

Harnessing drone technology

Ensuring timely vaccinations for zero-dose children



▲ Unpacking vaccines delivery by drone in Ghana.

Every child deserves access to life-saving vaccinations, yet zero-dose children—those who have not received their first dose of diphtheria, tetanus and pertussis-containing vaccine (DTP1) by their first birthday—remains a persistent challenge for healthcare systems, particularly in rural and underserved regions.

Drones offer a promising solution, navigating obstacles like mountainous terrains and flooded areas to deliver vaccines with unprecedented speed and efficiency. This technology can bridge the gap between healthcare resources and the most vulnerable populations, advancing health equity. While the initial investment is substantial, pilot programmes demonstrate that drones can prove cost-effective through faster and more reliable delivery, reduced wastage and improved healthcare access compared to other methods in specific scenarios.

When to deploy drones for vaccine delivery

Drones represent a transformative solution for vaccine delivery where traditional transportation methods fail to be reliable or efficient. These systems excel at connecting vaccine supplies

with hard-to-reach populations, particularly when geographic barriers, infrastructure limitations, or time constraints pose challenges to immunisation programmes.

Deployment scenarios



Remote areas

Deploy drones to reach isolated communities in mountainous terrain, dense forests, flooded areas or conflict zones where traditional transportation means are impossible or extremely difficult. Drones navigate independently of road networks, flying direct routes over natural barriers.



Time-sensitive deliveries

Automated systems can deliver vaccines within hours rather than days, ensuring temperature-sensitive vaccines maintain potency and meet strict timelines, especially in outbreak response and containment contexts.



Infrastructure challenges

Implement drone delivery where poor road conditions, bridge failures, or lack of transportation networks prevent traditional vaccine distribution. Drones can bypass damaged or non-existent infrastructure by operating from above.



Emergency response

Deploy drones immediately following natural disasters, conflicts, or disease outbreaks when conventional supply chains are disrupted. Rapid deployment maintains population immunity during critical periods.



Cost-effectiveness

Choose drones for frequent deliveries to multiple remote locations. Despite substantial initial investment, they can reduce long-term operational costs by eliminating extensive ground transportation networks and minimising fuel consumption and staffing requirements.



There are logistical issues with the vaccination process in our district. The vaccinator does not always have access to the necessary medicine and vaccine, and it is often difficult to bring these supplies, due to the lack of a convenient transportation method.

Wulta Gessese
Head of Hirko Health Centre, Ethiopia



Credit: Gavi/2024/Solomon Yimer

Key factors to consider before using drones

Before implementing a drone delivery system, assess various key factors including cost implications, logistical challenges and the specific healthcare needs of the target population.

Factor	Description
Regulatory approvals	Obtaining the necessary regulatory approvals for drone operations can be challenging and may include airspace regulations, drone licensing and permissions for commercial use.
Initial infrastructure costs	Establishing a drone delivery network involves significant upfront investments, including purchasing drones, setting up distribution centres and developing the necessary infrastructure for maintenance and operations.
Climate and environmental conditions	Weather conditions can impact the effectiveness, safety and reliability of vaccine distribution. Consider temperature sensitivity, adverse weather patterns, challenging geographic terrain and high altitude with low air density.
Safety requirements	Ensuring safe drone operation and secure vaccine delivery is paramount. This includes risk assessment, emergency protocols and fail-safe mechanisms.
Visual line of sight (VLOS) constraints	Some jurisdictions restrict drone operations to the visual line of sight, which can significantly limit operational range and delivery capabilities.
On-going operational expenses	Drones incur continuous costs including fuel or battery charging, regular maintenance, personnel training and skilled workforce management. Additional considerations include landing zone preparation, communication systems for coordination and charging station infrastructure.
Supply chain integration	Integrating drone delivery into existing healthcare supply chains requires careful planning to avoid duplication. This may involve costs for logistics management systems, delivery monitoring technology and coordination protocols with healthcare facilities.
Cost-effectiveness analysis	Overall cost-effectiveness varies based on delivery distance, shipment volume, regulatory complexity and maintenance requirements. Traditional delivery methods often prove more economical in densely populated areas with established road networks, while drones offer significant advantages in remote or inaccessible regions.

Country spotlights

Nigeria

In Nigeria, where 2.25 million zero-dose children live, children often lack access to education, clean water, sanitation, nutrition and healthcare, contributing to a third of all child deaths. To reach these children, Gavi and state partners deployed Zipline's drone delivery system to transport vaccines to

hard-to-reach areas. Drones deliver vaccines and supplies to health centres and trained Community Health Workers near zero-dose clusters identified by state partners. Within the initial months of operation, the innovative approach has achieved remarkable results. More than 16,000 children were immunised, over 9,000 children provided with nutritional support and over approximately 1,500 new mothers received reproductive health services. The initiative demonstrates how targeted drone delivery can address the complex challenges faced by Nigeria's most vulnerable populations.

Source: [Zipline Newsroom](#)

Ethiopia

Ethiopia's first long-range medical drone network has transformed healthcare delivery in remote villages like Hirko, where resident Etalemahu Geletu previously struggled to vaccinate her children due to frequent vaccine stockouts and poor road conditions. The

newly introduced Kite drones can fly up to 120 kilometres carrying a three-kilogram payload on a single battery charge. In just 30 days of operation, the system delivered nearly 7,000 vaccine doses to local health centres, with 44 flights to six isolated communities in the Hadiya Zone. Community response has been overwhelmingly positive, with residents suggesting expansion to address other healthcare needs. Future trials are planned to evaluate the system's long-term effectiveness and potential scalability.

Source: [Gavi VaccinesWork](#)

This product was produced by the Zero Dose Story Generation Consortium, led by [Sabin Vaccine Institute](#). Sabin is a leading advocate for expanding vaccine access and uptake globally, advancing vaccine research and development, and amplifying vaccine knowledge and innovation.

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