


Computing and Global Health Lecture 7 Treatment support and mobile devices

Winter 2015
Richard Anderson

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Today's topics

- Aditya Vashistha
 - Voice based messaging
- Treatment Support
 - Adherence
 - Protocol Support
 - Diagnostics
- Gadgets
 - Hijack
 - ODK Sensors
 - FoneAstra
 - Partopen
 - CellScope
 - ColdTrace



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Readings and Assignments

- Readings
 - eIMCI
 - CellScope
 - Hijack
- Homework 6
 - Design an SMS syntax for cold chain reporting
- Homework 7
 - Paper prototype of medical protocol
 - Details TBD
- Homework 8
 - Open Data Kit

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

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Homework 7: SMS Reporting



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Homework 7: Solutions

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Data Record | Symbol | Complete Syntax | Example
---|---|---|---
Monthly Stock | MS | MS [pen system yyyy] [Fridge status] [B10] [C] [D] | MS pen 2013 [Fridge OK] B10 C D
Stock Out | SO | SO [quantity short code] | SO pen 3
Refrigerator Failure | RF | RF [Fridge status] | RF a b c
Refrigerator Repair | RR | RR [Fridge status] | RR a b c
Temperature Failure | TF | TF [Fridge status] | TF d
    
```

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[Facility] OR
[optional 6 digit facility code] followed by
[digit days high] [digit days low] [character: a-z fridge ID]
[digit quantity] [stock prefix non-digit character: a-g pen for pentavalent vaccine]
[quantity] [stock or fridge prefix: a-g a-z or pen for pentavalent vaccine]
[emergency] followed by
[pen stock prefix]
[refrigerator]
[temperature]
    
```

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Medication Adherence

- TB and HIV
 - Concerns about drug resistant strains
- Adherence obstacles
 - Side effects, inconvenience, perceived cure, stigma

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Adherence

- Direct Observation Therapy
 - Health worker observes daily medication
 - Home or clinic
 - Considered burdensome
 - Variations
 - Family member observes
 - Pick up medication every few days



WHO TB Strategy
Pursue high-quality DOTS expansion and enhancement

1. Secure political commitment, with adequate and sustained financing
2. Ensure early case detection, and diagnosis through quality-assured bacteriology
3. Provide standardized treatment with supervision, and patient support
4. Ensure effective drug supply and management
5. Monitor and evaluate performance and impact

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TB Drug Distribution

- Fingerprint scanning in drug distribution
 - Reduce record keeping and increase accuracy
 - Verification of drug pick up
 - Allow follow up of non-compliant



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SMS Reporting

- Send confirmation code associated with each pill to a given number



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Pill box notifications

- Pill box records openings
- Dispense a fixed amount each day
- SimPill – built in SMS modem and simcard
 - Automatic notifications
 - Initial development for low resource settings but commercialized for developed world



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Delivery of health services

- Routine care delivered by Nurses or CHWs
- Problems to solve
 - Consistent delivery of services
 - Standards based
 - Competent
 - Availability
 - Appropriate escalation and referral

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Vision versus reality



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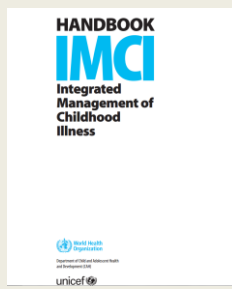
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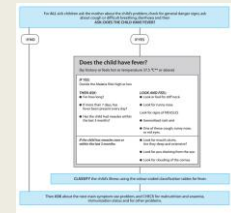
IMCI

- WHO Designed protocol on diagnosing/treating childhood illness
- Step through diseases with flow chart
- Target nurses/health workers
- Standardize care

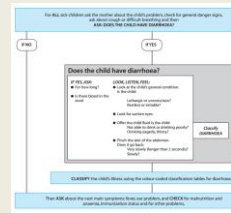


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IMCI



The IMCI flowchart for fever is designed to help health workers decide if a child has a fever and what to do next.



The IMCI flowchart for diarrhoea is designed to help health workers decide if a child has diarrhoea and what to do next.



Category	Signs and symptoms	Management
Diarrhoea	Stools with mucus or blood	Refer to hospital
Diarrhoea	Stools with mucus	Refer to hospital
Diarrhoea	Stools with blood	Refer to hospital
Diarrhoea	Stools with pus	Refer to hospital
Diarrhoea	Stools with pus and blood	Refer to hospital
Diarrhoea	Stools with pus and mucus	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever and dehydration	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever and dehydration and severe dehydration	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever and dehydration and severe dehydration and shock	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever and dehydration and severe dehydration and shock and convulsions	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever and dehydration and severe dehydration and shock and convulsions and coma	Refer to hospital
Diarrhoea	Stools with pus and blood and mucus and fever and dehydration and severe dehydration and shock and convulsions and coma and death	Refer to hospital

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Tanzania e-IMCI Study


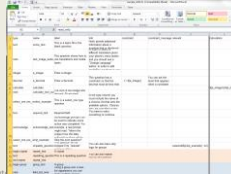
- Implement IMCI on a PDA
- Goal:
 - Demonstrate improved compliance to IMCI protocol
 - No increase in time of visits

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Open Data Kit 1.0

- Collect
 - Forms based data collection application running on Android device
- XLSForm
 - Form creation tool reading in Excel spreadsheet
- Aggregate
 - Backend server to receive data

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IMCI to ODK



- Convert IMCI Protocol to decision tree
- Encode in forms
- Establish branching logic
- Implement in spreadsheet
 - Compile to ODK



- Challenges
 - Extracting the decision tree
 - Verification of wording and workflow
 - Usability
- Medical review of IMCI
 - Difficulty in adapting protocol
 - Official approval of protocol
 - Determining correspondence of electronic and paper version

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IMCI + Pulse Oximetry

- Measure blood oxygen level
- Low oxygen levels can indicate pneumonia
- Add blood oxygen level into pneumonia questions
- Pulse oximeter connected to mobile phone so readings entered automatically

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Diagnostics

- Issues
 - Cost of test
 - Precision of test
 - Accuracy of test
 - Error profile
 - Action on positive test
 - Action on negative test
 - Goals
 - Individual treatment
 - Public health goals

	Positive Test	Negative Test
Have disease	True Positive	False Negative
Don't have disease	False Positive	True Negative

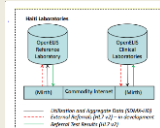
Lab Diagnostics

- Highly accurate tests
 - E.g., Enzyme-linked immunosorbent assay (ELISA)
 - Microscopy
- Requires infrastructure, trained staff, equipment
- Issues
 - Costs
 - Transport of samples
 - Delays in processing or notification



Lab Information System

- Internal lab management
- Tracking of samples and tests
- Interoperability with medical records
- Notifications
- Probably not much difference between developed and developing world



Rapid Diagnostic Tests

- Point of Care Tests
 - Deliver results without sending test to lab
 - Fast turn around
 - Limited test preparation
- Lateral flow immunochromatographic assays
- Large number of tests available
 - Blood, Urine
 - HIV, Malaria, Syphilis



ODK Diagnostics

- Nicki Dell, Gaetano Borriello
- Image analysis on Smartphone to read RDT
 - Computation done locally
 - Template to adapt to multiple tests
- Use cases
 - Enable lesser trained health workers to conduct tests
 - Support tests which are not frequently used
 - Supervision
 - Quality control
- Field trials
 - Zimbabwe



Gadgets

Hijack

- Sensor interface through audio jack
- EKG Interface
- Soil temperature monitor
- UBC Pulse Oximeter for iPhone
- HIV Diagnostic



Figure 14: The Hijack base platform, with a 1" x 1" footprint, offers power (>5 mW), analog (2x 12-bit), digital (1x GPIO), and serial (1x I2C and 1x UART) interfaces, exported via connectors, and all multiplexed over the headset port. This board provides the functionality needed to build a variety of external sensor interfaces for the mobile phone.

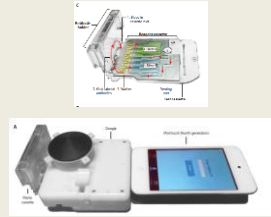
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Smartphone for point of care diagnosis

- Recent press attention on HIV/Syphilis diagnosis by Columbia University
- Laboratory quality immunoassay
- Ultra low power
- Power from cell phone
 - iPhone = Battery
 - Signal processing on cell phone to generate results



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ODK Sensors

- Build a user-level sensing framework with sensor drivers
 - No operating system modifications
 - Allows convenient reuse between applications
- Create a single sensor interface
 - Access wired, wireless, and built-in sensors
 - Support multiple sensors over multiple channels
- Focus on ease of deployment and development
 - Distribution through existing app store model
 - Reduce complexity
 - Without adverse effects on performance



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Fone Astra

- Sensor connection to low cost phone
 - Phone for communication and output
- \$25 board + \$25 phone
- Temperature monitoring



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Android Fone Astra

- Version 2 of FoneAstra replaced basic phone with Android phone
- Communication by bluetooth or USB
- Separate power for FoneAstra device
- Programmability and UI on phone



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Milk Pasteurization

- Human milk pasteurization
- Replace high price pasteurizer with hotplate
- Temperature monitoring to ensure proper heating and verify quality

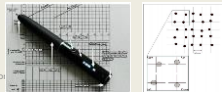
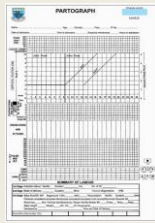


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PartoPen

- Paper record of birth progress
 - Plot dilation versus time
 - Too slow, issue an alert
- Idea
 - Implement using a LiveScribe digital pen
- Deployment
 - Nurses in Kenya, in both training and practice



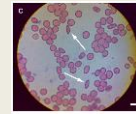
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Cell Scope

- UC Berkeley project
 - Dan Fletcher, Bioengineering
 - Build a cheaper microscope for diagnostics



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Cold Trace

- Remote temperature monitoring
- Connection through audio port to Android phone
- Deployments now rely on a single model of low cost Android phone
- Well engineered product with substantial support
- Need for multi sensor device



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Next week

- Supporting the health worker



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