

Software and Global Health: Assessing Vaccine Cold Chains from National Equipment Inventories

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What this talk is about

- The development and deployment of software for evaluating the vaccine cold chains in developing countries
 - Software has been used in four African countries to analyze recently completed cold chain inventories
- Bigger issues
 - Use of information in supporting health systems
 - Introduction and sustainability of technology

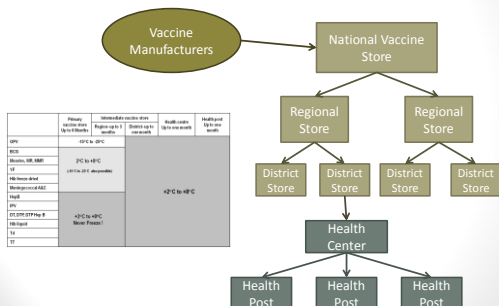
Three themes

1. Implications of inventory based cold chain planning to global health
2. Stakeholders for global health software
3. Software technologies for national health systems

Cold Chain Equipment Manager (CCEM) software

- CCEM Project at PATH
 - Develop software to support inventory based cold chain analysis and planning
 - Project initiated in 2006 with UNICEF and WHO
 - Application builds on public health expertise and global cold chain standards
- CCEM Software
 - Current version is a Microsoft Access application
 - Modest sized database with custom analysis and reporting
- Inventory based cold chain planning
 - Understand capacity of the cold chain with respect to vaccine requirements
 - Optimize allocation of equipment to minimize costs

Cold Chain Structure



Cold Chain



Cold Chain



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7

Cold chain inventory

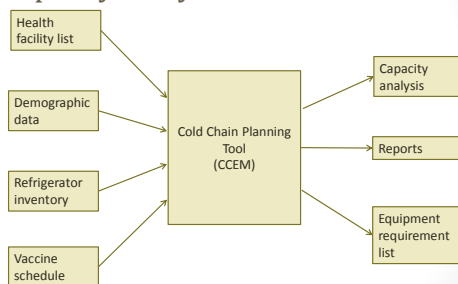
- What is the status of a country's cold chain?
- How many refrigerators?
- What types are they?
- How old?
- Are they working?
- Are they big enough for the required vaccines?
- Where are they?

Country A: 5306 facilities, 4946 refrigerators
 Country B: 827 facilities, 1426 refrigerators
 Country C: 2846 facilities, 3153 refrigerators
 Country D: 1605 facilities, 3080 refrigerators

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8

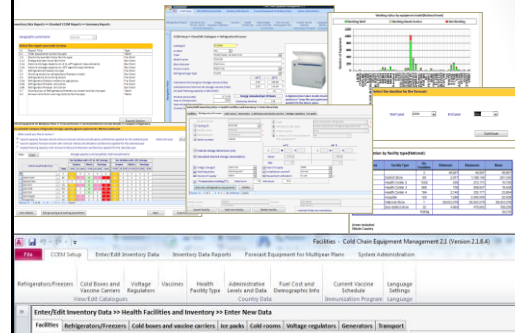
Inventory Based Cold Chain Capacity Analysis



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9

Cold Chain Equipment Manager (CCEM) Software



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10

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 CCEM Inventories and analysis in four African countries

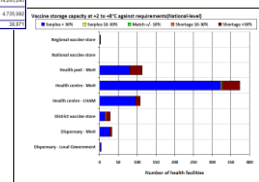


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11

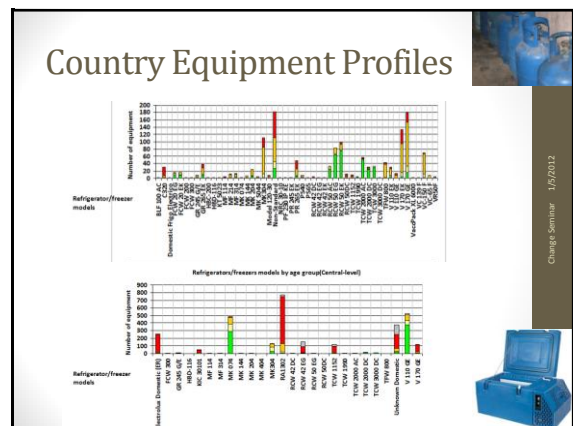
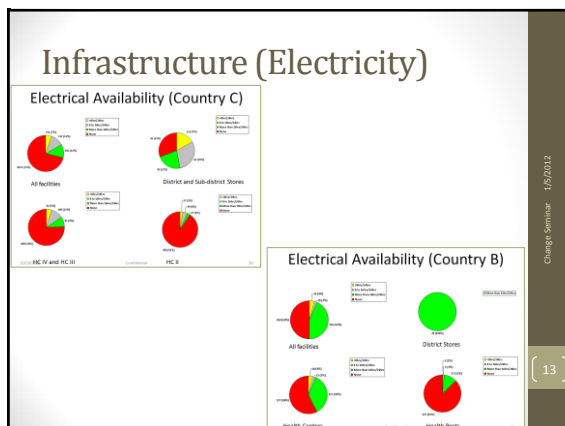
CCEM Reports: Facilities

Admin Area	Facility Type	All Facilities	Refrigerators	Vaccines	Stock
Indonesia	Health Center	4	42,804	199,094	88,079
Indonesia	Community Health Center	177	269	26,906	232,244
Indonesia	Community Health Center - Village	4	200	743,344	189,049
Indonesia	Community Health Center - Village	10	884	12,805	142,151
Indonesia	Community Health Center - Village	40	40,526	145,467	48,074
Indonesia	Community Health Center - Village	20	88,325	2,125,527	477,071
Indonesia	Community Health Center - Village	128	89	12,805	142,151
Indonesia	Community Health Center - Village	1074	1,133	249,426	24,441
Indonesia	Community Health Center - Village	424	39	12,805	142,151
Indonesia	Community Health Center - Village	133	42	145,467	3,174
Indonesia	Community Health Center - Village	40	8,121	24,914	12,174
Indonesia	Community Health Center - Village	133	221	11,101	12,174
Indonesia	Community Health Center - Village	133	8,121	24,914	12,174
Indonesia	Community Health Center - Village	1	14,095,044	14,095,044	
Indonesia	Community Health Center - Village	3	1,871,011	6,719,849	4,719,849
Indonesia	Community Health Center - Village	10	712,000	124,000	70,000



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12



Country reports

- CCEM analysis used to support country cold chain reports
- Reports prepared by country EPI teams
- Circulated to WHO, GAVI and donors

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Results from the four countries (Summary)

	Country A	Country B	Country C	Country D
Overall cold chain readiness	Yellow circle	Yellow circle	Yellow circle	Green circle
Capacity by level:				
• Stores (national/regional)	Yellow circle	Red circle	Red circle	Yellow circle
• District stores	Red circle	Yellow circle	Yellow circle	Green circle
• Health centers (public/private)	Green circle	Green circle	Green circle	Green circle
• Peripheral facilities	Yellow circle	Green circle	Red circle	Green circle
Equipment Quality/Age	Yellow circle	Green circle	Yellow circle	Red circle
Shortages with PCV 13		Yellow circle	Yellow circle	Green circle
Shortages with Rotavirus	Yellow circle	Red circle	Red circle	Yellow circle
Risk area identified	Capacity at district and national store for Rota launch	Cold room capacity at regional stores	Cold room capacity at national stores for Rota launch	Large percentage of equipment >10 years old

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16

Estimated costs to address cold chain equipment deficiencies in four countries¹ (USD in 000's)

Country	Base Schedule with Pneumo			Base Schedule with Pneumo and Rota				
	ILR units	Gas/Ker units	Cold rooms	Cost USD in 000's	ILR units	Gas/Ker units	Cold rooms	Cost USD in 000's
Country A ²	219	258	0	745	558	405	7	1,825
Country B ³	47	56	4	242	100	67	8	675
Country C ⁴	94	413	13	1,604	210	846	25	3,481
Country D ⁵	55	35	0	97	65	38	11	540

Notes

- Equipment assignment to meet all shortages at government health facilities and storage sites. A medium sized presentation of Rotavirus vaccine was assumed. Equipment assignments following country preferences. Inventory data from some countries was preliminary. There is a high variability in costs for cold rooms due to construction and setting up the site.
- Country A's analysis assumes three month supply intervals to district vaccine stores.
- Country B has some cold rooms on order or waiting installation. A quantity of new refrigeration equipment is available for allocation and not reflected in this analysis.
- Country C has 11 regional vaccine stores in the planning phase. The inventory did not account for new equipment on hand awaiting allocation.
- Country D's analysis does not consider replacement of out of date equipment.

The cost per annual birth of required equipment for introduction of Pneumo and Rota (Total cost / annual births) is \$1.32 for Country A, \$0.87 for Country B, \$2.11 for Country C, and \$1.40 for Country D.

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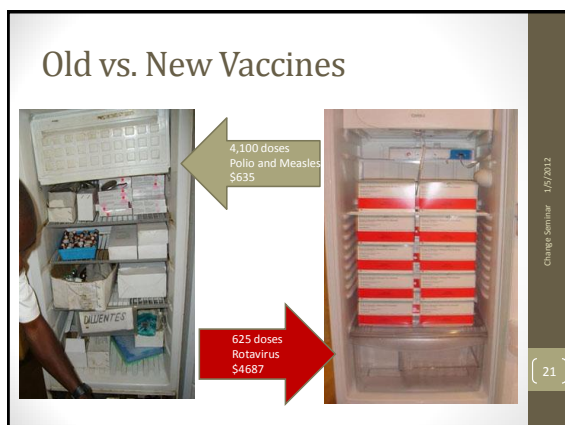
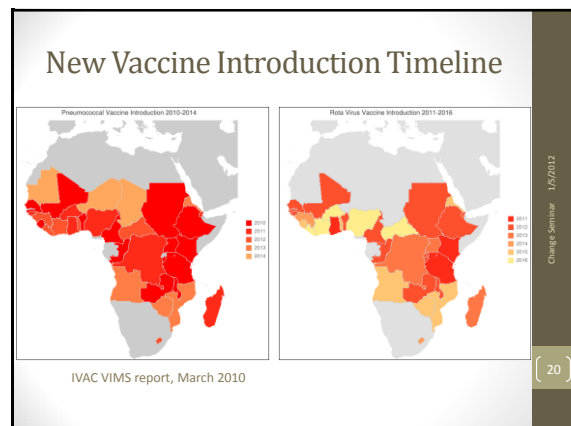
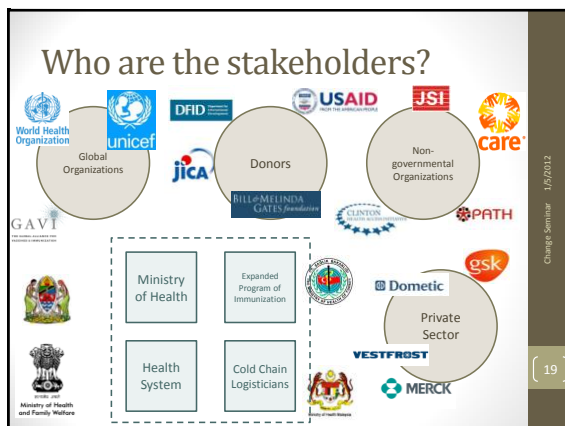
17

Vaccines and Immunization

- One of the world's most effective health interventions
 - Wide coverage of basic vaccines
 - Diphtheria, Pertussis, Tetanus: 77% in poorest countries
 - Tremendous reduction in deaths
 - Some diseases close to elimination
- Large scale global programs
 - Decade of Vaccines
- Introduction of new vaccines
 - Pneumococcal and Rotavirus vaccines

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18



Is Chad ready to introduce the Rotavirus vaccine?

- Is the cold chain of adequate capacity and quality to safely store vaccines from entry in to the country to use at peripheral health facilities?
- What areas of the cold chain should be targeted for improvement?
- How much will it cost?

GAVI Alliance

- Global Alliance for Vaccines and Immunisation
- Founded in 2000 to develop long term funding mechanism for vaccines in developing countries
 - Building country commitment
 - Financing
 - Market based solutions
 - Reduced cost vaccines for developing countries
- Funding mechanism
 - Eligible countries request funding for vaccines
 - USD 7 Billion funding, 2000-2015
 - 70 countries have been funded

WHO and UNICEF

- Global organizations with international, global, and country presence
- Set global standards and policies
- Substantial influence on country policies
- UNICEF Scale-up in Immunization
 - Vaccine Logistics
 - Temperature Monitoring
 - Country Cold Chain Inventories
- Global network of consultants

Country EPI

- Expanded Program of Immunisation
 - Department in ministry of health
 - Responsible for all of immunization and vaccination
 - Focus on immunization coverage
 - Often dealing with emergencies
- Cold chain logistics
 - Department inside of EPI managing the cold chain and vaccine shipments
 - Responsible for vaccines from national store to facilities
 - Manage equipment in government facilities



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Value proposition for inventory based cold chain planning

- Global level
 - "I want to know if a country's cold chain is ready for introduction of a new vaccine"
- Donors
 - "What resources are needed to strengthen the country's cold chain"
- EPI
 - "I need to manage the country's vaccination programs and respond to external requirements"
- Logistician
 - "I need to manage the cold chain equipment in the system"

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26

Results from CCEM data sets

- Successful in completing inventories and generating information for national cold chain plan
- Simple analysis methodology identifies bottlenecks in the cold chain
 - Quantifies costs for upgrades
 - Analysis of energy costs
- Substantial differences between countries
- Country readiness analysis
 - Assess cold chain capacity with respect to vaccine introduction
 - High level analysis focusing on structure of cold chain
- Exploration of scenarios
 - What are the energy cost savings in replace gas equipment by electric equipment in facilities with access to electricity?
 - What is the impact on cold chain capacity requirements of reducing country vaccine delivery periods from three months to one month?

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27

Sustainability and Adoption

- What are the prospects for sustained and expanded use of CCEM at the country level?
- What did we learn from the four countries?



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Facility and Equipment Inventory

- Dominant cost for use of CCEM is inventory cost
- Estimated inventory costs \$50K - \$200K
- Controversy around CCEM relates to cost and feasibility of an inventory
- Conducting a cold chain inventory:
 - Start with a list of all health facilities in the country
 - Determine information to be collected
 - Train enumeration teams
 - Rent lots of land rovers
 - Visit all facilities and conduct inventory
 - Enter data into database
 - Review and clean the data



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Adoption of CCEM by countries

- Country A
 - Inventory and country plan in process, decided to use CCEM to support inventory and planning.
- Country B
 - NGO supporting EPI strengthening brought in PATH to support inventory and planning work.
- Country C
 - Already using older version of CCEM for cold chain inventory. Refreshed inventory to work with new version of software.
- Country D
 - WHO supported inventory and country plan, with CCEM brought in to structure inventory.

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30

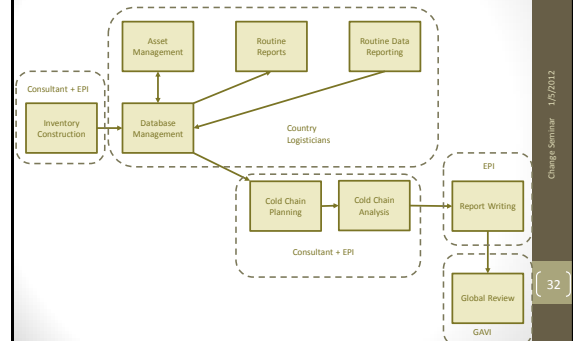
Summary of country introduction

- CCEM adopted as an inventory solution
 - Structure for inventory
 - Database with data entry
 - Reporting
- Developers viewed CCEM as a planning tool (that required having a database)
- Tension during introduction workshops between the planning and inventory components
- Results from working with inventories have validated the planning component
- Usability of the application was a barrier to adoption
- New model for application:
 - Country use for inventory and asset management
 - Consultant support for planning

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31

Model for sustainable use



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32

Base technologies

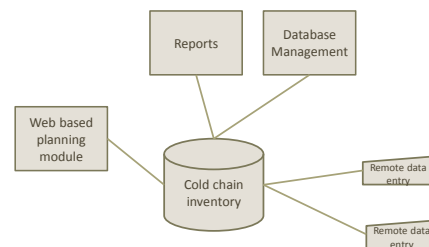
- CCEM implemented as MS Access 2007 application
 - Development History
 - CCEM 1.0 – PATH with contract developer
 - CCEM 2.0 – External software developer
 - CCEM 2.1 – PATH with project management and contract developer
 - CCEM 3.0 – ????
- Competition with MS Excel Tools
- MOH Environment strictly Windows / Office environment
 - Mix of Windows XP / Windows 7
- Internet access at MOH
- Reasonable to plan for Internet access to District level (likely with cellular modem)



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Future Application Architecture



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34

DHIS 2



- Health Information Systems Programme (HISP)
 - Founded by University of Oslo in 1994
 - HISP India established in 2000
 - Software for collection of health indicators
 - Focus on use of data
- District Health Information System (DHIS)
 - Initial version of software in MS Excel
 - Current software (DHIS2), web based system with Java back end
 - Deployment in roughly 20 countries in Africa
 - Deployment in roughly 20 states in India
- Basic software provides data entry and aggregation
 - Potential platform for new cold chain inventory tool
 - Extensions needed to handle fixed assets

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35

Sustainability of Asset Inventories

- Develop technology and methodology for creation and update of asset inventories
- Technology
 - Tools for collection and update of inventory information
- Work process
 - System where there are benefits to keeping the information up to date
 - Value from the inventory
 - Business process for management
 - Value from reporting data

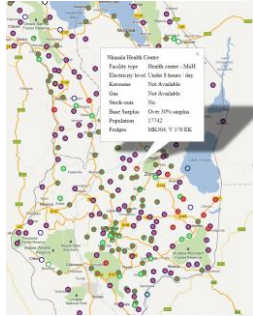
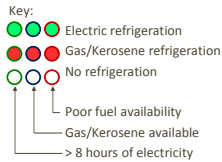
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36

Information Visualization

Inventory data plotted
with facility GPS data

Health center data



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(Simple) Health System Modeling

- CCEM relies on very simple models
 - Storage requirement = doses X volume per dose
- The challenge for application like CCEM is to make the modeling easy to use.
- Simulation based games solve the same interface problems that come up in CCEM.
 - Assignment of assets to locations on a map
 - Setting conditions over regions
 - Ease of use / learnability essential

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38

Questions or Comments?

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Software Downloads: www.path.org

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



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