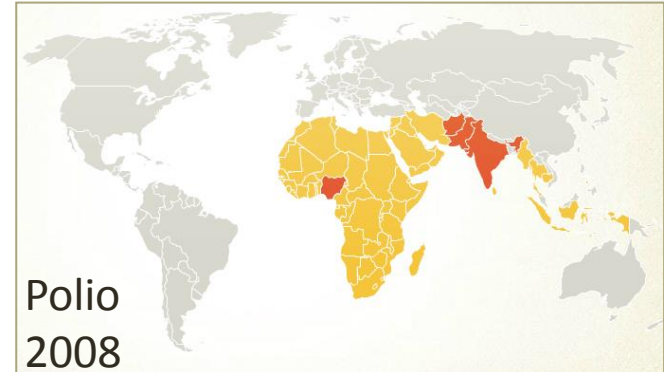
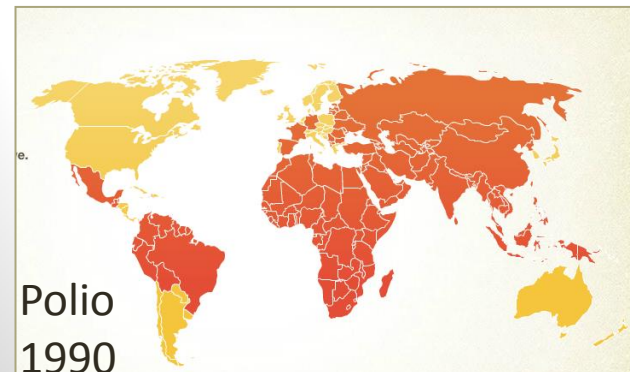


Software and Global Health: Information systems for the vaccine cold chain

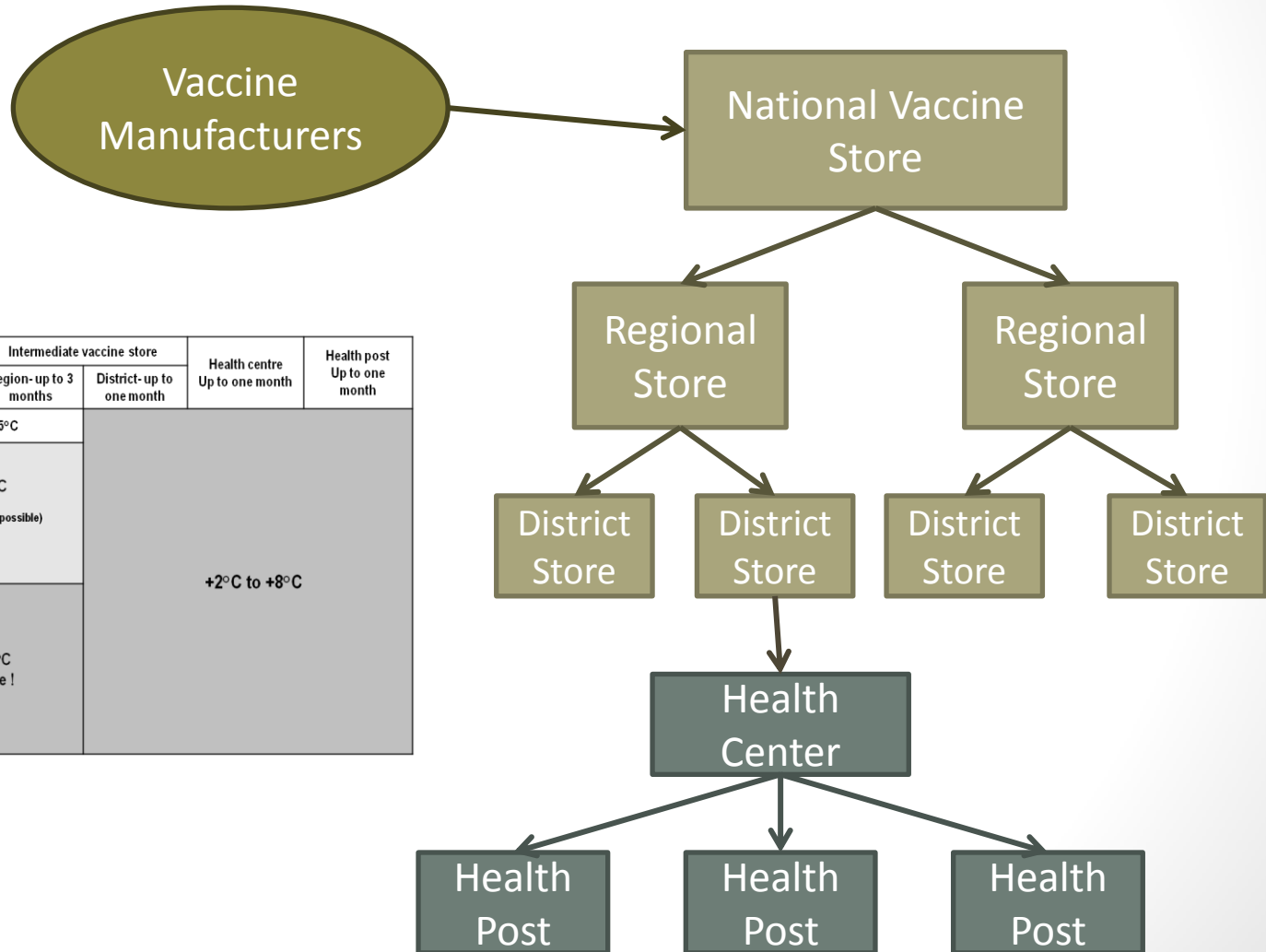
Richard Anderson

Department of Computer Science and Engineering

University of Washington



Vaccine Cold Chain Structure



	Primary vaccine store Up to 6 Months	Intermediate vaccine store		Health centre Up to one month	Health post Up to one month
		Region- up to 3 months	District- up to one month		
OPV	-15°C to -25°C		+2°C to +8°C		
BCG	2°C to +8°C (-15°C to -25°C also possible)				
Measles, MR, MMR					
YF					
Hib freeze-dried					
Meningococcal A&C					
HepB	+2°C to +8°C Never Freeze !				
IPV					
DT, DTP, DTP Hep B					
Hib liquid					
Td					
TT					

Cold Chain



Cold Chain



Cold chain equipment software



Old vs. New Vaccines



4,100 doses
Polio and Measles
\$635

625 doses
Rotavirus
\$4687



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?

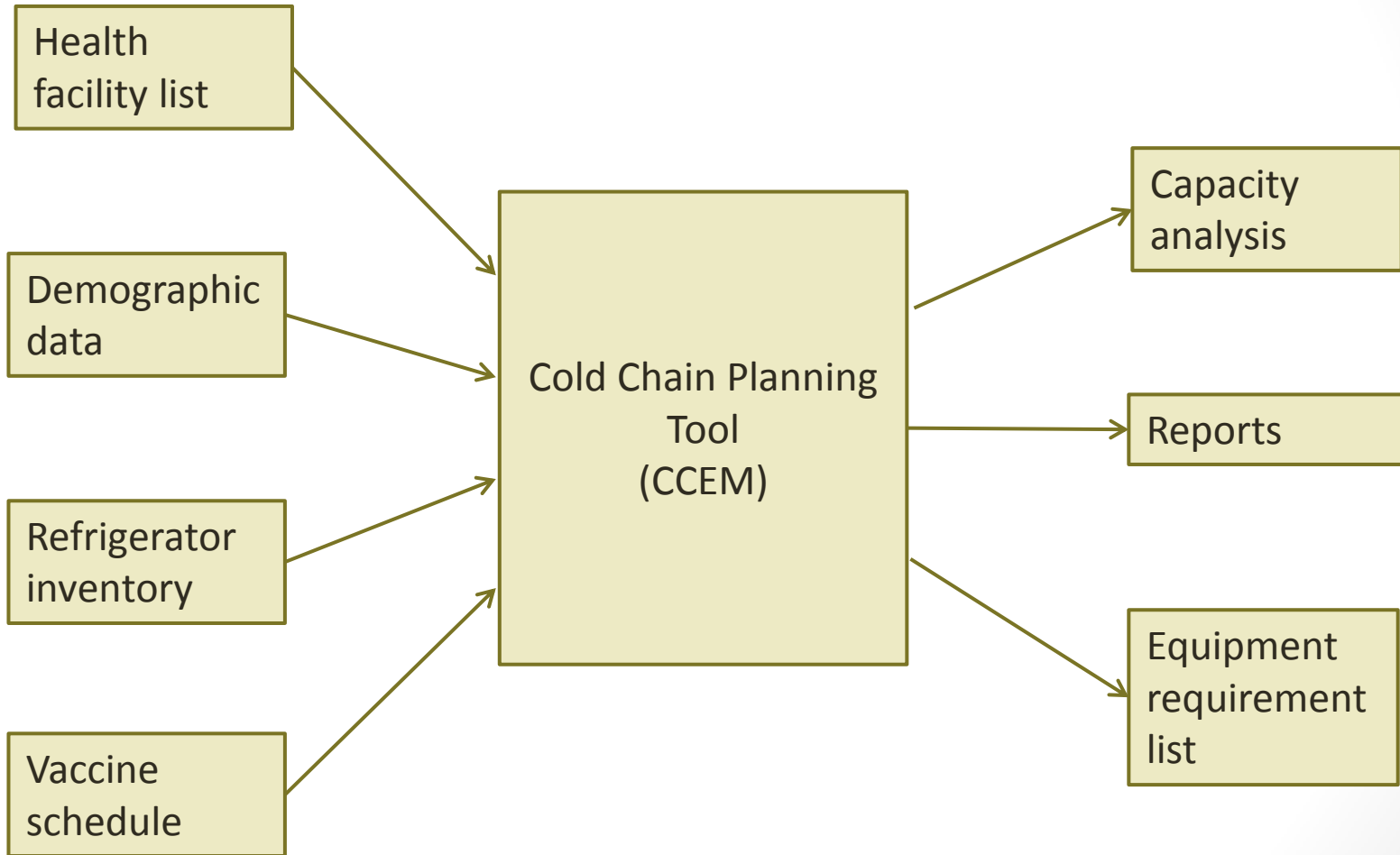
Country A: 5306 facilities, 4946 refrigerators

Country B: 827 facilities, 1426 refrigerators

Country C: 2846 facilities, 3153 refrigerators

Country D: 1605 facilities, 3080 refrigerators

Inventory Based Cold Chain Capacity Analysis



Cold Chain Equipment Manager (CCEM) Software

Change Seminar 1/5/2012

Inventory Data Reports >> Standard CCEM Reports >> Summary Reports

Geographic parameter: Central

Select the report you wish to view

Id	Report Title	Type
1.1	Total population by facility type	Table
1.8	Electricity availability by facility type	Pie Chart
1.12	Energy availability at facilities	Bar Chart
2.1a	Vaccine storage capacity at +2 to +8°C against requirements	Bar Chart
2.2a	Vaccine storage capacity at -20°C against requirements	Bar Chart
3.1	Refrigerators/freezers by type	Pie Chart
3.3	Working status by refrigerators/freezers model	Bar Chart
3.4	Refrigerators by working status	Pie Chart
3.5a	Refrigerator/freezer models by age group	Pie Chart
3.6a	Refrigerator/freezer utilization	Pie Chart
3.6b	Refrigerator/freezer utilization	Bar Chart
3.7	Distribution of Refrigerators/freezers by model and facility type	Bar Chart
4.2	Annual cold chain running costs by facility type	Table

Export Option

Forecast Equipment for Multiyear Plans >> Forecast Results >> Generate/Review Forecast Results >> Compare refrigeration

You selected: Compare refrigeration storage capacity against requirements: MyForecastParam2

What would you like to review?

Vaccine capacity forecast results without removal criteria and allocation preferences applied for the selected year

Vaccine capacity forecast results with removal criteria and allocation preferences applied for the selected year

Icepack freezing capacity with removal criteria and allocation preferences applied for the selected year

Select the year: 2011

Table Chart

Storage capacity summary(2011): MyForecastParam2

Admin Area/Facility Type	Total	No. facilities with +2C to +8C storage			No. facilities with -20C storage		
		Surplus	Match	Shortage	Surplus	Match	Shortage
District Store	80	74	3	3	0	0	0
National Store	1	0	1	0	0	0	0
NGO HCIII	241	127	1	111	241	0	0
NGO HCIII	201	132	0	42	201	0	0
NGO HCIV	16	16	0	0	16	0	0
NGO Hospital	43	43	0	0	43	0	0
Private HCII	54	37	0	16	54	0	0

CCEM Setup >> View/Edit Catalogues >> Refrigerators/Freezers

Catalog ID: E3100M

In PQS? Yes

Type: Chest freezer, AC electricity

Model name: FCW200

Manufacturer: Electrolux

Power source: Electricity

Refrigerant gas type: R134A

Calculated internal gross storage volume (liter): 180.00

Calculated and internal net storage volume (liter): 144.00

Ice pack freezing capacity in 24hr (liter): 13

Product price (US\$): 1172.00

Year of introduction: 2005

Year retired from market: 0.00

Climate Z0

Enter/Edit Inventory Data >> Health Facilities and Inventory >> Enter New Data

Facilities Refrigerators/Freezers Cold rooms Generators Cold boxes and vaccine carriers Voltage regulators Ice packs

Equipment ID: E3101M

Model name: PH150

Manufacturer: Solematica

Serial number: 23452

Type: Solar photovoltaic refrigerator

Refrigerant gas type: R134a compression refrigerant gas (Non-CFC)

Power source: Solar

Is there a CFC-free sticker on the equipment? Yes

Internal storage dimensions (cm): L 105.00 W 38.00 H 38.00

Calculated internal storage volume (litre): Gross 105.00 Net 38.00

Fridge storage? Vaccines Working well Installation correct? Equipment utilization

Temperature reading (°C): Maximum 1.0 Minimum 3.0

Year of supply: 1996

Installation correct? Correct

Equipment utilization: In use

Add new refrigeration equipment Delete

Record: 1 of 1 Unfiltered Search

Facility name: E3100M District

Search facility Add new facility Delete facility

marked fields are mandatory

Working status by equipment model(National-level)

Working Well Working Needs Service Not Working

Select the duration for the forecast:

Start year: 2009 End year: 2011

Continue

Distribution by facility type(National)

Area	Facility Type	No. Facilities	Minimum	Maximum	Mean
	District Store	3	49,807	49,807	49,807
	District Store 2	80	2,977	1,189,142	291,336
	Health Center 2	1202	200	212,173	10,726
	Health Center 3	989	708	809,837	18,428
	Health Center 4	184	2,145	303,171	33,854
	Hospital	126	1,288	2,000,000	52,429
	National Store	1	28,653,578	28,653,578	28,653,578
	Sub-district store	32	4,665	479,663	108,236
	TOTAL				38,019

Areas included: Whole Country

Facilities - Cold Chain Equipment Management 2.1 (Version 2.1.6.4)

File CCEM Setup Enter/Edit Inventory Data Inventory Data Reports Forecast Equipment for Multiyear Plans System Administration

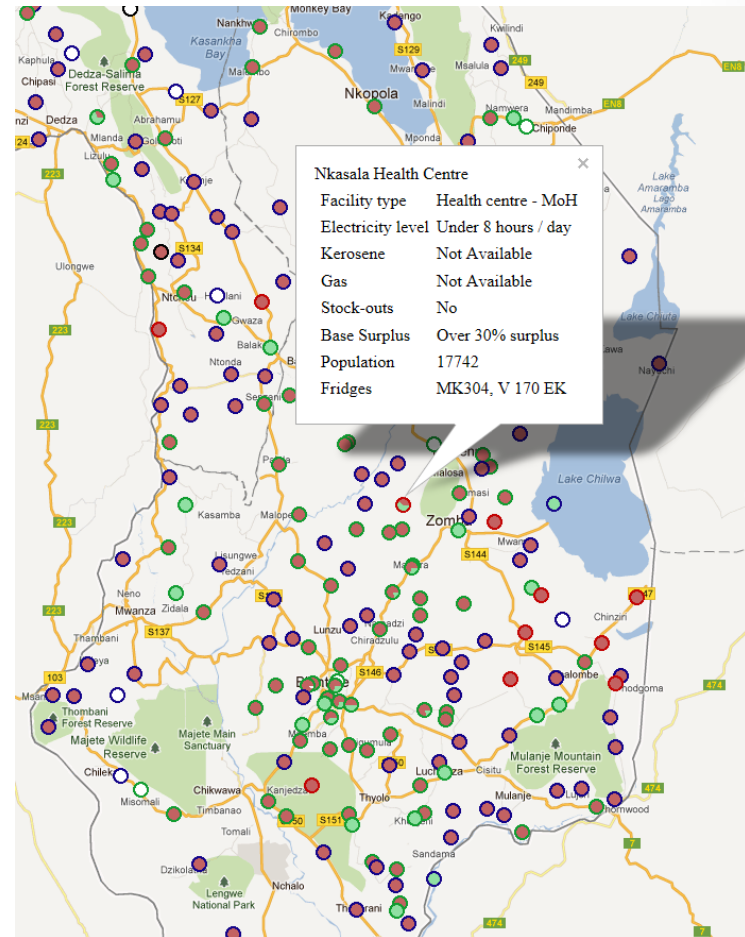
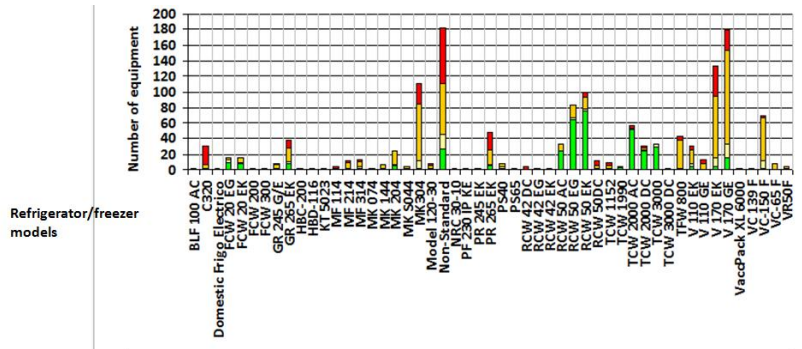
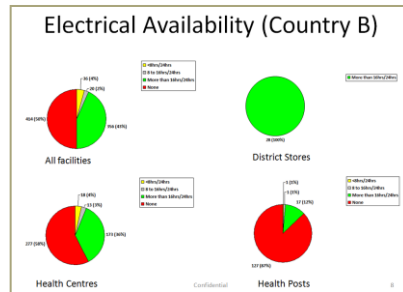
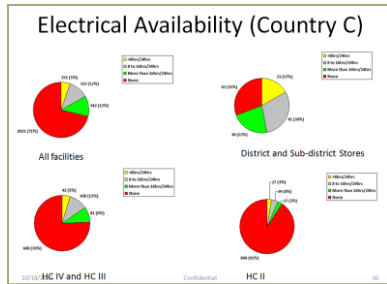
Refrigerators/Freezers Cold Boxes and Vaccine Carriers Voltage Regulators Vaccines Health Facility Type Administrative Levels and Data Fuel Cost and Demographic Info Current Vaccine Schedule Language Settings

View/Edit Catalogues Country Data Immunization Program Language

Enter/Edit Inventory Data >> Health Facilities and Inventory >> Enter New Data

Facilities Refrigerators/Freezers Cold boxes and vaccine carriers Ice packs Cold rooms Voltage regulators Generators Transport

Reports



CCEI Data Standards



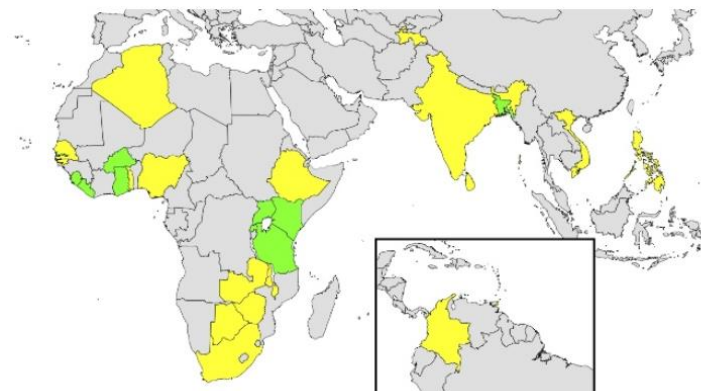
- Goal: Agree on standards to allow tools to interoperate
- Wide range of tools available
- Data integration problem is central
- Need for multiple software tools

1 - HEALTH FACILITY QUESTIONNAIRE		wCCEI Laos
1. Facility code:		
Administrative levels and facility information		
2. Province:	6. Type of health facility: <i>Mark only ONE box</i>	
3. District:	<input type="checkbox"/> National vaccine store <input type="checkbox"/> Province vaccine store <input type="checkbox"/> District vaccine store <input type="checkbox"/> Provincial hospital <input type="checkbox"/> Referral hospital <input type="checkbox"/> Health centre A <input type="checkbox"/> Health centre B	
4. Name of health facility:		
5. English name of health facility:		
Health facility immunisation activities		
7. Total population in area served by facility:		8. Facility coverage (per cent of population receiving immunization services from facility):
9. Number of villages reached by facility (Only for Health centre):		
10. Vaccine storage type: <i>Mark only ONE box</i>		11. Vaccine delivery type: <i>Mark only ONE box</i>
<input type="checkbox"/> Depot <input type="checkbox"/> Delivery <input type="checkbox"/> Depot and delivery <input type="checkbox"/> No storage		<input type="checkbox"/> Static <input type="checkbox"/> Outreach <input type="checkbox"/> Static and outreach <input type="checkbox"/> No delivery
Health facility energy sources available to power cold chain equipment		
11. Electricity source: <i>Mark only ONE box</i>		12. Grid electricity availability per day: <i>Mark only ONE box</i>
<input type="checkbox"/> Grid <input type="checkbox"/> Grid and Generator <input type="checkbox"/> Generator <input type="checkbox"/> None		<input type="checkbox"/> More than 16 hours <input type="checkbox"/> 4 to 8 hours <input type="checkbox"/> None <input type="checkbox"/> 8 to 16 hours <input type="checkbox"/> Less than 4 hours
13. Gas: <i>Mark only ONE box</i>		14. Kerosene: <i>Mark only ONE box</i>
<input type="checkbox"/> Available <input type="checkbox"/> Irregular <input type="checkbox"/> Not available <input type="checkbox"/> Unknown		<input type="checkbox"/> Available <input type="checkbox"/> Irregular <input type="checkbox"/> Not available <input type="checkbox"/> Unknown
Cold chain logistics information		
15. Vaccine supply interval (weeks):		16. Vaccine reserve stock requirement (weeks):
17. Mode of vaccine supply: <i>Mark only ONE box</i>		18. One way road distance to closest supply point (in KM):
<input type="checkbox"/> Delivered <input type="checkbox"/> Collected <input type="checkbox"/> Both delivered and collected <input type="checkbox"/> None		
19. Main supply point:		20. Secondary supply point:

HISP / DHIS2



- HISP: International effort with hubs in Norway, India, Vietnam, South Africa
- DHIS2: Health indicator reporting software
 - Web based, to data base back end
- Wide scale deployment
 - Roughly thirty countries, including nationwide use in some countries
 - State reporting in roughly half the states of India
- <http://www.hispindia.org/>
- <http://dhis2.org/>



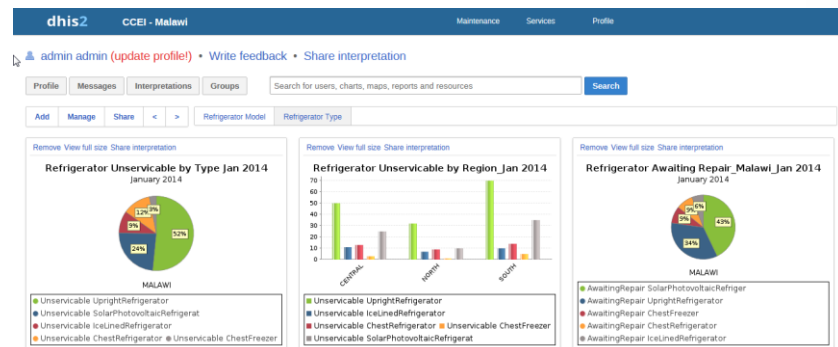
Incorporating CCEM into DHIS2

- Much better architecture
- Add to existing system, as opposed to introducing a new system
- Implementation of inventory component and reports by HISP India
- Working prototypes available

The screenshot shows the 'Equipment Manager' interface in DHIS2. It displays a table of equipment in the Gatundu Division. The table has columns for Administrative region, Health facility name, Climate Zone, Location, and Facility Type. Below the table, there is a section for 'Refrigerators/Freezers' with a search filter and a table listing individual units with columns for Administrative region, Health facility name, Catalog Name, Serial number, Year of Salsury, Working status, and Datamart Details.

Administrative region	Health facility name	Climate Zone	Location	Facility Type
Central Province/Gatundu District/Gatundu Division	Dava Njema Medical Clinic	Temperate	Kigango	Medical Clinic Private Details
Central Province/Gatundu District/Gatundu Division	Nembo Medical Clinic	Temperate	Kamwangi	Medical Clinic Private Details
Central Province/Gatundu District/Gatundu Division	New Test Facility	Hot		Dispensary Spt. Details
Central Province/Gatundu District/Gatundu Division	St. Mary's medical clinic	Temperate	Kigango	Medical Clinic Private Details
Central Province/Gatundu District/Gatundu Division	St. Mary's medical clinic	temperate	kigango	Medical Clinic Private Details

Administrative region	Health facility name	Catalog Name	Serial number	Year of Salsury	Working status	Datamart Details
Central Province/Gatundu District/Gatundu Division	St. Mary's medical clinic	HBC-116-Haier		2013	Working well	Datamart Details
Central Province/Gatundu District/Gatundu Division	St. Mary's medical clinic	HBC-200-Haier			Not working	Datamart Details
Central Province/Gatundu District/Gatundu Division	Dava Njema Medical Clinic	TCW 2000 DC-Domestic	1234	2012	Working well	Datamart Details
Central Province/Gatundu District/Gatundu Division	Dava Njema Medical Clinic	FCW 200-Domestic			Not working	Datamart Details
Central Province/Gatundu District/Gatundu Division	Nembo Medical Clinic	domestic fridge without freezer-domestic manufacturer	123456	1991	Working well	Datamart Details
Central Province/Gatundu District/Gatundu Division	Nembo Medical Clinic	HBC-116-Haier	2341234	2012	Working but needs maintenance	Datamart Details
Central Province/Gatundu District/Gatundu Division	Nembo Medical Clinic	MK 5044-Vestrost		2012	not working	Datamart Details
Central Province/Gatundu District/Gatundu Division	New Test Facility	RCW 42 EK-Domestic	1234	2012	Working well	Datamart Details



Unifying cold chain inventory tools

- Wide range of cold chain inventory tools are used
- Is it possible to bridge between the tools
 - Deal with the reality of Health Information System software
 - Support migration to contemporary software tools
- General approach
 - Cold chain inventory model with conversion/visualization tool
- One button import/export

ODK Tables

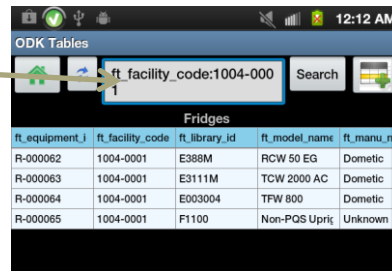
- Cold chain data sets natural match for tables
- Use cases for ODK Tables
 - Inventory construction
 - Facility visits
- Benin data set implemented in Tables



ODK Tables

Facilities

ft_facility_code	ft_facility_type	ft_facility_name	ft_target_births	ft_tot_pop
1004-0000	4	SALIMA HOSP	2527	56153
1004-0001	11	SALIMA DISTR	16737	371938
1004-0002	11	CHITALA HEAL	454	10096
1004-0003	11	KAPHATENGA	973	21624
1004-0004	10	CHINGULUWE	600	13344
1004-0005	12	KATAWA HEAL	363	8068
1004-0006	10	KHOMBEZA HI	2319	51535
1004-0007	10	MAKIYONI HE/	1031	22911
1004-0008	10	THAVITE HEAL	1030	22890
1004-0009	16	SALIMA ADMA	1115	24772
1004-0010	12	BLM CLINIC	85	1880
1004-0011	11	BAPTIST MEDI	643	14280
1004-0012	10	LIEJWU HEAL	652	14494
22				760055



ODK Tables

ft_facility_code:1004-000

Fridges

ft_equipment_id	ft_facility_code	ft_library_id	ft_model_name	ft_manu_name
R-000062	1004-0001	E388M	RCW 50 EG	Domestic
R-000063	1004-0001	E3111M	TCW 2000 AC	Domestic
R-000064	1004-0001	E003004	TFW 800	Domestic
R-000065	1004-0001	F1100	Non-PQS Uprig	Unknown



SAMSUNG

ODK Tables

hospital

city	hospital	beds
Hinche	Hinche First	1
Carrefour	Port General	12
Delmas	Town Hospital	12
Bombardopolis	General Hospital	12
Hinche	Hinche Second	12
Bombardopolis	Saint John	20
Milot	Milot Hospital	23
Carrefour	Delmas Dental	23
Milot	Town Hospital	23
Milot	Saint Marc	32

Temperature monitoring

- Real time reporting of vaccine refrigerator temperatures
- Key for sustainable use of temperature monitoring system is a back end that is linked to a national system



(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

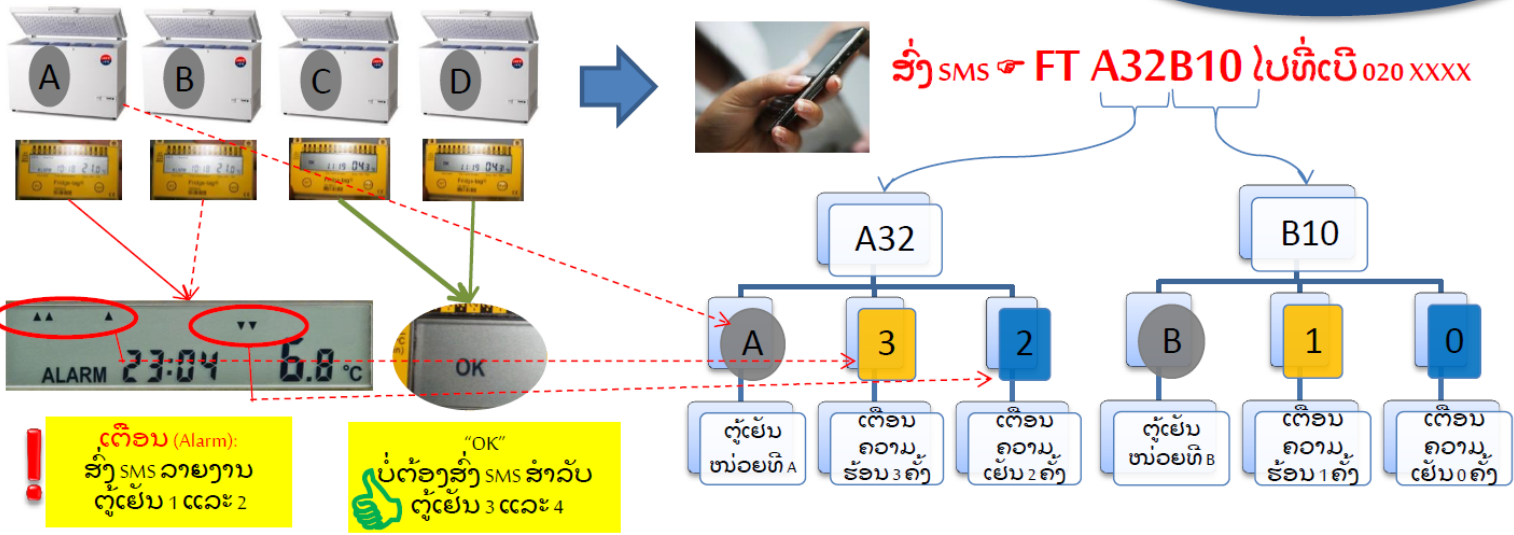
Reminders and Alerts

cWEEI - ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ຄຳແນະນຳການສົ່ງຂໍ້ຄວາມສັ່ນ (SMS) ເພື່ອລາຍງານການເຕືອນອຸນຫະພູມ ຈາກອຸປະກອນຕິດຕາມອຸນຫະພູມ 30 ຈຸດ

ສະເພາະຈຸດທີ່ມີຕູ້ເຢັນຫຼາຍໜ່ວຍ
ໜຶ່ງນັ້ນ
(ຂຶ້ນແຂວງ ແລະ ເມືອງ)

ຈະສົ່ງຂໍ້ຄວາມສັ່ນ (SMS) ແບບໃດເມື່ອອຸປະກອນສະແດງການເຕືອນ "Alarm"

ສົ່ງ SMS ທາງ
ວັນລັ່ນ ທີ່ຈຳນວນຂອງ
ເຕືອນ



ຈະສົ່ງຂໍ້ຄວາມສັ່ນ (SMS) ແບບໃດເມື່ອອຸປະກອນສະແດງ "OK"



Countries

