Optimizing Lab Sample Transport for Epidemic-Prone Diseases: Speed, Integration & Sustainability, at What Cost?

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Photo: VillageReach DRC

CONTEXT

Since 2022, VillageReach and partners have supported 15 countries to strengthen lab sample transport systems for polio surveillance (1). Countries like Guinea, Niger & Uganda have expanded the system to include samples for other outbreak-prone diseases — such as measles, yellow fever, Ebola, mpox and cholera — leveraging the same transport infrastructure, while Malawi, DRC, Angola & Tanzania have taken steps towards integration (2).

MOTIVATION

In remote areas, patients often wait weeks for lab results — delays that allow infectious diseases to spread undetected.

- Samples for rare but highly contagious diseases must be transported to regional, national, or international laboratories via complex, multi-step journeys involving motorbikes, cars, boats, planes and/or drones.
- Accelerating diagnosis while managing costs is an urgent priority, but costing analyses for lab sample transport systems remain limited.
- Equitable access to diagnostics must become the norm, especially as outbreaks grow more frequent.
- Our experience suggests that transport systems can be made more efficient, less fragmented, and more affordable through thoughtful integration.

METHODOLOGY

Following baseline assessments, we co-designed solutions with each government, WHO and local stakeholders to improve sample speed and quality, aiming to integrate sample transport across disease programs by aligning resources, staff & data.

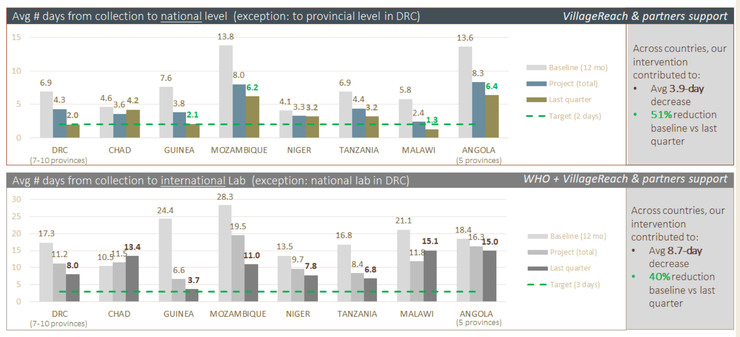
- Expansive partnerships: We engaged over 100 public, private, and nonprofit partners and built networks of local transporters — including transport management companies, associations, and individual motorcycle drivers — to ensure on-demand sample pickup, even in remote, conflict-affected, or geographically challenging areas.
- Transporter management: Most countries transitioned from health worker-led sample transport to local private transporters, reducing disruptions to frontline services. Transporters were trained and received timely payments, with performance monitoring in place.
- System redesign: Referral pathways were restructured to eliminate unnecessary transit points. SOPs were developed for health workers and transporters to streamline operations.
- Capacity building: With WHO, national surveillance and lab departments, we trained community and facility-level health workers, surveillance officers, and lab technicians on biosafety, data reporting, and sample transport protocols.
- Cost analyses: We analyzed the costs of various transport interventions to track efficiencies over time & across countries.

PERFORMANCE & COST DATA

In 8 countries that were not meeting polio sample transport targets at baseline, our interventions combined to cut transport time in half on average

There are early signs that integration can be not only cost-efficient but also maintain or improve sample transport timeliness, sample condition, and data availability

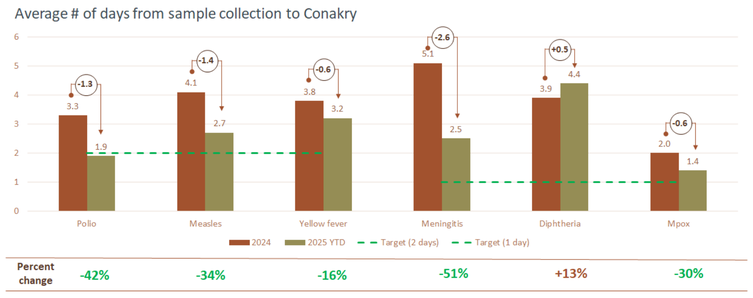
Across countries supported since late 2022, polio (AFP) sample transport timeliness has continued to improve



Data through: DRC – Sep '25, Chad – Feb '25, Guinea – Sep '25, Moz – Oct '24, Niger – Sep '25, Tanzania – May '25, Malawi – May '25, Angola – Sep '25

GUINEA

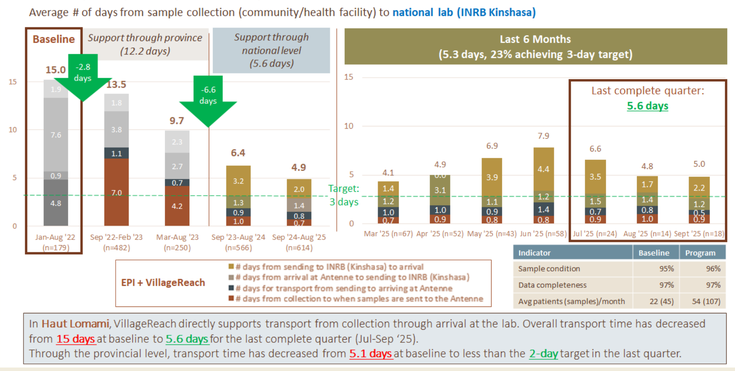
Average integrated sample transport time



▼ 5 of 6 integrated diseases saw improved timeliness, with reductions ranging from 16% to 51% (average 35%).
■ 1 of 6 diseases saw a slight reduction in timeliness (13%).

DEMOCRATIC REPUBLIC OF CONGO

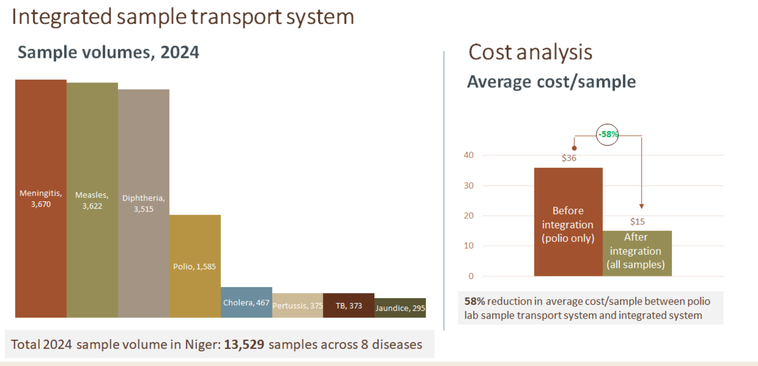
Polio (AFP) Sample Transport: Haut Lomami province



In Haut Lomami, VillageReach directly supports transport from collection through arrival at the lab. Overall transport time has decreased from 15 days at baseline to 5.6 days for the last complete quarter (Jul-Sep '25).
Through the provincial level, transport time has decreased from 5.1 days at baseline to less than the 2-day target in the last quarter.

NIGER

Integrated sample transport system



Total 2024 sample volume in Niger: **13,529** samples across 8 diseases

58% reduction in average cost/sample between polio lab sample transport system and integrated system

Polio Sample Transport Costs: Countries with large-scale private transporter networks

	Key indicators	Guinea	Sankuru	Mai Ndombe*	Lualaba	Haut Katanga	Tanganyika	Equateur	Tshopo**	Mainema	Haut Lomami^	Niger	Chad
	Sample type	AFP + ES	AFP									AFP + ES	AFP
Health Facility (HF) to Hub	Average per month	$ 159	$ 2,346	$ 623	$ 899	$ 2,260	$ 3,170	$ 2,039	$ 1,882	$ 2,207	$ 7,574	$ 3,771	$ 1,901
	Average per sample	$ 4	$ 58	$ 78	$ 141	$ 48	$ 51	$ 59	$ 42	$ 52	$ 51	$ 27	$ 9
	Average per trip	$ 6	$ 126	$ 156	$ 96	$ 50	$ 120	$ 128	$ 91	$ 115	$ 188	$ 70	$ 48
Hub to National level		$ 511	NA	NA	NA	NA	NA	NA	NA	NA	$ 1,815	$ 7,575	$ 1,761
		$ 22	NA	NA	NA	NA	NA	NA	NA	NA	$ 34	$ 42	$ 9
		$ 23	NA	NA	NA	NA	NA	NA	NA	NA	$ 134	$ 37	$ 45
All levels	Total per month	$ 670	NA	NA	NA	NA	NA	NA	NA	NA	$ 9,390	$ 11,346	$ 3,661
	# HFs (coverage area)	490	248	310	239	402	267	283	431	282	341	1,387	1,670
			2,803 (31% of all health facilities in DRC)										

Sample Transport Costs: Countries with 4PL services included in costs

	Key indicators	Malawi (R4H + SPEED)	Malawi (G4S only)	Mozambique
	Sample type	AFP	AFP, measles	AFP + ES
All levels	Average per month	$ 5,605	$ 1,889	$ 4,498
	Average per sample	$ 172	$ 20	$ 127
	Average per trip	$ 339	$ 41	$ 264
	# HFs (coverage area)	924	924	1,819

COST ANALYSIS

Analyzed actual sample transportation costs in countries:

- Cost per month – helpful for budgeting purposes if lab sample transport system is at full scale
- Cost per sample transported - helpful to examine over time when a system is becoming more integrated (it can show cost efficiencies gained) – but it is not how costs are incurred
- Cost per trip – for most samples, this is the way that costs are incurred – but it will not capture efficiencies of taking multiple samples on a trip
- Cost per health facility or district covered
- Cost per kilometer

Costs disaggregated by: travel segment & sample type

INTERPRETATION

Transport costs varied widely across countries due to differences in coverage area, transport modes, sample types and local context.

On-demand transport systems designed to meet strict timeliness, biosafety and cold chain requirements — especially during emergencies — are inherently more costly. However, layering on-demand transport atop scheduled transport or increasing transport frequency can help meet performance targets while keeping costs manageable.

Economies of scale are emerging in countries like Niger, where integrated transport systems serve multiple disease programs.

Health worker transport remains common in many countries, but is not necessarily more cost-effective, because of the hidden costs to the health system and patients—such as time away from clinical duties.

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1 https://www.villagereach.org/project/polio-laboratory-sample-transport/

2 https://www.villagereach.org/project/integrated-lab-transport-systems/

Global Health Supply Chain Summit

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