

Potential Benefits of Drones for Vaccine Last Mile Delivery in Nepal

Motivation / Background

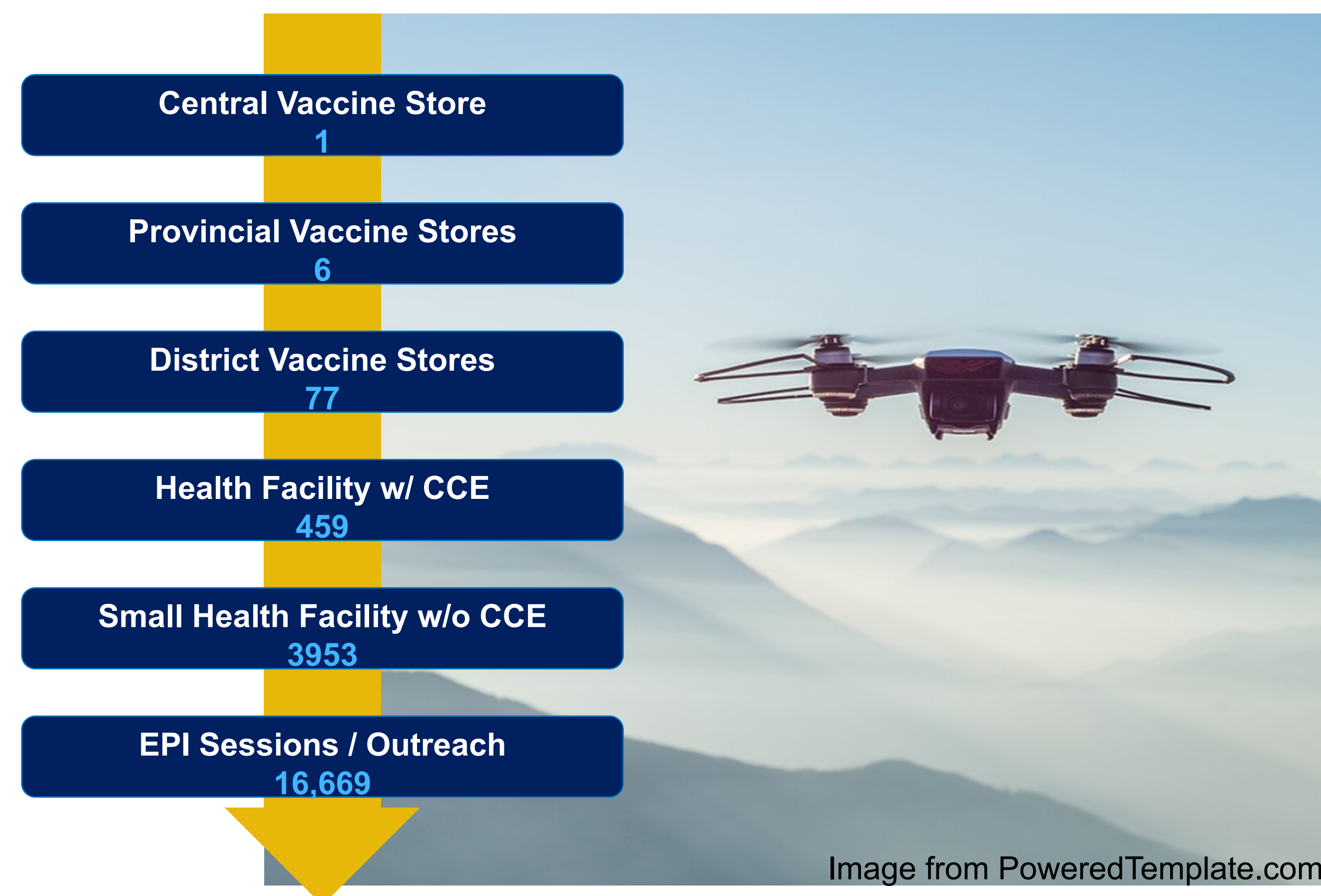
- Immunization is key to **child development** and **survival**
- Nepal's immunization coverage hovers around **78%**, but several antigens do not reach that level
- 10% of children do not receive full immunizations
3% of the children **never receive any vaccine**
- Only **18** districts out of 77 are declared as **fully immunized**
- There are significant challenges in distribution to **rural, mountainous** and underdeveloped districts.
- Drones** have been already used for medical supply delivery in other geographies

Key Question / Hypothesis

- Which districts in Nepal could utilize drones to improve vaccine availability?
- What is the recommended last-mile delivery strategy?

Relevant Literature

- Wright, C., Rupani, S., Nichols, K., Chandani, Y., & Machagge, M. (2018). What should you deliver by unmanned aerial systems?
- Nepal Ministry of Health. (2016). National Immunization Program, Nepal Comprehensive Multi-Year Plan 2073-2077 B.S. (2017—2021)



Methodology

Phase 1: District Classification Framework

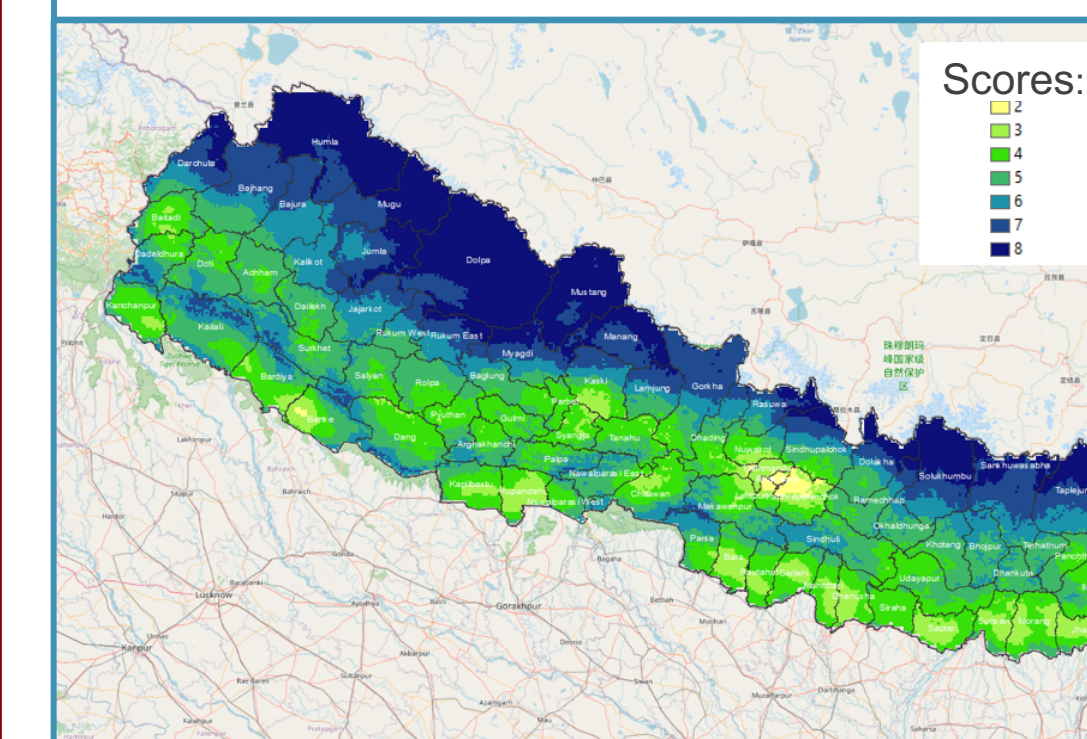
- Determine relevant factors for comparing drones to current modes of transportation.
- Weight factors by relevance and rate them on a 1-9 scale according to drone applicability.
- Apply weighted overlay technique using ArcGIS (platform for analyzing spatial data).

Phase 2: Optimization Model for Vaccine Delivery Strategy

- Select two high scoring districts from Phase 1, and model baseline to match real-life costs and coverage using LLamasoft's SCGx.
- Run different scenarios to model and compare different coverage levels, types of drones and outsourcing of drone operation.
- Perform sensitivity analysis for different demand levels and costs.

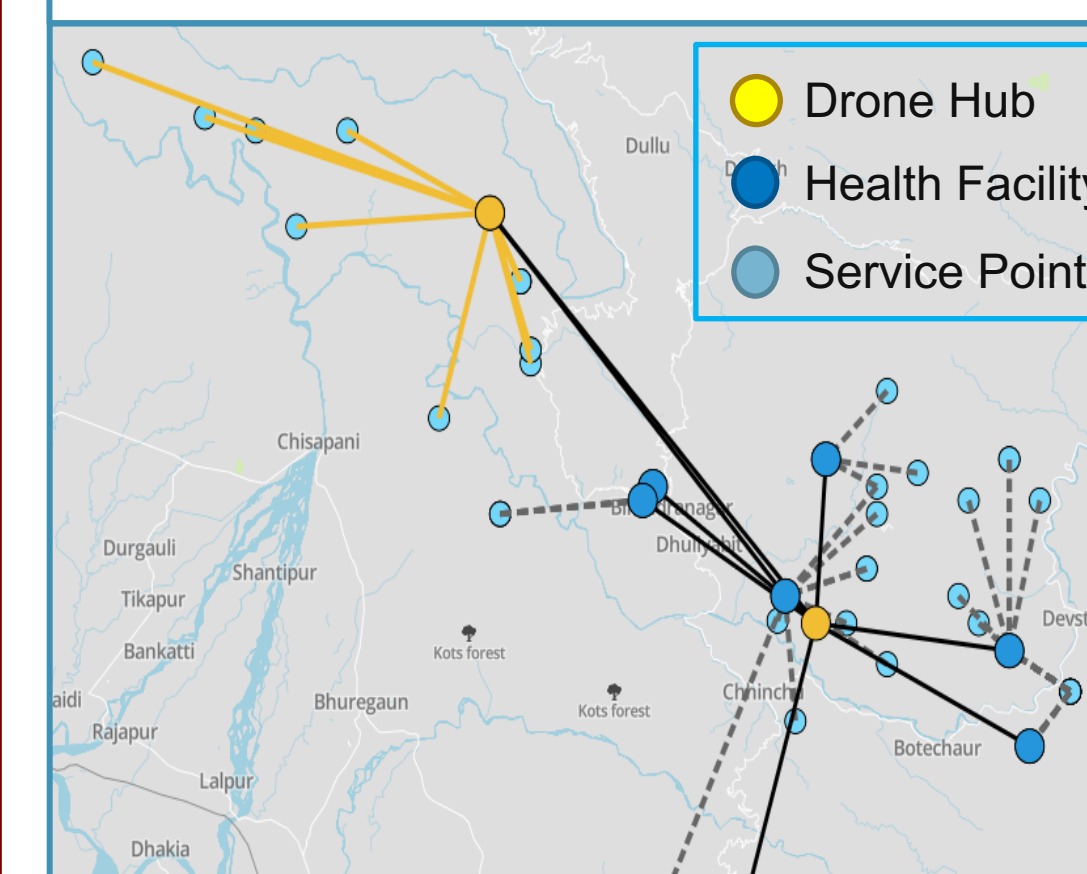
Results

Phase 1



- 6 districts (out of 77) were selected as the most suitable for drone application.
- These selected districts are located mainly in the mountainous area that borders with Tibet in the north of Nepal.

Phase 2



- Electric propulsion drones with ~11 kg payload and ~200 km range were selected.
- The incremental cost to serve using drones is reduced by \$2.40 /child (if start-up costs are subsidized)
- Recommended cost \$0.10 /dose if outsourcing operation.

Contribution

- Replicable district classification framework for drone applicability
- Selection of best drone type for Nepal, quantification of differences in transportation cost per child using drones.
- Evaluation of outside funding for drone base set-up costs and evaluation of outsourced drone operation.
- Recommendation of reasonable operating variable cost of outsourced operation.

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