ROBOTS AND SOCIETY

Bringing underserved communities life-saving aid through aerial logistics

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Autonomous drone delivery of medical supplies has improved access to health care for local communities in Africa.

In hard-to-reach areas, saving minutes can save lives during health emergencies. On-demand drone delivery can cut delivery times to under an hour, a stark improvement over traditional ground transportation methods (*1*). Zipline began using autonomous drones to deliver blood on demand to rural hospitals in Rwanda in 2016. Today, drone delivery of blood products has reduced in-hospital maternal mortality from postpartum hemorrhage by 51% and blood expirations by 67% over a year (*2*). The strategy's success led the government of Rwanda to restructure its national blood delivery system. Now, approximately 75% of the blood delivered in Rwanda, outside of Kigali, is delivered by drone.

The government of Rwanda has expanded drone delivery to other sectors, including childhood nutrition and agriculture. Zipline drones have delivered more than 260,000 units of ready-to-use therapeutic food and more than 25,000 doses of animal vaccines.

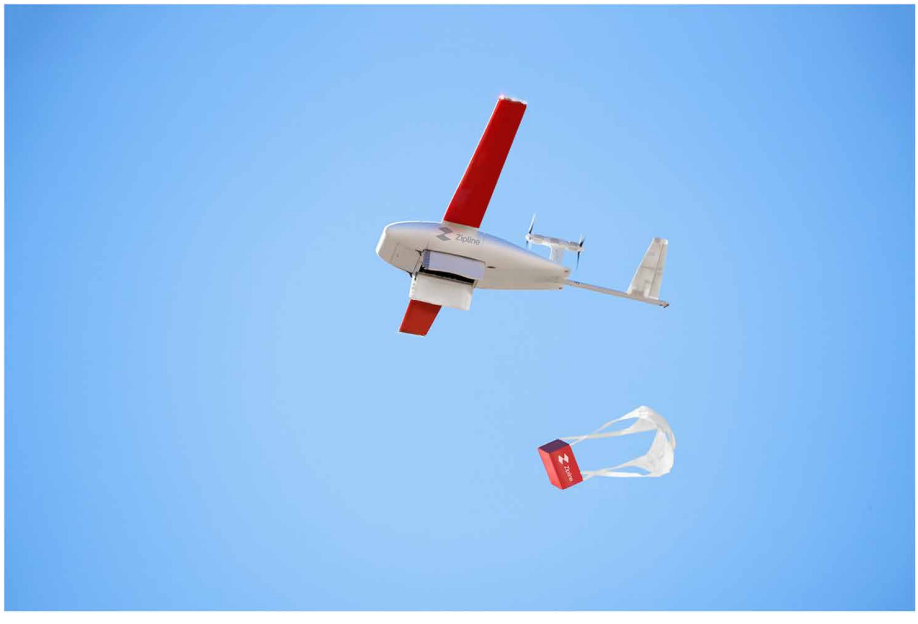
In Ghana, where Zipline launched in 2019, Zipline has enabled more than 15,000 children in the Western North region to access routine vaccines, which has been estimated to have saved an additional 727 lives between 2019 and 2021 (*3*). In addition, Ghana Health Service used Zipline to deliver more than 2 million COVID-19 vaccines to remote regions in the country, prioritizing the most vulnerable population groups (*4*). Since 2022, Zipline's drone deliveries are estimated, on the basis of critical emergency orders fulfilled, to have contributed to more than 10,000 saved lives.

The company has expanded its reach and now operates in seven countries from 13 distribution centers. Across these nations, Zipline has delivered 12.7 million vaccine doses, 220,000 units of blood, and 2.5 million units of medical supplies to a diverse range of health care facilities across all levels of care, from rural health posts to complex general hospitals.

In various countries, Zipline's partnerships have continued to evolve to meet a diversity of needs. In Kenya, the company collaborates with the Elton John AIDS Foundation to deliver HIV and AIDS prevention and treatment products. In Nigeria, the focus is on zero-dose children, or children who have never received a dose of any vaccine, in partnership with Gavi, the Vaccine Alliance. In Ghana, Zipline delivered exam materials to students in flood-affected areas, and in Rwanda, Zipline aids the Agricultural Board by delivering animal health products, such as cattle vaccines and swine semen, to support small farms. These collaborations embody Zipline's adaptive approach, customizing delivery services to meet the unique needs of different populations and sectors.

Launching and scaling up an aerial logistics system of this magnitude involves complexities that extend beyond advanced hardware. It necessitates an ecosystem of interconnected solutions. The first platform (P1), for instance, incorporated global positioning system (GPS)–enabled batteries to expedite takeoffs by eliminating the need for GPS units to "warm up" and acquire satellites. This allowed for a more rapid response to acute care needs.

Beyond improving Zipline's P1 system, Zipline is developing a second platform (P2) to diversify use cases and improve access to critical supplies. For example, in Rwanda, the first-generation platform enabled Zipline to cover nearly all hard-to-reach areas in the country but not urban centers, such as Kigali. To address this gap and the systemic limitations that often result in underserved urban areas globally, P2 is designed for safe, precise deliveries in densely packed areas. It can carry up to 8 pounds (3.6 kg) and deliver in any open place with a radius of a little under 2 feet (0.6 m). In addition, detect-and-avoid technology uses acoustic signals, allowing the drones to identify other flying objects depending on their speed and direction. This lets P2 navigate complicated urban airspaces autonomously.



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This technological advancement challenges the idea that urbanity guarantees dependable access, showing that true equity requires tackling problems in both hard-to-reach and technically available–but–underserved locations. In the United States, for example, 13.5 million people live in 6500 locations with insufficient access to healthy food, according to the US Department of Agriculture (*5*). Many of these are urban areas without supermarkets that an autonomous aerial drone could easily reach. This underscores the need for technological solutions that are nuanced enough to serve both rural and urban demographics effectively.

Expanding autonomous drone delivery systems may also allow for climate change mitigation and adaptation. Gas-powered vehicles have dominated traditional delivery networks. Switching to small unmanned aerial electric vehicles (EVs) might substantially cut delivery logistics carbon emissions. This sustainable shift at scale could also reduce harmful exposures, such as noise and air pollution, both in urban and rural areas. Furthermore, drone-based logistics systems are agile and responsive, making them adaptive to climate-related emergencies. These capabilities help create a more resilient infrastructure that can quickly adjust to climate-change–induced weather patterns and natural disasters, protecting vulnerable communities. Thus, drone delivery systems offer a dual advantage—improving access while also serving environmental goals.

Overcoming regulatory, logistical, and technical obstacles can bring about these benefits. Developing an efficient EV-charging infrastructure and a dependable network for controlling and coordinating unmanned aircrafts are logistical challenges. To use these new technologies safely and responsibly, regulatory frameworks must be updated. Overcoming these problems will enable a sustainable and resilient delivery system that meets society's changing requirements and provides unprecedented, equal, and sustainable access to essential services. The pursuit of these solutions is not merely a technical endeavor but also an ethical imperative and a guide toward a future where essential services are accessible to all, irrespective of geography or socioeconomic conditions.

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