17th TechNet Conference

Panama City, Panama | October 16-19, 2023

Immunization Programmes That Leave No One Behind

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Innovations for immunization: solarization, freeze prevention, and lifecycle assessment

Steven Diesburg, PATH - USA

Nadege Edwige Nnang Amougou, CHAI Cameroon

Sandeep Kumar, PATH – India; and **Surendra Uranw,** BPKIHS

October 18, 2023

Addressing climate change in immunization programs: procurement and electric power environmental considerations

Steven Diesburg, PATH – USA

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What is life cycle assessment and why?

The International Organization for Standardization's definition of life cycle assessment (LCA):

"Compilation and evaluation of the inputs, outputs, and the potential environmental impacts of a product system throughout its life cycle."

ISO 14044

How do you answer complex questions about environmental impacts?

- How could we make our product more environmentally friendly?
- Should I use paper bags, plastic, or reusable?
- Without compromising health impacts and safety, how can we decrease the greenhouse gas emissions due to the immunization system?

Perspective – UNICEF summary estimating carbon emissions

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UNICEF used primarily global warming “emissions factors” to analyze a **broad scope** – the immunization system and relative contributions to **greenhouse gas emissions** by categories.

The analysis provides a solid **starting point and opportunity** to further define the assumptions and target areas for decreasing emissions.

KEY CONTRIBUTORS OF EMISSIONS CONT.

Category	Contributor	Annual emissions (Ton CO_2)	Percentage to total emissions
Production	Vaccine	43	0.01%
	Syringes	38,401	10.97%
	Safety boxes	5,791	1.65%
	CCE	26,229	7.49%
Transportation (international shipments)	Vaccine	70,282	20.07%
	Ancillary supplies	5,688	1.62%
Transportation (in-country shipments)	Vaccine	10,808	3.09%
	Ancillary supplies	8,511	2.43%
Operations	Electricity from Grid	65,446	18.69%
	Diesel genset (backup)	20,386	5.82%
Waste disposal	Burning of waste	98,417	28.11%
	Decommissioning of CCE	125	0.04%
Total		**350,125**	100.00%

From UNICEF presentation: Estimating Carbon Emissions for Delivering Immunization Program globally. Available on TechNet-21 website.

Abbreviation: CCE, cold chain equipment.

Shipping considerations: “local” manufacture

Goal

Assess and identify potential areas to decrease the environmental impact of syringe products throughout the entire product life cycle:

- Where in the life cycle can the largest environmental sustainability improvements be achieved?
- What activities, investments, requirements, or changes could be targeted?

Initial model target – shipping contributions

Photos: PATH

Local manufacturing is discussed frequently as a potential area of improvement to production systems for many reasons. For vaccine delivery products (syringes specifically), one potential benefit could be decreased emissions of greenhouse gases (GHG) due to decreased shipping.

- But how might local production affect these emissions and what scenarios would be more (or less) beneficial?
- Is decreasing shipping emissions a high-priority target given the low estimated GHG impact as compared to the immunization system (1.62% of total emissions for international transport)?
    - Note that a single, average shipping distance of 4,517 km was assumed in the UNICEF analysis.

LCA vs. emissions factors

For this limited, initial analysis, emissions factors could be a simpler means of modeling instead of a more complicated LCA-type analysis:

- Emissions factors are used extensively in the European Union, industry, for reporting using carbon footprinting, for regulations, procurement, etc.
- They are a simplified way to estimate environmental impact, and usually there is an extensive LCA or other model carried out to arrive at the emissions factors.

We will use both methods in the investigation below as comparison.

Inputs

Contribution	Flow	Upstream incl. direct	Direct	Unit
100.00%	Aggregate, natural (Resource / in ...	7.14836E-8	0.00000	kg
100.00%	Air (Resource / in air)	0.00079	0.00000	kg
100.00%	Barite (Resource / in ground)	2.33403E-7	0.00000	kg
100.00%	Basalt, in ground (Resource / in gr...	1.87563E-9	0.00000	kg
100.00%	Bauxite (Resource / in ground)	1.10614E-8	0.00000	kg
100.00%	Calcium carbonate, in ground (Re...	4.07206E-6	0.00000	kg
100.00%	Calcium chloride (Resource / in gr...	2.68600E-17	0.00000	kg
100.00%	Carbon dioxide, in air (Resource / ...	4.45818E-8	0.00000	kg
100.00%	carcass meal (Wastes / Production...	4.55379E-12	0.00000	kg
100.00%	Chromium (Resource / in ground)	4.65299E-12	0.00000	kg
100.00%	Clay, bentonite, in ground (Resour...	2.00418E-7	0.00000	kg
100.00%	Clay, unspecified, in ground (Reso...	2.57700E-8	0.00000	kg
100.00%	Colemanite, in ground (Resource /...	1.29198E-12	0.00000	kg
100.00%	Copper (Resource / in ground)	1.80345E-9	0.00000	kg
100.00%	Dolomite, in ground (Resource / i...	9.18127E-7	0.00000	kg
100.00%	Energy, from biomass (Resource / ...	0.00022	0.00000	MJ
100.00%	Energy, from coal (Resource / in g...	0.00763	0.00000	MJ
100.00%	Energy, from coal, brown (Resourc...	4.67564E-6	0.00000	MJ
100.00%	Energy, from gas, natural (Resourc...	0.06278	0.00000	MJ
100.00%	Energy, from oil (Resource / in gr...	0.12522	0.00000	MJ
100.00%	Energy, from peat (Resource / uns...	2.15104E-5	0.00000	MJ
100.00%	Energy, from wood (Resource / bi...	3.84948E-8	0.00000	MJ
100.00%	Energy, primary, from geothermal...	6.12352E-5	0.00000	MJ
100.00%	Energy, primary, from solar energ...	7.10952E-7	0.00000	MJ
100.00%	Energy, primary, from water powe...	0.00079	0.00000	MJ
100.00%	Energy, primary, from waves (Res...	1.29448E-6	0.00000	MJ
100.00%	Energy, primary, from wind power...	3.36492E-5	0.00000	MJ
100.00%	Feldspar, in ground (Resource / in ...	2.17060E-19	0.00000	kg
100.00%	Fluorspar (Resource / in ground)	1.11197E-9	0.00000	kg
100.00%	Granite, in ground (Resource / in ...	1.32347E-17	0.00000	kg
100.00%	Gypsum, in ground (Resource / in ...	1.40361E-8	0.00000	kg
100.00%	Iron (Resource / in ground)	1.19715E-5	0.00000	kg
100.00%	Kaolin (Resource / in ground)	2.29508E-12	0.00000	kg
100.00%	Lead (Resource / in ground)	3.06120E-9	0.00000	kg
100.00%	Magnesite (Resource / in ground)	6.97843E-14	0.00000	kg
100.00%	Magnesium (Resource / in ground)	1.50007E-12	0.00000	kg
100.00%	Magnesium chloride (Resource / i...	5.98305E-9	0.00000	kg
100.00%	Manganese (Resource / in ground)	6.81326E-10	0.00000	kg

Outputs

Contribution	Flow	Upstream incl. direct	Direct	Unit
100.00%	Acenaphthene (Emission to water ...	1.02379E-12	0.00000	kg
100.00%	Acenaphthene (Emission to water ...	1.72253E-14	0.00000	kg
100.00%	Acenaphthylene (Emission to wat...	3.89979E-13	0.00000	kg
100.00%	Acenaphthylene (Emission to wat...	7.28319E-15	0.00000	kg
100.00%	Acetaldehyde (Emission to air / u...	7.85199E-12	0.00000	kg
100.00%	Acetic acid (Emission to water / o...	3.22364E-12	0.00000	kg
100.00%	Acetic acid (Emission to air / unsp...	7.17598E-12	0.00000	kg
100.00%	Acetic acid (Emission to water / fr...	4.93016E-11	0.00000	kg
100.00%	Acetone (Emission to air / unspeci...	7.01994E-12	0.00000	kg
100.00%	Acidity, unspecified (Emission to a...	8.65918E-15	0.00000	kg
100.00%	Acidity, unspecified (Emission to ...	5.55368E-9	0.00000	kg
100.00%	Acrolein (Emission to air / unspeci...	4.86048E-14	0.00000	kg
100.00%	Acrylonitrile (Emission to water / f...	1.05418E-16	0.00000	kg
100.00%	Air, used (Emission to air / unspec...	1.67241E-5	0.00000	kg
100.00%	Aluminium (Emission to water / o...	5.09508E-16	0.00000	kg
100.00%	Aluminium (Emission to soil / uns...	1.13320E-11	0.00000	kg
100.00%	Aluminium (Emission to water / fr...	1.13022E-9	0.00000	kg
100.00%	Americium-241 (Emission to wate...	4.79890E-11	0.00000	kBq
100.00%	Ammonia (Emission to water / fre...	1.56943E-8	0.00000	kg
100.00%	Ammonia (Emission to soil / unsp...	5.19855E-9	0.00000	kg
100.00%	Ammonia (Emission to air / unspe...	2.82871E-9	0.00000	kg
100.00%	Ammonia (Emission to water / oc...	1.51407E-14	0.00000	kg
100.00%	Ammonium, ion (Emission to air / ...	3.58551E-17	0.00000	kg
100.00%	Anthracene (Emission to air / unsp...	6.88808E-15	0.00000	kg
100.00%	Anthracene (Emission to water / fr...	2.86820E-14	0.00000	kg
100.00%	Anthracene (Emission to water / o...	2.64218E-13	0.00000	kg
100.00%	Antimony (Emission to water / fre...	3.75004E-19	0.00000	kg
100.00%	Antimony (Emission to air / unspe...	2.43239E-13	0.00000	kg
100.00%	Antimony-124 (Emission to water ...	4.99030E-13	0.00000	kBq
100.00%	Antimony-124 (Emission to air / u...	1.68339E-14	0.00000	kBq
100.00%	Antimony-125 (Emission to water ...	3.40021E-13	0.00000	kBq
100.00%	AOX, Adsorbable Organic Haloge...	7.81499E-11	0.00000	kg
100.00%	AOX, Adsorbable Organic Haloge...	4.30849E-17	0.00000	kg
100.00%	Argon-41 (Emission to air / unspe...	1.06145E-7	0.00000	kBq
100.00%	Arsenic (Emission to air / unspecif...	1.29948E-12	0.00000	kg
100.00%	Arsenic (Emission to water / fresh ...	1.48259E-11	0.00000	kg
100.00%	Arsenic (Emission to soil / unspeci...	4.02330E-15	0.00000	kg
100.00%	Arsenic (Emission to water / ocean)	1.76293E-11	0.00000	kg

A small portion of the inputs and outputs of a limited LCA analysis.

All values in (g-CO2e/t-km) or (g-CO2/t-km)	US-EPA	EDF Green Freight Handbook	McKinnon quoted in ECTA guidelines	Congressional Budget Office
Ocean	30.80	12.0	8	43.5
Train	14.51	15.7	22	15.5
Truck	117.43	110.8	62	124.3
Air	482.48	594.7	602	798.5

Some examples of emissions factors

Abbreviations: ECTA, European Chemical Transport Association; EDF, Environmental Defense Fund; US-EPA, United States Environmental Protection Agency.

Model scope for initial transport analysis

Core assessment of transport

Production and mfr. processes (incl. energy, waste & consumables)

Packaging

Capital equipment

Storage

System boundary

Unit processes from data sources

Polypropylene

Steel

Polybutadiene

~~Adhesive~~ (cut-off)

~~Silicone oil~~ (cut-off)

INITIAL LIMITED

Transport 0 (raw materials to production location)

Transport 1 (production to port)

Transport 2 (port to port)

Transport 3 (port to national store)

Use

Additional transport? (to point of use)

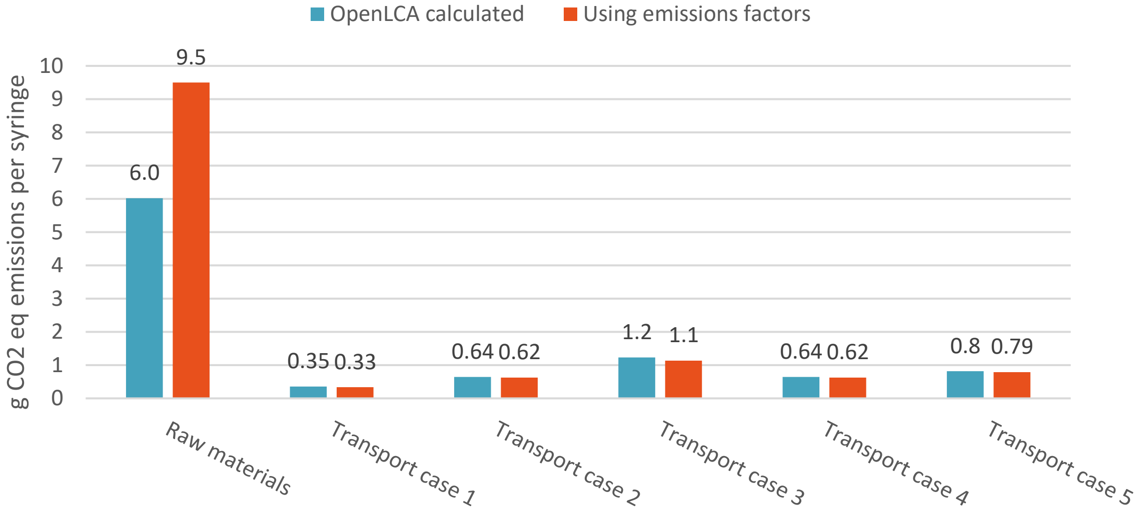
Disposal waste management

Initial takeaways

Considering only raw materials and transport to national stores (not production/manufacture, or in-country distribution):

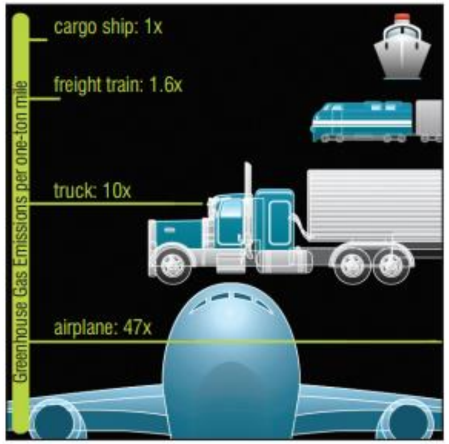
1. Location of manufacture and country of use do matter, but not nearly as much as raw material production (assuming no air freight!).
   - Estimated international transport emissions are a fraction of raw material emissions (~12% on average, or ~8% of the UNICEF estimate).
2. Emissions decreased when:
   a. The raw material comes from close to the production location.
   b. Longer-distance ground transport is avoided.
3. Using LCA vs. emissions factors for transport in this simple model can be relatively equivalent.
   - Similar, basic analysis could be done easily using just transportation emission factors (excluding the raw material comparison).

Rough comparison of emissions using OpenLCA software, emissions factors, and comparable UNICEF estimate*



An explanatory visual from the source of transport emission factors used.

https://storage.googleapis.com/scsc/Green%20Freight/EDF-Green-Freight-Handbook.pdf



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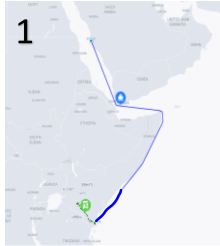

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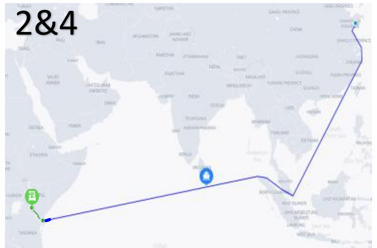

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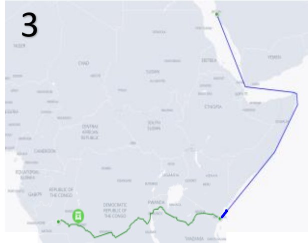

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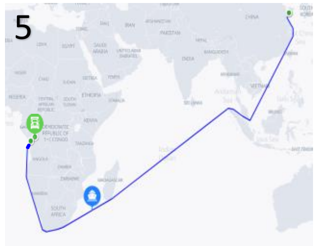

Next tasks and work

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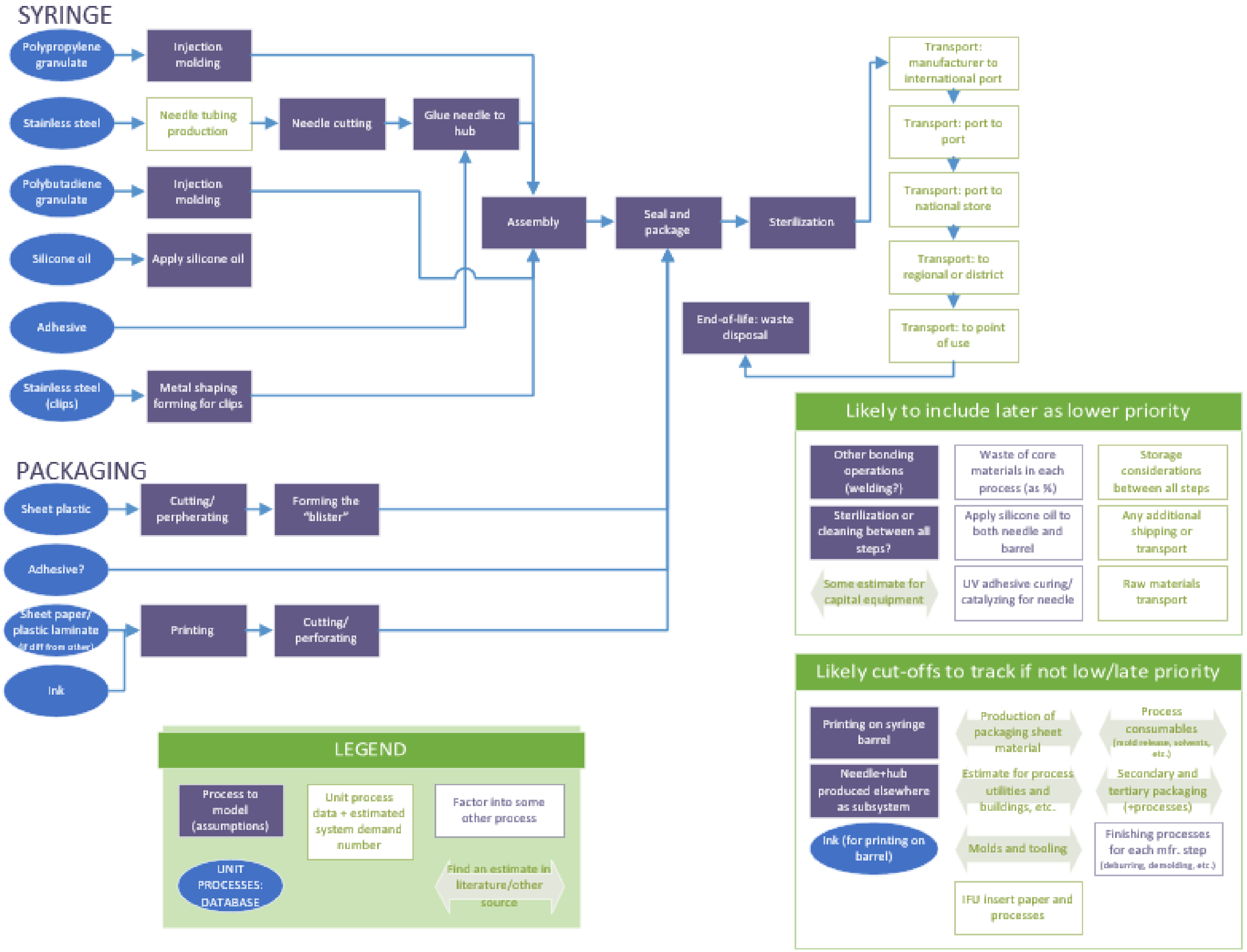
Many of the outcomes from the limited transport models discussed are somewhat obvious. As we continue to add detail, we can assess more complex questions and target more nuanced outputs.

Our ongoing work will progressively build toward the overall goal of defining activities, investments, procurement changes, design requirements, product development efforts, market shaping, etc., to reduce emissions.



Solar electrification topics

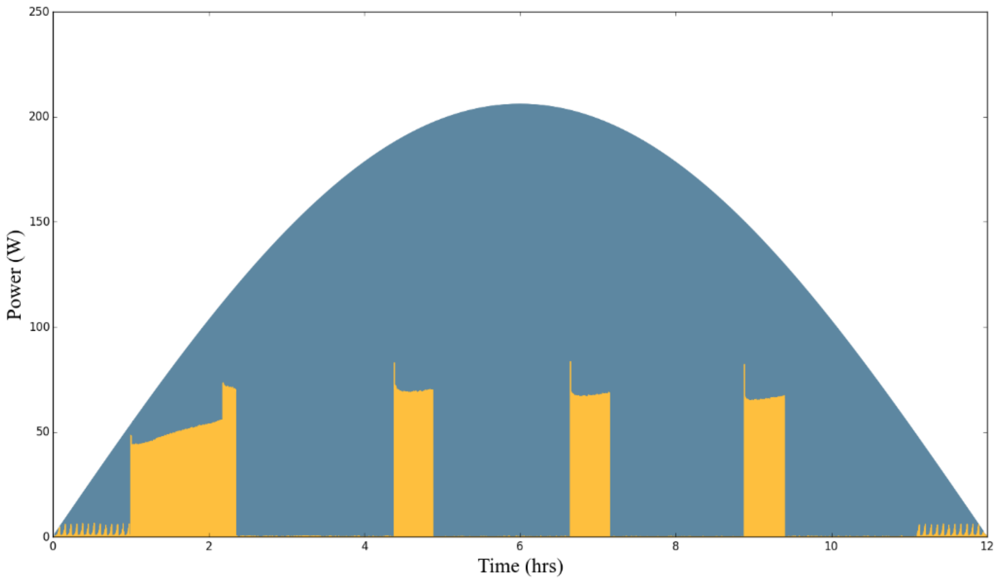
Need: power

Electricity is a foundational requirement for a well-functioning health facility and is critical to the delivery of high-quality health services, yet the following studies show health facilities have inadequate power:

- Nearly **60%** of 121,000 health care facilities analyzed across 46 low- and middle-income countries **did not have reliable power** (Cronk et al. 2018).
- In sub-Saharan Africa, roughly **25%** of health facilities across 11 countries reported **no access to electricity**, and only **33% of hospitals had reliable electricity access** (Power Africa 2022).

The lack of adequate and reliable power prevents health care staff from providing high-quality health services and unnecessarily jeopardizes the health of millions of patients.

Prior electrification (energy harvest control) work

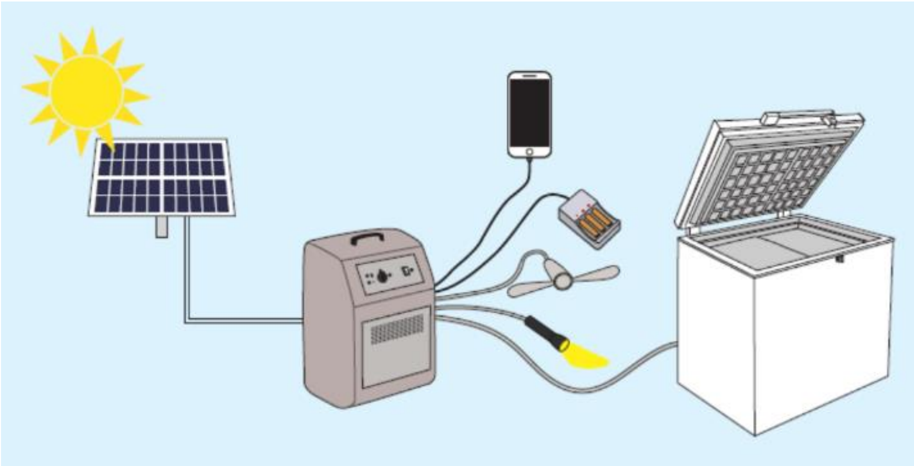


Previously, in collaboration with the Senegalese government, the World Health Organization, and equipment manufacturers, our team has **facilitated several solar installations at health facilities** in two regions.

We've **championed a newer technology called energy harvest control (EHC)** that diverts excess solar power from dedicated solar vaccine refrigerator installations so health care workers can access basic electricity for primary care and other uses.

Any amount of electricity has been useful to health centers, but the **facilities and staff could use more** to expand services.

Holistic approaches are needed to ensure health system fit, support for training and resources, and long-term, **operational sustainability**. Operating expenses/operations & maintenance are continual issues for solarization.



Immunization systems don't operate in isolation

Expanding services, increasing access, and improving staff and patient experiences through electrification can all help improve the immunization system effectiveness as well.

1. In **Senegal,** we started **initial work** on equipment and processes to introduce broader electrification efforts.
2. We are actively looking for funding to address a need for a similar **EHC device that would function with solar-powered water pumps** by request from Oxfam and Médecins Sans Frontières (MSF).
    1. This includes work toward a more **universal power prioritizer** device that would not need to be linked to specific, primary load type.
3. We've proposed **national health facility solar electrification** efforts to address issues of equity in care across regions and countries and build the evidence base showing linked improvements in health systems and outcomes.
    1. There are many organizations working on solarization globally, but the health connection evidence base and responsibly addressing O&M costs are places where we could add more value.

“Now they [health workers] get light at night when women are giving birth or when they have urgency – instead of using candles, light from mobile phones, or flashlight lamps.”

*- Moustapha Mbaye, Head nurse, Kohel Health Post, Nioro District**

*Feedback from PATH’s field trials of energy harvest controls bringing basic solar-powered equipment to facilities with solar direct-drive vaccine refrigerators.

Thank you

Cameroon's experience with implementation of the cool water pack policy for optimal management of vaccine temperature during transportation

Speaker: Nadege Edwige Nnang Amougou (CHAI Cameroon)

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Plan

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1. Background
2. Results
3. Recommendations

Background

A cool water pack (CWP) is an enclosed recipient containing water in liquid form with an initial temperature of 2-8 degrees Celsius. Their role is to maintain the temperature of vaccines, particularly during transport in cold boxes through the various cold stores and in vaccine carriers during immunisation outreach sessions in order to prevent temperature excursions that can affect the vaccine quality. In 2019, the Cameroon Ministry of Health introduced the use of cool water packs (CWPs) for transportation of vaccines into the Expanded Program on Immunization (EPI) Norms and Standards. Prior to this change, vaccine handlers used frozen and conditioned ice packs during transportation and a study conducted by CHAI in 2017 showed that up to 42% of vaccines transported in cold boxes were exposed to sub-optimal temperatures. A post-installation assessment conducted during the cold chain equipment optimization platform (CCEOP) implementation also revealed gaps in healthcare workers' knowledge of the new guidelines on the use of CWPs.

OBJECTIVES

To further investigate these gaps observed in health workers' knowledge of the CWP policy and the exposure of vaccines to suboptimal temperatures, CHAI conducted a study in 2022 to

1. assess health workers' knowledge and use of CWPs during vaccine transport
2. determine the effectiveness of current CWP practices in ensuring that vaccines are stored at the right temperature during transportation.

METHOGOLOGY

This CWP study had two parts:

- The first part involved administration of a web-based questionnaire to 121 EPI personnel involved in vaccine handling, to assess their knowledge of the CWP guidelines and use of CWP for vaccine transport.
- The second part of the study involved the use of Parsyl® Trek devices to record the temperatures inside cold boxes, to assess the variations in temperature during vaccine transportation.

Figure 1: Cold box with cool water

Figure 2: The Parsyl® Trek device used for temperature monitoring

RESULTS

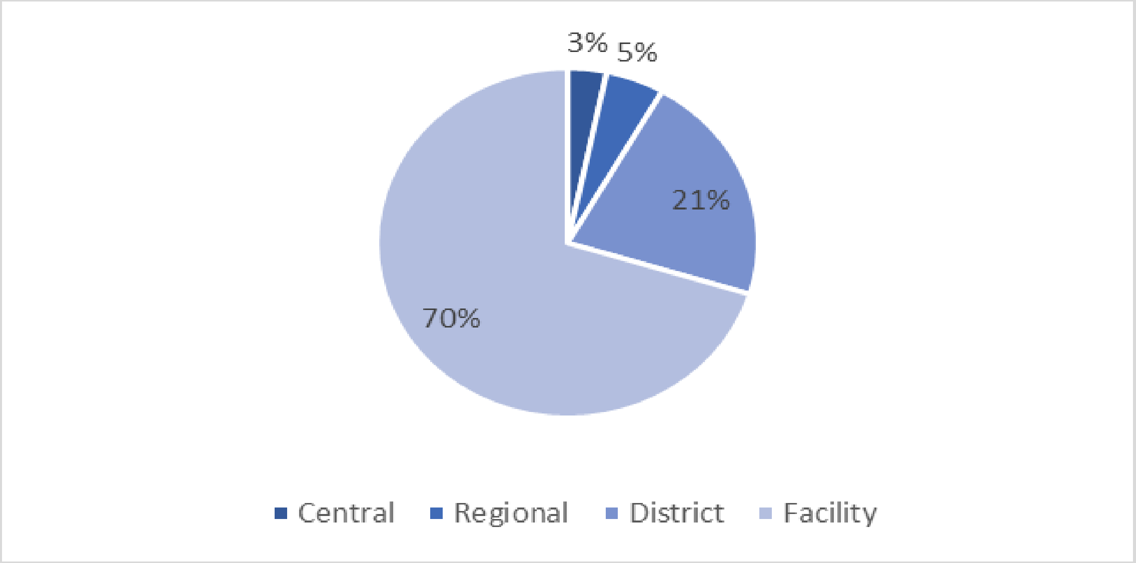


Figure 3:Distribution of respondent per level of health pyramid

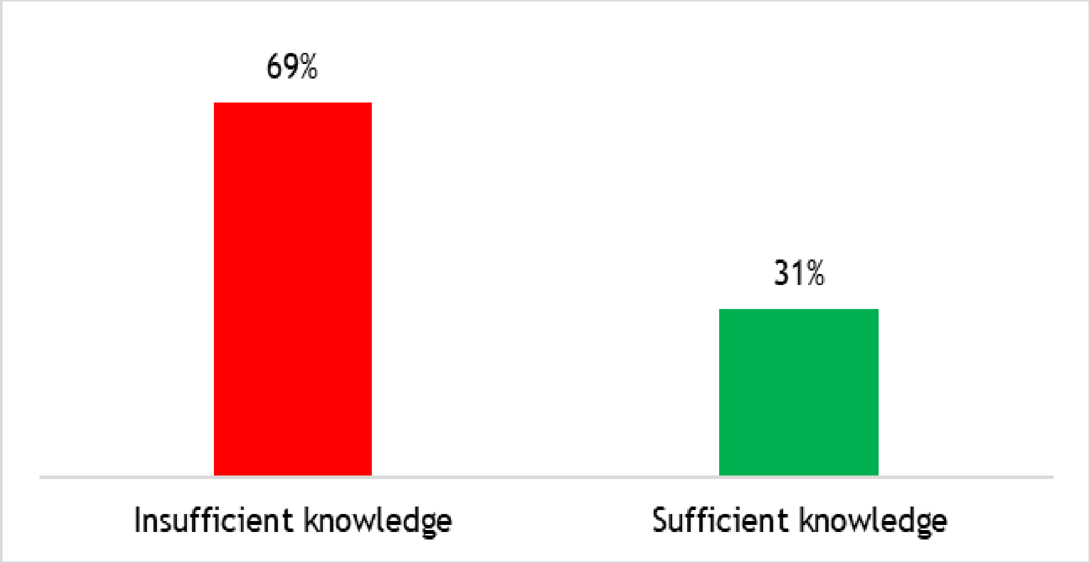


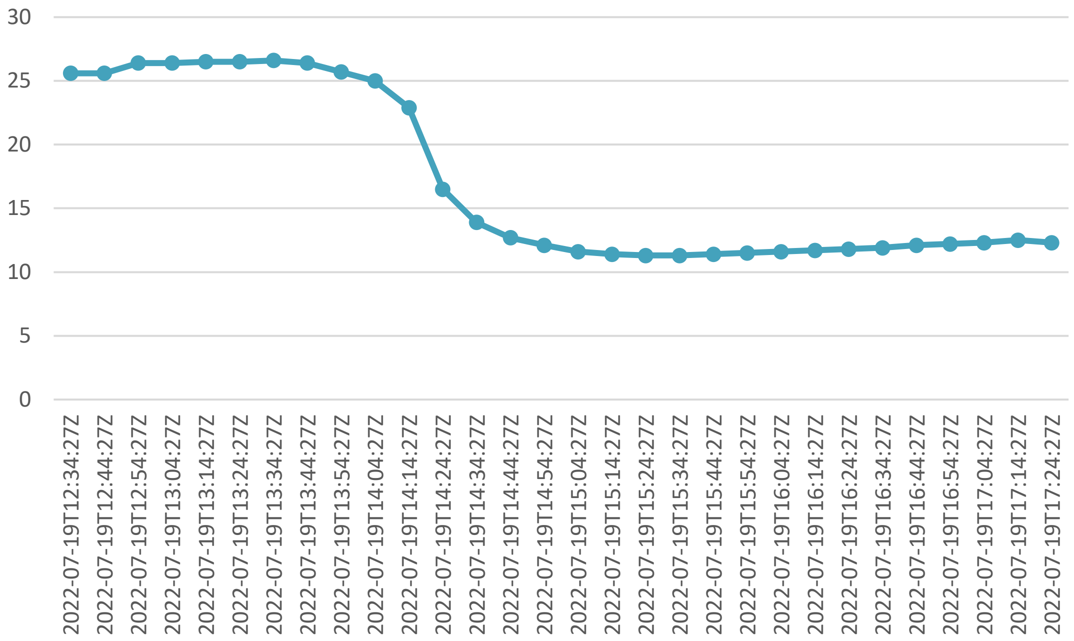
Figure 4:Distribution of respondent according to their level of knowledge

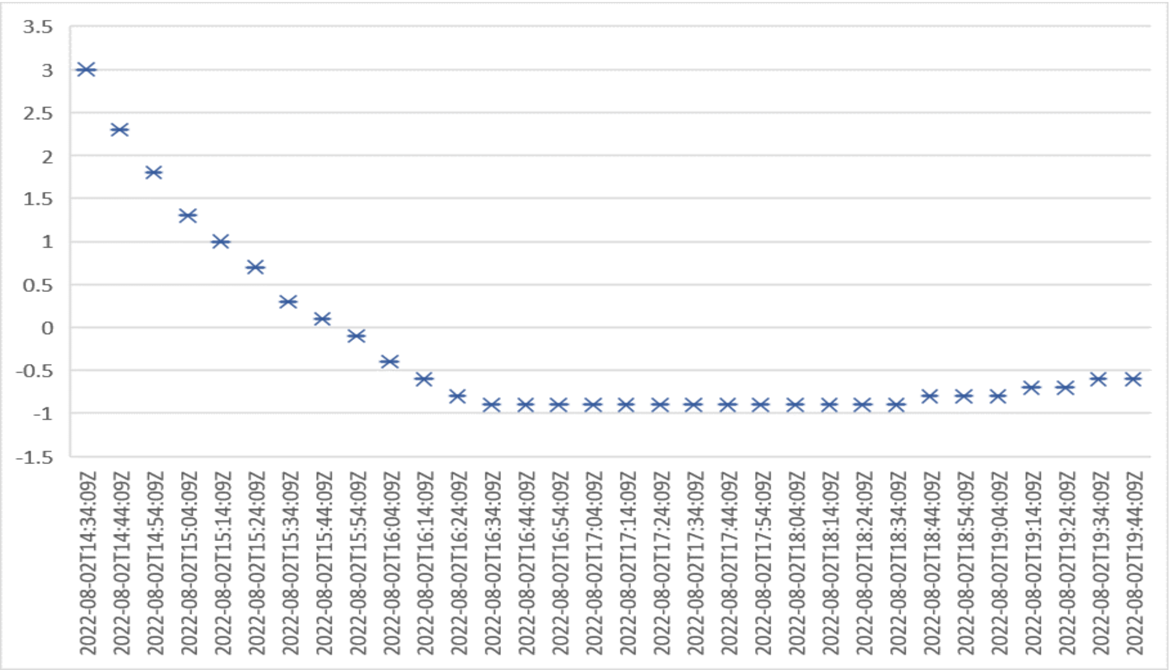
- Health worker knowledge and attitude towards the CWP policy: One-third (31%) of vaccine handlers had sufficient knowledge of the CWP policy. About 53% of participants felt that they were sufficiently informed about the CWP policy and felt confident packing CWPs in a fully loaded cold box, while 21% felt they were not very well informed of the policy. Only 7% of respondents found the CWPs to be inadequate for vaccine transport and reported that the CWPs got warm when transporting vaccines for over 6 hours.

- Use of CWPs: About 72% of respondents brought their prepared CWPs to the point of vaccine collection, and 44% of respondents transported their vaccines with the CWPs they prepared.

- Temperature management and variations during vaccine transportation: Only 2% of respondents carried out the four recommended quality checks[1] prior to vaccine transport while 20%, 37%, 38%, and 3% of respondents carried out 3/4, 2/4,1/4, and 0/4 of the quality checks respectively.

RESULTS





- 35% of vaccines transported to the districts and health facilities were exposed to temperatures above 8°C.
- There was one freeze excursion recorded

Conclusion

- Cool water packs are important and recommended in Cameroon for temperature management during vaccine transportation.
- Despite introduction of the CWP policy 3 years before the study, and the efforts made to disseminate it, healthcare workers' knowledge and accuracy of implementation of the policy remain suboptimal.
- This could explain the gaps in temperature management recorded during this study (freeze excursion and heat exposures).
- There is a need for targeted interventions to address the gaps in vaccine handlers' knowledge and use of CWPs, to protect the potency of vaccines during transportation.
- Proposed interventions include:
  - **Targeted training of vaccine handlers on the CWP policy,**
  - **Hands-on capacity building to improve and harmonize CWP implementation practices,**
  - **Dissemination of CWP standard operating procedures,**
  - **Exploration of last mile delivery interventions, and**
  - **Performance management to ensure accountability.**

Thank you

Freeze Preventive Cold Box Evaluation in Nepal-Lessons Learned

Presenter: Sandeep Kumar, PATH
Surendra Uranw, BPKIHS

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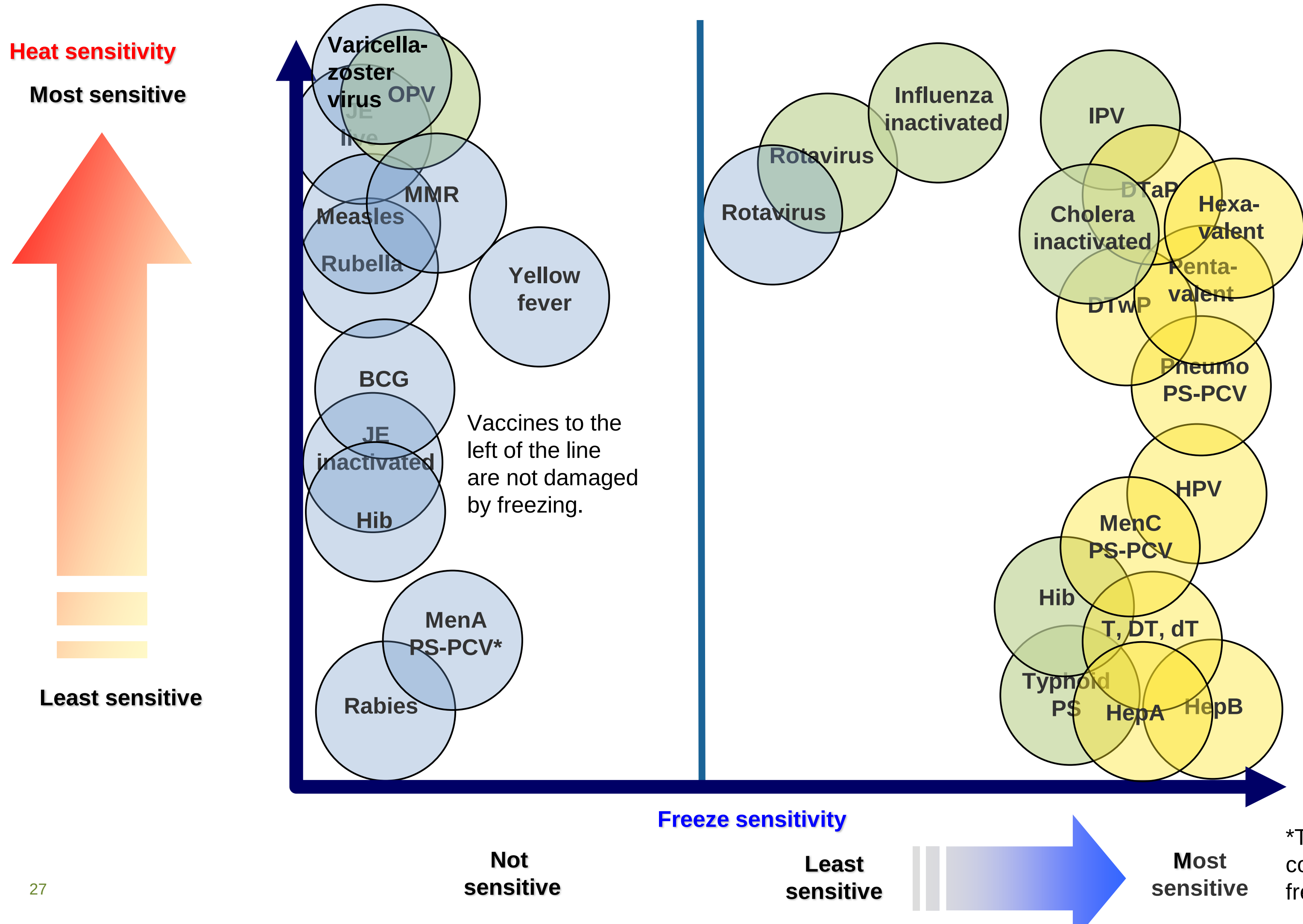
Temperature sensitivity of vaccines



Vaccine formulation

- Freeze-dried
- Liquid, no adjuvant
- Liquid, with alum adjuvant

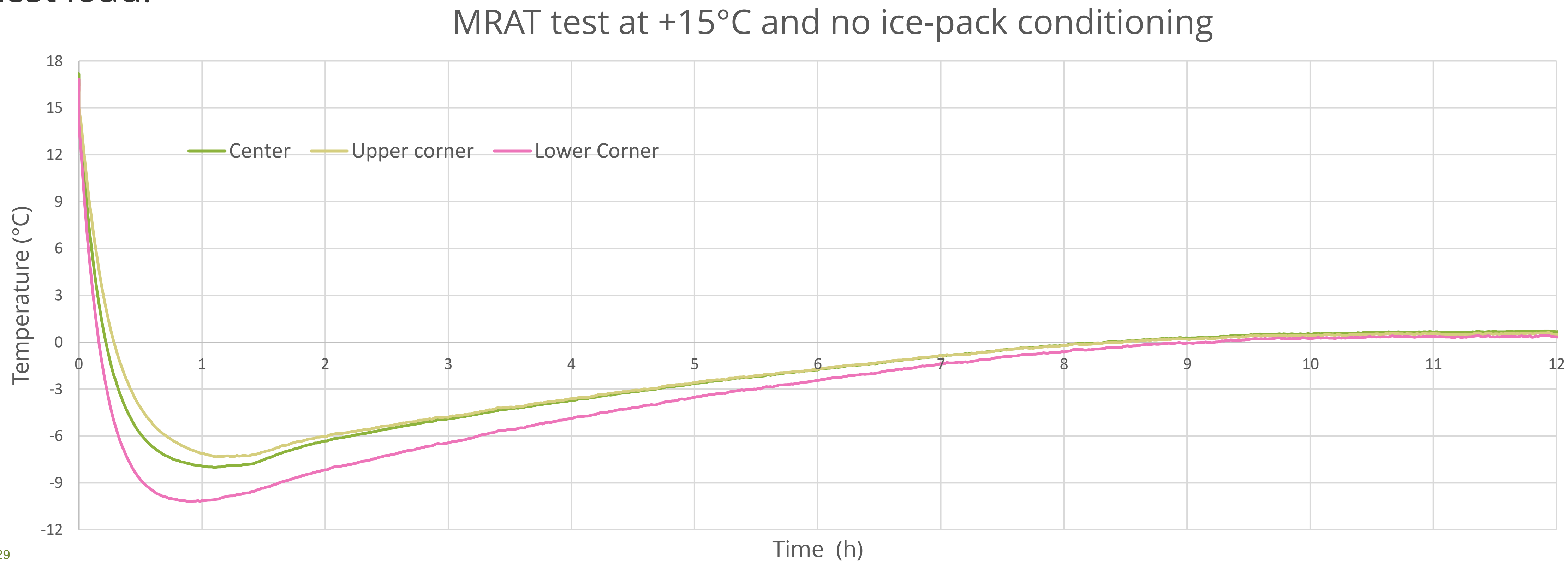
Abbreviations: BCG, bacillus Calmette-Guérin; dT, diphtheria (low-dose), tetanus; DT, diphtheria, tetanus; DTaP, diphtheria, tetanus, acellular pertussis; DTwP, diphtheria, tetanus, whole-cell pertussis; HepA, hepatitis A; HepB, hepatitis B; hexavalent, DTaP-HepB-Hib-IPV; Hib, *Haemophilus influenzae* type b; HPV, human papillomavirus; influenza, influenza (inactivated, split vaccine); IPV, inactivated poliovirus vaccine; JE, Japanese encephalitis; MenA, meningitis A; MenC, meningitis C; MMR, measles, mumps, rubella; OPV, oral poliovirus vaccine; pentavalent, DTwP-HepB-Hib; pneumo, pneumococcal; PS, polysaccharide; PS-PCV, PS-protein conjugate vaccine; T, tetanus.

*The diluent for MenA PS-PCV contains alum adjuvant and is freeze sensitive.

PATH

Risk of freezing at +15°C ambient in standard cold boxes with frozen ice packs

In our laboratory, we evaluated one of the standard cold boxes and followed the procedure for the Minimum Rated Ambient Temperature (MRAT) testing as per the Performance, Quality and Safety (PQS) protocol with ice packs frozen at -25°C to test a worst-case scenario* for freezing. The standard cold box maintains temperatures below 0°C for multiple hours with a minimal test load.



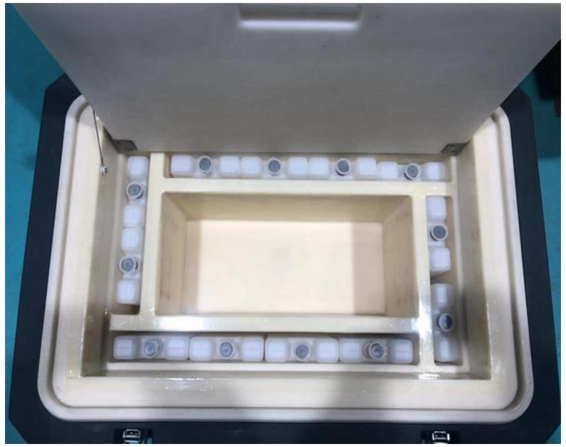
Freeze preventive cold box

WHO PQS performance specifications for freeze prevention in cold boxes:

- Temperature in vaccine storage compartment must remain above 0°C and below +10°C with an accuracy of ±0.5°C in ambient temperatures of +15°C to +43°C.
- Minimum of 48 hours for a short-range cold box and 96 hours for a long-range cold box.

Leff Trade freeze preventive cold box (FPCB) (model FFCB-15L, WHO PQS code E004/057, China):

- First WHO PQS prequalified FPCB.
- Uses chlorofluorocarbon-free polyurethane as the insulating liner and high-density polyethylene as the external material.
- Uses 21 frozen ice packs.
- Vaccine storage dimensions: 41.5 cm X 18.5 cm X 20.0 cm.
  Storage volume: 15 L.
  Empty weight: 24 kg.
  Fully loaded weight: 49.9 kg.



PATH/Sandeep Kumar

Abbreviations: FPCB, freeze preventive cold box; PQS, Performance, Quality and Safety; WHO, World Health Organization.

Partnering with B.P. Koirala Institute of Health Sciences

- Strong field presence.
- Well-known experience in conducting field studies in collaboration with the Nepalese Ministry of Health.
- Previous experience working with PATH.

Photo- BPKIHS

Evaluating performance in Nepal

Objectives were to determine whether FPCBs (2021):

1. Perform according to the WHO PQS specifications for freeze-preventive cold boxes.
2. Are acceptable to end users when compared to standard cold boxes (SCBs).
3. Fit well within the health system including cost considerations.

PATH/Sandeep Kumar

Abbreviations: FPCB, freeze preventive cold box; PQS, Performance, Quality and Safety; SCB, standard cold boxes; WHO, World Health Organization.

Study design

Phase 1: Simulated use

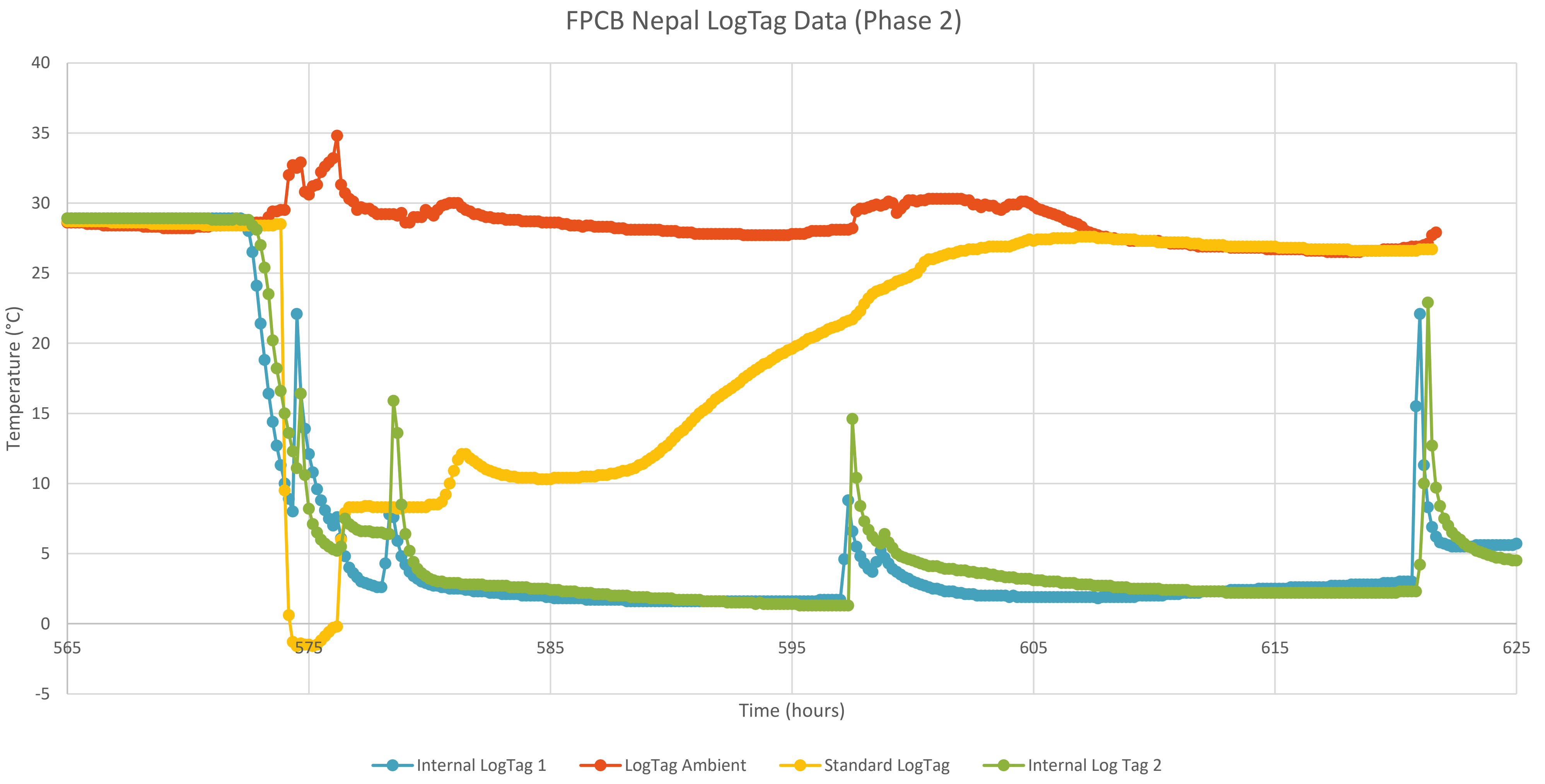
- FPCBs were loaded with a dummy test load to simulate real vaccines.
- Standard cold boxes (SCBs) were used as normal with inclusion of temperature monitoring devices (LogTags and Parsyl).

Phase 2: Actual use

- FPCBs were used to store and transport actual vaccines.
- Due to inconclusive SCB data from phase 1, SCBs were included only in the first month of phase 2 data collection.

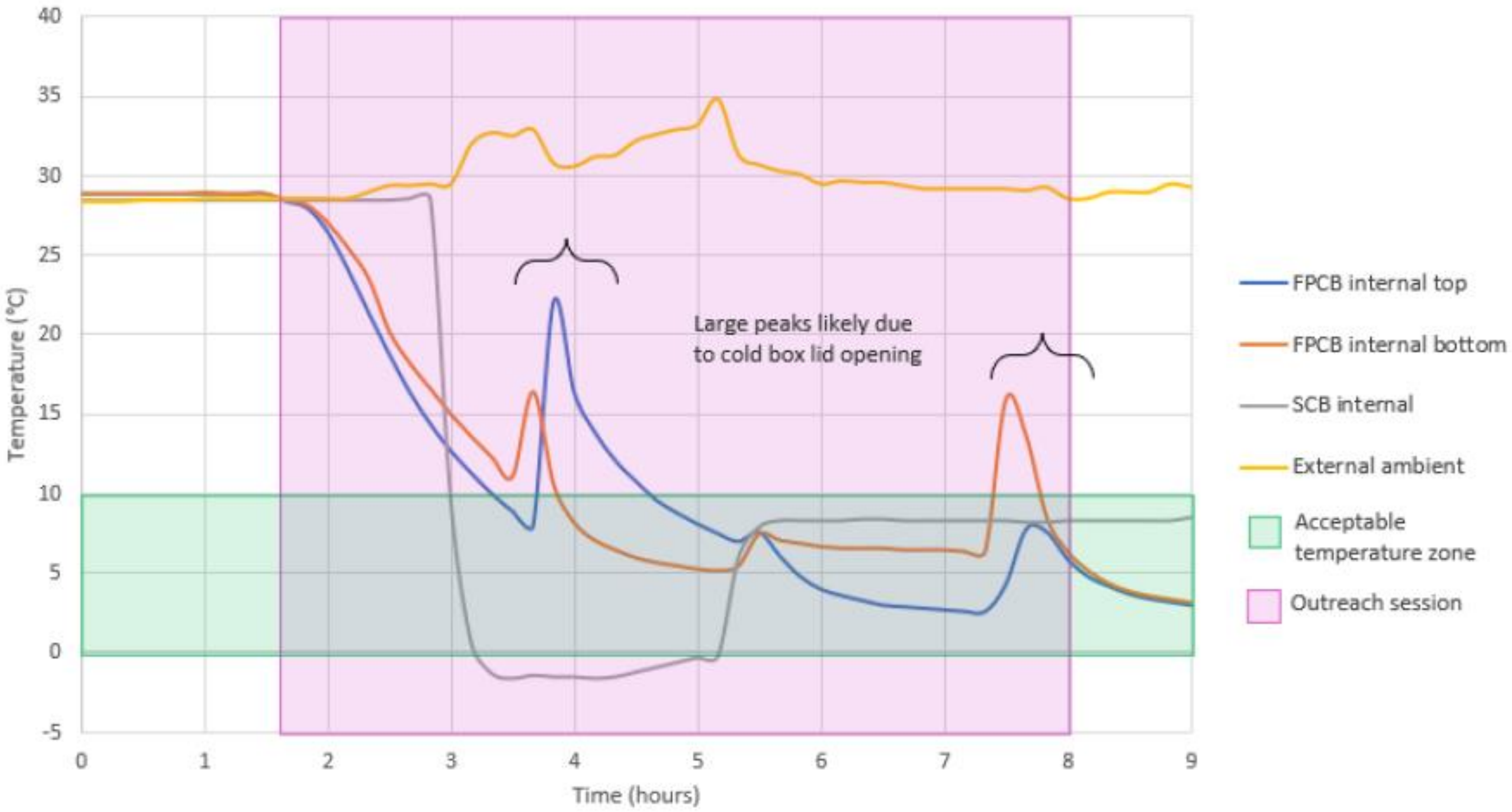
Abbreviations: FPCB, freeze preventive cold box; SCB, standard cold boxes.

Temperature data performance



Abbreviation: FPCB, freeze preventive cold box.

Example of temperature data demonstrating important features



Summary of key data points from phase 1 and 2

Phase 1

Temperature	Freeze-preventive cold box		Standard cold box
	Internal 1 (top LogTag) readings	Internal 2 (bottom LogTag) readings	Internal 1 readings
	No. (%)	No. (%)	No. (%)
<0°C	0 (0)	0 (0)	2 (3.6)
0°C to +10°C	23 (52.3)	22 (22.4)	31 (56.4)
>+10°C	21 (47.7)	76 (77.6)	22 (40.0)
Total readings	44	98	55

Phase 2

Temperature	Freeze-preventive cold box		Standard cold box
	Internal 1 (top LogTag) readings	Internal 2 (bottom LogTag) readings	Internal 1 readings
	No. (%)	No. (%)	No. (%)
<0°C	0 (0.0)	0 (0.0)	19 (1.0)
0°C to +10°C	8,561 (98.3)	7,461 (95.3)	1,679 (84.0)
>+10°C	152 (1.7)	372 (4.7)	300 (15.0)
Total readings	8,713	7,833	1,998

Data shows potential issues with LogTag placement

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- Based on internal testing results, the freezing temperatures seen in the FPCB 1 data were due to incorrect placement of the temperature logger.
- With updated instructions on sensor placement, there were no further incidents of freezing seen in FPCBs in phase 2 data.
  - This indicates further that the only freezing temperatures seen were likely due to placement of the sensors outside of the vaccine storage area during the study.
- Other issues were seen when LogTags were placed in the wrong equipment, such as SCB LogTags being placed in a freezer or refrigerator.
- Occasionally the LogTags appear to have been removed prematurely from the cold boxes, which led to insufficient length of data collection.

Abbreviations: FPCB, freeze preventive cold box; SCB, standard cold boxes.

Temperature results: Standard and freeze-preventive cold boxes

Phase 1 results

- Both types of equipment experienced high temperature excursions.

Phase 2 results

- Not a single incident of freezing in the FPCBs.
- In contrast to 19 freezing temperatures (1% of readings) in the SCBs.
- Both types of equipment experienced high temperature excursions:
  - ❖ FPCBs, 152 (1.7%) of the top internal LogTag readings and 372 (4.7%) of the bottom internal LogTag readings were above +10°C,
  - ❖ SCBs, 300 (15%) of the readings were above +10°C.

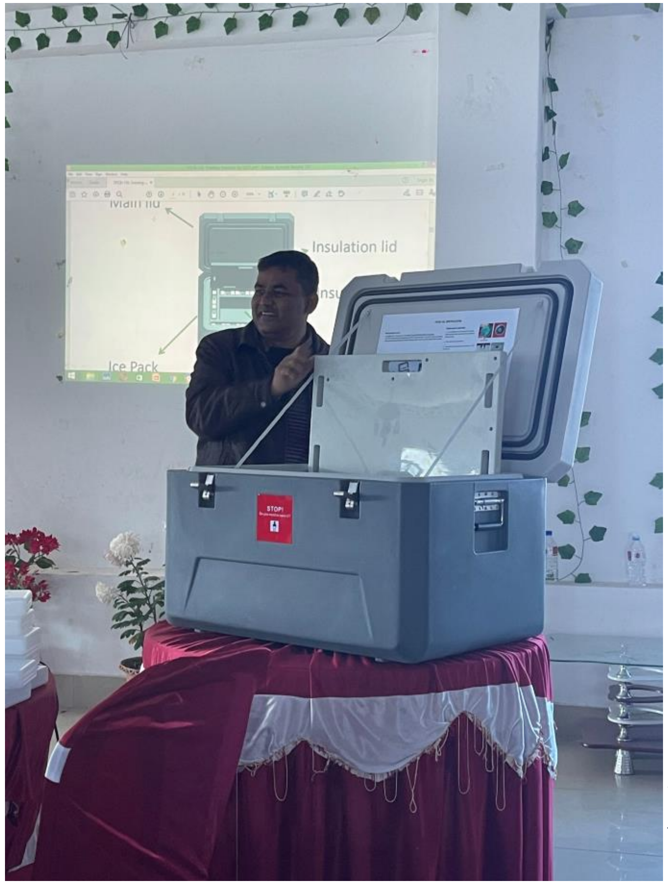
PATH/Sandeep Kumar

Abbreviations: FPCB, freeze preventive cold box; SCB, standard cold boxes.

Health workers perceptions on freeze-preventive cold box

17th TechNet Conference

- The ice pack partitions in the cold box increased vaccine safety by reducing the risk of freezing.
- The partitions decrease or eliminate condensation and water build up in the vaccine area, potentially reducing wastage by preventing damage to vial labels by water accumulation.
- Use of frozen ice packs saved time in preparing the FPCB.
- More challenging was to transport the FPCB, especially in hilly regions/districts, and one person found difficult to handle/carry during transportation.
- Storage volume appears less as compared to the SCBs and additional cold boxes will be required during campaigns.



PATH/Sandeep Kumar

Abbreviation: FPCB, freeze preventive cold box.

PATH

Costing results: Freeze preventive cold boxes

	Average	Minimum	Maximum
Doses taken per shipment	4,059	1,184	7,990
Value of all vaccines taken per shipment	$2,739	$676	$5,499
Value of freeze sensitive vaccines taken per shipment	$1,704	$360	$3,371
Percentage of freeze sensitive vaccines taken per shipment	62%	53%	65%

Thus, one freezing incident can result in a loss of vaccines that cost 5X more than the price of the FPCB.

Abbreviation: FPCB, freeze preventive cold box.

Thank You!

Steven Diesburg, PATH – USA

Nadege Edwige Nnang Amougou, CHAI Cameroon

Sandeep Kumar, PATH – India; and **Surendra Uranw,** BPKIHS