

Since 2016, VillageReach has collaborated with governments, the private sector and non-governmental organizations to pioneer the integration of drone delivery into public health supply chains, increasing equitable access to lifesaving medicines and vaccines. We have developed expertise that is unique to the sector based on our proven experience in using drones for routine, on-demand and emergency deliveries. Through partnerships with five different drone service providers, we have been able to identify the criteria needed to succeed in multi-sectoral partnerships. In addition, our technical oversight of sustained drone transport operations in Malawi and the Democratic Republic of Congo (DRC) has led us to develop a body of case studies and research that supports the growth of the sector.

As a result of this extensive experience implementing drones for health delivery programs, VillageReach developed a set of four principles needed to initiate the mindset shift to achieve the full benefit of an integrated health product transport system. By applying these principles, we believe countries can harness drone transport to implement the demand-driven and resilient public health supply chains necessary to reach all communities in support of universal health coverage (UHC).

This technical note focuses on integrated drone transport system in the health sector. However, logistic drones can operate across a variety of sectors, and cross-sectoral applications offer additional opportunities for reaching operational efficiencies and cost savings.

Four key principles for integrating drones

Defining Integration

The concept of integration goes beyond vertical health program products in the delivery chain, addressing the leadership and technical skills, partnerships, data systems, and transportation needed to enable demand-driven, responsive, and resilient supply chains. Today, we can elevate the principle of integration by accessing the sky and transforming how last mile health supply chain works.

Last mile direct delivery using land-based transportation modalities (e.g., truck, motorcycle, canoe, or bicycle) enables more efficient routine and pre-scheduled deliveries¹ of bulky products that are not cold chain dependent and have a longer shelf life. However, drone routine and on-demand direct delivery are more appropriate for light weight, cold chain dependent product transportation and allows health workers in remote and hard-to-reach locations to respond to unpredictable demand and dedicate full attention to patient care and needs. Integrating drone technology as an additional transportation modality will enable more efficient, responsive and resilient supply chains, especially for facilities with persistent or seasonal road-infrastructure challenges.

¹ Prosser W, Sampath V, West M, Burey J, Bancroft E. Lessons Learned in Reaching the Final 20: Building a Next-Generation Immunization Supply Chain in Mozambique. Seattle: VillageReach; 2016.

Principle 1: Cargo drone complements rather than replaces other means of transportation

Drones do not replace traditional modes of transportation. In many cases, trucks, airplane, boats and motorcycles enable efficient and high-performance supply chains. It is where land-based transportation modalities fail to support supply chains – due to the environment context or the specificity of the transport needs – that drones are most useful.

An on-demand drone transport allows a more adaptive delivery system based on both product and health facilities characteristics. For example, low-cost, bulky or heavy items with predictable demand that do not require special storage conditioning can be transported on a less frequent basis (e.g., quarterly or bimonthly) using land-based traditional mode of transport. Conversely, resupplying items that are small and light weight, time-sensitive, expensive to hold at health facilities or have unpredictable demand and special storage considerations is more appropriate using an on-demand drone transport model.

In January 2021, the Ministry of Public Health of the Democratic Republic of Congo (DRC) launched routine drone delivery operations with a fleet of drones covering 22,000 km² delivering health products routinely and on-demand to 70 hard-to-reach facilities.

Moving some products to on-demand delivery schedules can also reduce the need for both cold-chain equipment (CCE) and dry storage capacity at health facilities, resulting in substantial cost savings both in storage and wastage of high-value products (e.g., vaccines, blood or oxytocin).

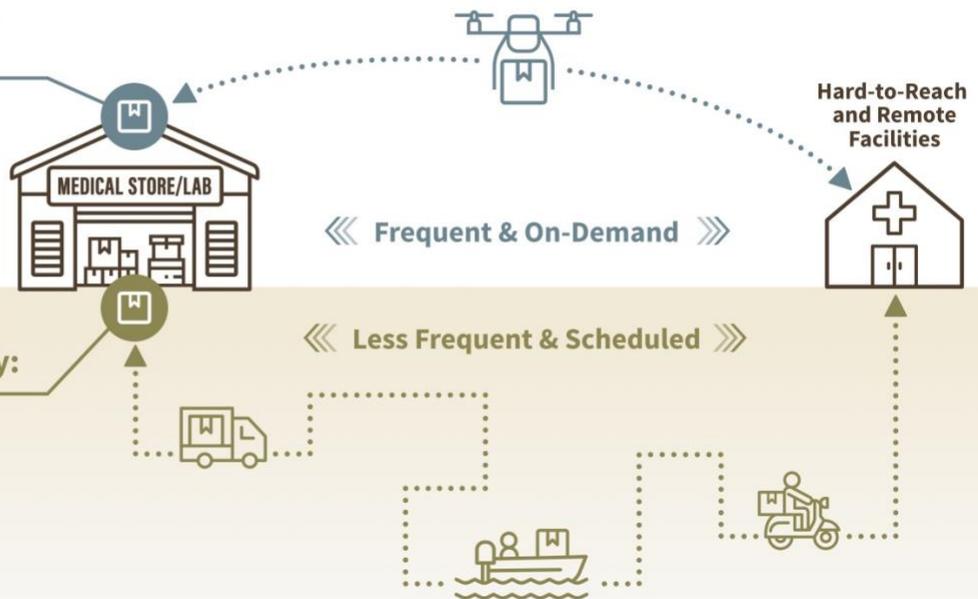
Integrated Drone Transport

Products Suited for Drone Delivery:

- ✓ Light Weight
- ✓ Cold Chain Dependent
- ✓ Short Shelf Life
- ✓ High Cost

Products Suited for Land-Based Delivery:

- ✓ Bulky
- ✓ Not Cold Chain Dependent
- ✓ Long Shelf Life
- ✓ Low Cost



Principle 2: Agility and resiliency are critical for public health supply chains now and in the future

In February 2022, following Cyclone Ana in Malawi, the Swoop Aero on-demand drone transport service allowed the continued provision of essential health services to cut off communities, including routine vaccination clinics for COVID-19 and other preventable and communicable diseases such as malaria, TB and polio.

As recently confirmed during the Covid-19 pandemic, agility² and resiliency³ are two essential attributes of the supply chains needed to support both global health security and UHC goals. Conflict, climate impacts and outbreaks lead to quick shifts in demand. Including drone transport into supply chains allows for quick reaction to the ever-changing conditions at the last mile that directly affect supply chain performance and service delivery. In the event of equipment failure following environmental disaster or an emergency response following a disease outbreak, drone delivery schedules can be adapted to respond to specific needs and build resilience in the health services.

A direct effect of resilient health services is rebuilding community trust resulting in an increase of community demand for services. A recent survey in Equateur Province of DRC showed that mothers living in the catchment area of an integrated drone transport network expressed growing confidence in their local health services. Even when their village is isolated after a heavy storm, they know that their local health center will have the medicines and vaccines their children need.

Principle 3: Drone transport systems must be designed around roundtrip capacity

Most national health supply chain strategies in low- and middle-income countries (LMICs) emphasize the need to improve the reverse logistics capabilities of health supply chains. This has been a challenge due in part to the financial and operational constraints that rapid and responsive collection systems require. The availability of frequent, rapid and on-demand drone transportation can help create breakthroughs in the reverse logistic process not only for bringing back health products (e.g., expired vaccines and waste), but also for collecting lab and environmental samples and improving disease surveillance systems.

In April 2022, the Ministry of Health of Mozambique initiated the second phase of the Drones for Health study transporting laboratory samples for early detection of infectious diseases in the province of Inhambane.

In remote places where internet and cellular connectivity is lacking, drones can enable a reverse logistic process that facilitate the collection of valuable data from the last mile. Increased access to logistics data results in more informed decisions at all levels of the health system and contributes to increased forecasting and resupply accuracy. Similarly, by improving the access of epidemiological data from remote

and isolated locations, drone transport allows decision makers to have a more accurate understanding of the health of its population, providing powerful feedback that can drive health planning and resourcing. Overall, the integration of two-way drone transport makes public health systems more responsive and efficient.

² **Agility** is the ability to quickly plan, source, make and deliver to adapt and respond to changes in the environment.

³ **Resiliency** is the ability to return to a position of equilibrium after experiencing an event that causes operational results to deviate from expectations.

Principle 4: Workforce development needs to be part of the sustainability plan

While there are many managers and operational staff experienced with traditional land transportation, drone transport introduces the need for a workforce with new skill sets in most countries. As is the case with any specialized skill set, a human resources strategy, plan with sufficient technical and managerial leadership and a path to professionalization is required to scale and sustain integrated routine and on-demand drone transportation. Some of the resources may need to be in the health care delivery and regulatory bodies, while others will need to be in the private sector (e.g., 3rd and 4th party logistics providers). From drone pilots and drone port operators to engineers and experts in GIS and data analysis, a skilled and competent workforce needs to be developed and maintained through sustainable technical workforce and education programs

In DRC, VillageReach is leveraging an existing educational institution, the National Institute of Professional Preparation (INPP) in partnership with Virginia Tech University, to offer training, certified by the Civil Aviation Authority (AAC) of the DRC and by the International Civil Aviation Organization (ICAO).

An integrated transport system mindset

While first seen as disruptive technology, drones are now accelerating a discussion on how to implement an integrated, forward-looking supply chain transportation system. The mindset shift will take time, especially when it involves collaboration across multiple health programs and sectors. Forward-looking leaders and champions will need to rethink strategic plans, negotiate priorities and consider the best use of different transport modes, weighing costs, benefits and responsiveness of each modality. Supply chain managers will need to take on the integration of operational processes, including transportation planning, scheduling, ordering and data management and analysis.

By applying the four principles described above, we believe governments can succeed in transforming their current health product transport systems, using all transport modalities including drones, to be more demand-driven, resilient, agile, responsive and affordable.

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