ICTD Capstone Software Design for Underserved Populations

CSE 482B

COLD CHAIN INFORMATION SYSTEM, APRIL 13, 2021

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Schedule

Today

- Cold chain information system
- Check in with groups – breakout groups – 5 minutes each

Thursday – Group presentations

- 10:00 – Group 1: Vaccine Stock Tracker
- 10:15 – Group 2: Vaccine Passport
- 10:30 – Group 3: Immunization Campaign Planning
- 10:45 – Group 4: Notification / Registration Tool
- 11:00 – Group 5: Vaccine Impact Modelling tool

Admin stuff

Weekly group turn ins through Canvas

- This week: Presentation Slides. Progress report.

I have some Android phones for projects who wish to use the Android platform

First presentation, Thursday, April 15

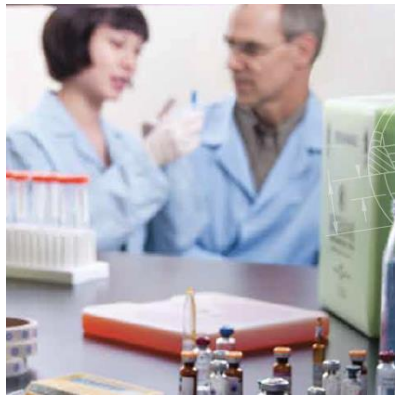
- Project pitch
- Slides
- 15 minutes per group

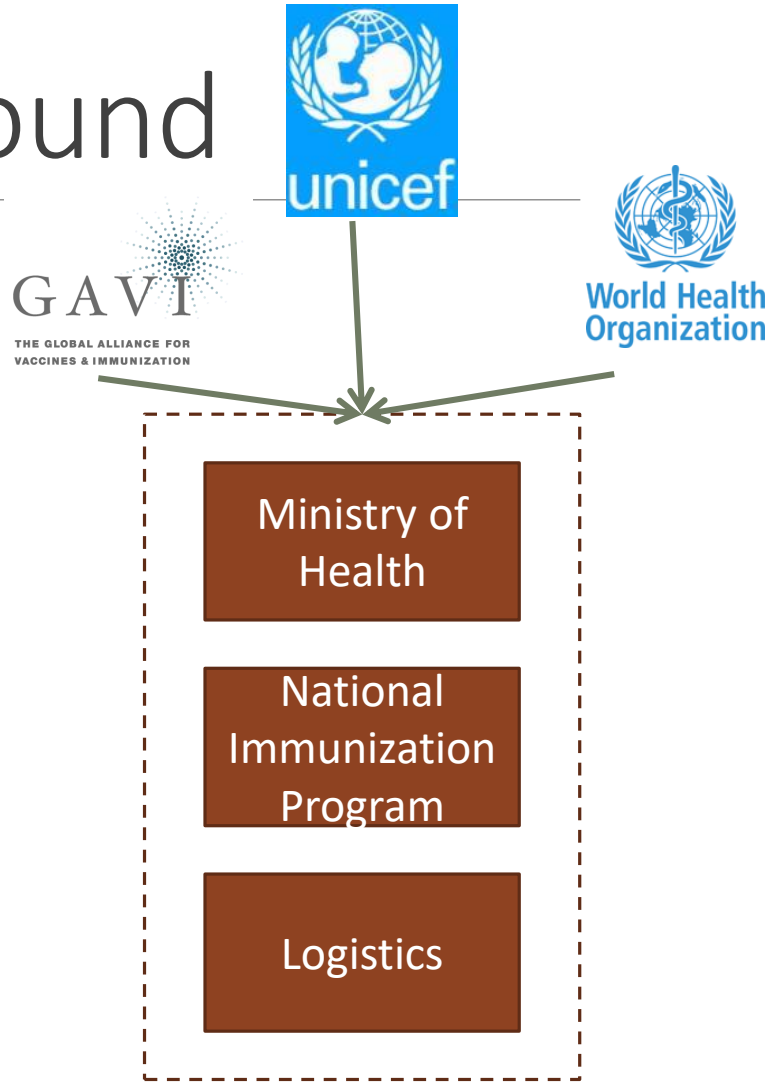
Goal of the course is for students to have a *successful experience, as a team, developing software*

Immunization Domain Background

Vaccines are the same around the world

For many countries – immunization is managed and funded globally





Developing Country Health System Structure

Health System Managed by Ministry of Health

- Exception – some large countries such as India, Pakistan, and Nigeria will delegate some authority to the states

Health System divided into a collection of verticals such as infectious diseases and maternal and child health

- Immunization is generally a separate vertical
  - (NIP) National Immunization Program or (EPI) Expanded Program for Immunization
- Often a separate health information systems organization

Central Professional Staff with regional immunization officers

- Set activities around immunization distribution, budgeting and reporting
- Important interactions with global organizations and NGOs

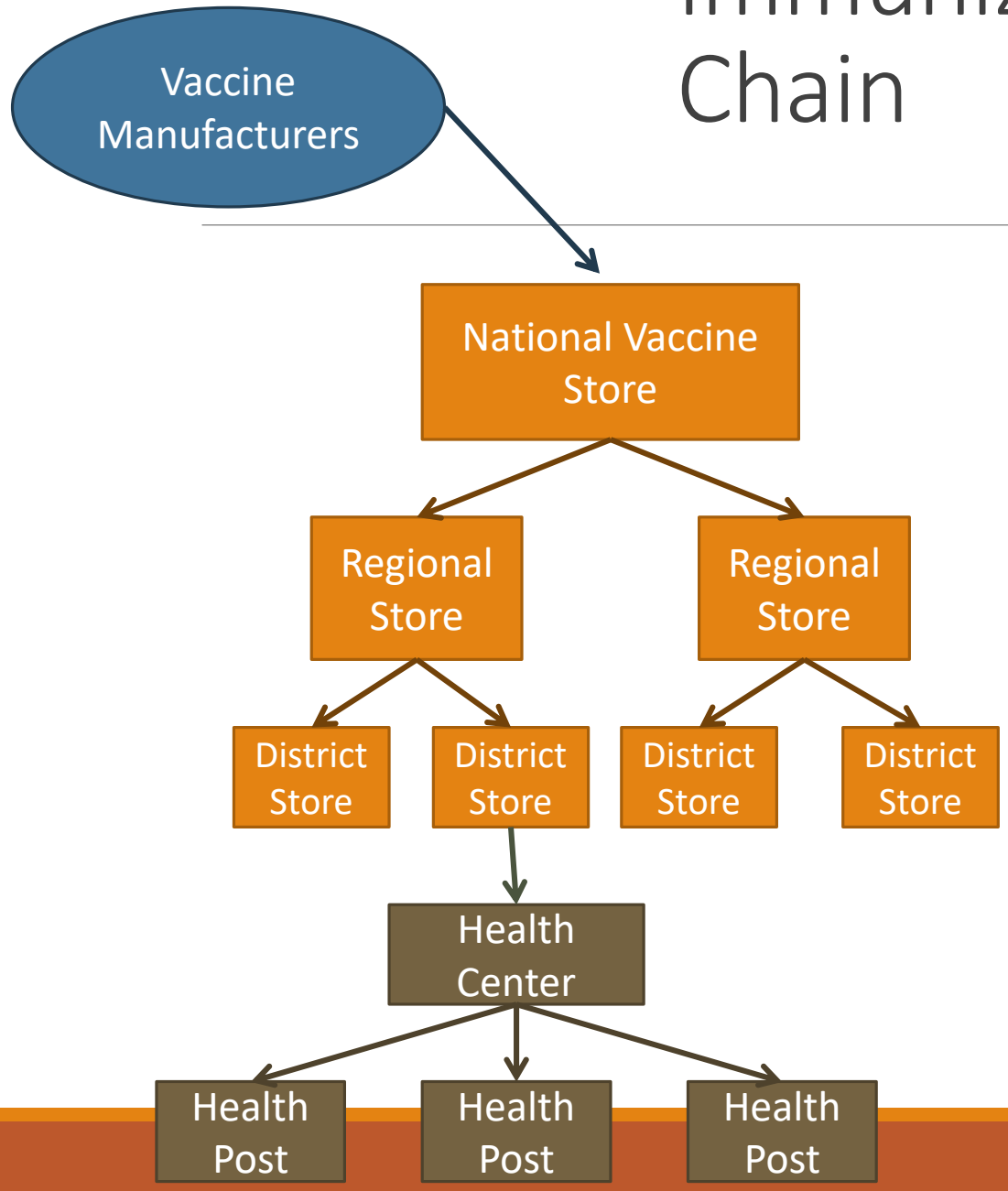
Country immunization programs

Routine immunization programs
- Ensure that all children receive all childhood immunizations
  - Generally results are fairly good – 80-90% vaccination
  - Children come in to clinics, or nurses hold village immunization days
  - Many health facilities are public, but there may also be religious, NGO, or private facilities

Immunization Campaigns
- Period efforts to vaccinate populations with respect to an outbreak
  - Vaccinate everybody in the area
- Measles (in response to an outbreak)
- HPV (School based immunization)
- Polio (done as a separate campaign)

Different groups of workers involved
- Health program managers (Region, District)
- Immunization Logistics
- Health workers

Immunization Cold Chain



Immunization Cold Chain Challenges

Ensure that all countries have high quality vaccine cold chains
- Working equipment at all points in vaccine supply chain
- Sufficient capacity for vaccines

Refrigerators need power
- Grid power, Solar power, Gas, Kerosene
- Many areas suffer from regular power outages
- Desire to replace Kerosene / Gas equipment with Solar

Equipment upgrades
- Identify needs and determine order size
- Remove obsolete equipment
- Ensure proper installation
- Establish repair infrastructure
- Monitoring of equipment condition

Cold Chain Equipment Inventories

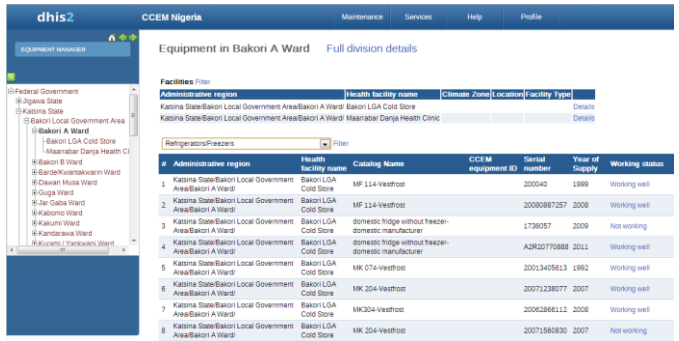
No accurate global equipment inventories

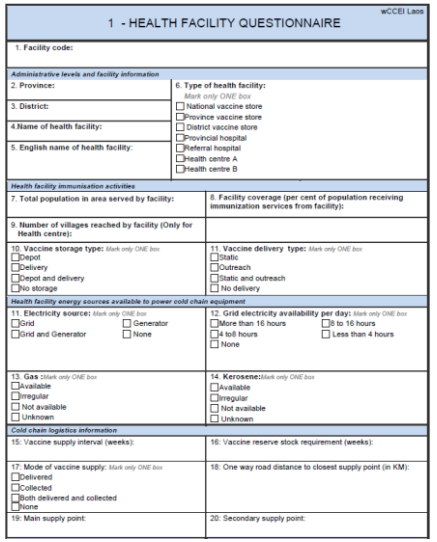
Inconsistent at the country level
- Inventories often become out of date
- Not updated for equipment changes
- Health facility information is also a challenge

Periodic efforts to collect inventory information for reporting
- Often restricted to sampling

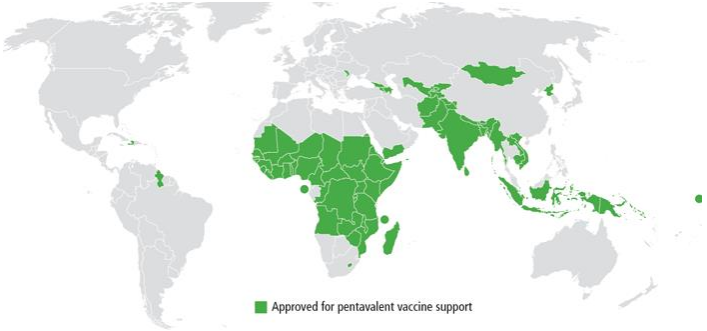
Fragmented data sources

Different health systems inside a country
- Public, Private, NGO, Faith-based





Vision



Country Cold Chain Information System

Country Cold Chain Information System

Country Cold Chain Information System

Global Cold Chain Information System

THE REPUBLIC OF UGANDA
MINISTRY OF HEALTH

JOHNS HOPKINS UNIVERSITY

unicef

World Health Organization

dulas

GAVI
THE GLOBAL ALLIANCE FOR VACCINES & IMMUNIZATION

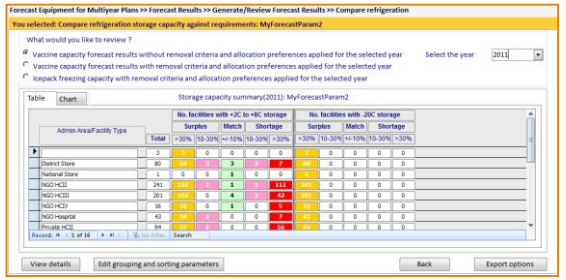
BILL & MELINDA GATES foundation

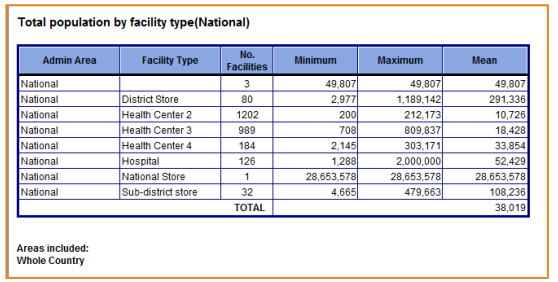
Part I: Visualizing the Cold Chain

Map based visualization
- GIS Coords
- Regions

Global Management Questions
- Country summaries
- Equipment trends
- Integrated analysis tools and models

Country Cold Chain Management
- Equipment management
- Allocation
- Reporting

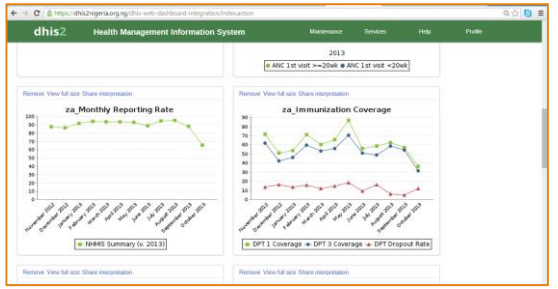


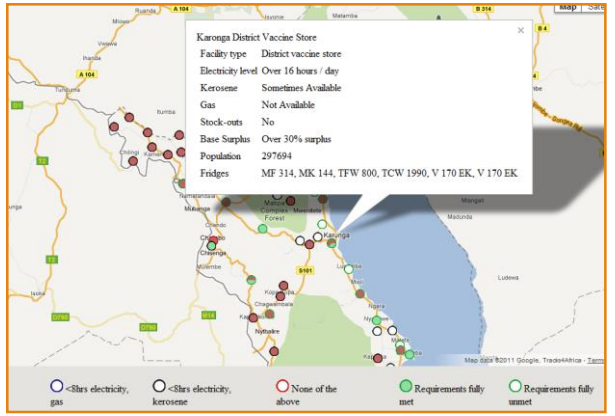


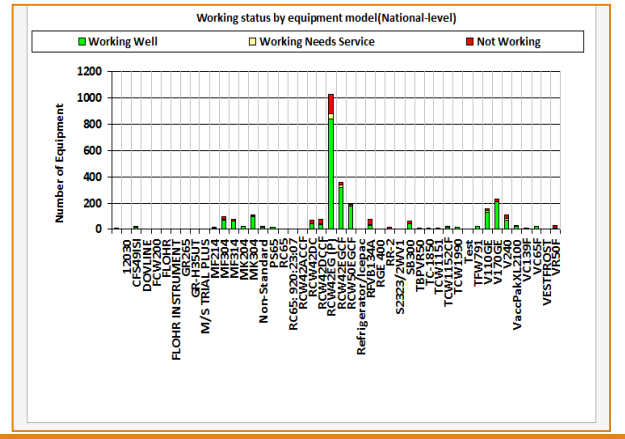
Total population by facility type(National)

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

Areas included:
Whole Country







Part II: Data Management

Cold Chain Equipment Inventory

- Basic equipment and facility information
- Tracking of performance and maintenance

Remote data updates

- Keeping data up to date is the critical challenge
- District cold chain supervisor responsible for managing equipment
- Mobile App is feasible for district supervisors

Integrate with other Health Information Systems

Ownership by the country

ODK-X

Mobile data collection on Android Phones. Project started at University of Washington by Professor Gaetano Borriello

Open Data Kit 1.0 aka ODK

- Submission of forms

Open Data Kit 2.0 aka ODK-X

- Synchronization with a database

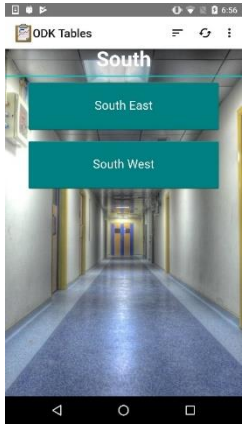
Open source tools. Strong commitment to contributing to global good software

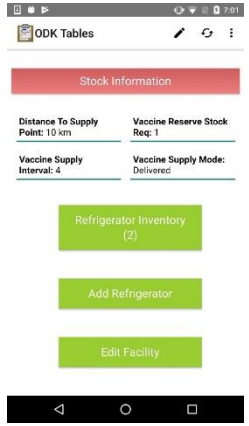
Cold Chain App

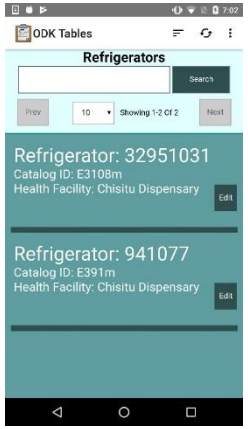
App built on top of the ODK-X platform

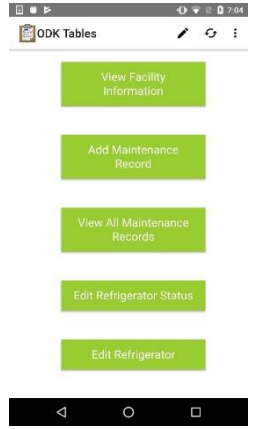
- Combination of ODK Survey and ODK Tables
- Written in Java Script

Manage a database of health facilities and refrigerators associated with facilities

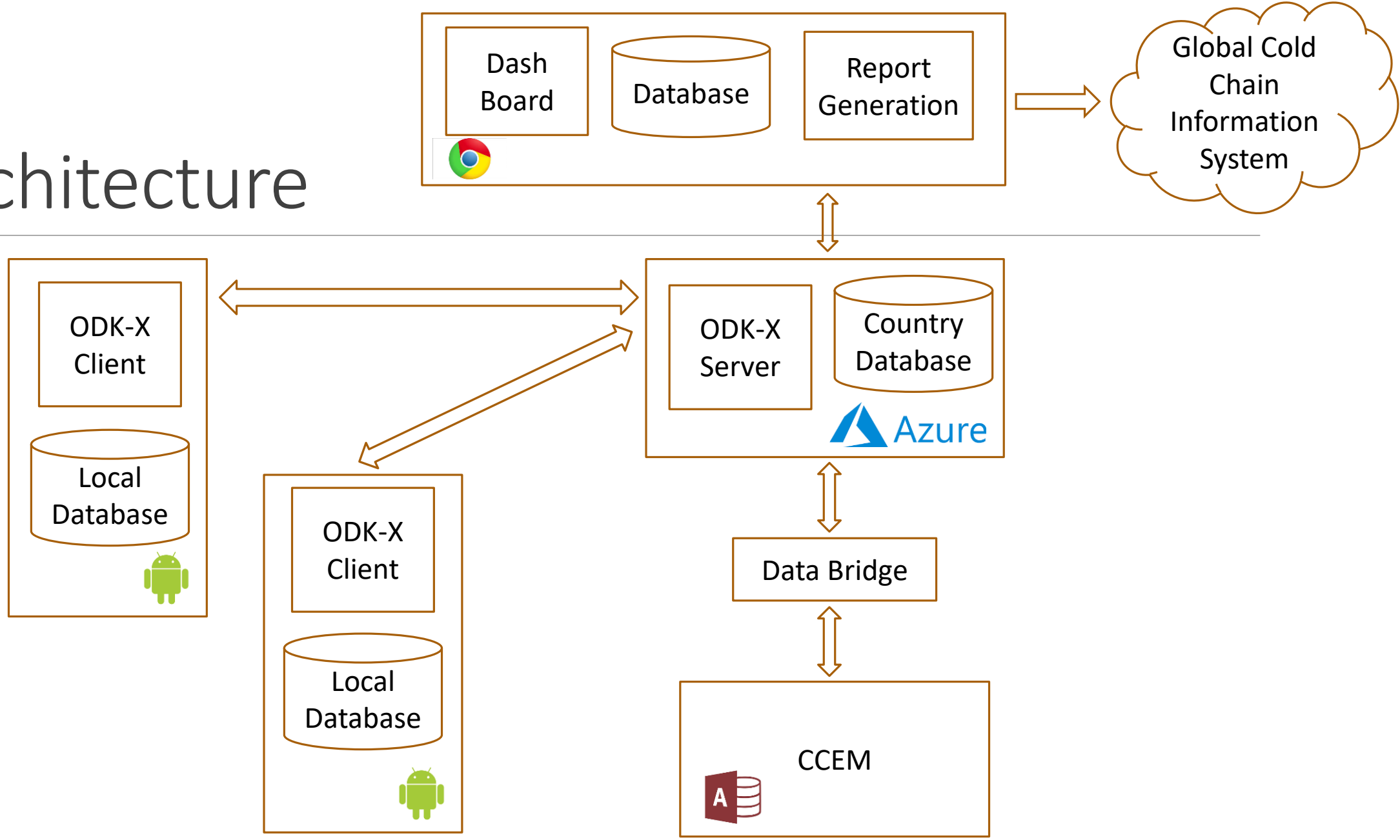








Architecture



Project Status

Cold Chain Visualization project – team YAASS

Cold Chain App prototype

WHO Deployment

- Haiti, Pakistan, DRC, Bangladesh
- Sentinel Surveillance officers

GAVI Deployment – Uganda

- Two regions - Kampala and Wakiso (13 Districts)
- Expansion to national scale underway

Pilot phase results

Deployment in 14 districts for four months

Usage
- Updated cold chain inventory across 14 districts

Feasibility Assessment
- Usage

Impact measures
- What was done with the data
  - Update cold chain equipment inventory
  - Prioritize maintenance and repairs of equipment
  - Retire obsolete equipment

Potential long term impact
- Strengthen vaccine cold chain

Results: Functionality

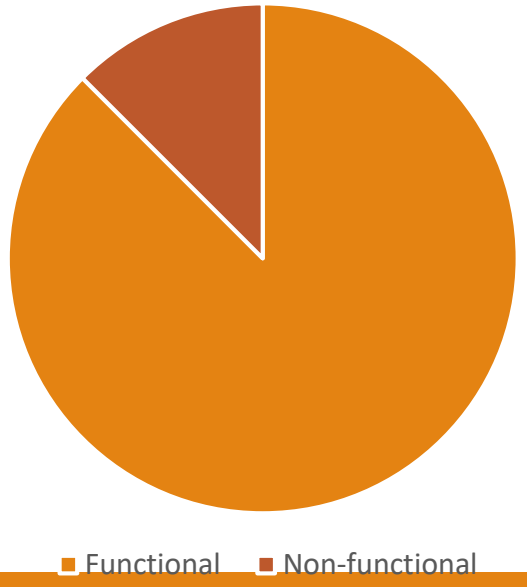
Updating CCEI

Data reported from 80.15% of the 394 HCFs in the study districts

Data reported from 80.77% of the 486 CCE in the study districts

Frequency of temperature excursion:

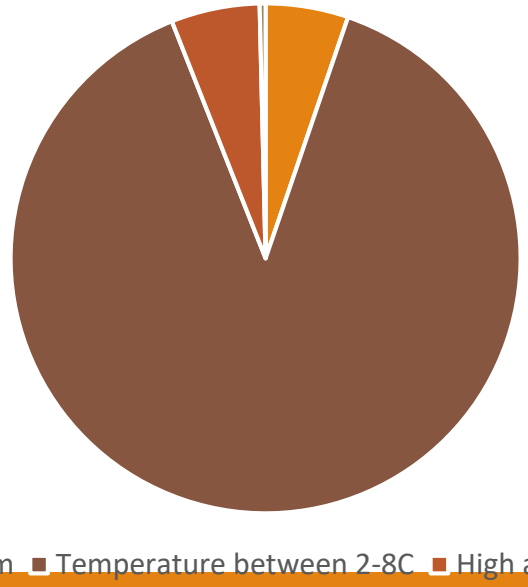
Analysis: CCE functionality



Analysis:
60 non-functional CCE out of 489 in study as of July 10,2020

Prioritizing repair:
129 Out of 795 entries showed CCE with either freeze (35) or high alarm (94) data

Analysis: CCE temperature performance



Results: Functionality

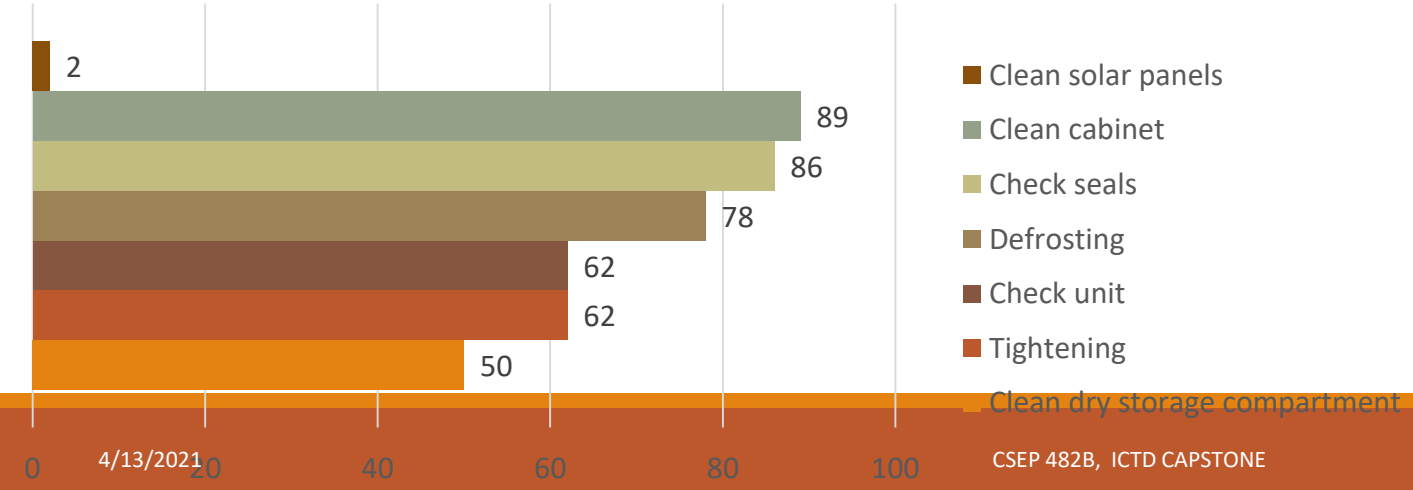
Reporting maintenance and repair

Type of maintenance	Frequency reported
Preventive	133
Repair	3
Other	5
Blank	12
TOTAL	**153**

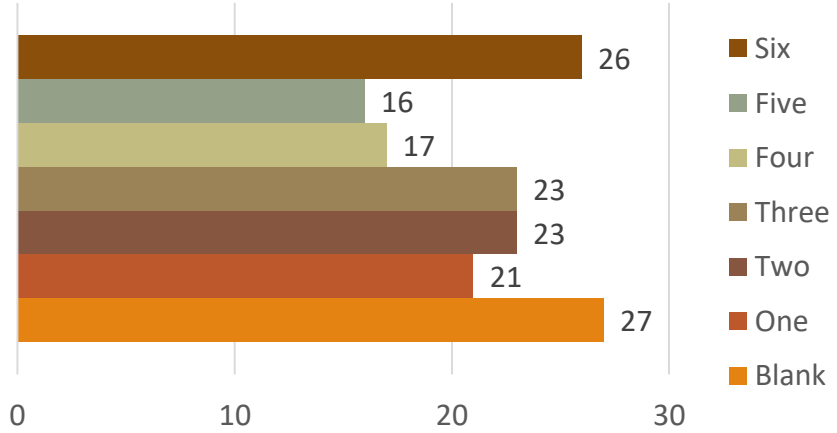
Analysis: Spare parts

Spare part	No.
Thermostat controller	2
Voltage stabilizer	12
Solar related part (unknown)	1

Analysis: Preventative maintenance activities



Analysis: No. maintenance activities performed at each visit



Results: Acceptability

ODK-X advantages	ODK-X challenges
• **Very easy to use with clear questions** • **Reduces resource requirements for reporting** • **Simplifies work processes** (e.g., sending monthly report on vaccine fridges). It reduced to burden of dealing with reports hard copies and their space for storage. • **User friendly and saved time**. I liked the ability to change only what needed to be updated. • **Clear, accurate, accessible data set:** it enabled us to know what is expected at a facility, be able to tell what is missing, and review maintenance records. CCE inventories to all facilities is **kept readily available and retrievable** at all times. • **Timely, simple reporting:** it eases the movement of data from facilities to the ministry and allows for faster repair & replacements. Monthly Temperature reporting is **quite simplified** and can be timely. • Helps **track CCE movement** • **Features:** Easy to locate facilities on map; works offline; easy to access data, e.g., fridge maintenance records and status really stands out	• **No vaccine storage** information. For example capturing data with in the vaccine and injection material control book. Also it does not cater for **monthly Vaccine utilization and monitoring** yet it's also essential. • **HCF codes:** Some DCCT/As do not know the healthcare facility codes, which could lead to inaccurate data • **Adjust permissions** so DCCT/A only sees facilities within their catchment area • **The number of pages are many**. If possible, they should summarize on the pages • Since it was a new tool sometimes the **phone would freeze and loose all data** which would require to start afresh • **Relying on network** to sync data • **Delay in picking geographical coordinates and accuracy** • In temperature reports at the section of number of days +8, to some facilities the **data charted is far different from the fridge tag data when retrieved from it using the attached USB in computer.** • Entering Maintenance activities performed on the cold chain equipment [is a challenge] because **some words and parts seem to be particularly for DCCTs than DCCAs.**

Scaling

Deploy at national scale

- All 140 districts

Transfer ownership to Ministry of Health

Made possible by strong partnership with a Global Health NGO

Transfer to country ownership

Goal: Project fully managed and owned by country at the end of one year

Steps:

- Infrastructure managed by country
- Build technical team to run the project
- Capacity development

Implementation:

- Develop transfer plan at the start of the project
- Identify components that are country managed at start, such as managing servers

Country concern

- Technical capacity to run the project in the future

Global goods model consistent with country ownership

Scaling the application

Technical questions

- What is the server requirement for a national deployment

What are the other issues / concerns as the number of users increase?

A useful thought experiment for scaling is to thinking about how teaching a 20 person class is similar/different from teaching a 200 person class

National scale roll out

Finalize application

Finalize data set

Establish technical teams

Configure national infrastructure

Phased training

- Workshop training by region
- Training has multiple components
  - App use
  - Platform (ODK-X) use
  - Workflow
  - Policies

Device management

Project requires each technician to have an Android Phone

- This is now a feasible requirements

Strategies

- Provision devices to all workers
- Personally owned devices

Risk to project

- Project becomes a device management project

Overhead of account/credential management

Data configuration

Surprising challenge: Getting good data

Need to have a national list of health facilities with administrative regions and geocodes

Multiple lists of health facilities

Administrative regions change

Health Information System Software as a Political Process

Multiple systems are present in an information system

Different goals of technical managers

Desire for a ``rational'' system

Importance of system alignment and integration

Stakeholders: Donors, Global Orgs, MoH IT, Health Departments

Sahay, Sundeep; Monteiro, Eric; and Aanestad, Margunn (2009) "Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India," *Journal of the Association for Information Systems*: Vol. 10 : Iss. 5 , Article 4. DOI: 10.17705/1jais.00198. Available at: https://aisel.aisnet.org/jais/vol10/iss5/4

Evaluation at scale

What will success look like?

Success as a product

- Sales and customer use
- Is the Android Application used by 90% of cold chain technicians after 3 years

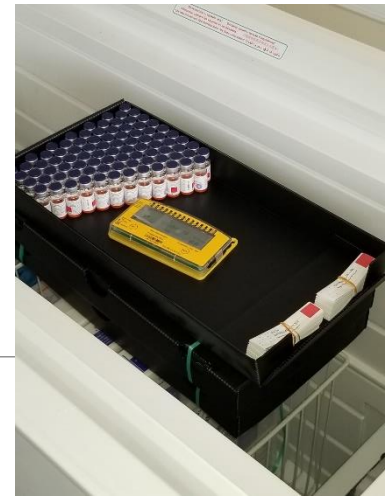
Success as a system intervention – impact on the vaccine cold chain

- Cold chain equipment inventory
- Quality of cold chain equipment
- Maintenance metrics

Success on public health

- Hard to measure as this is contributing to the immunization program is responsible for impact

Questions and Discussion



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