# EXECUTIVE SUMMARY:
# WHAT SHOULD YOU DELIVER BY UNMANNED AERIAL SYSTEMS?

As more low- and middle-income countries (LMICs) explore opportunities to improve efficiency and performance in their public health supply chains and diagnostics networks, they face myriad choices about how best to use unmanned aerial systems (UASs) to improve public health outcomes and reach the last mile. JSI Research & Training Institute, Inc. (JSI) and our partners LLamasoft and the Nichols Group wrote this paper to provide countries and public health stakeholders with objective guidance on how to make informed decisions about which health products to prioritize for delivery and by which type of UAS platform to achieve the six 'rights' of a supply chain.

## Methods and Approaches

The team undertook a cost-effectiveness analysis to compare various transport options for a variety of delivery categories using UAS vs. well-managed traditional modes of last-mile delivery, such as land cruisers and motorcycles. The analysis took into account geography, UAS characteristics, and characteristics of products and their demand patterns. We also mined and analyzed 12 months of health-facility data from three country datasets in sub-Saharan Africa to identify five use cases that would allow us to define the cargo characteristics and examine cost-effectiveness for each of the following product types: a) safe blood for transfusion; b) long-tail products (small quantity, unpredictable demand products); c) program and essential medicines; d) vaccines; and e) diagnostic specimens.

## Results

Overall, our findings show that UAS cost-effectiveness is driven by the number of flights per year and increasing flight numbers is dependent on facility density within the UAS range area. Similarly, with the exception of safe blood for transfusion, the results clearly demonstrate that using UAS for single-product category deliveries is not optimal from a cost-effectiveness perspective, and that layering multiple use-cases will increase the UAS cost-effectiveness by increasing the number of flights the UAV will be used for. For safe blood for transfusions, small, fixed-wing UASs can offer both cost and speed/responsiveness advantages over land transport to deliver rare blood types and support-products on-demand. We estimate that for a region of average facility density, approximate annual costs to serve 500 health facilities will range from US$ 1–5 million, depending on the UAS and cargo categories. Ultimately, even projecting rapid improvements in cost and performance, most UASs are still 3+ years away from being transport-cost competitive with motorcycles.

**Unmanned aerial systems (UAS) have significant potential to improve the availability of health products in hard to reach locations.**

The case for using UASs must be examined within the context of the total system costs (considering factors such as inventory holding costs and capital investment for storage capacity), other supply chain objectives such as speed and availability, and broader health benefits. UAS cost-effectiveness is substantially driven by the number of flights per year that can defray fixed costs. Flight numbers can be increased by operating in areas of higher health facility density and selecting UASs that have longer ranges. Flight numbers can also be increased by layering multiple use-cases. Unmanned aerial systems have significant potential to improve the availability of health products in hard-to-reach locations. Every potential use case must be considered individually factoring in geography, UAS characteristics, and product and demand characteristics. However, the following sets of factors are broadly indicative of a potential value-adding use case for UAS:

- High density of health facilities (within range of UAS).
- Difficult to access by road (large proportion of year).
- High financial value, scarce, or high health value (e.g., life-saving) products.
- Unpredictable demand (at level of individual facility) products.
- Expensive, short shelf-life, or difficult to store at last-mile products.

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