Computing and Global Health

CSE 482b
ICTD Capstone, April 17, 2023
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
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
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

No intervention.

One-way SMS

Pregnant woman receives twice-weekly SMS with health information relevant to her health and her stage of pregnancy.

Two-way SMS

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
Vaccine Cold Chain Structure

<table>
<thead>
<tr>
<th>Vaccine Manufacturers</th>
<th>National Vaccine Store</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPV</td>
<td>Regional Store</td>
</tr>
<tr>
<td>BCG</td>
<td>Regional Store</td>
</tr>
<tr>
<td>Measles, MR, MMR</td>
<td>District Store</td>
</tr>
<tr>
<td>YF</td>
<td>District Store</td>
</tr>
<tr>
<td>Hib Dose-spread</td>
<td>District Store</td>
</tr>
<tr>
<td>Menegesoccal A+C</td>
<td>District Store</td>
</tr>
<tr>
<td>HepB</td>
<td>District Store</td>
</tr>
<tr>
<td>IPV</td>
<td>District Store</td>
</tr>
<tr>
<td>DT, DTP, DTaP Hep B</td>
<td>Health Center</td>
</tr>
<tr>
<td>Hib liquid</td>
<td>Health Post</td>
</tr>
<tr>
<td>Td</td>
<td>Health Post</td>
</tr>
<tr>
<td>YF</td>
<td>Health Post</td>
</tr>
</tbody>
</table>
Cold Chain
Cold Chain
Cold chain equipment
Cold Chain Equipment Manager (CCEM) Software
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
Countries
Laos – Integration with SMS reporting
Uganda CCIS Architecture

- ODK-X Client
  - Local Database
  - Android

- ODK-X Server
  - Country Database
  - Azure

- Data Bridge

- CCEM

- Global Cold Chain Information System

Dash Board
Database
Report Generation

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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

- Functional
- Non-functional

Analysis: CCE temperature performance

- Freeze alarm
- Temperature between 2-8C
- High alarm
- Blanks

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
Questions and Discussion

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