Computing and Global Health: Bridging Health System Needs and Computing Solutions

Richard Anderson
Department of Computer Science and Engineering
University of Washington

PATH
What I did during my sabbatical
PATH, Seattle
PATH

- Seattle based NGO working in health technologies
- Founded 1977
  - Now working in 70 countries
- Program for Appropriate Technology in Health
- Approximately 1000 employees world wide, 400 in Seattle
PATH focus

• Solutions for emerging and epidemic diseases, like AIDS, tuberculosis, and malaria.
• Health technologies designed for low-resource settings, by the people who will use them.
• Safer childbirth and healthy children.
• Health equity for women, among the world’s most vulnerable—and influential—populations.
• The basic protection of vaccines for women and children around the world.
Path Mission Statement

Our mission is to improve the health of people around the world by:

– Advancing technologies
– Strengthening systems
– Encouraging healthy behaviors
PATH Organization

Board of Directors
- President and CEO: Christopher Elias

Executive Leadership Team
- VP and Senior Advisor for Technologies: Michael Free
- VP Field Programs: Ayorinde Ajayi
- VP Global Programs: Jacqueline Sherris
- VP External Relations: Scott Jackson
- VP Corporate Services: Eric Walker

Field Programs
- Country Programs:
  - Cambodia: Michelle Gardner
  - China: Bankang (Jack) Zhang
  - India: Anjali Nayar
  - Kenya: Rikka Trangrud
  - Nicaragua: Margarita Quintanilla
  - South Africa: Catherine Brokenshire-Scott
  - Tanzania: Mohammed Makame
  - Thailand: Brian McLaughlin
  - Ukraine: Kateryna (Katya) Gasamzina
  - Vietnam: Mona Byrkit
- Multi-Country Programs:
  - Malaria Control Program
  - Carlos (Kent) Campbell

Global Programs
- HIV and Tuberculosis: Julie Pulerwitz
- Vaccine Access and Delivery: John Wecker
- Malaria Vaccine Initiative: Christian Louq
- Maternal and Child Health and Nutrition: Catharine Taylor
- Meningitis Vaccine Project: Marc LaForce
- Reproductive Health: Brandon Gilbert

External Relations
- Advocacy Program Initiatives
  - Global Campaign for Microbicides
- Advocacy and Public Policy
  - Rachel Wilson
- Business Development Support
  - Suzanne Rexing
- Communications and Media Relations
  - Amy MacIver
- Donor Relations
  - Ian Jacobs
- Marketing and Visibility
  - Ellen Cole
- Publication Services
  - Michele Burns

Corporate Services
- Finance: Marlow Kee
- Human Resources: Sharon Thompson
- Information Services: Erik Arnold
- Infrastructure: Doug Palm
- Legal Affairs: Dan Laster, General Counsel

Technology Solutions: Michael Free

Vaccine Development: John Boslego

10/12/2010
CSE Colloquium
Technology Solutions

• Immunization & vaccine technologies
• Diagnostic tests for diseases
• Reproductive health technologies
• Maternal & child health technologies
• Nutrition technologies
• Safe water
• Health management information systems
PATH Technologies

• Develop basic health technologies
• Work with partners to commercialize technologies
HEATmarker™
Vaccine vial monitors

Illustration of HEATmarker™ Color Change

- The square is lighter than the circle. If the expiry date is not passed, use the vaccine.
- The square is lighter than the circle. If the expiry date is not passed, use the vaccine. Soon!
- The square matches the circle. Do not use the vaccine. Inform your supervisor.
- The square is darker than the circle. Do not use the vaccine. Inform your supervisor.
Injection Technologies
Maternal and Reproductive Health
Nutrition and Safe Water
What is the role of computing in PATH’s portfolio?
Bridging between Global Health and Computing

• The real challenge is the sustained integration of computing technologies into health systems
• Computing and Health are very different domains, with different skill sets and knowledge bases
Computing and Global Health

• Broad interest in introducing computing based solutions to health challenges

• Rapidly changing technological landscape
Global Health Landscape
Health Information Systems Projects

- Planning support for the vaccine cold chain
- Information services for tuberculosis management in Tanzania
- Communication needs of peripheral health facilities in Nicaragua
CCEM: Cold Chain Equipment Manager

• Problem: Understand a nation’s vaccine refrigerator capacity
• PATH software project to develop a planning tool for use by countries’ Ministries of Health
• Not rocket science
  – Database of equipment and a simple analysis algorithm
• Domain understanding critical for this work
• “MOH Software” could be a high impact domain
Q: I'm just curious - and this must be very hard as very practical, successful people to admit - but has there been an occasion where you've let some foundation money out the door and after a couple of years you would say, oh, that was pretty much a failure; that was wasted money; didn't work?

Melinda Gates: And sometimes you make a mistake where it's a fantastic investment but there's a little piece of it you didn't get right. So, a great example is rotavirus. We have, thank God, an amazing life-saving vaccine that's coming for kids. And it's actually being delivered now in Nicaragua; we're going to get it out in lots of places. It's a vaccine against diarrhea. . . . Well, unfortunately, the rotavirus packaging came out too large. We had these large boxes. Well, you can't carry large boxes of vials of vaccinations out into villages. That requires too much refrigeration.
Cold Chain
Cold Chain
Old vs. New Vaccines

4,100 doses
Polio and Measles
$635

625 doses
Rotavirus
$4,687
CCEM Vision

- Capture expertise of cold chain experts in software
- Provide a basic tool for analyzing a nation’s cold chain
- Enable countries to do their own cold chain analysis
- Model
  - Initial cold chain inventory
  - Inventory updates
  - Cold chain analysis
CCEM Implementation

- Visual Basic / Microsoft Access Application
- Catalogs / Data Entry / Reporting / Forecasting
Engineering CCEM

- Development History
  - CCEM 1.0: PATH with developer
  - CCEM 2.0: External contract
  - CCEM 2.1: PATH with project management and external developer

- Challenges and experiences from CCEM are not unique

- Lessons from CCEM 2.1
  - Need for specifications
  - Communication with developers
  - In house software testing
  - Management of data sets
  - Issue tracking
CCEM Results

• Where are the capacity shortages with respect to the current national vaccine schedule?
• What is the impact on refrigeration capacity of adding Pneumococcal vaccine to the national schedule?
• Suppose all old Electrolux refrigerators are removed from health centers
  – What is the impact on needed capacity?
  – What is the savings in energy costs?
• What percentage of health posts have storage requirements of less than 5 liters?
Bigger Picture

• National Level Equipment Inventory
  – Assumptions: Inventory of refrigerators at facilities, demographic info for facilities
  – Scale: Kenya, 40 M people, 5000 health facilities

• MOH level software
  – Target planners in EPI (Extended Program of Immunization)

• Country adoption
  – Introduction with support of UNICEF / WHO
  – Push: Concern of refrigeration capacity shortages with the introduction of new vaccines
CCEM Opportunities

• Web based application on top of a real database
  – Database, Modeling Engine, and possibly a GIS
• Practical solution needed for database updates
  – Remote updates
  – Data submission from peripheral facilities
• Challenge for application
  – Common functionality for modeling
  – Country based customization for local needs
Handheld CCEM

• Implement CCEM functionality on a Handheld device
  – Data collection
  – Modeling and analysis

• Target the district supervisor
  – District supervisor has management authority and will benefit from access to information
  – Mobile device needed for supervisory visits
Information flows for Tuberculosis management in Tanzania

• Projects
  – Mobile phone support for community health workers to identify suspected cases of Tuberculosis
  – Electronic support for Tuberculosis case reporting for national surveillance
Tuberculosis

- Infectious disease primarily affecting the lungs
  - Chronic cough, spitting blood, weight loss
- Worldwide impact [2007]:
  - 13.7 M active cases, 1.8 M deaths
  - Co-occurrence with HIV
- Diagnosis in lab with microscope from sputum sample
- Treatable with long course of antibiotics
  - DOTS: Directly observed treatment short course
  - Emergence of drug resistant strains of TB
Information Flows for TB Case Detection and Treatment

• Key problem: detect new cases of TB and get patients enrolled for treatment

• Information processes
  – Suspect Identification
  – Lab diagnostics
  – Enrollment
  – Reporting

• Develop a formal understanding of these processes to provide requirements for information technology projects
Process Diagram for Identification/Enrollment

1. Suspect Identified

2. TB 03 Collect Sample at Clinic

3. TB 05 Test Sample in Laboratory

4. Result Delivered to Patient

5. Positive

6. TB 01 TB 02 TB 03 Enroll in Treatment

7. Start Treatment

NOTES:
2) Variation observed in usage TB 03 register
5) In some cases, a retest is done in 7 days on negative result
Mobile Phones for Community Health Workers

• Assist tuberculosis case identification by CHWs in Tanzania
  • Small pilot in Kis aware District, Tanzania
    – Apr through Aug 2010
  • D-Tree / CommCare
    – Diagnostic checklist
    – Data collection
    – Reminders
    – Case tracking
    – Supervision
Workflow for Household visit

1. Household education
2. Ask TB screening questions from checklist
3. Case identified
4. Conduct referral
5. Follow up
6. Update status
7. Complete log book entry for visit

NOTES:
1) General information about TB presented before screening
2) Ask screening questions about all people in household
4) Collect information for referral and give information on going to clinic
6) Whether client has been tested, result of test, or treatment status
Tuberculosis Surveillance

- National record of all TB cases and treatment
  - Understand progress in managing the disease
  - Report to donors
What we learned

• Information flow
  – Clinic TB 03 register
  – District TB 04 register
  – National Electronic register

• Clinic
  – Maintain patient register
  – Unofficial registers used in conjunction with TB 03

• District
  – District supervisor collects information for TB 04 register on facility visits
  – Quarterly reporting to ETR
  – Additional reporting requirements
Electronic support for surveillance reporting

Rejected idea

• Clinic based reporting to national system by mobile phone
  – Phone poor form factor for data entry
  – Basic phones not appropriate because this can’t be a text message application
  – Deployment issues for feature/smart phones
  – Change in workflow at the district level
  – Lack of demand for real time reporting of data

Current idea

• Electronic version of the District TB register
  – District supervisor will copy from facility register, then electronic submission upwards
  – Requirements
    • Mobile device
      – Likely a laptop
    • Data safety
      – Automatic backup
  – Registers are very common, so this is an important area
  – Develop requirements, then decide on development strategy
Communication Needs of Peripheral Health Facilities

• How can a digital dial tone be established with remote health facilities?
• Technical question: What type of device do we use to establish a data connection?
• User needs question: What would a health clinic do with a data connection?
• Health system question: How does a data connection link to the sustainable information processes of the health system?
Yolaina, Nueva Guinea, Nicaragua
Yolaina
El Serrano: Doctor with Assistant
La Fonseca
Technical Solution

- Take advantage of cellular network
- SMS connectivity
  - 161 character messages
  - $0.00 to $0.20 per message
  - Augment to GPRS when appropriate
- Focus on facility owned communication appliance
  - Not a user programmable device
  - Not a mobile communication device
Smart Connect
FoneAstra (Rohit Chaudhri)
Clinic Level Applications

- Field visits
  - January
  - August (Nell O’Rourke)

- Basic communication
  - “Call me” message
  - Administrative broadcast

- Surveillance reporting
  - Summary of cases
  - Vaccinations

- Incidence Reporting
  - Cases of Dengue Fever

- Diagnostic results
Health System Considerations

• Health systems applications only apply if used at scale
• Sustainability: provide benefit to organization who will fund and keep devices running
• Potential for Nicaragua
  – Well organized health system
  – National surveillance system
    • Quality control
    • Desire for up to date information
  – Radio based system for communication with remote facilities
• Multi application vs. single application deployments
Back to Bridges

• Public health software
  – Domain expertise and state of the art software
  – Power of data and analytics for decision making

• Health system requirements
  – Description language for health business processes
  – Greater involvement of health system in IT design
  – Clearer specification of desired systems

• Electronic infrastructure for health systems
  – Software applications for health information flows
  – Integration with national level systems
Questions or Comments?