ICTD Capstone
Software Design for Underserved Populations

CSE 482b, Lecture 3

Today

- Course Logistics
- Project Groups
  - ODK
  - Content Apps
  - Protocol Apps
  - Scaling Logistics Apps
  - Referral for post Caesarian Care

Expectations

- Work as a team to produce an interesting software system
- Proof of concept prototypes

Requirements

- Each group will give three intermediate presentations
- Each group will give a final presentation
- Turn in code and documentation
- 10 page paper
- Check in meetings
- Weekly written status reports

Schedule (Dates tentative)	
Project Pitch	Thursday, April 11
Progress Report	Thursday, April 25
Prototype Demo	Thursday, May 16
Final Presentations	Monday, June 3, 10:30 AM, CSE2 371
Deliverables due: Code, Write-up	Friday, June7, 6:00 pm

Computing and Global Health

CSE 482b

ICTD Capstone, April 2, 2024

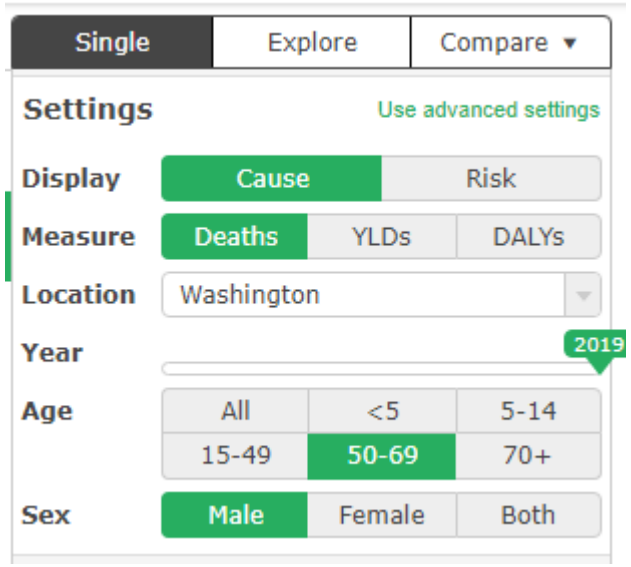
Richard Anderson

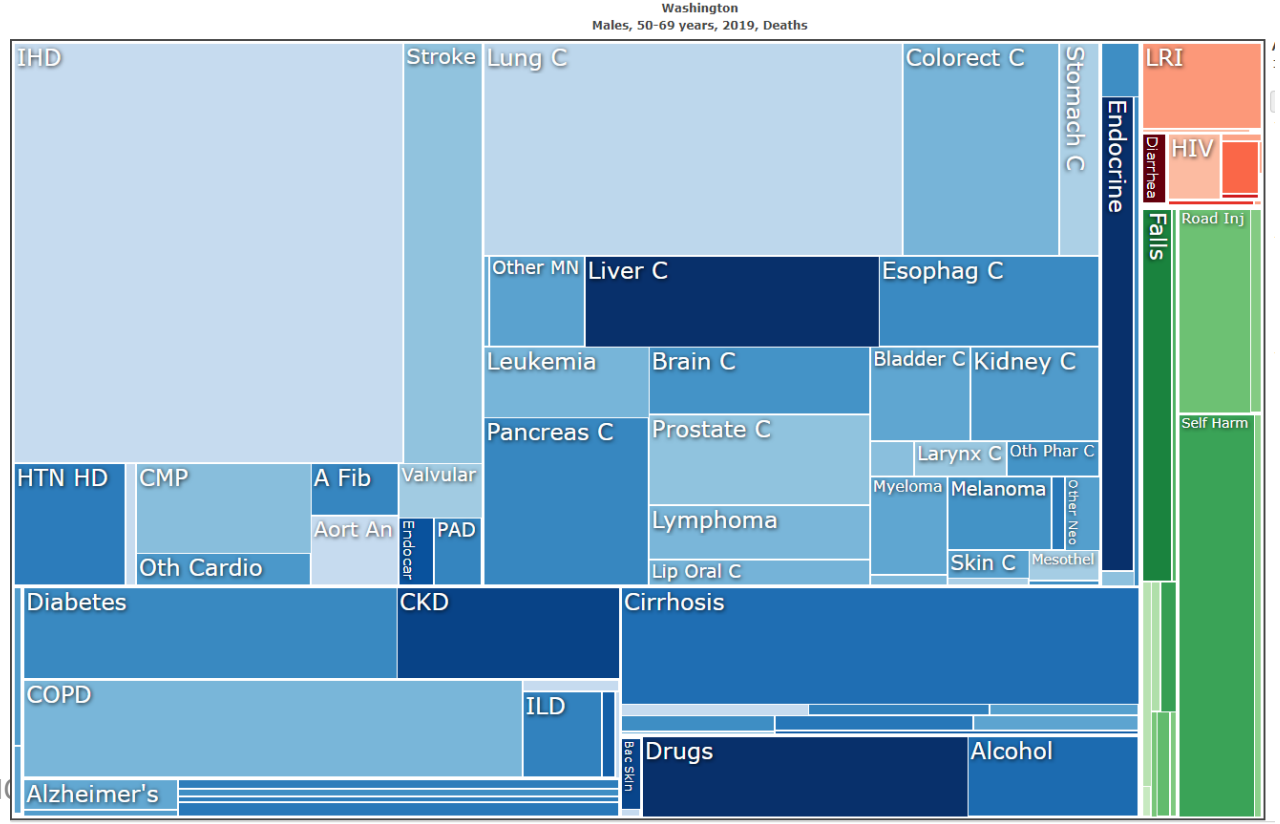
Today

- Global Health Overview
  - Burden of Disease
  - Health Care Systems
  - Global Organizations and Funding
- Computing and Global Health Projects
  - Mobile Wellness Toolkit Project
  - Mobile Midwife Platform
  - Projecting Health
  - mPneumonia
  - Cold Chain Equipment Inventories
  - mWach
  - Uganda CCIS

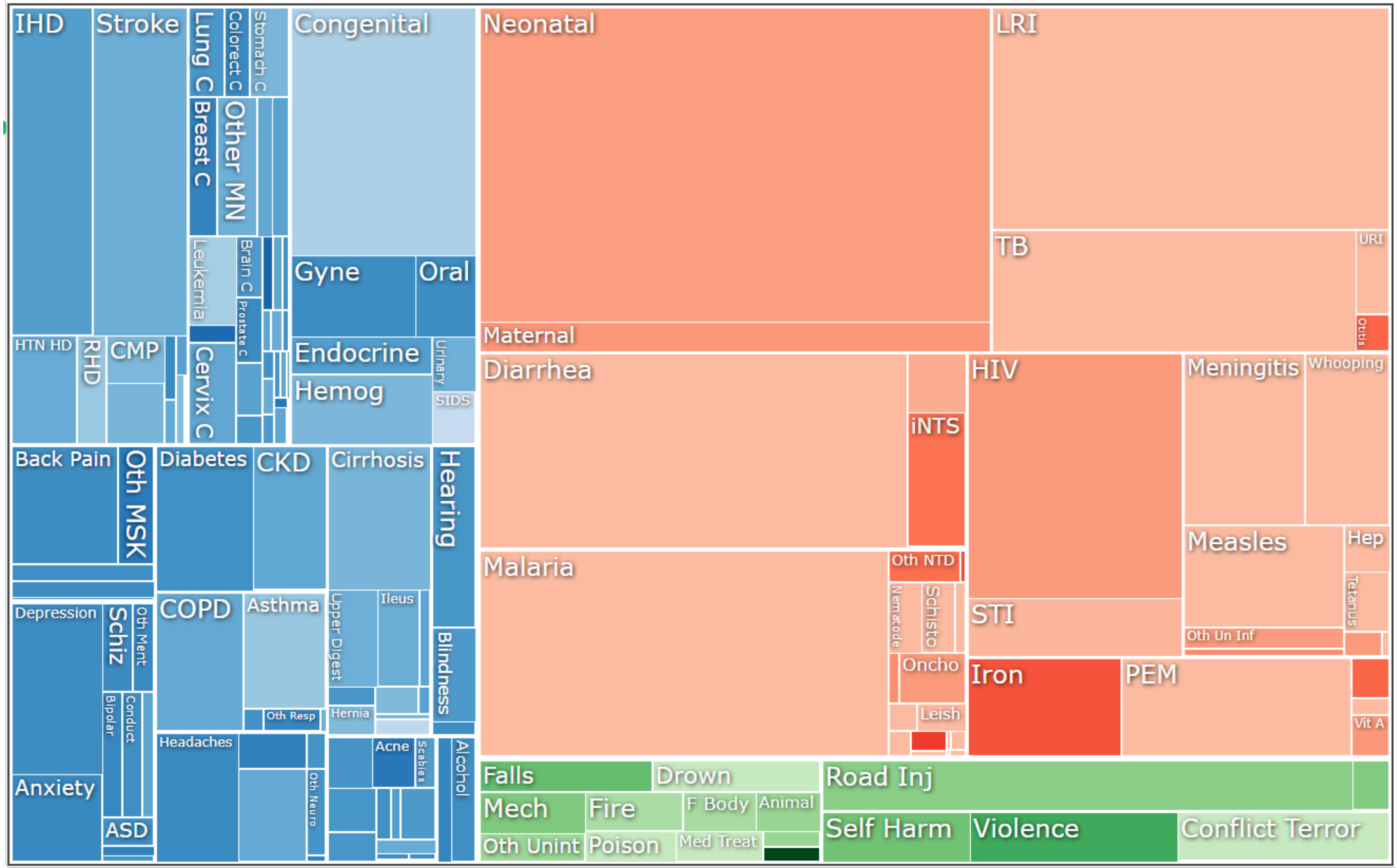
Global Burden of Disease

- We are all human – so subject to the same frailties
- However, the burdens of disease vary dramatically
- IHME Global Burden of Disease
  - GBD Compare





World Bank Low Income
Both sexes, All ages, 2019, DALYs



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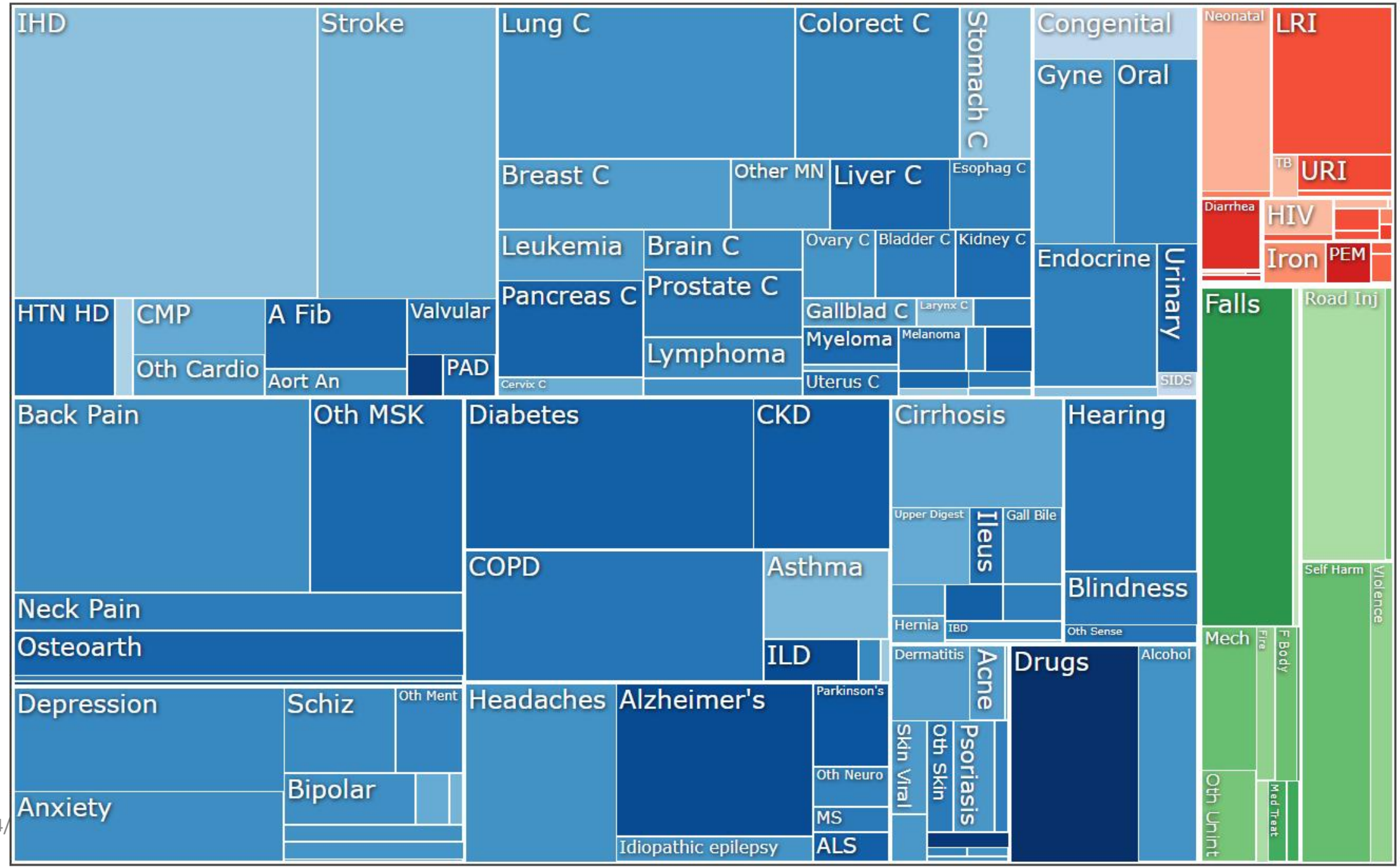


Health Care Systems in LMICs

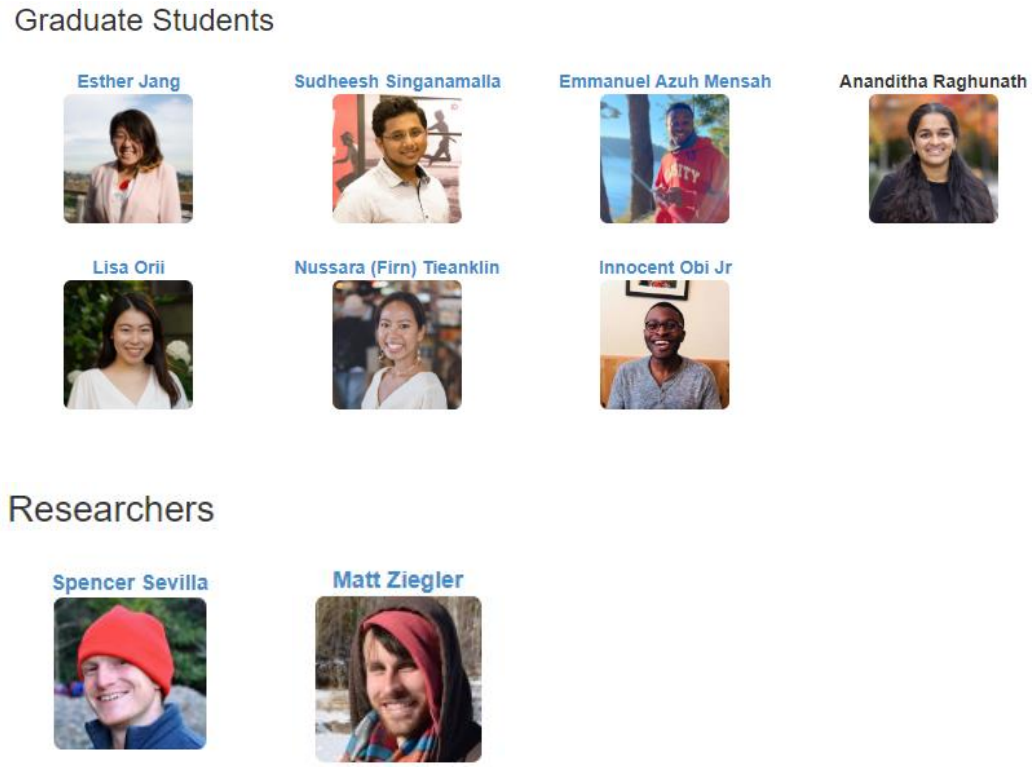
- Public and Private Health Care
- Hierarchy of facilities
  - Major Hospitals, District Hospitals, Health Centers, Health Posts
- Under resourced
  - Limited equipment and supplies
  - Lack of trained people in rural areas
- Limited governmental financial support
- Ministry of Health controls policy

Global Organizations and Funding

- Global stake holders
  - Unicef, GAVI, WHO
- National Donors
  - USAID, PEPFAR, CDC, GDZ, DFID, Norad, JICA, . . .
- Private Donors
  - BMGF, Clinton Foundation, . . .
- Broad mix of implementing organization
- Funding streams determine priorities
  - Focus on particular diseases

UW ICTD Lab Projects

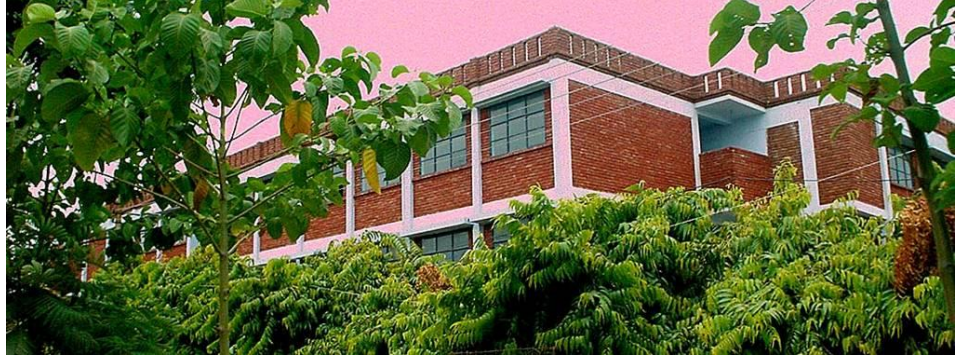
- Research group founded by Richard Anderson and Gaetano Borriello
  - Kurtis Heimerl joined in 2015, June Lukuyu in ECE is an Affiliate



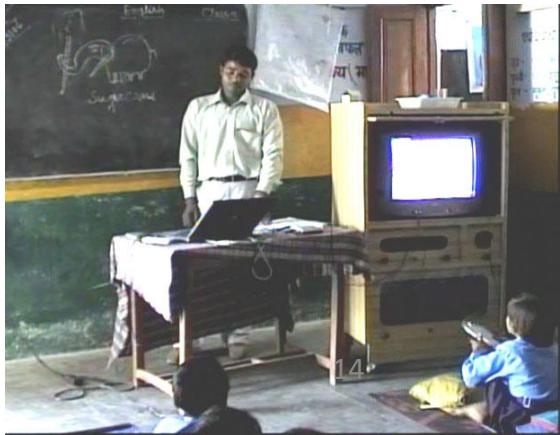
Digital StudyHall

- Video based education using Tutored Video Instruction model
  - Idea was to use mediated video presentation
  - Benefit of expert content, mediation, and peer discussion
- Project was conceived by Randy Wang, a Princeton University professor who left the university to establish the project in Lucknow India
- Goal was to provide educational content to rural Indian schools which often lacked qualified teachers
  - Model – teachers in the schools would “co-teach” with a video lesson filled in a different school
- UW Faculty involvement: Richard Anderson, Tom Anderson, Arvind Krishnamurthy, and Kurtis Heimerl (as a student)

Digital StudyHall



- Project was initially technology focused
  - Viewed as a networking project for distributing content
  - Secondary project was developing low cost display mechanisms
  - Education was viewed as the “Application Domain” for the technology
- Randy Wang was employed at Microsoft Research India
  - Spin off project (by Rikin Gandhi) on agricultural education: Digital Green



Digital Public Health -> Projecting Health

- Application of Digital StudyHall/Digital Green ideas to Public Health
- Led by University of Washington and PATH in Uttar Pradesh India
- Most similar to Digital Green in technology approach
- Video topics had standard messaging based on official guidelines
  - Far more concerns about getting messaging correct
  - Implemented community advisory board
- Deployment approach
  - Use by ASHAs (Community Health Workers) leading Mothers' groups
  - Local NGO to manage deployment
- Social media technology has changed since project wrapped up

PATH

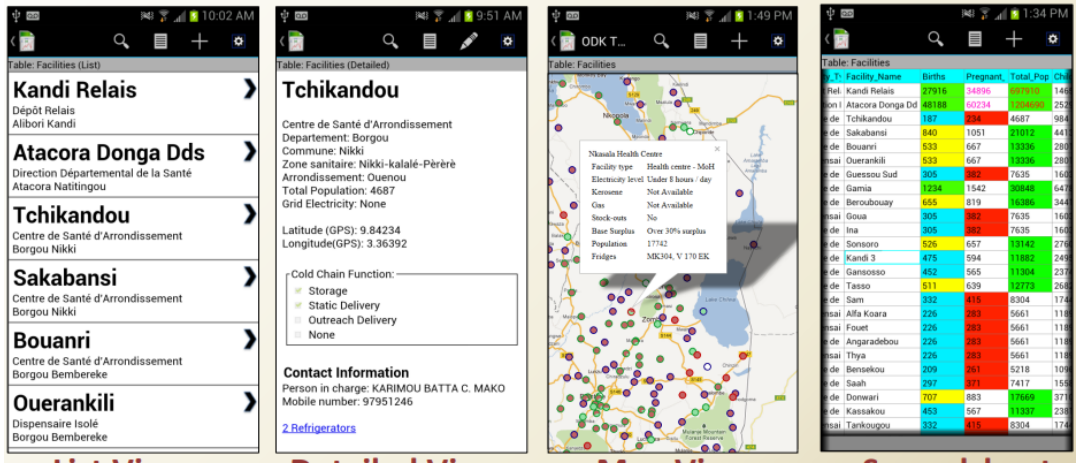
Open Data Kit

- Problem: Digital data collection in poorly connected environments
- 2007 Technologies:
  - Personal Digital Assistants (PDAs)
  - Feature Phones
- Forms based data collection
  - Enter data based on individual forms
  - Forms end up as records in a database
  - Example: tracking Malaria outbreak in remote villages
- Initially University of Washington project, now a widely used system under a number of different brandings

Open Data Kit History

- Brainchild of Gaetano Borriello
- “Let’s do data collection with Smart Phones in developing countries”
- Use of Android Platform
- In 2008-2010 there was great skepticism that smart phones would be a feasible device for global work
- Initial development by UW PhD students
- Open Data Kit: Suite of tools for data collection
- Spun out from UW as independent projects

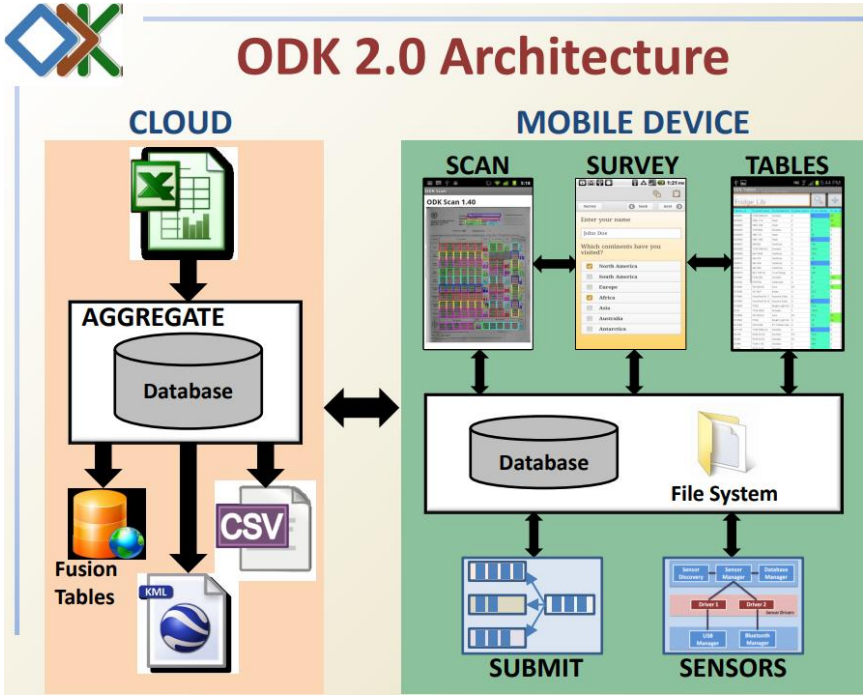
ODK Lessons



- Successful bet on future technologies
- Reliance on consumer technology
- “Market fit” – addressed an important global development use case
- Identified different roles in the digital data collection
  - Deployment architect – manage data collection and forms design, but not systems programming
- Enabled organizations with “moderate” technical capacity to manage data collection
- Open source allowed multiple organizations to build on platform including commercial organizations

ODK 2 aka ODK-X

- ODK 1 – Submission of forms based information from Android Device to Server
- ODK 2 – Data management platform with database on both Android Device and Server
  - Row based synchronization in online/offline environment
  - Substantial generalization of ODK 1
  - Platform for research projects



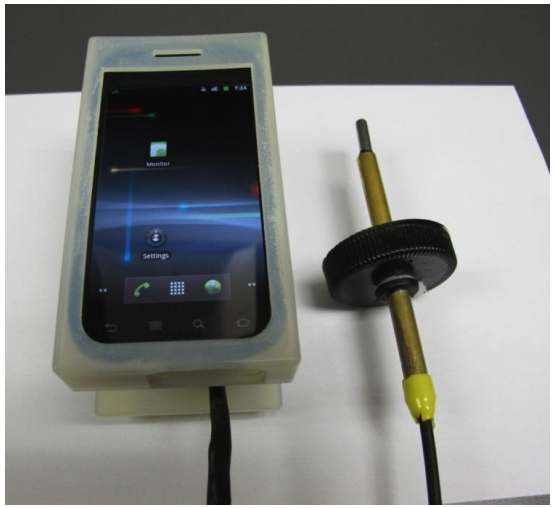
Mobile Wellness Toolkit Project

- National Science Foundation project
- Partnership between University of Washington and PATH
- University of Washington
  - Richard Anderson, CSE
  - Gaetano Borriello, CSE
  - Beth Kolko, HCDE
  - PostDocs: Brian DeRenzi, Neha Kumar
- PATH
  - David Lubinski, Kiersten Israel-Ballard, Noah Perin

How do we make low cost consumer technologies available to organizations who implement health and wellness programs?

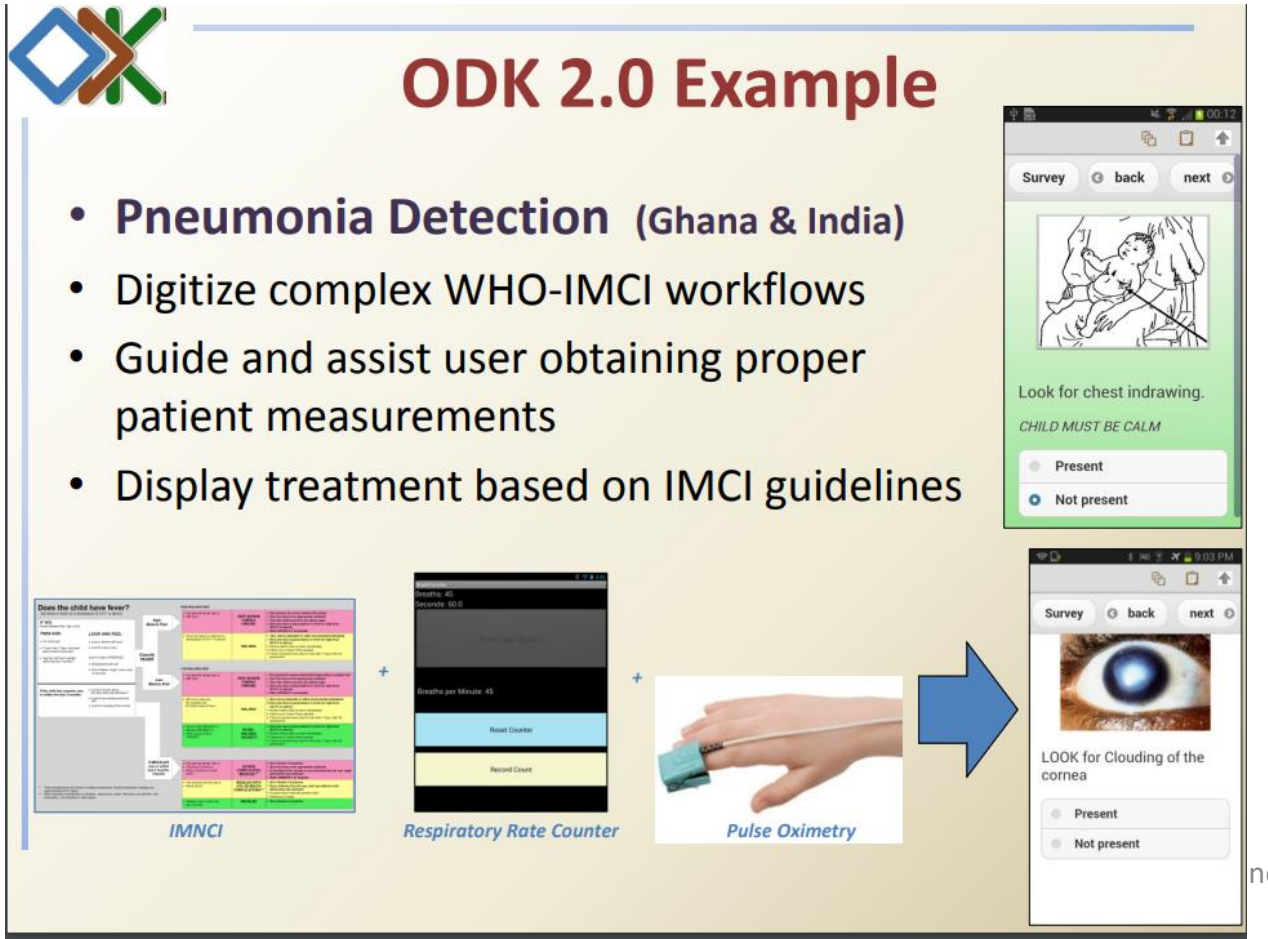
ODK Sensors

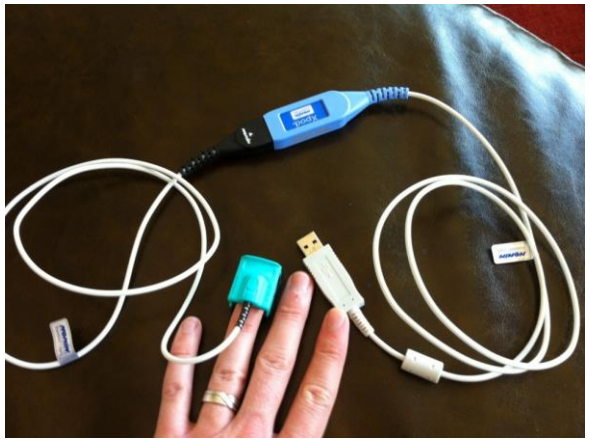
- Framework for integrating sensors into an ODK2 Application
- FoneAstra – sensor bridge for mobile phones
  - Initially basic phones, but later android phones
- Temperature Monitoring for Vaccine Refrigerators
- Temperature Monitoring for low cost breast milk pasteurization



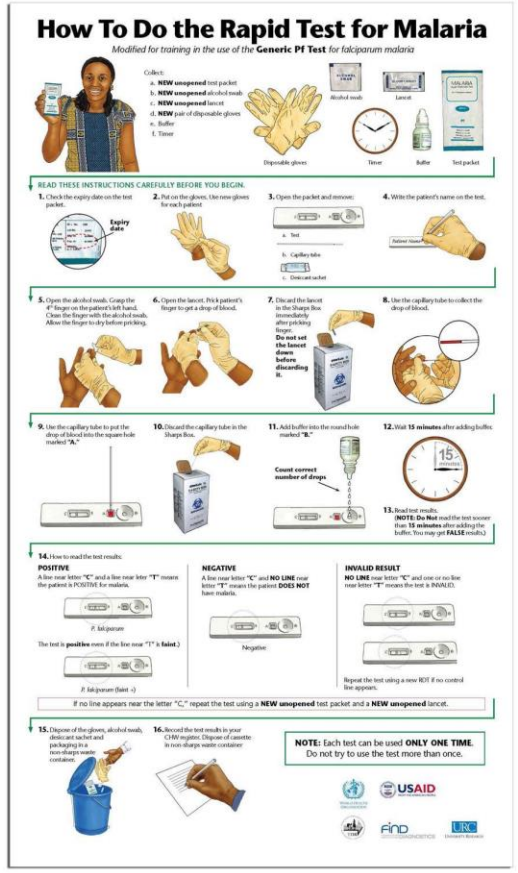
mPneumonia

- Pulse Oximetry for detection of childhood pneumonia





Job Aids: Smartphone Apps for health workers

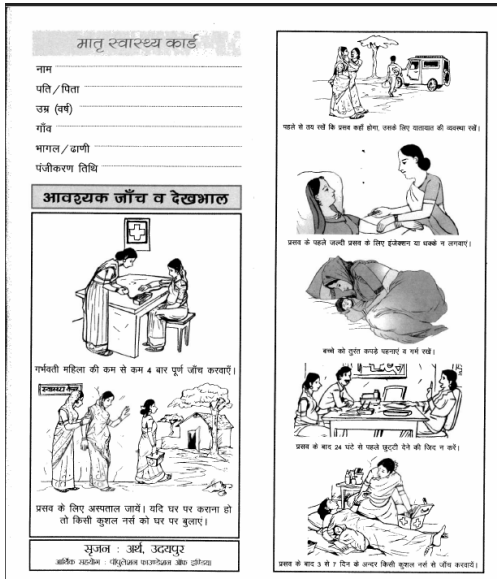


Point of care diagnostics

- Rapid diagnostic tests (RDTs) quickly test for conditions based on blood/urine sample
- Supportive tools to aid health workers with the administration and interpretation of these tests.

Mobile Midwife Platform

- Mobile data collection to support PNC visits
  - Data collection
  - Protocol support
- Open Data Kit application
- Android phones deployed with nurse midwives



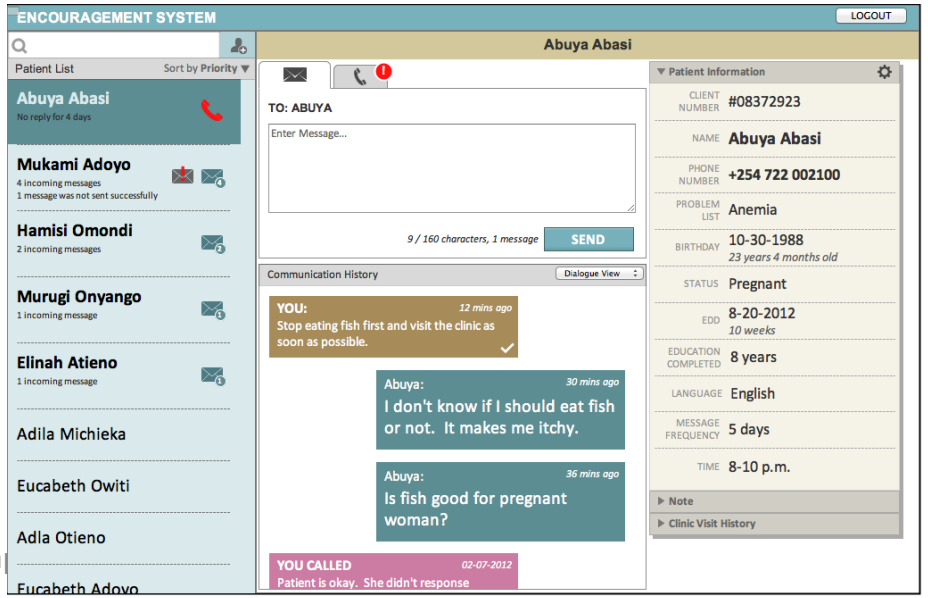
Mobile Videos in MMP

- The use of video is feasible in PNC visits
- The PNC environment is complicated
  - Patient education occurs throughout visits with various levels of effort
  - Multiple settings and participants
- Authority and trust
  - Nurses viewed video as being authoritative and enhancing their communication

mWACH

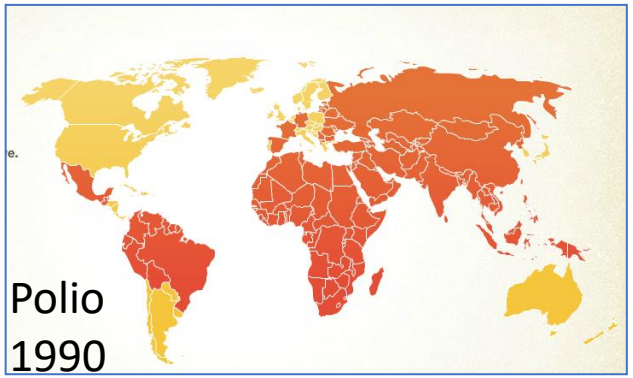
- Study with Dept of Global Health
- SMS Reminders to Pregnant Women in Kenya
- Target basic mobile phone users
- Innovation was two-way SMS

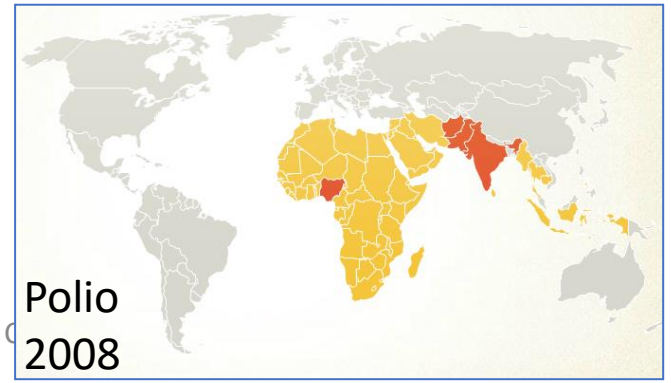
Control Group	One-way SMS	Two-way SMS
No intervention.	Pregnant woman receives twice-weekly SMS with health information relevant to her health and her stage of pregnancy.	Pregnant woman receives twice-weekly SMS requesting a reply.
		Hypothesis that woman's reply can be a proxy for engagement and uptake of health services.



Cold Chain Equipment Inventories

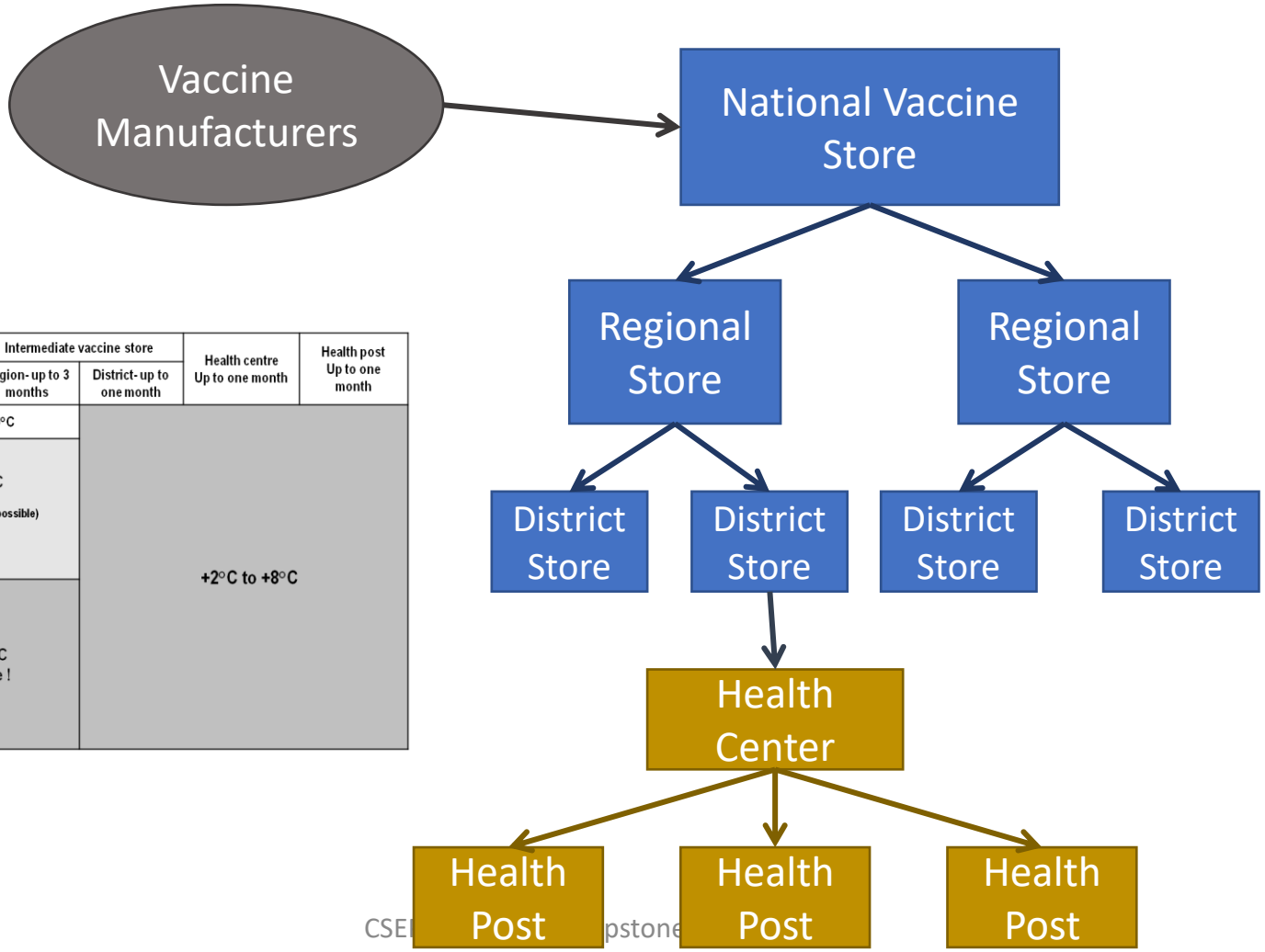
- Vaccine Cold Chain: National Storage of Vaccines from import to delivery
- Critical for management of national vaccine programs
- Expanded Program of Immunization had dramatic impact on reducing childhood deaths


Polio
1990


Polio
2008

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

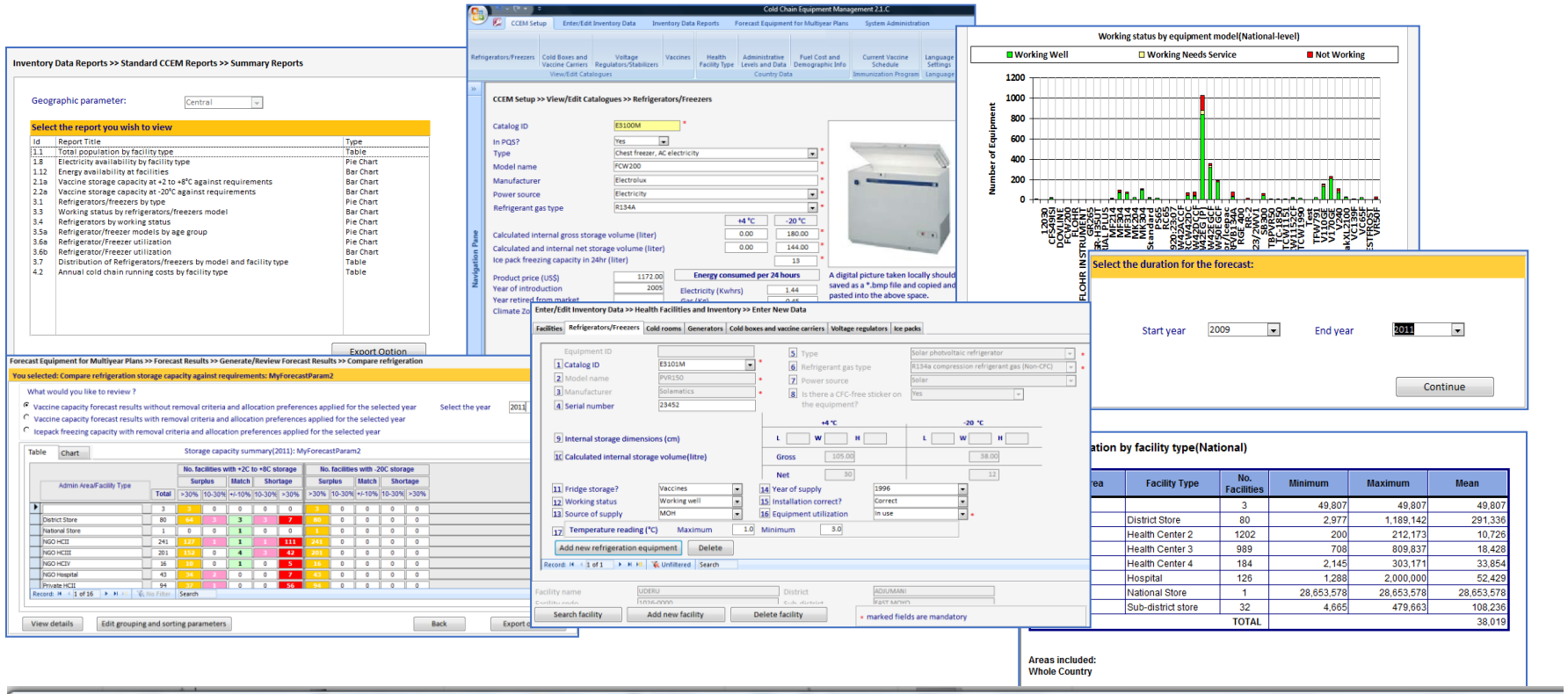

JAPÓN


MINSA
MINSA
CLINICAS MOVILES
DONADAS POR LA HERMANA
REPUBLICA BOLIVARIANA
DE VENEZUELA

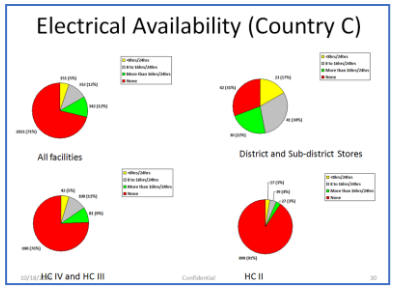
Cold Chain

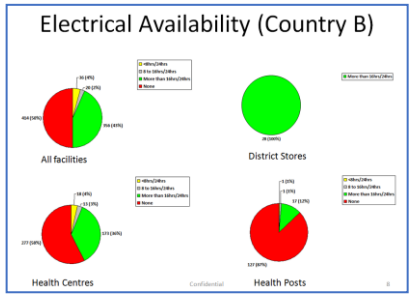
Cold chain equipment

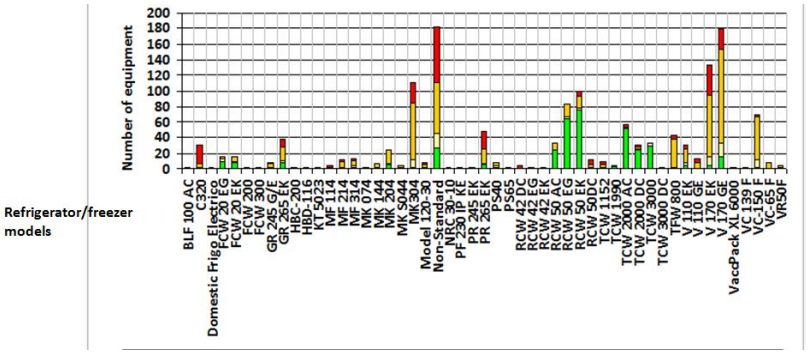
Cold Chain Equipment Manager (CCEM) Software

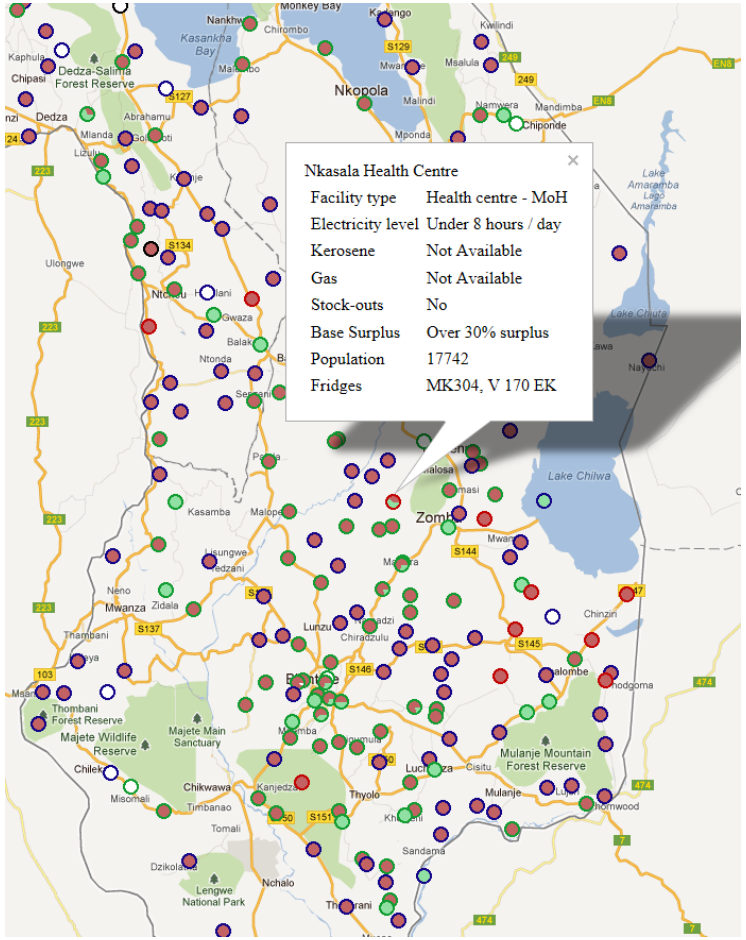


Reports


Electrical Availability (Country C)
All facilities
District and Sub-district Stores
HC IV and HC III
HC II


Electrical Availability (Country B)
All facilities
District Stores
Health Centres
Health Posts


Number of equipment
Refrigerator/freezer models
0
20
40
60
80
100
120
140
160
180
200
BLF 100 AC
C 320
Domestic Frig Electrico
FCW 20 EG
FCW 20 EK
FCW 200
FCW 300
GR 245 EK
GR 255 EK
HBC-200
HBD-116
KT 5023
MF 114
MF 214
MK 074
MK 144
MK 204
MK 3044
MK 304
Model 12da30
Non-Standard
NRC 30-10
PF 230 IP KE
PR 245 EK
PR 265 EK
PS40
PS65
RCW 42 DC
RCW 42 EG
RCW 42 EK
RCW 50 AC
RCW 50 EG
RCW 50 EK
RCW 50 DC
TCW 1152
TCW 1990
TCW 2000 AC
TCW 2000 DC
TCW 3000
TCW 3000 DC
TFW 800
V 110 EK
V 110 GE
V 170 EK
V 170 GE
VacPack V 1600
VC 130 F
VC 150 F
VC-65 F
VR50F


Nkasala Health Centre
Facility type Health centre - MoH
Electricity level Under 8 hours / day
Kerosene Not Available
Gas Not Available
Stock-outs No
Base Surplus Over 30% surplus
Population 17742
Fridges MK304, V 170 EK
Nkopola
Dedza-Salima Forest Reserve
Lake Chilwa
Majete Wildlife Reserve
Majete Main Sanctuary
Thombani Forest Reserve
Mulanje Mountain Forest Reserve
Lengwe National Park

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

wCCEI Laos

1 - HEALTH FACILITY QUESTIONNAIRE

1. Facility code:

Administrative levels and facility information

2. Province:

3. District:

4.Name of health facility:

5. English name of health facility:

6. Type of health facility:
Mark only ONE box
- ☐ National vaccine store
- ☐ Province vaccine store
- ☐ District vaccine store
- ☐ Provincial hospital
- ☐ Referral hospital
- ☐ Health centre A
- ☐ Health centre B

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: *Mark only ONE box*
- ☐ Depot
- ☐ Delivery
- ☐ Depot and delivery
- ☐ No storage

11. Vaccine delivery type: *Mark only ONE box*
- ☐ Static
- ☐ Outreach
- ☐ Static and outreach
- ☐ No delivery

Health facility energy sources available to power cold chain equipment

11. Electricity source: *Mark only ONE box*
- ☐ Grid
- ☐ Generator
- ☐ Grid and Generator
- ☐ None

12. Grid electricity availability per day: *Mark only ONE box*
- ☐ More than 16 hours
- ☐ 8 to 16 hours
- ☐ 4 to8 hours
- ☐ Less than 4 hours
- ☐ None

13. Gas : *Mark only ONE box*
- ☐ Available
- ☐ Irregular
- ☐ Not available
- ☐ Unknown

14. Kerosene: *Mark only ONE box*
- ☐ Available
- ☐ Irregular
- ☐ Not available
- ☐ Unknown

Cold chain logistics information

15: Vaccine supply interval (weeks):

16: Vaccine reserve stock requirement (weeks):

17: Mode of vaccine supply: *Mark only ONE box*
- ☐ Delivered
- ☐ Collected
- ☐ Both delivered and collected
- ☐ None

18: One way road distance to closest supply point (in KM):

19: Main supply point:

20: Secondary supply point:

Countries


CHINA
CHINA
Mekong
Phôngsali
VIETNAM
BURMA
Louang Namtha
Louangphrabang
Gulf of Tonkin
Xiangkhoang
VIENTIANE
Ban Napé
Mekong
Savannakhét
THAILAND
Saravan
Pakxé
0 100 200 km
0 100 200 mi
CAMBODIA


SOUTH SUDAN
ETHIOPIA
Mandera
Lodwar
SOMALIA
Marsabit
Wajir
UGANDA
Maralal
KENYA
Bungoma
Busia
Kitale
Eldoret
Isiolo
Meru
Nyahururu Falls
Nanyuki
Equator
Kisumu
Nakuru
Nyeri
Embu
Garissa
Kericho
Kisii
Murang'a
Thika
Nairobi
Machakos
Lamu
INDIAN OCEAN
Voi
Malindi
TANZANIA
Mombasa
Tanga
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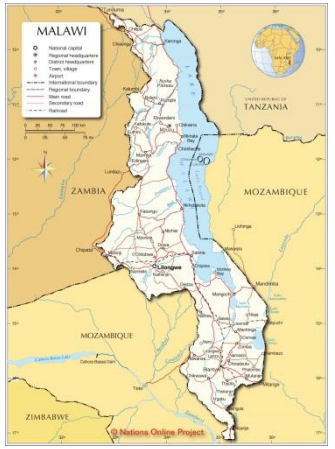
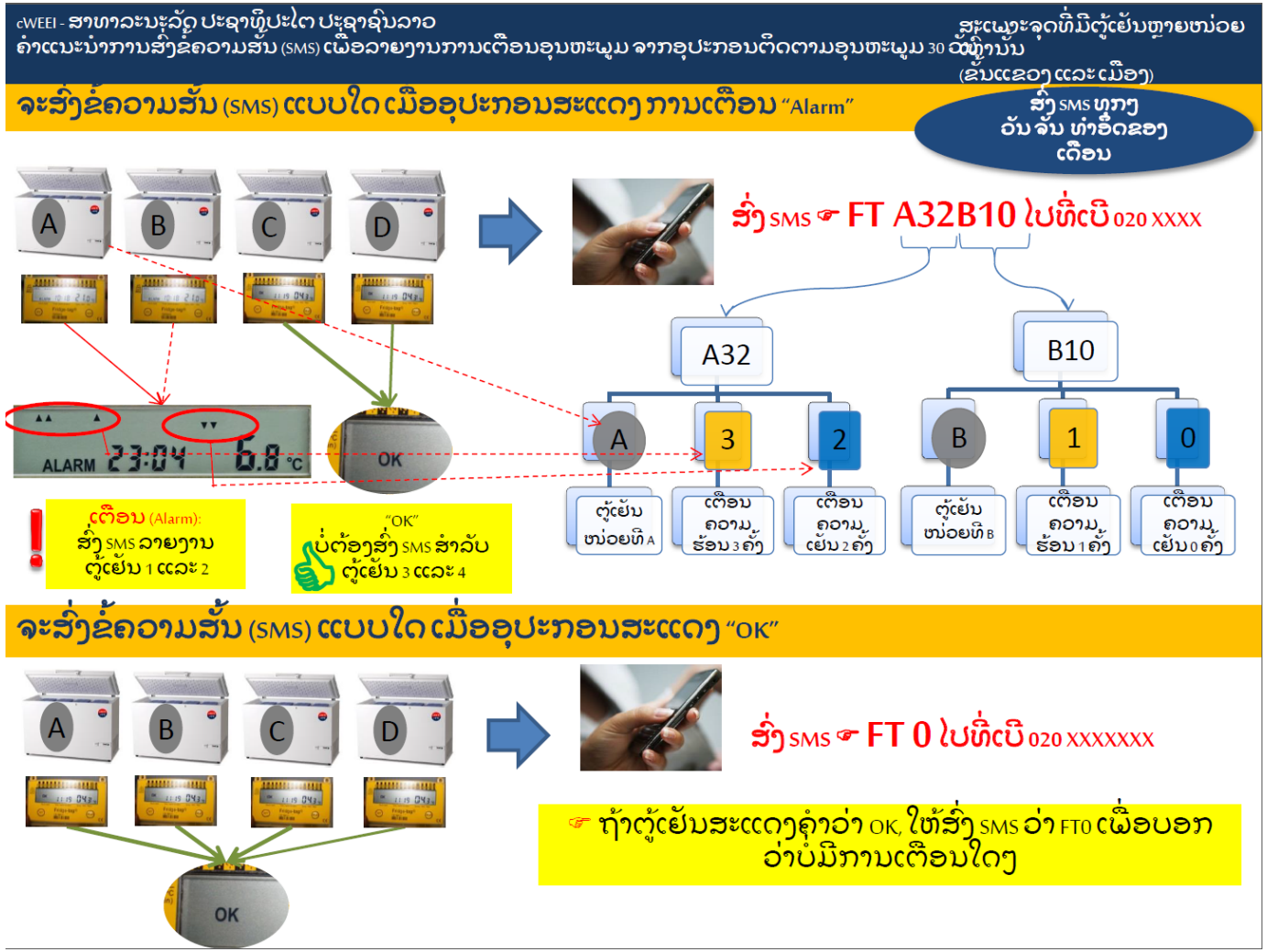
BURKINA FASO
Bolgatanga
BENIN
White Volta
Tamale
Black Volta
TOGO
CÔTE D'IVOIRE
Sunyani
Lake Volta
Mount Afadjato
Kumasi
Ho
Tano
Obuasi
Koforidua
Volta
ACCRA
Ankobra
Cape Coast
Tema
Takoradi
Gulf of Guinea
0 50 100 km
0 50 100 mi


PRRINN-MNCH Focal States

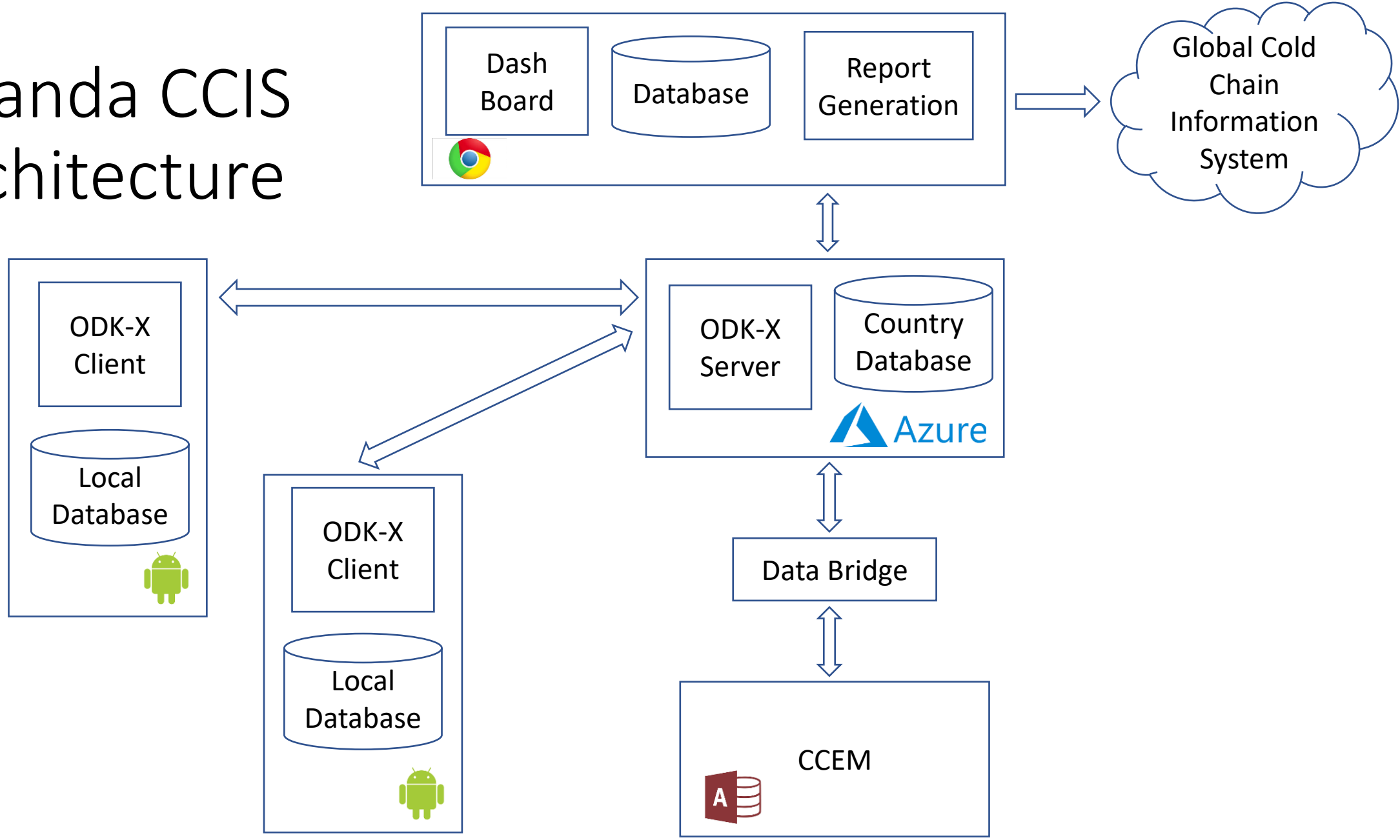

Pakistan
AFGHANISTAN
PAKISTAN
INDIA
IRAN
Arabian Sea


MALAWI
TANZANIA
ZAMBIA
MOZAMBIQUE
MOZAMBIQUE
ZIMBABWE
© Nations Online Project

Laos – Integration with SMS reporting



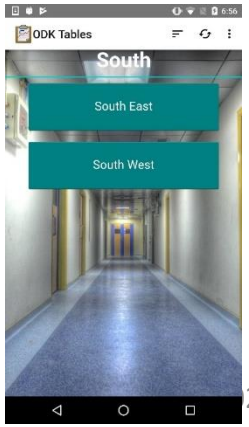
Uganda CCIS Architecture

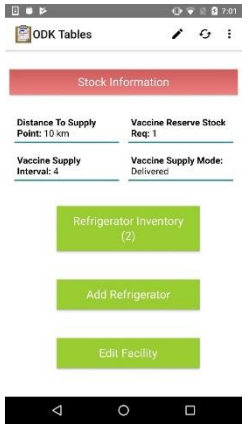


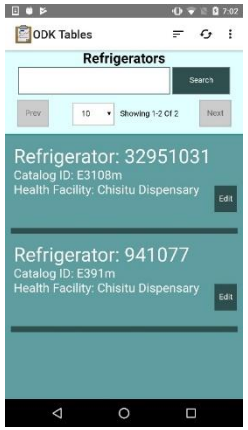
Uganda Cold Chain Mobile Application

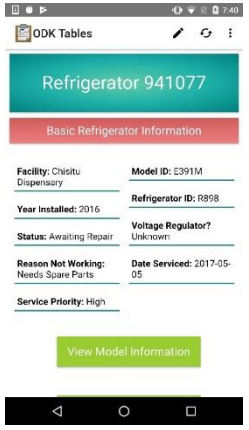
- App built on top of the ODK-X platform
  - Combination of ODK Survey and ODK Tables
  - Written in Java Script

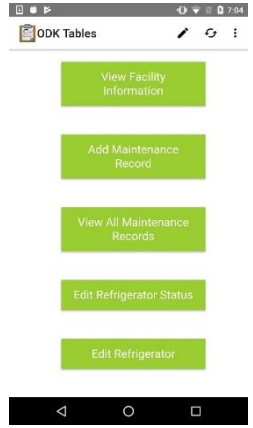
- Manage a database of health facilities and refrigerators associated with facilities









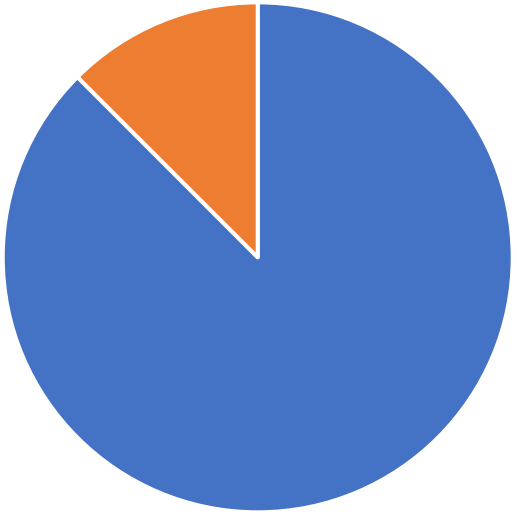


Results: Functionality

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:

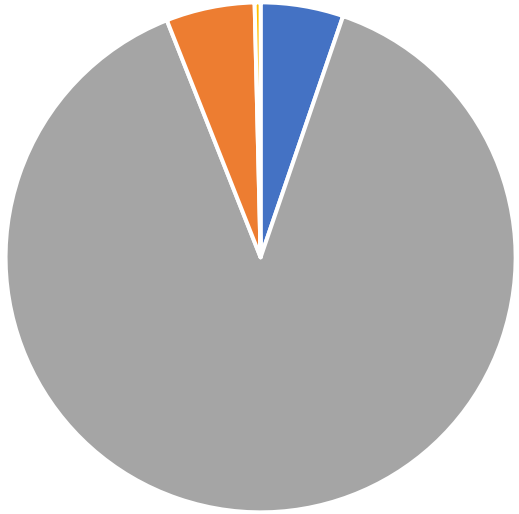
Analysis: CCE functionality



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



Questions and Discussion

Richard Anderson anderson@cs.washington.edu