



World Health
Organization

unicef



Global update on temperature monitoring



Why bother about temperature monitoring

Objectives of the immunization supply chain

Impacts of temperature excursions...

Availability of vaccines at the right place in the right time



If undetected

If detected

Vaccines are potent and have not been impacted by temperature excursions



Potential damaged

Potential stockouts

Resources are used efficiently

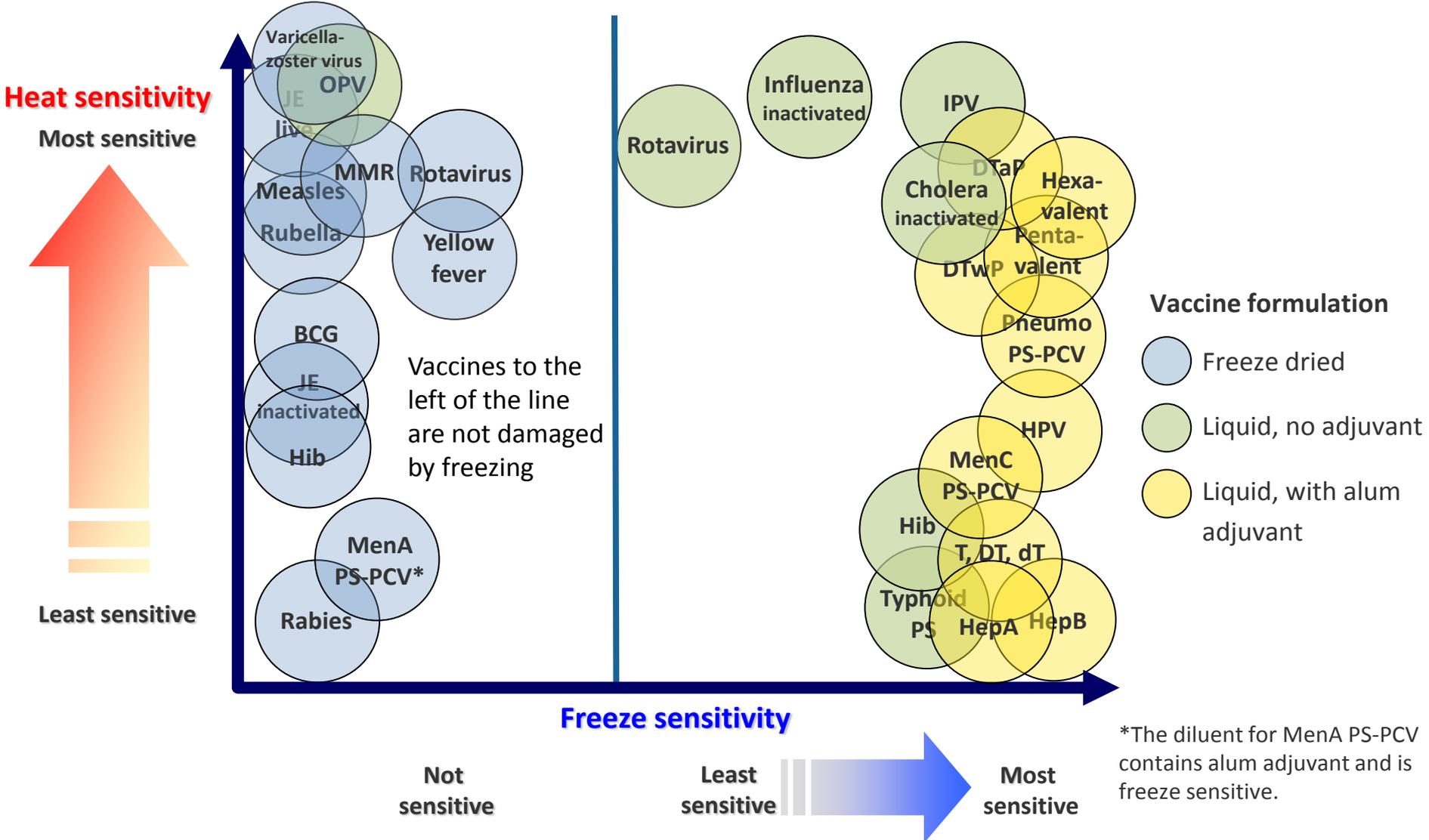


May not achieve sero-conversion

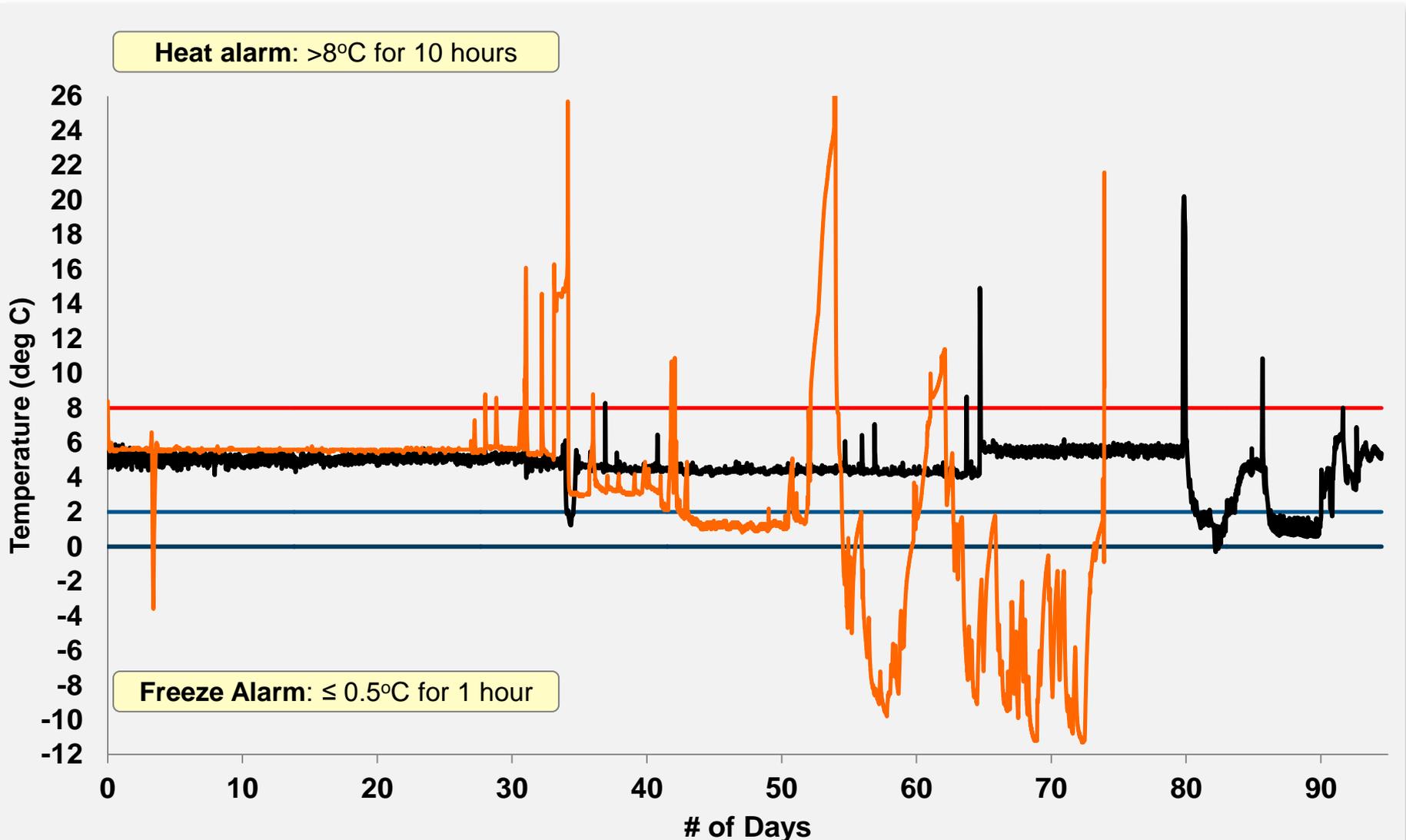
Wastage

Temperature monitoring: detects excursions and can help avoid future excursions

Temperature sensitivity of vaccines



Two stories of what happened to a vaccine at country level



Vaccine travelled from national level to point of service

Currently heat excursions are easier to detect than freezing if VVM is applied

Too hot
“Easier to detect”



Health worker in Niger shows bottles with vaccine vial monitors. Source: WHO

What do we know from the EVM Data Analysis

Over 90% of storekeepers and health workers know how to read VVMs.



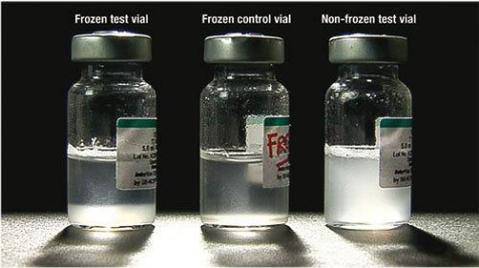
Continuous temperature monitoring

“What about excursions during weekends?”

Too cold
“Harder to detect”



Example of Freeze indicators



Shake test. Source WHO

Only 11 % of facilities pack freeze indicators with deliveries of freeze-sensitive vaccines

Recent evidence in literature and from country studies suggests that freezing remains a major concern, especially during transit

Systematic literature review in 2007 covering 35 studies: 14-35% of refrigerators or transport exposed vaccines to freezing temperatures¹

Recent literature (courtesy of PATH)

Thailand 2006²: 6.3% (peripheral health facilities) and 6.4% (transit) of time

Min: -12°C

China 2009³: 23.3% of time in county stores
Min: -5.5°C

Malaysia 2010⁴: 20.2% of refrigerators

India 2012⁵: 10.5% (peripheral health facilities) and 18.1% (transit) of the time
Min: -21.3 and -15.0°C

Recent UNICEF country studies

Asia: Country1 2010				
Level	Time (%)			
	< 0 deg C	0 to 2 deg C	2-8 deg C	> 8 deg C
National	0.0%	0.0%	99.7%	0.3%
Province	0.4%	0.6%	93.7%	5.4%
Health Facility	1.2%	5.5%	90.6%	2.7%
Transit*	12.5%	9.5%	61.9%	16.1%

Asia: Country2 2010				
Level	Time (%)			
	< 0 deg C	0 to 2 deg C	2-8 deg C	> 8 deg C
National	0.0%	0.0%	99.8%	0.2%
Province	0.2%	3.6%	89.0%	7.2%
Health Facility	3.8%	10.5%	66.0%	19.7%
Transit**	26.7%	18.2%	47.0%	8.1%

*Total hours: 486 and min: -3.2°C

**Total hours: 99 and min: -4.5°C

¹Matthias DM, Robertson J, Garrison MM, Newland S, Nelson C. Freezing temperatures in the vaccine cold chain: a systematic literature review. *Vaccine*. 2007;25(20):3980–3986.

²Techathawat S, et. al. Exposure to heat and freezing in the vaccine cold chain in Thailand. *Vaccine*. 2007;25(7):1328-33.

³Ren Q, et. al. Evaluation of an Outside-the-Cold-Chain Vaccine Delivery Strategy in Remote Regions of Western China. *Public Health Rep*. 2009 Sep-Oct; 124(5): 745–750.

⁴Norhayati AB, et. al. Optimal Temperature of Cold Chain and its Associated Factors among General Practitioners in Kelantan, Malaysia. *Intl Journal of Collaborative Research on Internal Medicine & Public Health*. Vol. 6 No. 6 (2014)

⁵Murhekar MV, et. al. Frequent exposure to suboptimal temperatures in vaccine cold-chain system in India. *Bull World Health Organ*. 2013 Dec 1; 91(12): 906–913.

... and more evidence...

Link to Potency

HepB study⁶: Damage to the vaccine increased with duration of freezing, lower temperature, and the number of freezing episodes.

China 2009 study³: 6.3% of vials tested from 7 health facilities showed decreased potency

Link to Infection

Mongolia HepB study⁷: Association between winter vaccination and total infection was evident for rural areas. The study tied this with the vaccine temperature study showing exposure to freezing temperatures during rural transport.

**Additional evidence
welcome**

**But evidence shows
that temperature
monitoring works**

Vietnam 2010⁸: EPI work to prevent freezing using approaches such as continuous temperature monitoring
Minimum between 0-2°C, but no sub-zero temp

Tunisia 2014⁹: Using continuous temperature monitoring and PCM transport packs
Freeze alarms at health facility level reduced by 40%
Freezing during transit: reduced from 13.8% to 1.7%

⁶Chen D, et. al. Characterization of the freeze sensitivity of a hepatitis B vaccine. Hum Vaccin. 2009 Jan-Feb;5(1):26-32.

⁷Davaalkham D, et. al.. Administration of hepatitis B vaccine in winter as a significant predictor of the poor effectiveness of vaccination in rural Mongolia. J Epidemiol Community Health. 2007 Jul;61(7):578-84.

⁸Robertson J, Vu H, Le N, et al. Cold Chain Temperature Monitoring in Vietnam: Monitoring Ambient and Cold Chain Temperatures During Delivery of HPV. Seattle: PATH; 2010.

⁹Lloyd J, Lydon P, Ouichi R, Zaffran M. Reducing the loss of vaccines from accidental freezing in the cold chain: The experience of continuous temperature monitoring in Tunisia. Vaccine. 2015; 33(7):902-907.

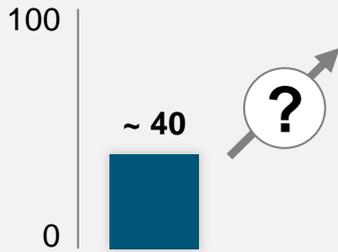
WHO recommendations for temperature monitoring for storing vaccines

Recommended best practices

EVM data

Walk in cold rooms

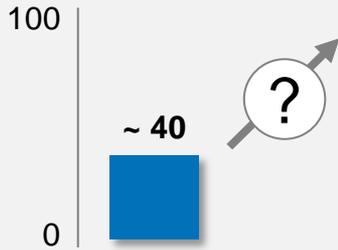
- Central temperature monitoring system



% of facilities in which all cold and freezer rooms have continuous temperature recorders

Refrigerators

- 30 day electronic temperature logger
- Stem thermometer (as backup)
- Integrated digital thermometer or gas/vapour pressure-dial thermometer
- VVMs



% of facilities in which all vaccine refrigerators have continuous temperature recorders or freeze indicators

Freezers

- Stem thermometer
- Integrated digital thermometer or gas/vapour pressure-dial thermometer
- VVMs

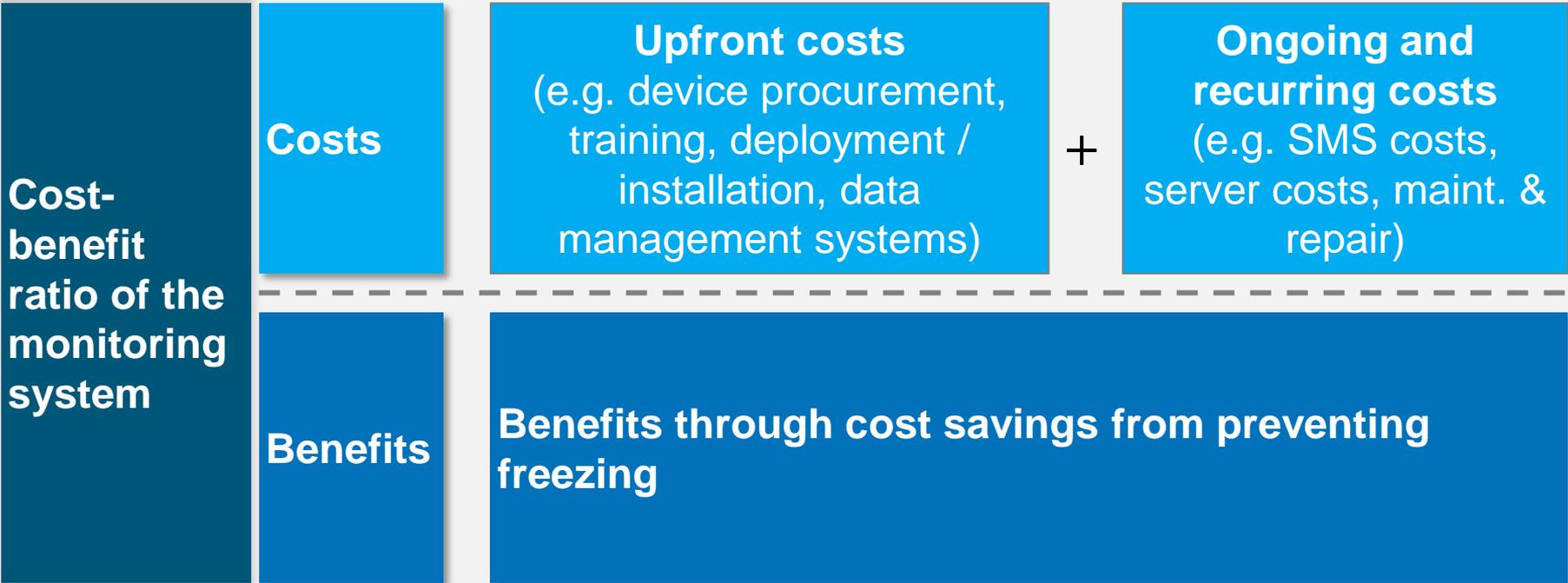
Can new technology make systems more “reactive”?

Partners developed cost-benefit tool to assist countries to make evidence based decision about temperature monitoring system



How to think through the costs and benefits of different temperature monitoring systems?

- 30 DTRs
- 30 DTRs + sms model (e.g. Laos)
- Remote Temperature Monitoring Devices (e.g. Mozambique)



Can we actually put a value on the Risk of Freezing?

72% of the vaccine value is for freeze sensitive vaccines!

National store

EPI target population of 1 million children;
stores 4 months of vaccine stock:

\$ 7,000,000

\$ 5,300,000

Regional store

Serves 125,000 children;
stores 3 months of vaccine stock:

\$ 653,000

\$ 473,000

Health center

Serves 300 children;
stores 1 month of vaccine stock:

\$ 520

\$ 380

Assumptions: Vaccine schedule includes BCG, OPV, pentavalent, measles, rotavirus, and PCV vaccines all at 85% coverage rate, and tetanus toxoid at 70% coverage rate. Uses Gavi vaccine prices.

Next steps... and welcome to TECHNET

New guidance materials are being developed :

- Vaccine Management handbook on temperature monitoring
- UNICEF practical guide for 30 DTR (& remote temp. devices) implementation
- Cost/benefit analysis tool
- Protocols review and new tools developed for temperature monitoring studies and temp. mapping

**Get inspired –
play with devices &
talk to experts**

- **Take a look at of what is possible**
- **Provide feedback to the suppliers – express your needs!**

**Learn from some
failures and
successes**

Country presentations

- Laos, Mozambique, Turkey

Posters

- E-health Africa & UNICEF Nigeria
- Village Reach, Nexleaf Analytics, EPI Mozambique and PATH
- CHAI
- U. of Wash. & PATH

**Think “beyond”
devices**

**Right device
+
Right process
+
Right system
+
= SUCCESS**

!!! DON'T FORGET THE USER!!!

!!! DON'T FORGET THE OVERAL HEALTH SYSTEM !!!