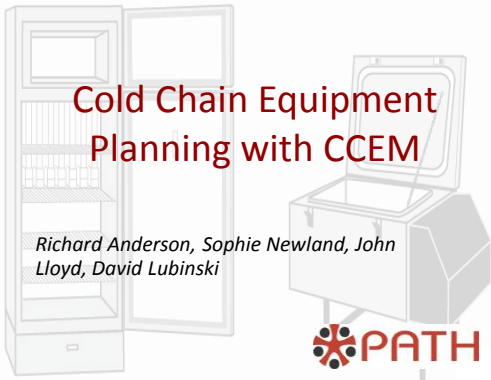



# Cold Chain Equipment Planning with CCEM

*Richard Anderson, Sophie Newland, John Lloyd, David Lubinski*




2


## My background

University of Washington, Computer Science and Engineering

- On faculty since 1986
- Professional interests
  - Computing for low resource environments
  - Educational technology
  - Software engineering
  - Algorithms
- On leave 2009-2011 with PATH

**PATH HMIS Projects**

- CCEM: Cold chain equipment manager
- FoneAstra: Temperature monitoring
- SmartConnect: Data communication
- Cell Phones for TB Case Screening in TZ
- Systems requirements for TB surveillance
- Mobile Midwife Project



TechNet 2010 Consultation, Kuala Lumpur, Malaysia

3
Cold Chain Equipment Planning with CCEM

### Outline

1. Problem Statement
2. CCEM Application
3. Project Status
4. Inventory-based Cold Chain Planning

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

4
Cold Chain Equipment Planning with CCEM


### CCEM Problem Statement

- Understand national cold chain capacity
  - Especially for introduction of new vaccines
  - Does the country have capacity
  - Develop a plan for meeting capacity needs
- Solution
  - Inventory of cold chain equipment
  - Analytics and modeling
  - Implementation: CCEM

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia


5
Cold Chain Equipment Planning with CCEM

### Old vs. New Vaccines



←

4,100 doses  
Polio and Measles  
\$635



→

625 doses  
Rotavirus  
\$4,687

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

6
Cold Chain Equipment Planning with CCEM

### Cold Chain Inventory






December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

7 Cold Chain Equipment Planning with CCEM

**CCEM History**

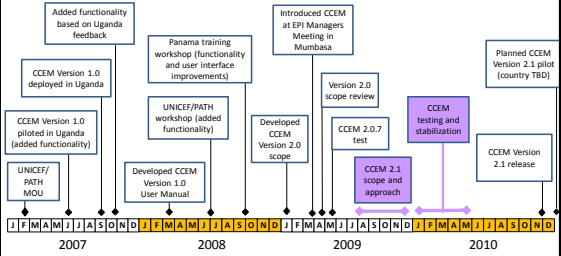
- **2006.** CCEM development starts at the TechNet Consultation in Mexico City with the idea that an equipment inventory and planning tool would support systematic management of the cold chain. (Dr. Fernando Perez, MOH Peru)
- **2007.** In collaboration with Uganda EPI team, WHO/IST, and UNICEF/TACRO, CCEM is piloted.
- **2009.** CCEM is migrated to MS Access 2007, with a new user interface and deploying software engineering principles.

December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia

8 Cold Chain Equipment Planning with CCEM

**CCEM roadmap**



December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia

9 Cold Chain Equipment Planning with CCEM

**CCEM Vision**

- Equipment Inventory + Analysis Tools
- Capture expertise of cold chain experts in software
- Provide basic tool for analyzing a nation's cold chain
- Enable countries to do their own cold chain analysis and equipment planning
- Model:
  - Cold chain inventory and capacity
  - Inventory changes
  - Cold chain and supply chain policy changes

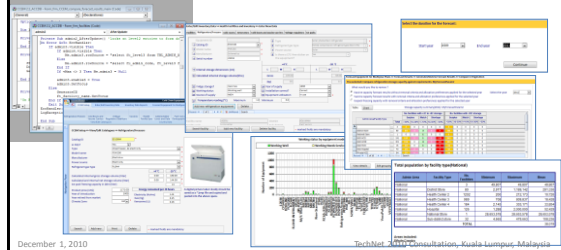
December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia

10 Cold Chain Equipment Planning with CCEM

**CCEM Application**

- Visual Basic / Microsoft Access Application
- Catalogs / Data Entry / Reporting / Forecasting



December 1, 2010

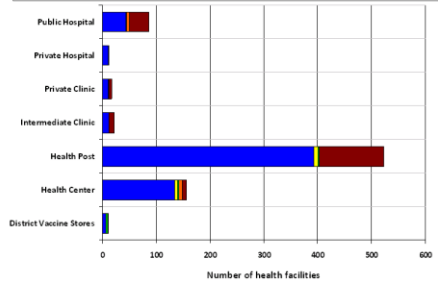
TechNet 2010 Consultation, Kuala Lumpur, Malaysia

11 Cold Chain Equipment Planning with CCEM

**Scenario 1 - Cold chain capacity analysis**

Vaccine storage capacity at +2 to +8°C against requirements (Central-level)

Legend: Surplus > 30% (Blue), Surplus 10-30% (Yellow), Match +/- 10% (Green), Shortage 10-30% (Orange), Shortage > 30% (Red)



December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia

12 Cold Chain Equipment Planning with CCEM

**Scenario 2 - PCV7 introduction**

Admin Area/Facility Type	No. facilities with +2C to +8C storage			
	Surplus	Match	Shortage	
<b>Total</b>	>30%	10-30%	+/-10%	10-30%
Central Vaccine Stores	1	0	0	0
District Vaccine Stores	11	11	0	0
Health Center	157	154	0	9
Health Post	523	403	0	120
Intermediate Clinic	22	12	0	10
Private Clinic	13	13	0	0
Private Hospital	13	11	0	2
Public Hospital	86	49	0	37

Admin Area/Facility Type	No. facilities with +2C to +8C storage			
	Surplus	Match	Shortage	
<b>Total</b>	>30%	10-30%	+/-10%	10-30%
Central Vaccine Stores	1	0	0	0
District Vaccine Stores	11	11	0	0
Health Center	157	154	0	9
Health Post	523	393	0	130
Intermediate Clinic	22	12	0	10
Private Clinic	13	13	0	0
Private Hospital	13	11	0	2
Public Hospital	86	44	0	42

December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia

13 Cold Chain Equipment Planning with CCEM

### Scenario 3 - Equipment removal

**Inventory report:**  
Significant numbers of MK074, TCW1152CF, and TCW1990 are >10 years old

**Forecast report:**  
Impact of removal of MK074, TCW1152CF and TCW1990 on capacity

Admin Area/Facility Type	Total	No. facilities with *C to *BC storage			
		Surplus	Match	Shortage	
Central vaccine Stores	1	0	0	0	0
District vaccine Stores	11	4	2	1	1
Health Center	157	126	2	1	23
Health Post	523	218	0	0	285
Intermediate Clinic	22	0	0	0	14
Private Clinic	17	0	0	0	12
Private Hospital	13	4	0	0	9
Public Hospital	86	23	0	0	62

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

14 Cold Chain Equipment Planning with CCEM

### Scenario 4 -Equipment allocation

CCEM will allocate equipment to meet capacity shortages using user-set equipment preferences, evaluating energy availability, climate zones, and identification of the least cost (capital) option.

If a single ILR model is selected for allocation to meet capacity needs for all facilities below the District Vaccine Store, CCEM generates the following results:

You selected: **Multi-year new equipment allocation table: removal with ILR allocation**

Review multiyear new equipment allocation table by:

- Equipment types
- Equipment types and models

Equipment Type	2010		1-Year Totals	
	Qty	Cost \$US	Qty	Cost \$US
Balanced refrigerator	330	268,300	330	168,300

However, for 144 facilities with electricity <8 hours per day, an ILR is not an option....

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

15 Cold Chain Equipment Planning with CCEM

### Scenario 5 -Multiyear forecast and planning

CCEM generates equipment requirements to meet capacity shortages in multiyear plans

- CCEM user requests cold chain capacity impact analysis of removing TCW 2000, TCW1152CF, and MK 074 over 10 years old in Year 1 of a 5 year plan.
- CCEM user requests capacity impact analysis of adding PCV7 vaccine in Year 3 and Year 4, then adding rotavirus vaccine in Year 5 of this 5 year plan.
- CCEM user requests multiyear equipment budget report associated with the automated allocation of equipment for all facilities below the District Vaccine Store needing additional cold chain capacity in each year of the 5 year plan. User selects a specific ILR model, EG refrigerator model, and solar refrigerator model for CCEM to evaluate for suitability.

**Results:**

Equipment Type	2010		2011		2012		2013		2014		5-Year Totals	
	Qty	Cost \$US	Qty	Cost \$US	Qty	Cost \$US	Qty	Cost \$US	Qty	Cost \$US	Qty	Cost \$US
Cheese refrigerator	102	249,250.00			1	2,050.00			103	103	251,750.00	
Balanced refrigerator	819	417,090.00			135	68,850.00			6	3,060.00	860	489,000.00
Solar refrigerator	57	278,445.00			1	4,885.00					58	283,330.00

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

16 Cold Chain Equipment Planning with CCEM

### Where CCEM is today

- CCEM 2 and Supporting Materials available online at [www.path.org](http://www.path.org) and [www.technet21.org](http://www.technet21.org)
- Ongoing collaboration with Kenya EPI team to pilot CCEM 2 for cold chain inventory and planning
- Regional technical workshop under discussion with the WHO regional team for ESAR

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

17 Cold Chain Equipment Planning with CCEM

### CCEM Core Data Elements


- Administrative hierarchy
  - Country, Province, Region, District, Subdistrict
- Facilities and vaccine stores
  - Facility info
  - Demographics: Population, Live births
- Refrigerator Inventory

December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

18 Cold Chain Equipment Planning with CCEM

### Software Development Challenges

- Challenges and experiences from developing CCEM are not unique
- Lessons from CCEM
  - Developing software is hard!
  - Software engineering tools helped
    - Issue tracking
    - Configuration management
    - Test cases
  - Absolutely critical to have strong public health input and domain knowledge
  - Important to figure out how to bridge between public health and computing technology



December 1, 2010 TechNet 2010 Consultation, Kuala Lumpur, Malaysia

## 19 Cold Chain Equipment Planning with CCEM

**Wishlist for the future**

- Robust database for inventory
- Multiple mechanisms for updates
- Core inventory / geographic info with country customization
- Geographic information system
- Web accessible (with access control)
- Extensible analytics and visualization



December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia

## 20 Cold Chain Equipment Planning with CCEM

**Acknowledgements**

**USAID**  
FROM THE AMERICAN PEOPLE



Kenya Ministry of  
Health



**unicef** 



Republic of Uganda  
Ministry of Health



World Health  
Organization

December 1, 2010

TechNet 2010 Consultation, Kuala Lumpur, Malaysia