

Cold Chain Equipment Planning with CCEM

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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



Outline

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

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

Old vs. New Vaccines



4,100 doses
Polio and Measles
\$635

625 doses
Rotavirus
\$4,687



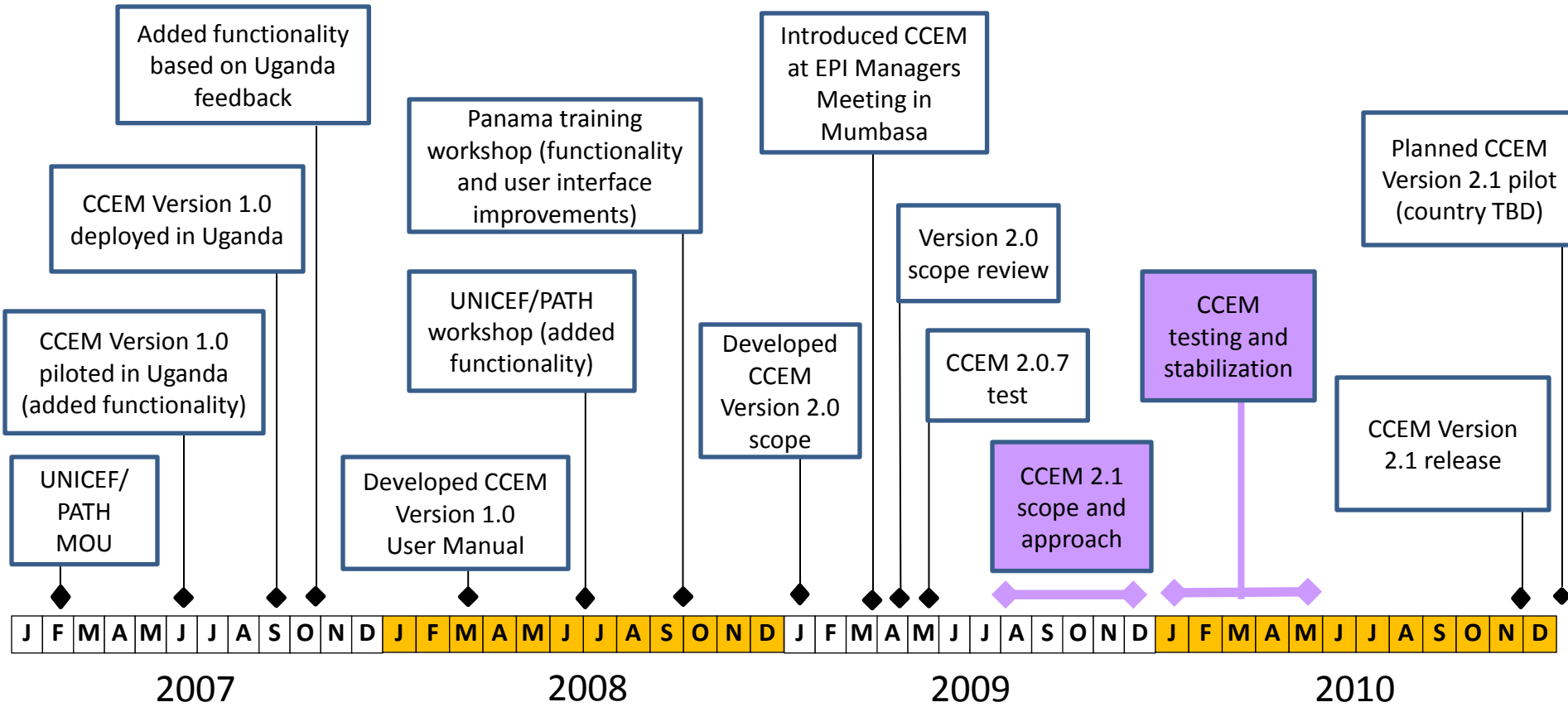
Cold Chain Inventory



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.

CCEM roadmap



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

CCEM Application

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

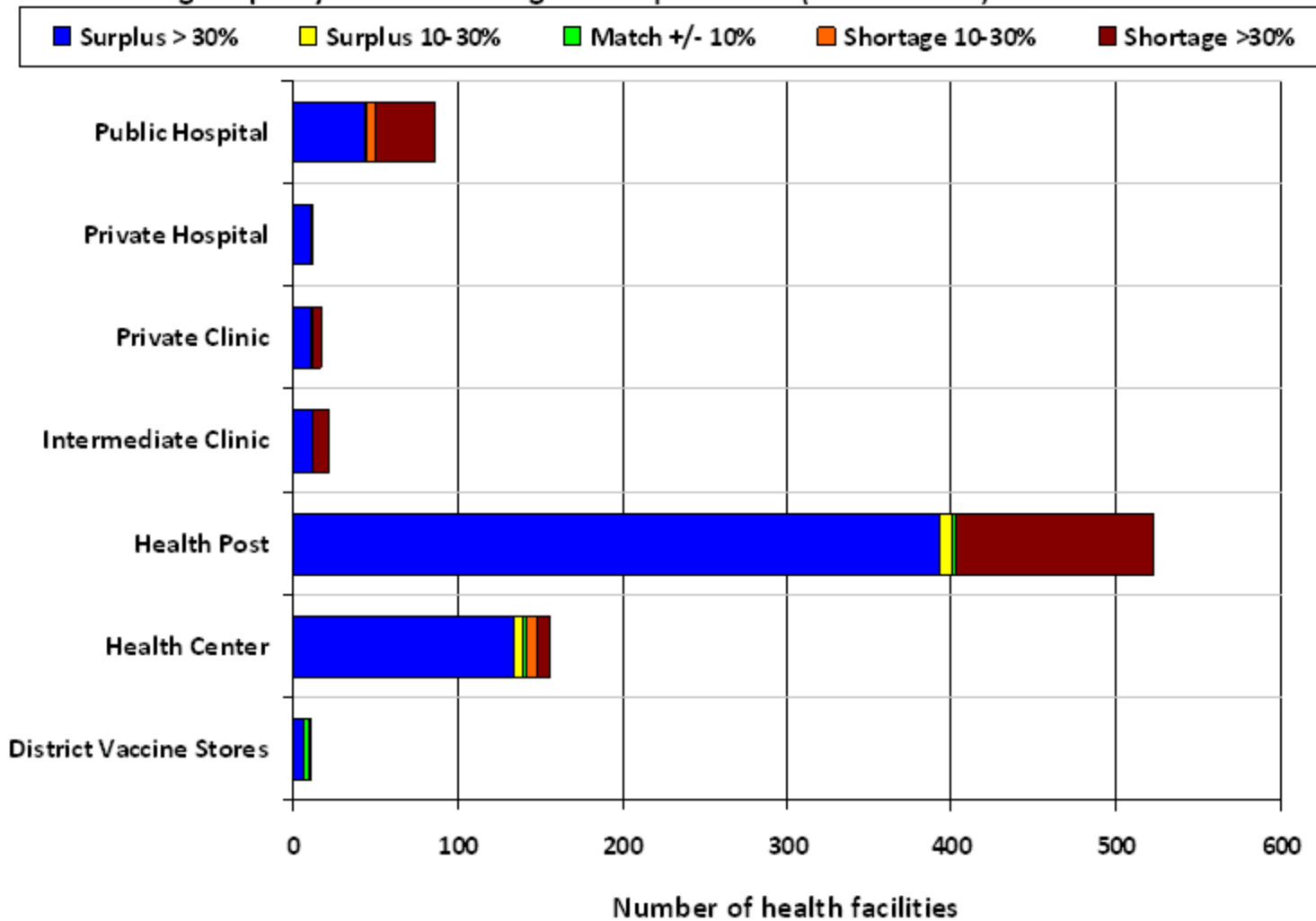
The image displays several key components of the CCEM application:

- VBA Code Editor:** Shows Visual Basic code for handling facility updates and focus settings.
- Facility Data Entry Form:** A detailed form for entering facility information, including location, equipment type, and storage capacity.
- Forecast Duration Selection:** A dialog box to specify the start and end years for the forecast.
- Forecast Results Summary:** A table showing forecasted capacity and equipment utilization for different facility types.
- Working Status by Equipment Model:** A bar chart showing the number of equipment units in different working states across various models.
- Total Population by Facility Type:** A table summarizing the total number of facilities and their associated population across different administrative areas.

Admin Area	Facility Type	No. Facilities	Shoppers	Maximum	Mean
National		3	49,807	49,807	49,807
National	District State	80	2,877	1,199,142	291,336
National	Health Center 2	1202	268	212,173	19,726
National	Health Center 3	900	756	908,837	18,428
National	Health Center 4	198	2,147	301,171	33,854
National	Hospital	126	1,284	2,093,000	82,429
National	National Store	1	26,893,578	26,893,578	26,893,578
National	Sub-District state	52	4,665	478,563	198,236
	TOTAL				38,019

Scenario 1 - Cold chain capacity analysis

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



Scenario 2 - PCV7 introduction

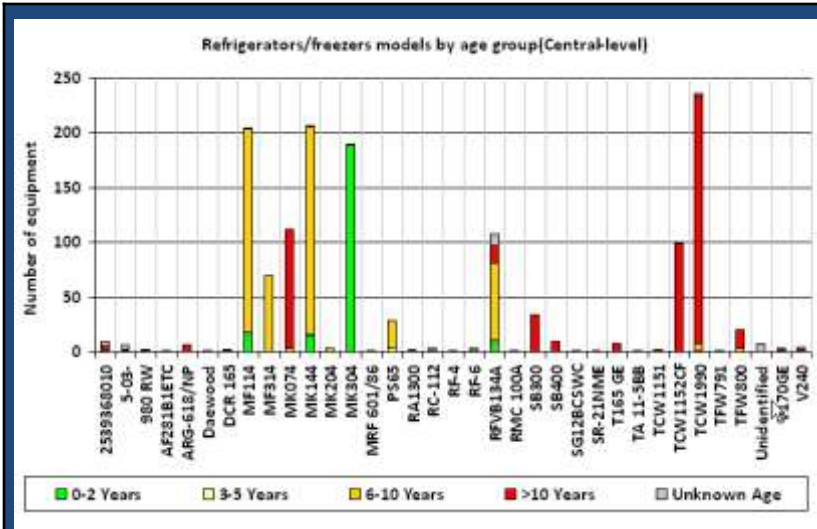
Before PCV7

Admin Area/Facility Type	Total	No. facilities with +2C to +8C storage				
		Surplus		Match	Shortage	
		>30%	10-30%	+/-10%	10-30%	>30%
Central Vaccine Stores	1	1	0	0	0	0
District Vaccine Stores	11	11	0	0	0	0
Health Center	157	145	3	0	0	9
Health Post	523	403	0	1	0	119
Intermediate Clinic	22	13	0	0	0	9
Private Clinic	17	13	0	0	0	4
Private Hospital	13	11	0	0	0	2
Public Hospital	86	49	4	0	0	33

After PCV7

Admin Area/Facility Type	Total	No. facilities with +2C to +8C storage				
		Surplus		Match	Shortage	
		>30%	10-30%	+/-10%	10-30%	>30%
Central Vaccine Stores	1	0	1	0	0	0
District Vaccine Stores	11	7	0	3	1	0
Health Center	157	134	5	3	6	9
Health Post	523	393	7	2	1	120
Intermediate Clinic	22	13	0	0	0	9
Private Clinic	17	12	0	0	1	4
Private Hospital	13	11	0	0	0	2
Public Hospital	86	44	1	0	5	36

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 +2C to +8C storage				
		Surplus		Match	Shortage	
		>30%	10-30%	+/-10%	10-30%	>30%
Central Vaccine Stores	1	1	0	0	0	0
District Vaccine Stores	11	6	1	2	1	1
Health Center	157	126	5	2	1	23
Health Post	523	238	0	0	0	285
Intermediate Clinic	22	8	0	0	0	14
Private Clinic	17	5	0	0	0	12
Private Hospital	13	4	0	0	0	9
Public Hospital	86	23	1	0	0	62

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
▶ Ice-lined refrigerator	330	168,300	330	168,300

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

Scenario 5 -Multiyear forecast and planning

CCEM generates equipment requirements to meet capacity shortages in multiyear plans

1. 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.
2. 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.
3. 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:

Multi-year new equipment allocation table



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
Chest refrigerator, electricity & gas	102	249,250.00			1	2,500.00					103	251,750.00
Icelined refrigerator	819	417,690.00			135	68,850.00			6	3,060.00	960	489,600.00
Solar photovoltaic refrigerator	57	278,445.00			1	4,885.00					58	283,330.00

Where CCEM is today

- CCEM 2 and Supporting Materials available online at www.path.org and 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

CCEM Core Data Elements

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



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

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



Acknowledgements



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FROM THE AMERICAN PEOPLE



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