

Computing and Global Health
Lecture 7
Treatment support and mobile devices

Winter 2015
Richard Anderson

Today's topics

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



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

Homework 7: SMS Reporting

WVEE1 - ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
 ຄຳແນະນຳການສົ່ງຂໍ້ຄວາມສັນ (SMS) ເພື່ອລາຍງານການເຕືອນອຸນຫະພູມ ຈາກອຸປະກອນຕິດຕາມອຸນຫະພູມ 30 ວຽງ
 ສະແດງຈຸດທີ່ມີຕູ້ເຢັນຫຼາຍໜ່ວຍ (ຂຽນແຂວງ ແລະ ເມືອງ)

ຈະສົ່ງຂໍ້ຄວາມສັນ (SMS) ແບບໃດ ເມື່ອອຸປະກອນສະແດງ ການເຕືອນ "Alarm"

ສົ່ງ SMS ທຸກໆ ວັນຈົນ ທ່າອິດຂອງເດືອນ

ສົ່ງ SMS ຜ່ານ FT A32B10 ໄປທີ່ເບີ 020 XXXX

ເຕືອນ (Alarm):
 ສົ່ງ SMS ລາຍງານ ຕູ້ເຢັນ 1 ແລະ 2

"OK"
 ບໍ່ຕ້ອງສົ່ງ SMS ສຳລັບ ຕູ້ເຢັນ 3 ແລະ 4

ຈະສົ່ງຂໍ້ຄວາມສັນ (SMS) ແບບໃດ ເມື່ອອຸປະກອນສະແດງ "OK"

ສົ່ງ SMS ຜ່ານ FT 0 ໄປທີ່ເບີ 020 XXXXXX

ຖ້າຕູ້ເຢັນສະແດງຄຳວ່າ OK, ໃຫ້ສົ່ງ SMS ວ່າ FT0 ເພື່ອບອກ ວ່າບໍ່ມີການເຕືອນໃດໆ

Homework 7: Solutions

```

OneCharId ::= [a-zA-Z]
TwoCharId ::= (OneCharId)(OneCharId)
FacilityId ::= '@'(TwoCharId)(TwoCharId)(TwoCharId)
VaccineId ::= (OneCharId)
RefrigeratorId ::= (OneCharId)
TemperatureDeviceId ::= '*'RefrigeratorId
Ref_Alarm_Count ::= [1-5]
Ref_Status_Val ::= (RefrigeratorId)(Ref_Alarm_Count)
Ref_Status ::= 'ST'(Ref_Status_Val)
Stock_Val ::= [1-9]+
Stock_Status_Val ::= (VaccineId)(Stock_Val)
Stock_Status ::= 'SS'(Stock_Status_Val)
Status_Emergency ::= (VaccineId|RefrigeratorId|
    TemperatureDeviceId) [!]+
Query_Temp ::= (FacilityId)'QT'(Ref_Status_Val)
Query_Stock ::= (FacilityId)'QS'(Stock_Status_Val)
Hashtag ::= '#'(all visible characters)+
HashtagSeq ::= Hashtag+
ccSeq ::= '/cc:(FacilityId)+
MessageValue ::= (Ref_Status|Stock_Status|
    Status_Emergency|Query_Stock|
    Query_Temp)
Message ::= (FacilityId)(MessageValue+)
    (HashtagSeq)(ccSeq)
    
```

Data Record	Symbol	Complete Syntax	Example
Monthly temperature	MT	MT (mm yy mm yyyy) [[Fridge letter] H [0-5] C [0-5]]+	MT a H 3 C 4 f H 0 C 0 c H 1 C 0
Monthly Stock	MS	MS (mm yy mm yyyy) [[vaccine short code] [0-999]]+	MS pcv13 33 rv5 2
Stock Out	SO	SO [[vaccine short code]]+	SO pcv13
Refrigerator Failure	RF	RF [[fridge letter]]+	RF a b c
Refrigerator Repair	RR	RR [[fridge letter]]+	RR a b c
Temperature failure	TF	TF [[fridge letter]]+	TF d

SUBMIT DATA

These commands submit data to a central database. They all follow the same pattern: Command ID (CID), Facility ID (FID), Command Data (CDATA), and Terminator ("#"):

```
[CID][FID][CDATA]#
```

FACILITY IDENTIFIER (FID)

All data submissions require a prefix which identifies the province, district, and facility number in the form of:

```
[PP][DD][FF]
```

For example, for facility 3 in district 17 in province 8, the FID would be: 081703

[help] 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, e.g pen for pentavalent vaccine]

[query] [stock or fridge prefix; e.g a-z or pen for pentavalent vaccine]

[emergency] followed by

[any stock prefix]

[refrigerator]

[temperature]

Medication Adherence

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

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

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



SMS Reporting

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



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



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

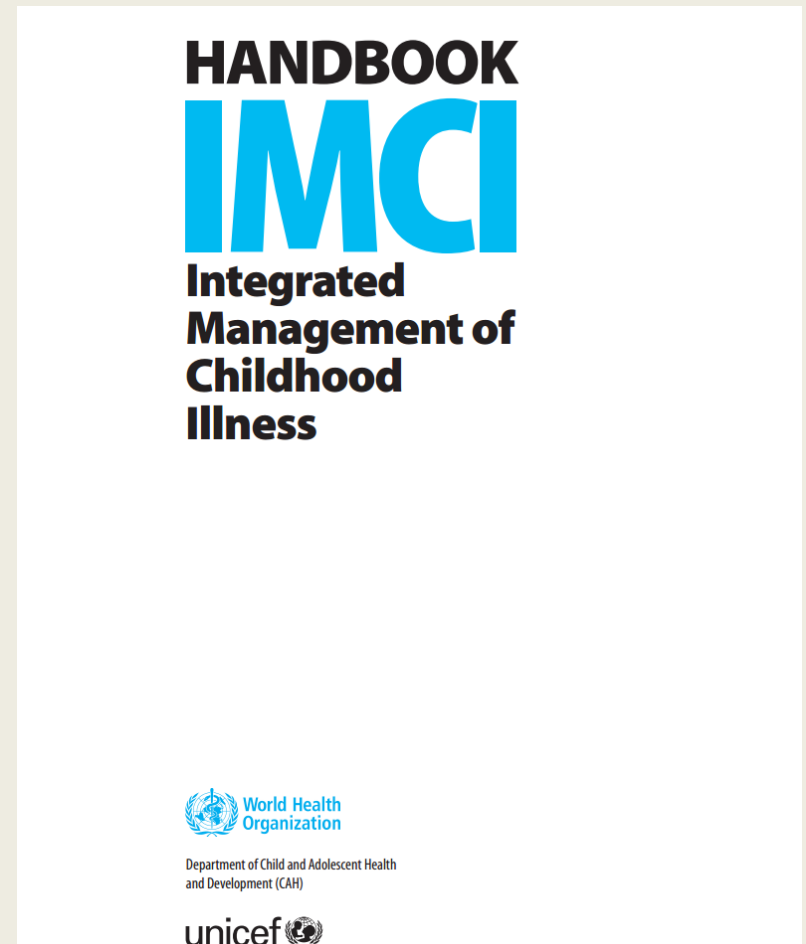
Vision versus reality



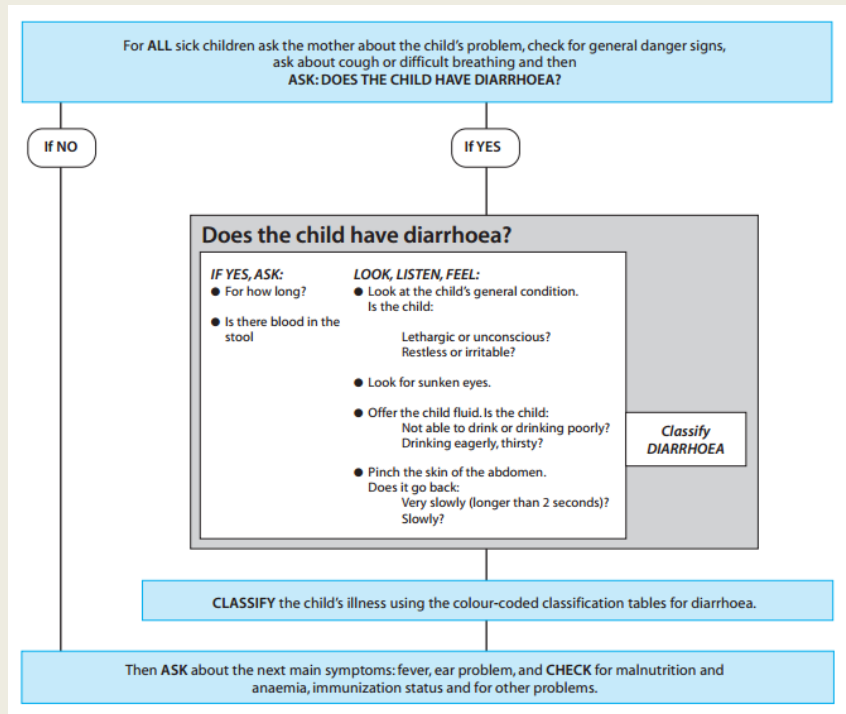
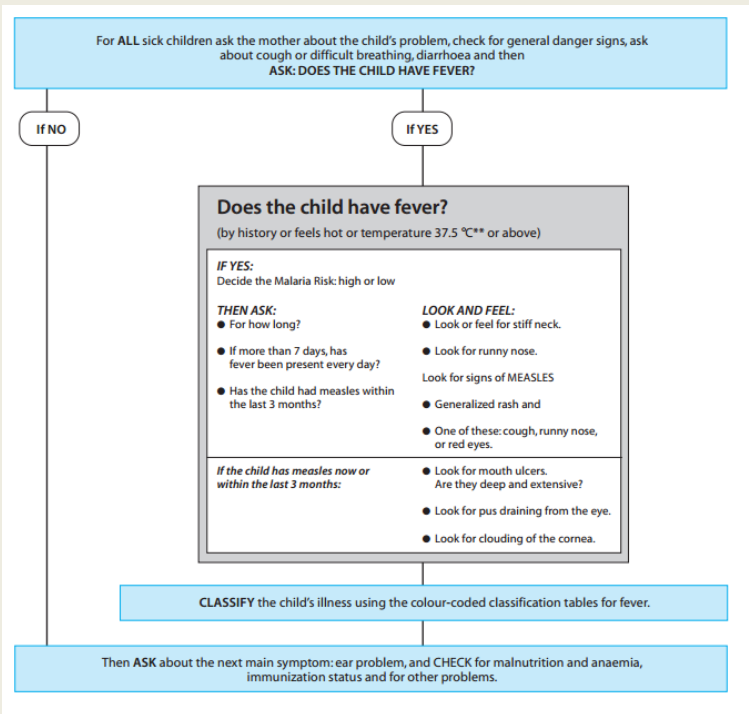


IMCI

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



IMCI



EXAMPLE 11: CLASSIFICATION TABLE FOR LOW MALARIA RISK AND NO TRAVEL TO A HIGH RISK AREA

SIGNS	CLASSIFY AS	IDENTIFY TREATMENT (Urgent pre-referral treatments are in bold print.)
<ul style="list-style-type: none"> Any general danger sign Stiff neck 	VERY SEVERE FEBRILE DISEASE	<ul style="list-style-type: none"> Give quinine for severe malaria (first dose). Give first dose of an appropriate antibiotic. Treat the child to prevent low blood sugar. Give one dose of paracetamol in clinic for high fever (38.5° C or above). Refer URGENTLY to hospital.
<ul style="list-style-type: none"> NO runny nose and NO measles and NO other cause of fever. 	MALARIA	<ul style="list-style-type: none"> If NO cough with fast breathing, treat with oral antimalarial. OR If cough with fast breathing, treat with cotrimoxazole for 5 days Give one dose of paracetamol in clinic for high fever (38.5° C or above). Advise mother when to return immediately. Follow-up in 2 days if fever persists. If fever is present every day for more than 7 days, REFER for assessment.
<ul style="list-style-type: none"> Runny nose PRESENT OR Measles PRESENT OR Other cause of fever PRESENT. 	FEVER—MALARIA UNLIKELY	<ul style="list-style-type: none"> Give one dose of paracetamol in clinic for high fever (38.5° C or above). Advise mother when to return immediately. Follow-up in 2 days if fever persists. If fever is present every day for more than 7 days, REFER for assessment.

EXAMPLE 6: CLASSIFICATION TABLE FOR DEHYDRATION

SIGNS	CLASSIFY AS	IDENTIFY TREATMENT (Urgent pre-referral treatments are in bold print.)
<ul style="list-style-type: none"> Two of the following signs: <ul style="list-style-type: none"> Lethargic or unconscious Sunken eyes Not able to drink or drinking poorly Skin pinch goes back very slowly 	SEVERE DEHYDRATION	<ul style="list-style-type: none"> If child has no other severe classification: <ul style="list-style-type: none"> Give fluid for severe dehydration (Plan C). OR If child also has another severe classification: <ul style="list-style-type: none"> Refer URGENTLY to hospital with mother giving frequent sips of ORS on the way. Advise the mother to continue breastfeeding If child is 2 years or older and there is cholera in your area, give antibiotic for cholera.
<ul style="list-style-type: none"> Two of the following signs: <ul style="list-style-type: none"> Restless, irritable Sunken eyes Drinks eagerly, thirsty Skin pinch goes back slowly 	SOME DEHYDRATION	<ul style="list-style-type: none"> Give fluid and food for some dehydration (Plan B). If child also has a severe classification: <ul style="list-style-type: none"> Refer URGENTLY to hospital with mother giving frequent sips of ORS on the way. Advise the mother to continue breastfeeding Advise mother when to return immediately. Follow-up in 5 days if not improving.
<ul style="list-style-type: none"> Not enough signs to classify as some or severe dehydration. 	NO DEHYDRATION	<ul style="list-style-type: none"> Give fluid and food to treat diarrhoea at home (Plan A). Advise mother when to return immediately. Follow-up in 5 days if not improving.

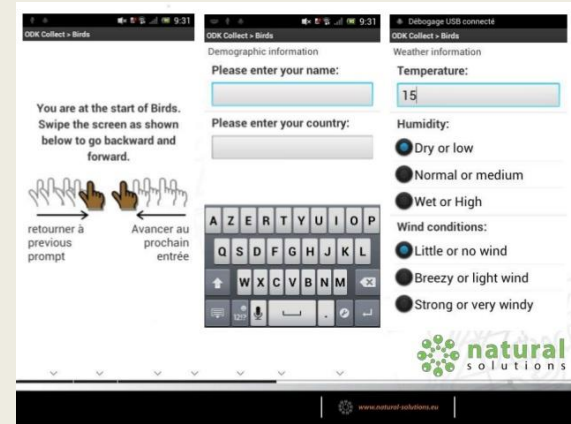
Tanzania e-IMCI Study

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



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



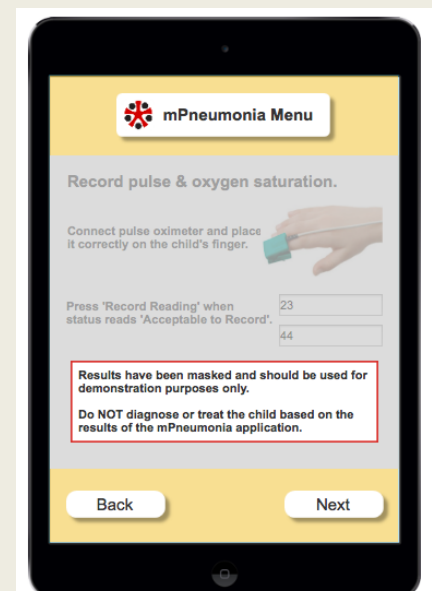
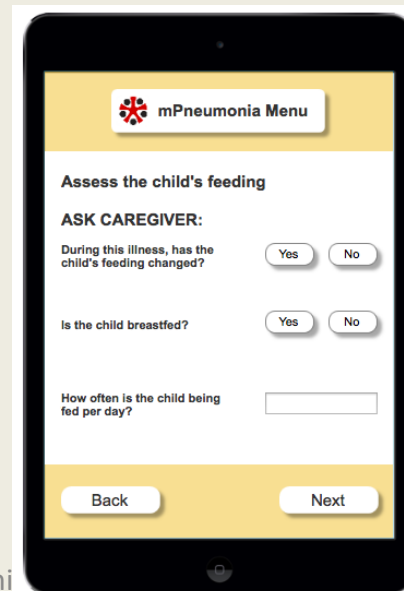
	A	B	C	D	E	F	G	H	I	J	K	L
1	type	name	label	hint	constraint	constraint_message	relevant	calculation				
2	text	some_text	This is a basic fill in the blank question.	Hints provide additional information about a question that is relevant.								
3	note	text_image_audio	This question shows how to use translations and media types.	different translation press your phone's menu button and you should see a "Change Language" button. In order to add								
4	integer	a_integer	Enter an integer.	This question has a constraint so that the decimal must be less than	<= \${a_integer}	You can set the toast that appears when a constraint						
5	decimal	a_decimal	Enter a decimal.									
6	calculate	calculate_test_out	the sum of the integer and	Arithmetic: \${a_integer} +								
7	note	calculate_test_out										
8	select_one_yes	select_example	This is a select_one type question.	in the type column you must include the name of a choices list that sets the available options. Choices here are restricted on the You have to enter something to continue.								
9	text	required_text	Required field	Micromessage prompts can be used to indicate some action was completed. For example, a real prompt might read, "form the subject how the data collected on this will be								
10	acknowledge	acknowledge_test_example										
11	select_one_yes	skip_example	Skip the next question?	skip question you use this operator skip if its "relevant"								
12	text	skippable_question	skipped if its "relevant"									
13	begin repeat	repeat_test	A repeat	You can also have skip logic for groups.								
14	text	repeating_question	This is a repeating question.	You can also repeat groups of questions								
15	end repeat	repeat_test										
16	begin group	group_test	A group using a group with a no-list appearance you can									
17	note	field_list_note										

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

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

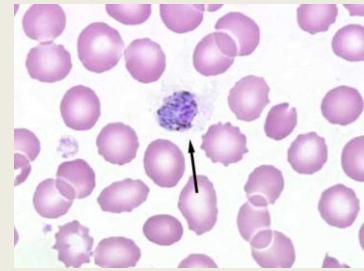
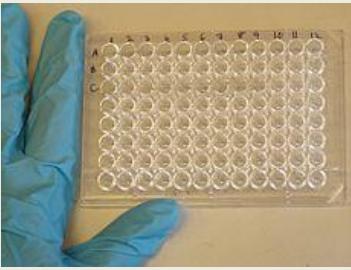


Diagnostics

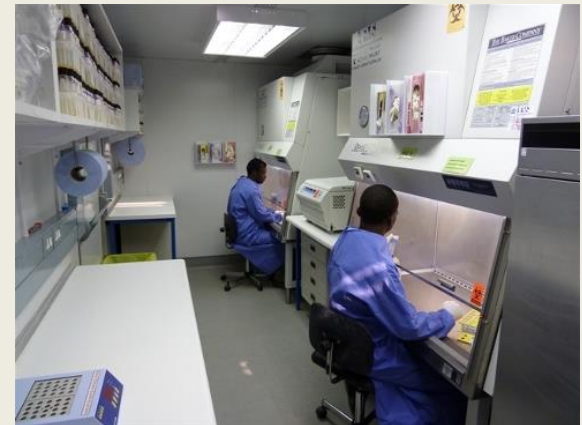
- Issues
 - Cost of test
 - Precision of test
 - Accuracy of test
 - Error profile
 - Action on positive test
 - Action on negative test
 - Goals
 - Individual treatment
 - Public health goals

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

Lab Diagnostics

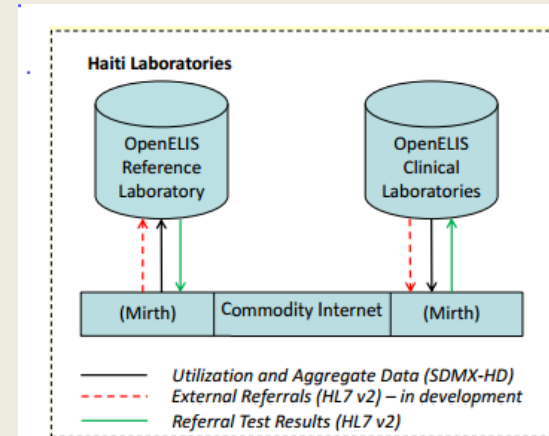


- Highly accurate tests
 - E.g., Enzyme-linked immunosorbent assay (ELISA)
 - Microscopy
- Requires infrastructure, trained staff, equipment
- Issues
 - Costs
 - Transport of samples
 - Delays in processing or notification



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



The screenshot shows the OpenELIS Global website. At the top, it features the logos for the University of Washington and I-TECH. Below the header is a navigation bar with tabs for 'Global Implementation', 'Demos', 'Downloads', 'Current Development', 'History', 'About/Project Team', and 'Sitemap'. The main content area includes a table of laboratory information, a section titled 'Enregistrement d'échantillon/spécimen (1)', and a photograph of a person at a computer. Below the main content is a section titled 'Laboratory Information System for Global Health' which provides a detailed description of the system's goals and challenges. The text states: 'The global version of OpenELIS (<http://openelis.cirg.washington.edu>) builds on the foundation provided by the original US Public Health Lab version of OpenELIS. Our challenge is to provide the flexibility demanded by different laboratories while maintaining a common code base. Some examples:

- Some laboratories refer to the number attached to the sample as an accession number while others refer to it as a laboratory number.
- End user computer literacy can not be assumed
- Phone number formats vary country by country.
- The number and kind of patient identifiers varies by country and type of laboratory.
- Required patient demographics may depend on why a test is being requested.
- Address fields are country dependent.
- And many more...

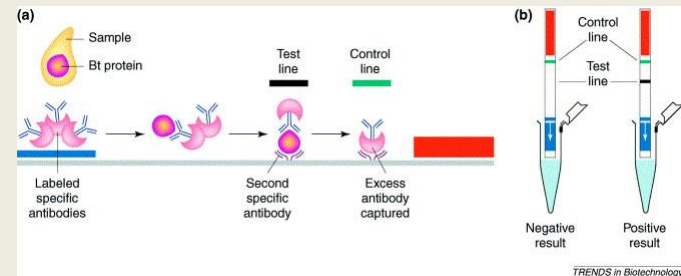
 Our goal in meeting the challenges is to ensure that the code does not become fractured by each variation in requirements. We have so far been successful and all of the implementations differ only by configuration files. The work is done in partnership with International Training and Education Center for Health (I-TECH). They provide a wide perspective on the background, goals and collaborators of the work being done worldwide. For specifics of I-TECH's work in two countries where OpenELIS is being implemented: [I-TECH in Haiti](#), [I-TECH in Côte d'Ivoire](#). We keep track of country specific progress and roadmaps for our OpenELIS implementation work at the following public sites:

- [Blog for OpenELIS in Haiti](#)
- [Blog for OpenELIS in Côte d'Ivoire](#)

 OpenELIS has also been implemented in Vietnam, at sites both in Hanoi and Ho Chi Minh City. [Contact](#) us if you want to know more. At the bottom, there is a 'FOLLOW US ON twitter' button.

Rapid Diagnostic Tests

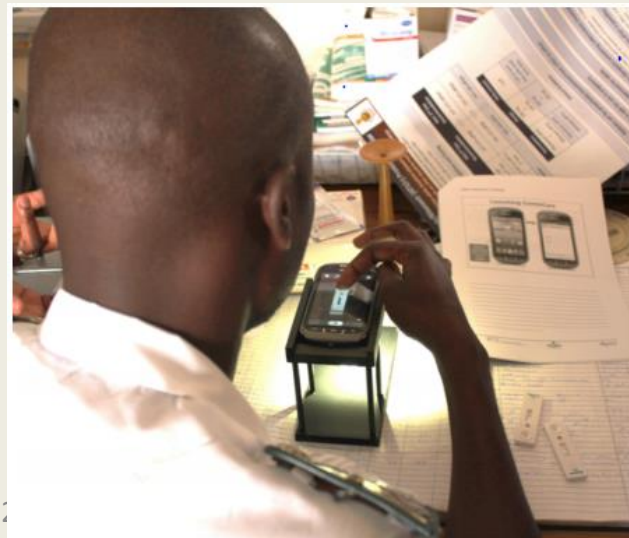
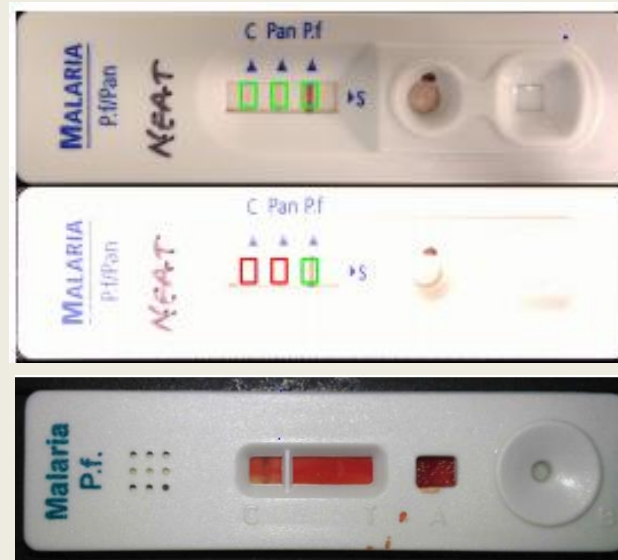
- Point of Care Tests
 - Deliver results without sending test to lab
 - Fast turn around
 - Limited test preparation
- Lateral flow immunochromatographic assays
- Large number of tests available
 - Blood, Urine
 - HIV, Malaria, Syphilis





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

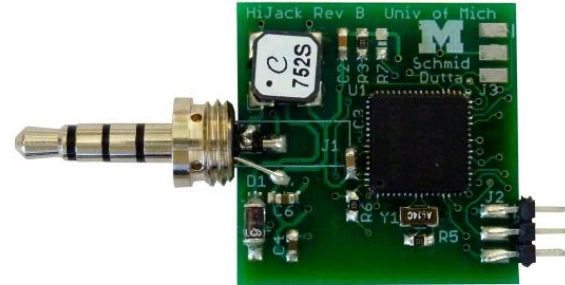
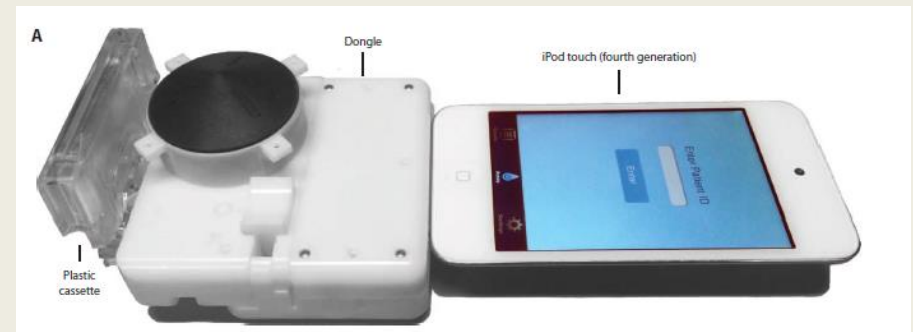
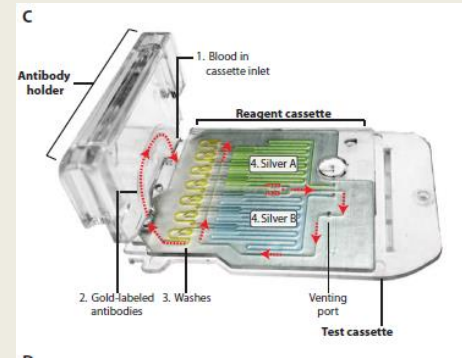


Figure 14: The HiJack base platform, with a 1" x 1" footprint, offers power (>5 mW), analog (2x 12-bit), digital (1x GPIO), and serial (1x I2C and 1x UART) interfaces, exported via connectors, and all multiplexed over the headset port. This board provides the functionality needed to build a variety of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

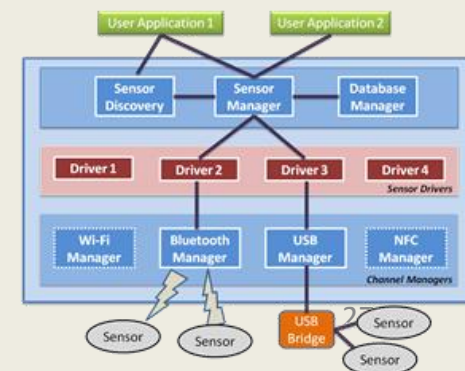
Smartphone for point of care diagnosis

- 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



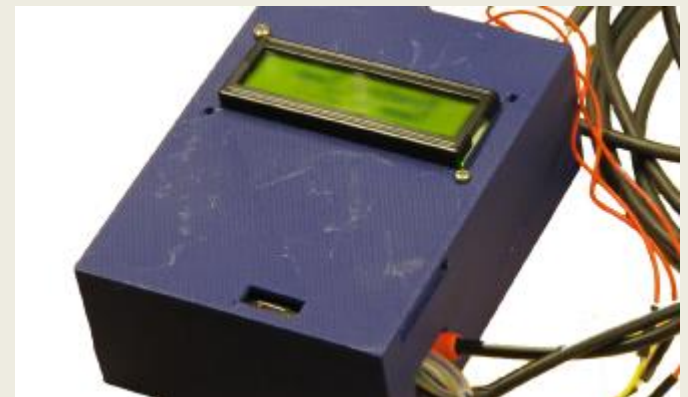
ODK Sensors

- 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



Fone Astra

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



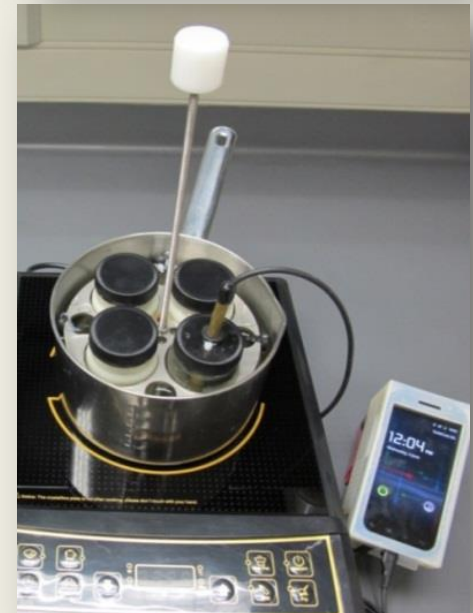
Android Fone Astra

- 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



Milk Pasteurization

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



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

PARTOGRAPH Paragraph complete KNH329

Name: _____ Age: _____ Gravida: _____ Para: _____ IP No: _____

Date of admission: _____ Time of admission: _____ Ruptured membranes: _____ Hours on admission: _____

Foetal Heart Rate: _____

Liquor GBMP MOULDING: _____

CERVICAL DILATION (CM) PLUG X

Label Phase Active Phase

CONTRACTIONS

DRUGS GIVEN AND IV FLUIDS

PULSE AND B.P.

TEMP

URINE

SUMMARY OF LABOUR

1st Stage Induction labour: Yes/No _____ Duration: _____ hrs No. of VE _____

2nd Stage Mode of delivery: _____ Duration: _____ Mins: _____ Oxytocin/Ergometrine I/II _____

3rd Stage Baby Alive/IS MF: Apparscore 1 Min: _____ 5Min: _____ Resuscitation: Yes/No _____ Duration: _____ Mins _____

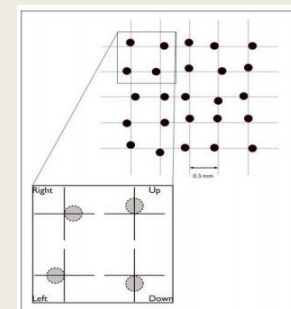
Placenta complete/incomplete Membranes complete/incomplete Cord normal/Abnormal Placenta Wt: _____ Mins _____

Blood loss: _____ Mls. Perineal tear/Episiotomy: Repair Yes/No Mother BP: _____ Pulse: _____ Temp: _____ Resp: _____

Baby Length: _____ cm. HC: _____ cm Drugs given: _____

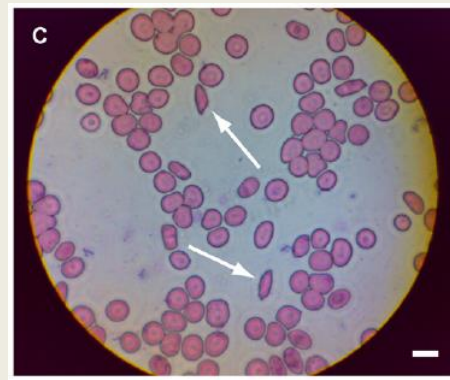
Delivered by: _____ Time and Date of Delivery: _____

PartoPen Reminder ID: _____



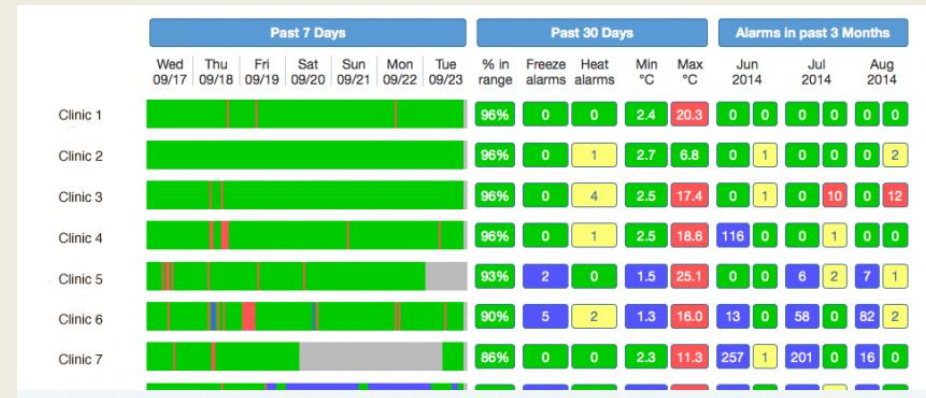
Cell Scope

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



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



Next week

- Supporting the health worker

