


Cold Chain Equipment Planning with CCEM

Richard Anderson, Sophie Newland, John Lloyd, David Lubinski, Stefano Malvolti, John Wecker, Kate Wilson

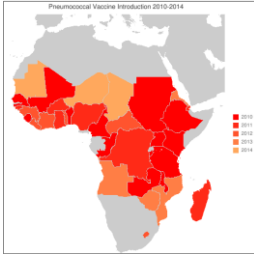


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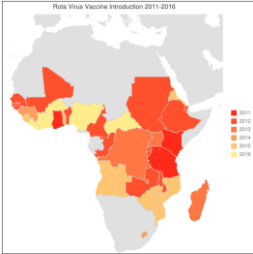
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Vaccine Introduction Timeline

Pneumococcal Vaccine Introduction 2010-2014



Rota Virus Vaccine Introduction 2011-2016




IVAC VIMS report, March 2010


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Old vs. New Vaccines



4,100 doses
Polio and Measles



625 doses
Rotavirus

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Does a country have sufficient cold chain capacity for new vaccines?

- Preparation for introduction of new vaccines
 - Assess cold chain capacity
 - Make cold chain capacity visible
 - Develop a plan for meeting capacity needs
- Approach
 - Inventory of cold chain equipment
 - Analytics and modeling
- Software
 - CCEM, Cold Chain Equipment Manager

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Cold Chain Inventory

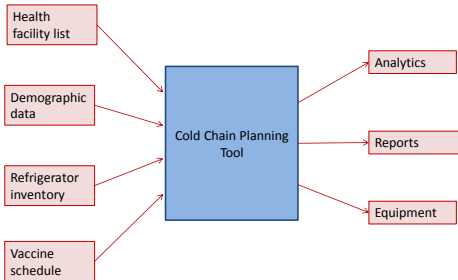





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Inventory Based Cold Chain Capacity Analysis



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    graph LR
      A[Health facility list] --> C[Cold Chain Planning Tool]
      B[Demographic data] --> C
      D[Refrigerator inventory] --> C
      E[Vaccine schedule] --> C
      C --> F[Analytics]
      C --> G[Reports]
      C --> H[Equipment]
    
```

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CCEM History

- 2006 CCEM development starts at the TechNet Consultation in Mexico
- 2007 CCEM piloted in collaboration with Uganda EPI team, WHO/IST, and UNICEF/TACRO.
- 2009 CCEM migrated to MS Access 2007, with a new user interface and stability enhancements
- 2010 Release of CCEM at TechNet Consultation in Kuala Lumpur
- 2011 Cold Chain Planning in Kenya on new national inventory (tentative)

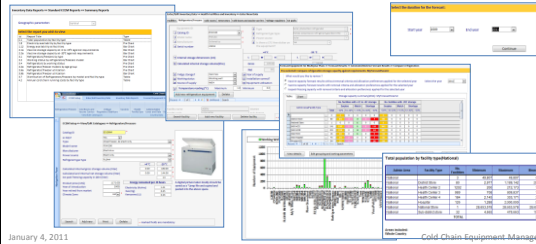
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CCEM Application

- Cold chain inventory
- Analysis and modeling tools
- Components: Catalogs, data entry, reports, forecasting

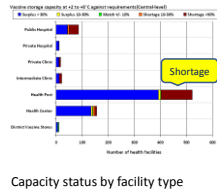


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Does the country have sufficient cold chain space for current vaccines?

- Compute capacity requirements for each facility
- Compare with available capacity



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What is the impact of the introduction of a new vaccine on available cold chain capacity?

- Add a new vaccine to the national schedule
- Identify capacity shortages created by new vaccine
- Determine facilities that need to add equipment to meet the shortages

Admin level/Facility Type	No. facilities with VC to VC shortage					No. facilities with VC to VC shortage				
	Total	Surplus	Match	Shortage	Capacity	Total	Surplus	Match	Shortage	Capacity
Central Vaccine Stores	1	1	0	0	0	1	1	0	0	0
District Vaccine Stores	11	0	0	0	0	11	0	0	0	0
Health Center	137	0	0	0	0	137	0	0	0	0
Health Post	523	0	0	0	0	523	0	0	0	0
Intermediate Clinic	23	0	0	0	0	23	0	0	0	0
Private Clinic	1	0	0	0	0	1	0	0	0	0
Private Hospital	13	0	0	0	0	13	0	0	0	0
Public Hospital	36	0	0	0	0	36	0	0	0	0

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How much would it cost to add equipment to address capacity shortages?

- Assign equipment to facilities with insufficient capacity
- Equipment assigned based on available energy and cost
- Policies can set equipment options for regions and facility types

Equipment	Type	2010	2011	2012	2013	2014	5 Year Totals
1.00	Central vaccine store	0	0	0	0	0	0
1.01	District vaccine store	0	0	0	0	0	0
1.02	Health center	0	0	0	0	0	0
1.03	Health post	0	0	0	0	0	0
1.04	Intermediate clinic	0	0	0	0	0	0
1.05	Private clinic	0	0	0	0	0	0
1.06	Private hospital	0	0	0	0	0	0
1.07	Public hospital	0	0	0	0	0	0

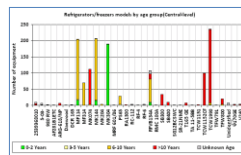
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What is the impact of retiring cold chain equipment?

- Remove equipment based on age, type, energy source, region, and facility type
- Evaluate capacity or energy cost



Admin level/Facility Type	No. facilities with VC to VC shortage					No. facilities with VC to VC shortage				
	Total	Surplus	Match	Shortage	Capacity	Total	Surplus	Match	Shortage	Capacity
Central Vaccine Stores	1	1	0	0	0	1	1	0	0	0
District Vaccine Stores	11	0	0	0	0	11	0	0	0	0
Health Center	137	0	0	0	0	137	0	0	0	0
Health Post	523	0	0	0	0	523	0	0	0	0
Intermediate Clinic	23	0	0	0	0	23	0	0	0	0
Private Clinic	1	0	0	0	0	1	0	0	0	0
Private Hospital	13	0	0	0	0	13	0	0	0	0
Public Hospital	36	0	0	0	0	36	0	0	0	0

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How many refrigerators are needed over the next five years?

- Multiyear planning based on:
 - Introduction of Vaccines
 - Vaccine Campaigns
 - Equipment introduction and removal
 - Equipment type, region, facility type, energy source, age
 - Population growth
- Products
 - Capacity analysis by facility
 - Equipment lists for each year
 - Comparison across scenarios



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Where CCEM is today

- Application and supporting materials available online at www.path.org.
- Kenya EPI team to deploy CCEM for cold chain inventory and planning
- Planning for regional technical workshop with the WHO regional team for ESAR (Feb 2011)

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Acknowledgements



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Contact Information

Richard Anderson, randerson@path.org
 Sophie Newland, snewland@path.org
 David Lubinski, dlubinski@path.org

Software Downloads: www.path.org
<http://www.path.org/publications/detail.php?i=1569>

CCEMinfo@path.org

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EXTRA SLIDES

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COLD CHAIN INVENTORY ISSUES



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CCEM Core Data Elements

- Administrative hierarchy
 - Country, Province, Region, District, Subdistrict
- Facilities and vaccine stores
 - Facility info
 - Cold chain function
 - Power sources
 - Vaccine supply
 - Demographics: Population, Live births
- Refrigerator Inventory
 - Equipment available at each facility

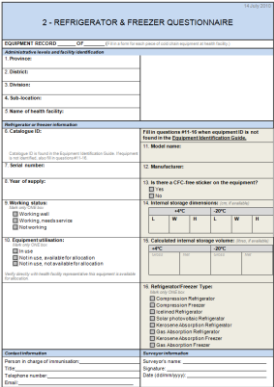




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Inventories

- National Inventory
 - Train enumerators
 - Visit each facility, record information on paper forms
 - Data entry clerks use CCEM to enter data

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Trade offs for inventory based planning

- Advantages
 - Improved management with cold chain inventory
 - Allocation of equipment
 - Matching equipment to available power sources
 - Avoiding over allocation of equipment
 - Planning at different levels based on data
 - Transparency
- Disadvantages
 - Initial inventory cost
 - Inventory updates
 - Transparency

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Inventory Updates

- Current model: update entered manually into the main application
- Regions may maintain their own databases, and then merge them with feed forward files to national database
- Future work
 - Distributed updates to inventory database
 - Multiple input mechanisms: web, cell phone

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CCEM with incomplete data

- Application results depend on data completeness
- But . . .
 - Application can be restricted to geographic levels or facility levels or regions
 - Workarounds available for missing or incomplete data
 - Depending on analysis needs, some data may be omitted

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COLD CHAIN CAPACITY ANALYSIS

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Basic capacity calculations

- For each vaccine:
 - Compute number of doses needed
 - Covered Populations X Doses reqd X coverage
 - Account for wastage
 - Divide by (1 – wastage pct)
 - Determine weeks of supply
 - Supply interval + Reserve stock period
 - Compute doses on hand
 - Multiply by weeks of supply divided by 52
 - Convert to volume
 - Multiply by CCM per dose

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Other approaches to capacity analysis

- Compute capacity requirements based on population
 - Guidelines for number of refrigeration devices for different facilities types
- Historical data
- Sampling based assessments

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Other cold chain tools

- Cold Chain Logistics Planning Tool
 - Excel based tool for computing capacity. Same capacity calculation is used
- EVM: Effective Vaccine Management Initiative
 - Country assessment tool including sampling to evaluate cold chain capacity
- VSSM: Vaccine Supplies Stock Management
 - Stock management tool, not for capacity analysis

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ADDITIONAL USE CASES AND FEATURES FOR CCEM

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Reporting

The screenshot displays several reporting components:

- Summary Data Reports:** A list of reports including 'Coverage by Facility Type', 'Coverage by Vaccine', 'Coverage by Region', etc.
- Facility Capacity by Vaccine:** A pie chart showing the distribution of capacity across different vaccines.
- Capacity Utilization by Facility Type:** A horizontal bar chart showing capacity utilization for different facility types.
- Regional Capacity Requirements:** A bar chart showing capacity requirements across different regions.
- Total population by facility type (Central level):** A table with columns for 'Facility Type', 'Pop', 'Reserve', 'Reserve', and 'Total'.

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CCEM 2.1.5.2

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Forecasting

The screenshot displays several forecasting components:

- Forecasting Summary:** A table showing 'Forecasted Capacity' and 'Storage Requirements' for various facility types and vaccines.
- Facility Data Table:** A table with columns for 'Facility Code', 'Facility Name', 'Status', 'Inventory', 'Parity', 'Connectivity', 'Cold Room Capacity (Liters)', 'Self-generated Capacity', 'Storage Requirements', and 'Capacity Util'.
- Forecasting Parameters:** A section for defining forecasting parameters like 'Forecasting Method' and 'Forecasting Period'.
- Forecasting Results:** A section showing the results of the forecasting process, including 'Forecasted Capacity' and 'Storage Requirements'.

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Multiyear Scenarios

Summary of forecast parameter set: 5 year allocation removal

Years in the forecast: 2010 to 2014

Year	Removal criteria in effect	Allocation preferences in effect	Vaccine schedule
2010	<none>	Alloc I.R North	<Current Country Schedule>
2011	TCW Health Center over 10 years	Alloc I.R South	<Current Country Schedule>
2012	Remove over 10	Alloc I.R	Country with Pneumo
2013	<none>	Alloc I.R	Country with Pneumo
2014	<none>	Alloc I.R	Country with Pneumo and R

All Facilities with Shortfall, Threshold (%) 10
 Annual population growth rate (%) 2
 % freight, insurance, clearing cost 37

Energy cost for running cost reports:
 Price of electricity (Kwhrs) 0.08
 Price of gas (Kg) 2.16
 Price of kerosene (L) 0.85

Include SMA's in capacity requirement calculation? **No**

Storage requirements will be calculated using frequency of resupply (weeks) and reserve stocks (weeks) as specified by Health facility type in CCEM setup.

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Equipment Lists and Transactions

Summary of equipment transactions: List of equipment transactions

Year	Facility	Equipment	Quantity	Unit Cost	Total Cost
2010
2011
2012
2013
2014

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Multiyear costs

Forecast Equipment for Multiyear Plans

Year	Cost B/S	City	Cost B/S	City	Cost B/S	City	Cost B/S	City	Cost B/S	City
2010
2011
2012
2013
2014

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Comparing Forecasts

Actual Investment in Stock Requirements

Forecasted Investment in Stock Requirements

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Spanish available (French in progress)

Configuraciones de CCEM >> Ver / Editar Catálogos >> Cajas Frías y Porta Vacunas

ID del catálogo: **Portador Dia**

Tipo: **Portador Dia**

Fabricante: **Coldpack**

Modelo: **Antifreeze Backpack Vaccine Carrier**

Capacidad neta de almacenamiento de vacunas (litro): **3.0**

Dimensiones externas (cm): **38x27x26**

Dimensiones internas (cm): **34x19x20**

Dimensiones del almacenamiento de vacunas (cm): **31.0**

Vida fría sin aperturas (horas a +4°C): **40.64**

Coste (\$EE.UU.): **6**

Volumen de cada bolsa de hielo utilizada (litro): **6**

Número de bolsas de hielo utilizadas: **6**

Volumen total de las bolsas de hielo (litro): **5.6**

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DEVELOPMENT AND DEPLOYMENT OF CCEM

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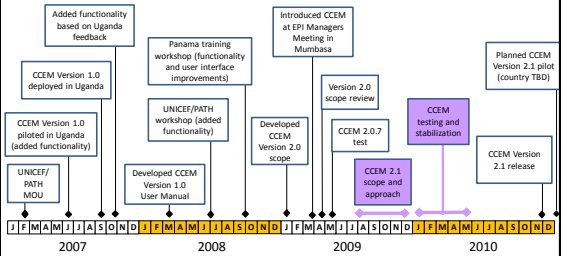
CCEM History

- **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.

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CCEM roadmap

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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

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TechNet 2010 Consultation, Kuala Lumpur, Malaysia

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WISH LIST FOR COLD CHAIN PLANNING TOOLS

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Web based inventory tool

- Replace MS Access with a relational database
 - Robust facilities for access and back up
- Provide access to inventory, reporting, and forecasting through a web application
- Allow standard solutions for updates
- Facilitate sharing of data across multiple levels of health system
- Access control to limit external viewing of information

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Update Mechanisms

- Multiple levels of update
 - Web interface for updates, so internet connected devices can be used
 - Mobile device updates to support reporting from facilities
- Other mobile tools for cold chain supervision

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Customization

- Extensibility for data elements collected and maintained by countries
 - Strong interest in adapting information at the country level
- Allow additional analytics to be implemented with a scripting engine
- Tie into a geographic information system

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Migration of CCEM 2 to new architecture

- Prior to development, stakeholder buy in and develop strategy for compatibility with other tools
- For CCEM, ensure that existing data formats can be transferred with import / export tools
- Development strategy
 - Create web based database, which can export to CCEM
 - Migrate analysis and reporting tools to work directly with the database

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COLD CHAIN MONITORING

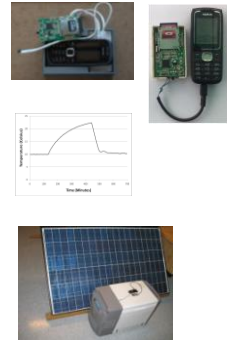
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FoneAstra

- Attachment to low cost cell phone to allow temperature monitoring
- University of Washington developed device
- Regularly report temperatures by SMS to server



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Temperature Monitoring

- Receive temperatures reports by SMS
- Allow monitoring of large number of machines
- Receive Alerts
- Identify problem equipment that is not triggering alerts
- Field test in Albania with Optimize



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