battlefield medicine. | United States | Medical supplies for military persons.                               |
| Balasingam M. 2017 <sup>[2]</sup>             | Drones in medicine - the rise of the machine.   | United States | Emergency medicine, telemedicine, and supply of bio medical product. |
| Zègre-Hemsey JK. 2018 <sup>[18]</sup>         | Delivery of Automated External Defibrillators (AED) by drones: Implications for Emergency Cardiac Care. | United States | Supply of Emergency kits.  |

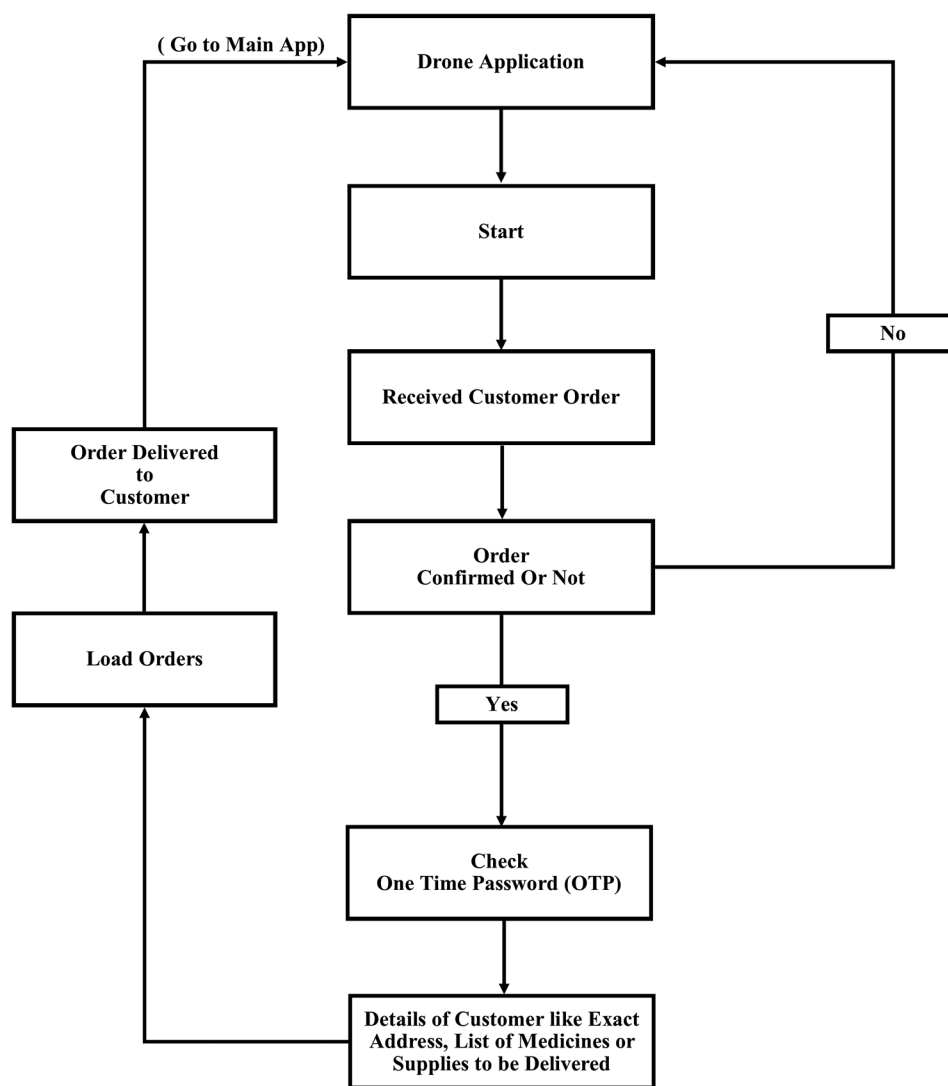


Figure 1: Drone Deployment Mechanism for Health Care Delivery

### Discussion

The article highlights the potential of drones in revolutionizing healthcare delivery, particularly in challenging and remote areas. Drones offer a cost-effective and efficient alternative for transporting medical products, vaccines, and other essential supplies where road transportation is difficult or time-consuming. They can cover longer distances using beyond visual line of sight (BVLOS) technology and can be deployed quickly, making them valuable in emergency situations and disaster management.<sup>[20,21]</sup>

The opportunities presented by drones in healthcare delivery are significant. They can be used for mapping infectious disease landscapes, conducting search and rescue missions in difficult terrains, and delivering medical supplies to remote areas.<sup>[24,29]</sup> The use of drones can enhance healthcare equity by

ensuring that essential healthcare services reach underserved communities.

However, several challenges need to be addressed for the widespread adoption of drone technology in healthcare delivery. One limitation is the payload capacity of drones, as they can only carry relatively light items, typically around 2 to 4 kg.<sup>[13]</sup> This restricts their use for transporting heavier medical equipment or supplies. Safety, security, and privacy concerns also need to be addressed to build public trust and ensure the secure transportation of medical products.

Furthermore, the use of drones in healthcare delivery may have implications for employment, potentially impacting jobs related to traditional transportation methods. It is important to consider the broader socioeconomic implications and plan for a smooth transition to ensure a sustainable and equitable healthcare system.

The examples provided in the article demonstrate the successful implementation of drone technology in healthcare delivery in various parts of the world, including the United States and India. Projects such as “Medicines from the Sky” in Telangana and the i-Drone project in Northeast India have shown promising results in delivering medical supplies and improving emergency response in challenging terrains.<sup>[26,27]</sup>

To further advance the use of drones in healthcare delivery, collaboration between the public and private sectors is crucial. Governments, research institutions, healthcare providers, and drone operators should work together to establish regulatory frameworks, develop safety standards, and promote research and development in drone technology. This collaboration will facilitate the integration of drones into existing healthcare systems, enhance access to healthcare services, and ensure the efficient delivery of medical supplies.

## Conclusion

In conclusion, the utilization of drone technology in healthcare delivery holds immense potential to overcome logistical challenges, improve access to healthcare services, and strengthen medical supply chains. While there are challenges to overcome, the benefits of drones in healthcare outweigh the limitations. Future research and collaboration among stakeholders will play a vital role in realizing the full potential of drones for equitable and efficient healthcare delivery.

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## Conflicts of interest

There are no conflicts of interest.

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