Computing and Global Health

Winter 2015

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Today: Course Overview

- What is computing and global health?
- Course organization and HW 1
- Background
  - Computing
  - Global health challenges
  - Health systems
  - Stakeholders
  - Millennium Development goals
  - Infrastructure
- Topics

Course organization

- Course organized by functional domain
  - Other options
    - By technology
    - By health domain

Date	Topic
Jan 7, 2015	Overview
Jan 14, 2015	Surveillance
Jan 21, 2015	Tracking
Jan 28, 2015	Medical records
Feb 4, 2015	Logistics
Feb 11, 2015	Patient support
Feb 18, 2015	Treatment support
Feb 25, 2015	Health worker support
Mar 4, 2015	Behavior change
Mar 11, 2015	Finance

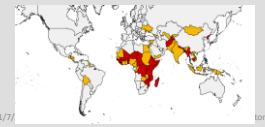
Course mechanics

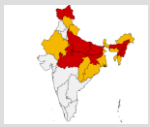
- Weekly lectures
- Weekly reading
- Additional optional readings
- Weekly assignments
  - Usually written
  - Submit word / PDF by email or other means
- Two multi-week lab assignments to learn about important tools
  - DHIS2 (dhis2.org)
  - ODK (opendatakit.org)
- You will be able to miss a couple of assignments
  - Course grade based on top 7 assignment scores out of 9.
- No term project
- No final exams

http://courses.cs.washington.edu/courses/csep590b/15wi/

Assignment 1a

- Pick three countries to become an 'expert' on
  - Assignments will often require specializing questions to countries, so pick countries in advance so you acquire background
  - Choose LICs (Low income countries) or LMICs (Low-middle income countries) but not UMICs or HICs
  - If you want to work with India, choose a low income state of India

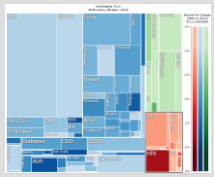




Assignment 1b

- Write a summary of the health challenges of your three countries. Use IHME's GBD visualization tool as a data source.

http://www.healthdata.org/results/data-visualizations

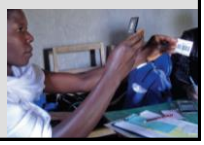


Assignment 1c

- For one of your three countries, design a national system for monitoring the countries vaccine cold chain equipment
- The system should capture information about whether or not vaccine refrigerators are working so that the indicator "percentage of time facilities have working refrigerators" can be computed
- Document challenges and trade offs in implementation of this system

What is 'Computing and Global Health'?

- Study of the use of Information and Communications Technology (ICT) to improve health care and health systems in developing countries



Global health challenges

- Burden of disease
  - Infant / Maternal mortality rates
  - Infectious diseases
- Weak health systems
  - Limited health infrastructure
  - Few doctors
- Poverty

The opportunity

- How eHealth can support improving global health?

Information and Communication Technology has changed everything else, why not global health?

Information and Communication Technology is required for or enables specific interventions which strengthen health systems

But eHealth isn't everything

- Doctors and health workers
- Finance
- Governance
- Infrastructure
- Pharmaceuticals
- Vaccines
- Medical research
- Sanitation

Where is the Computer Science?

Getting the technology correct

- Implementation of large scale systems in novel settings
- Challenging blend of technologies
- Opportunity to implement with current technologies
  - People involved with implementation may not utilize current technologies
  - People in charge of implementation may not understand current technologies

Problems at scale

- Health systems are large
  - Impacts everyone
- Basis of computer science: what happens when *n* gets large?
- Focus of computer science and the computing industry
  - Large scale deployment
  - Autonomous deployment
  - Robust deployment

Data

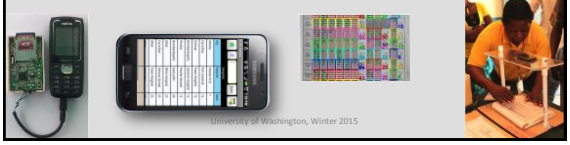
- Essentially all ICT applications in global health involve data
- Computer science
  - Database management
  - Data visualization
  - Data processing
  - Big data

HCI and Usability

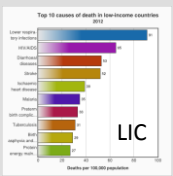
- Novel applications
- New user populations
- Technology change

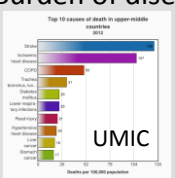
Innovation

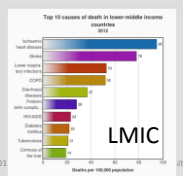
- Potential for computing ideas to have impact

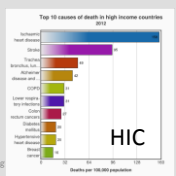


Health domains / Burden of disease









Source: WHO

Immunization

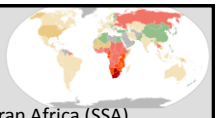
- Routine immunization: "Most successful public health intervention ever"
  - Reach is near universal
- Schedule of about 6 to 8 vaccines over first two years
- Vaccine logistics: making sure there is enough stock and keeping vaccines cold
- Coverage problem: reach the fifth child
- Push to introduce new vaccines
- Polio is a special case

Major diseases

- HIV / TB / Malaria

The Global Fund
To Fight AIDS, Tuberculosis and Malaria

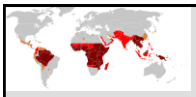
HIV



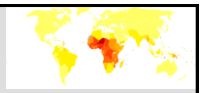
- High rates of infection in Sub Saharan Africa (SSA)
- Wide scale introduction of Anti Retroviral Therapy (ART)
- Massive resources devoted to HIV
  - President's Emergency Plan for AIDS Relief (PEPFAR)
  - Direct support for 4.5 million people on ART
- Issues of stigma
  - Sex workers, Men who have sex with men, IV Drug users
- Case based treatment
- Behavior change to reduce transmission
- Prevention of mother to child transmission (PMTCT)

Tuberculosis

- Widespread lung disease
  - Roughly 1/3rd of population estimated to have latent TB
  - Active TB
    - Chronic cough, spitting up blood
- Treatable with antibiotics
  - Rise of Multidrug Resistant (MDR) TB
  - Six month treatment regimen, but symptoms disappear earlier
  - Directly observed therapy, short-course (DOTS)
- Case detection
  - View sputum sample under microscope



Malaria



- Parasitic disease transmitted by mosquitos
  - Recurrent fever
  - Significant cause of childhood deaths
- Treatable with various drugs
  - Diagnose and treat vs. Presumptive treatment
- Malaria eradication
  - Europe and US used to be malarial
  - Disrupt cycle at multiple points
    - Habitat, mosquito elimination, infection prevention, parasite reservoir
    - Track individual cases for elimination
- Hope for vaccine

Maternal and child health and nutrition (MCHN)

- Maternal Mortality Rate (Deaths per 100,000)
- Infant Mortality Rate (Deaths per 1,000 live births)

	MMR (1990)	MMR (2013)	IMR (1990)	IMR (2013)
Ethiopia	1400	420	115	58
India	560	190	76	42
Nigeria	1200	560	126	73
USA	12	28	9	5

- Causes of maternal death: postpartum hemorrhage, eclampsia, obstructed labor, and sepsis
- Causes of infant death: preterm delivery, infection, asphyxia
- Interventions
  - Improved care, institutional delivery, antenatal care visits, recognition of danger signs, immunization, community health workers

Reproductive health

- Access to Family Planning
  - Temporary and permanent methods
- Challenges
  - Awareness, cultural barriers, logistics, finance

Neglected tropical diseases

- Chagas, Human African trypanosomiasis, Leishmaniases, Buruli ulcer, Leprosy, Trachoma, Yaws, Cysticercosis/Taeniasis, Dracunculiasis, Echinococcosis, Foodborne trematodiases, Lymphatic filariasis, Onchocerciasis, Schistosomiasis, Soil-transmitted helminthiasis, Dengue and Chikungunya, Rabies
- Limited support for care, research, and eradication
- Lack of financial incentives for pharmaceutical companies
- Need for surveillance and diagnostics

Infectious diseases

- Diarrhea and Pneumonia are the top two causes of childhood deaths
- Vaccines are being introduced to prevent some of these deaths
- Treatment
  - Diarrhea: Oral Rehydration Salts
  - Pneumonia: Antibiotics
- Emergent infectious diseases
  - SARS, Ebola

Chronic diseases

- Hypertension, Diabetes, Smoking related illness
  - Increasing burden in developing countries
  - Limited focus in global health
  - Lifestyle interventions and public health

Health systems

- Common structure across the world
- Majority of health care delivered by the public system (with a private system for the affluent)
- Staffing
  - Health system: Doctors, Nurses
  - Community: Community health workers, ASHAs
  - Private: Pharmacists, Shop keepers, Private practice, traditional

Facility hierarchy

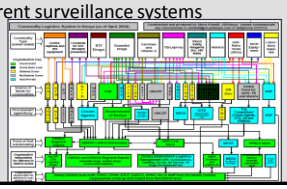
- Administrative hierarchy
  - Country, Province, District, Subdistrict
- Health facility hierarchy
  - Province hospital, district hospital, health center, health post
- Often similar hierarchies.
- Hierarchies important for administration, finance, and reporting

Ministry of Health

- Health minister: moderately important cabinet position
- Multiple departments inside MoH
  - Separate departments for some diseases, immunization, supplies, surveillance
- Issues in working across departments
  - Collecting data and using data
- Potential issues in at different levels of the country
  - Powers devolved to provinces or regions

Disease verticals

- Different health domains work independently
  - Different funding
  - Different donor requirements
  - Different personal
  - Different supply chains
  - Different surveillance systems



External Stakeholders

- Follow the money . . .

Global

- World health organization
- UNICEF
- GAVI

Donors

- Bill & Melinda Gates Foundation
- USAID
- DFID
- GDZ
- NORAD

Implementing NGOs

Research establishment

THE EARTH INSTITUTE COLUMBIA UNIVERSITY

JOHNS HOPKINS CENTER FOR GLOBAL HEALTH
Transcending Borders for World Health

UNIVERSITY of WASHINGTON DEPARTMENT OF GLOBAL HEALTH
SCHOOL OF MEDICINE • SCHOOL OF PUBLIC HEALTH

THE HARVARD MEDICAL SCHOOL

IFAKARA HEALTH INSTITUTE

Institute for Health Metrics and Evaluation

Technology NGOs

inveneo.

dimagi

DATADYNE
We get data.

wisp
HEALTH INFORMATION SYSTEM PROGRAMME

ONEXLEAF

OpenMRS

NAFUNDI

Millennium development goals

- International development goals established by United Nations in 2000
- Targets results by end of 2015

Millennium development goals

1. To eradicate extreme poverty and hunger
2. To achieve universal primary education
3. To promote gender equality and empower women
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria, and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for development

Targets and Indicators (1-3)

- Goal 1: Eradicate extreme poverty and hunger
  - Target 1A: Halve, between 1990 and 2015, the proportion of people living on less than $1.25 a day
    - Poverty gap ratio [incidence x depth of poverty]
    - Share of poorest quintile in national consumption
  - Target 1B: Achieve Decent Employment for Women, Men, and Young People
    - GDP Growth per Employed Person
    - Employment Rate
    - Proportion of employed population below $1.25 per day (PPP values)
    - Proportion of family-based workers in employed population
  - Target 1C: Halve, between 1990 and 2015, the proportion of people who suffer from hunger
    - Prevalence of underweight children under five years of age
    - Proportion of population below minimum level of dietary energy consumption
- Goal 2: Achieve universal primary education
  - Target 2A: By 2015, all children can complete a full course of primary schooling, girls and boys
    - Enrolment in primary education
    - Completion of primary education
- Goal 3: Promote gender equality and empower women
  - Target 3A: Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015
    - Ratios of girls to boys in primary, secondary and tertiary education
    - Share of women in wage employment in the non-agricultural sector
    - Proportion of seats held by women in national parliament

Targets and Indicators (4-5)

- Goal 4: Reduce child mortality rates
  - Target 4A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
    - Under-five mortality rate
    - Infant (under 1) mortality rate
    - Proportion of 1-year-old children immunized against measles
- Goal 5: Improve maternal health
  - Target 5A: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio
    - Maternal mortality ratio
    - Proportion of births attended by skilled health personnel
  - Target 5B: Achieve, by 2015, universal access to reproductive health
    - Contraceptive prevalence rate
    - Adolescent birth rate
    - Antenatal care coverage
    - Unmet need for family planning

Targets and Indicators (6)

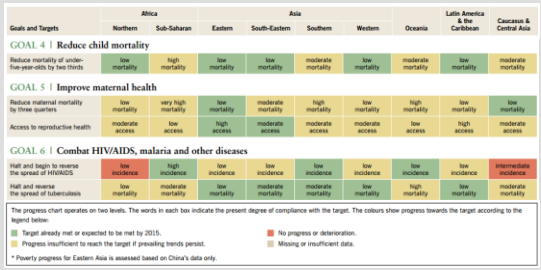
- Goal 6: Combat HIV/AIDS, malaria, and other diseases
  - Target 6A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS
    - HIV prevalence among population aged 15–24 years
    - Condom use at last high-risk sex
    - Proportion of population aged 15–24 years with comprehensive correct knowledge of HIV/AIDS
  - Target 6B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it
    - Proportion of population with advanced HIV infection with access to antiretroviral drugs
  - Target 6C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
    - Prevalence and death rates associated with malaria
    - Proportion of children under 5 sleeping under insecticide-treated bednets
    - Proportion of children under 5 with fever who are treated with appropriate anti-malarial drugs
    - Incidence, prevalence and death rates associated with tuberculosis
    - Proportion of tuberculosis cases detected and cured under DOTS (Directly Observed Treatment Short Course)

Targets (Goals 7-8)

- Goal 7: Ensure environmental sustainability
  - Target 7A: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources
  - Target 7B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
  - Target 7C: Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation (for more information see the entry on water supply)
  - Target 7D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum-dwellers
- Goal 8: Develop a global partnership for development
  - Target 8A: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system
  - Target 8B: Address the Special Needs of the Least Developed Countries (LDCs)
  - Target 8C: Address the special needs of landlocked developing countries and small island developing States
  - Target 8D: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
  - Target 8E: In co-operation with pharmaceutical companies, provide access to affordable, essential drugs in developing countries
  - Target 8F: In co-operation with the private sector, make available the benefits of new technologies, especially information and communications
    - Telephone lines and cellular subscribers per 100 population
    - Personal computers in use per 100 population
    - Internet users per 100 Population

Progress to MDG (2013)

http://www.un.org/millenniumgoals/pdf/report-2013/2013_progress_english.pdf



Health Indicators

- Numbers to quantify health outcomes
- Standardized to allow a basis of comparison
- Challenges and issues
  - Often inaccurate or based on very different estimates
  - Errors or bias in reporting
  - Denominator issues (guessing at the population)
  - Achieving good indicators can influence policies

Technologies

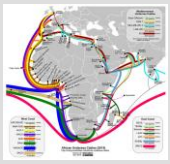
- Technology is changing very rapidly
- In the capital city
  - Computers, WIFI, Starbucks, electricity
- In the district town
  - Network by WIFI Dongle
- In the remote health post
  - More challenging

Electrical Infrastructure

- Highly variable by country
- Major cities often have reliable power
- Some areas have frequent cuts due to lack of capacity or fuel (power off 20 hours a day)
- Remote areas may be cut off from grid for extended periods of time for repairs
- Health facilities often have generators
  - But can be expensive to run

Networking Infrastructure

- Dramatic improvement in network bandwidth
  - Most countries have substantial international connectivity
- Domestic fiber increasing
- Connections through mobile network
  - High variation in price



Computing Infrastructure

- Windows
  - Windows 7, Windows 8, Windows XP
  - Office
  - Substantial improvement in quality of PCs in recent years
- Linux and Apple
  - Tech NGOs
- Server hosting issues

Mobile phone infrastructure

- Very high penetration of mobile phones
- Most health workers will have access to a mobile phone
- However
  - Some remote areas will not have access
  - Some countries have low competition and consequently high costs
  - Paying for calls or charging phones will be an issue in some places

Smart phones and dumb phones

- Smart phones and tablets are growing very fast in developing countries
  - Low cost Android phones ($50) or proprietary OS touch phones
  - Fastest growth in urban areas and amongst the youth
  - Social media and multimedia apps
- Feature phones are still important for multimedia

Additional issues

Data ownership and privacy

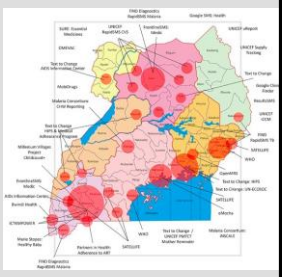
- Countries protective of health data
  - Proprietary data
  - Concerns about loss of control or 'looking bad'
- Where is the data hosted?
- How sensitive is health data
  - Risks of disclosure
  - Practices are common that would not be acceptable/legal in the US
  - Where is there an expectation of privacy on data

Research Ethics and IRBs

- Very strict ethics requirements have been developed for medical research (in response to horrific abuses)
  - Many countries have also established review boards
- Principles
  - Informed consent
  - Free from harm
  - Avoid conflicts of interest
- Process designed for controlled trials but less clear for other activities
  - Is it research?
  - Issues on conducting a pilot project that won't be continued

mHealth pilots

- Country reaction against small mHealth projects
  - Several countries have declared moratoriums. "No more pilots"
- Issues
  - Lack of results from Pilots
  - No sustainability plans
  - Incompatibility



Topics

Surveillance

- Collect national health statistics
- Monthly report of how many children have been vaccinated for measles from every health facility in the country

Patient Tracking

- Track people with a specific condition
- Maintain a registry of all TB patients in the country with weekly updates on medication taken

Medical records

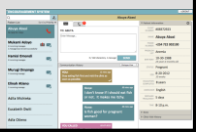
- Clinical records of patients with full history of health treatment and lab tests
- Care of HIV patients with access to lab tests

Logistics

- Deliver drugs and medical supplies to health facilities
- Track the stock levels of vaccines at all health facilities and storage depots to have advanced warning of impending stockouts


Patient support

- Assist the patient in receiving appropriate care
- SMS information and reminder messages during pregnancy

Treatment support

- Tools to assist in the diagnosis or treatment of a condition
- Pulse oximeter connected to a mobile device to assist health worker in diagnosing pneumonia

Health worker support

- Tools to assist health workers in performing their tasks
- Mobile data collection tools to allow community health workers to record information about household visits


Behavior change

- Promote or create awareness of practices that will improve health
- Mobile phone videos to assist couples in understanding their family planning options


Finance

- Providing mechanisms to pay for services
- Mobile money for community health worker incentive payments


Next week

- Assign 1 Due, Start of class
- Topic - Surveillance