Global Health Informatics

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Logos of Brigham and Women's Hospital and Harvard Medical School have been removed from all slides due to copyright restrictions.
Overview

• Challenges and opportunities for global health informatics (eHealth)
• The PIH-EMR system in Peru
• The background for OpenMRS
• The OpenMRS platform
• Evaluation of medical information systems
• Systematic review of evaluations
Typical problem:

- Can HIV and MDR-TB care be delivered
  1. In settings with limited or absent infrastructure?
  2. To thousands or tens of thousands of patients?
  3. Over long periods of time?
  4. With outcomes equivalent to ARV treatment in the US?
  5. At a “manageable” cost?
Status of Global Health Informatics

• Rapid development over the last 2 years
  – Bellagio meeting on e-Health in July 2008

• Driven by the coincidence of:
  – need for better Global Health Delivery
  – increased resources for health system strengthening such as the Global Fund
  – more effective, robust, low-cost technologies
Partners In Health Model of Care

• Access to health care for all people
• Creation of long-term development by partnering with local people and communities
• Use of community health workers to grow a local and sustainable work force
• Addressing the effects of poverty including poor nutrition, water, and housing
• Drawing on the resources of the world’s elite medical and academic institutions and on the lived experience of the world’s poorest and sickest communities
Directly observed therapy in Haiti
Chronic disease management

- Identifying patients requiring treatment
- Starting patients on the correct medication
- Ensuring stable and economical supply of medication
- Ensuring compliance with treatment
- Monitoring treatment progress and outcomes and addressing adverse events promptly
Core Functions of e-Health Systems

- Clinical care and quality improvement
- Monitoring and reporting
- Drug supply management
- Research
Example: MDR-TB in Lima, Peru

- Highest incidence of TB in South America
- 40,000 patients treated with DOTS per year
- > 3% have MDR-TB
- Require up to 9 drugs to treat MDR-TB

DOTS = directly observed therapy short course
PIH-EMR System in Peru

- Secure web-based EMR
- Operational since 2001
- Usable with low-speed dialup connections
- Bilingual (Spanish/English)
- 50,000+ patients tracked
- 13,000 patients treated for MDR-TB

## PIH-EMR Data

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### PIH-EMR: Electronic Medical Record

- Smears
- Cultures
- Drug sensitivity (DST)
- History/exam
- Previous Rx
- Previous Dx
- Contacts
- Follow up
- Chest X-ray
- Biochem.
- Hematology
- Drug regimens
- Pharmacy
Requirements for general purpose medical record system

- Simple to setup
- Multiple computing platforms
- Local users can create EMR forms and reports
- Web based (but can also be run locally)
- Open standards - HL7, LOINC, SNOMED, ICD10
- Fully open source
  - supported by a community of programmers
  - using best ideas and software from many projects

- Able to be setup, modified and owned by the countries where we work, not just a “present from the US” but a full transfer of technology, skills and ownership
OpenMRS: a modular, open source, EMR platform

- Developed as a collaboration of PIH, the Regenstrief Institute and South African MRC
- Uses concept dictionary for data storage
- Modular design simplifies adding new functions and linking to other systems
- Supports multiple languages
- Released with open source license (April 2007)
- Core of paid programmers with growing community support
- www.openmrs.org
## Concept Dictionary

**Concept Form**

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| Synonyms | WEIGHT LOSS GREATER THAN TEN PERCENT (1352)  
COUGH LASTING MORE THAN THREE WEEKS (1430)  
DIARRHEA CHRONIC (GREATER THAN OR EQUAL TO 1 MONTH) (1431)  
SEIZURE (206)  
JAUNDICE (215)  
RASH (512)  
FEVER (5945)  
FATIGUE (5949)  
VISION DIFFICULTIES (5953)  
SHORTNESS OF BREATH (5960)  
NAUSEA (5978)  
VOMITING (5980)  
PARESTHESIA (6004)  
CONFUSION (6006)  
NIGHT SWEATS (6029)  
HEADACHE (620)  
PRURITIS (879)  
DYSPHAGIA (881)  
HEMOPTYSIS (970) |
| Class    | Question |
| Datatype | Coded    |
| Answers  |         |
Image of Google Maps showing locations of OpenMRS sites in Uganda, Congo, Kenya, Tanzania, and Malawi, has been removed due to copyright restrictions.
Rwanda health indicators

• A small central African country:
  – Population 9 M people
  – Highest population density in Africa, 85% rural

• Achieved rapid economic growth since genocide in 1994, but still has very poor health outcomes:
  – Life expectancy 38-44 years
  – Infant mortality 152/1000
  – Maternal mortality 1071/100K
  – Medium income $230
  – HIV prevalence 3%
  – Malaria prevalence 46%
OpenMRS at PIH sites in Rwanda

- Currently used for 12 PIH – supported health centers
- Data for patients with HIV, TB and now heart failure
- Over 10,000 patients tracked (Sept. 2009)
- Team of Rwandan data officers trained to enter data, ensure quality & produce reports
- Clinicians lookup of electronic patient summaries
- 8 sites have their own server, 6 remote sites maintain a synchronized copy of the entire database
- Many new research and clinical applications
- Primary care version is under development
Physician looking up ARV patient
Potential components of integrated national eHealth architecture in Rwanda

- Supply chain systems: Camerwa
- National reporting system: TRACNet
- Pharmacy system: PIH
- EMR System: OpenMRS
- Mobile health systems: OpenROSA
- Registration and insurance: Mutuelle
- Laboratory System: PIH-Lab-system
- Radiology / telemedicine system

Connections:
- HL7 from Camerwa to OpenMRS
- HL7 from PIH to OpenMRS
- HL7 from Mutuelle to OpenMRS
- SDMX-HD from TRACNet to OpenMRS
- HL7 from OpenMRS to PIH-Lab-system
- Dicom from PIH-Lab-system to OpenMRS
- HL7 from OpenMRS to OpenROSA
Relationship between facilities for reporting in Rwanda
The Government of Rwanda is committed to having a strong national EMR program.

MoH has announced that OpenMRS will be used for the national roll out to health centers and small hospitals.

MoH wants a non-disease specific system which:
- Can assist in the management of all outpatients
- Will also continue to be used for HIV management

Detailed rollout plan being developed at present.
We are running a training program in Kigali for computer science graduates.

One year, mentored training course:
- Web development
- Java programming
- OpenMRS programming
- Medical informatics

Ten students graduated last week. They will support OpenMRS rollout as well as building software development capacity in Rwanda.
Community: OpenMRS Wiki

OpenMRS® is a community-developed, open-source, enterprise electronic medical record system framework. We've come together to specifically respond to those actively building and managing health systems in the developing world, where AIDS, tuberculosis, and malaria afflict the lives of millions. Our mission is to foster self-sustaining health information technology implementations in these environments through peer mentorship, proactive collaboration, and a code base that equals or surpasses proprietary equivalents. You are welcome to come participate in our community, whether by implementing our software, or contributing your efforts to our mission.

- About OpenMRS
- Downloads
- Getting Started
- FAQ
- Online Demo
- Blog
Disease-specific EMR (MDR-TB)

MDR TB

Find Patient(s)

Find Patient(s): mukherjee

1 to 1 of 1

Identifier First Middle Last Age Gender Birthdate Health Center
1 44006563-G Joia Test Mukherjee 28 F ~ 01/01/1981 Mulindi

Create Patient

To create a new person, enter the person's name and other information below. It is good practice to first verify that this person is not already in the database using the search box above.

Name

Birthdate (Format: mm/dd/yyyy)

Gender

Create Person

View All MDR-TB Reports

- WHO Form 05 Quarterly (2008 version)
- WHO Form 06 6-month (2008 version)
- WHO Form 07 Annual (2008 version)
- WHO Form 07 Quarterly Report (2006 version)
- WHO Form 08 6-month report (2006 version)
- WHO Form 09 Annual Report (2006 version)

View Drug Requirements

- drug requirements for next month
- number of patients taking each drug
Previous drug prescriptions and decision support tools

Warning: The following drugs from this patient’s active orders are contra-indicated by DST results:

ISONIAZID (INH)
RIFAMPICIN (R)
CAPREOMYCIN (CM)

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Update Current Regimen Type: [ ] [ ] [ ] [update]

Add A New Drug Order

Alternative alerts and warnings view
# MDR-TB treatment history

**Overview**

- **Regimen:** Ethionamide (Eto), Ciprofloxacin (Cfx), Pyrazinamide (Z), Cycloserine (Cs), P-aminosalicylic acid (PAS), Capreomycin (Cm), Moxifloxacin (Mfx)

- **BMI:** Weight: 67.5 kg, Height: 165.0 cm

- **Last encounter:** Specimen Collection @ Cange | 19-Aug-2010 | Louise Allen

- **MDR-TB program start date:** 05-Apr-2007

- **Treatment start date:** 05-Apr-2007

- **Culture Status:** Unconverted

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**Patient Overview**

- **Patient Enrollment Date:** 05/04/2007

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### Treatment Schedule for MDR-TB

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OpenMRS-Google Maps–SMS-Integration, Karachi

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Image of Google Maps mash-up with OpenMRS has been removed due to copyright restrictions.

Credit: Owais Ahmed, Aamir Khan
TB in homeless patients in Los Angeles

Credit: Monica Waggoner
Research Data Coordination

Credit: Dave Thomas

Usuario: ADMINISTRADOR
Formulario: DEMO FORM
Fecha de recepción: 02/11/08
Fin de revisión: 01/11/09
Primera entrega: 15/09/09
Segunda entrega: 15/09/09
Fecha de completado: 25/09/09
Nombre del usuario: Nilda García Leiva

Resolver diferencias entre ingresos de formulario

Fecha de encuentro
- Primer Ingreso: 2009-05-05
- Segundo ingreso: 2009-05-20

Proveedor de encuentro
- Primer Ingreso: Judith Dalila Jiménez
- Segundo ingreso: Mercedes Becerra

Tipo de especimenes recogidos
- Primero: Test
- Segundo: Test Test

¿El participante tiene un resultado positivo de una esfrega que fue realizado en un centro de salud, hospital, o hospital?
- Primer Ingreso: Sí
- Segundo ingreso: No

Esta imagen fue proporcionada por Dave Thomas. Se utilizó con permiso.
Adaptive Turnaround Documents

Credit: Vibha Anand, Paul Biondich (Regenstrief)
Testing touch screen patient registration in Rwinkwavu, Rwanda
Synchronization

• We created a new component to allow bi-directional synchronization between OpenMRS instances
• Uses limited internet capability (soon to be usable with USB memory stick)
• 6 sites in Rwanda are now synchronizing
• Working on a general version, requires modification to the data model
Security and confidentiality of medical data

• Patient data is highly sensitive in all countries – HIV in Africa a key example
• We encrypt data transfers with SSL
• Staff receive training in patient data and security management
• All logins and page views can be audited
• Government policy on health data ownership and control are required
Challenges for OpenMRS deployments

• Reliability and support for equipment, power supplies and software

• Training

• Data management and quality control

• Evaluation
Technical challenges

- Online-offline data use and synchronization
- Building complex applications with modular architectures
- Rapid data entry from clinical staff
- Simple drug order entry
- Reporting from EAV data models

We welcome opportunities to share the work of building open and interoperable systems and expanding collaboration.
Evaluation of Global Health Informatics Projects
Why Evaluate?

- Quality of care
- Efficiency and economics
- Evidence based medicine
- Advance the science of Medical Informatics
5 Levels of Evaluation (Stead et al)

1. Problem definition
2. Bench testing
3. Field trials: observational
4. Field trials: interventional
5. Long term follow-up
Evaluation Types

• **Formative Evaluation**
  1. Determine important functionality of and improve system
  2. More qualitative methods
  3. Usually performed by implementers

• **Summative Evaluation**
  1. Determine benefits and sustainability of system
  2. More quantitative methods
  3. Usually performed by outside researchers
PDA Data Management
Collecting lab data in sites without internet

Sync through local PC

Processing Section

Processing & Verification

clinical Bacteriology Section

PIH-EMR

Palm Pilot

Sync through local PC

Errors Table
Smears Past Due (14 Days)

<table>
<thead>
<tr>
<th>PHID</th>
<th>Name</th>
<th>Sample Date</th>
<th>Site</th>
<th>Sample ID</th>
<th>Result</th>
<th>DSA</th>
<th>Health Center</th>
<th>Entry Date</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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Cultures Past Due (70 Days)

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<th>Name</th>
<th>Sample Date</th>
<th>Site</th>
<th>Sample ID</th>
<th>Result</th>
<th>DSA</th>
<th>Health Center</th>
<th>Entry Date</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
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<td></td>
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</tbody>
</table>

Errors and Warnings

<table>
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<th>Name</th>
<th>Sample Date</th>
<th>Site</th>
<th>Sample ID</th>
<th>Result</th>
<th>DSA</th>
<th>Health Center</th>
<th>Entry Date</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PIH-EMR: Informe médico electrónico

Maya a Paciente

Informe de Observación

Informe de Bacteriología

Informe de Electrocardiograma

Informe de Electroencefalograma

Informe de Examen Físico

Informe de Historia Clínica

Informe de Medicación

Informe de Nutrición

Informe de Radiología

Informe de Terapia

Informe de Urgencias

Informe de Vínculos

Informe de Verde de Salud

Informe de Visitas

Informe de Visitas de Emergencia

Informe de Visitas de Familia

Informe de Visitas de Paciente

Informe de Visitas de Próximos

Informe de Visitas de Servicio

Informe de Visitas de Seguridad

Informe de Visitas de Urgencia

Informe de Visitas de Vacunación

Informe de Visitas de Visitación

Informe de Visitas de Visitación de Emergencia

Informe de Visitas de Visitación de Urgencia

Informe de Visitas de Visitación de Urgencia de Emergencia

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Informe de Visitas de Visitación de Urgencia de Urgencia de Urgencia de Urgencia de Urgencia de Urgencia de Emergencia

Palm Project: Study Design

Controlled study

- (A) Prospective
- (B) Historical
# Palm Project: Study Results

## Median processing time

<table>
<thead>
<tr>
<th>Intervention Districts days (n)</th>
<th>Control Districts days (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Palm</strong></td>
<td></td>
</tr>
<tr>
<td>30.5 (4876)*</td>
<td>30.8 (5954)</td>
</tr>
<tr>
<td><strong>Post-Palm</strong></td>
<td></td>
</tr>
<tr>
<td>7.7 (2890)*†</td>
<td>22.7 (3263)†</td>
</tr>
</tbody>
</table>

* p < 0.001
† p < 0.001

## Frequency of Errors

* p < 0.001
‡ p = 0.055

Joaquin Blaya, PhD, Harvard-MIT HST program
Palm Project: Study Results

• Work Efficiency
  – 66% reduction in collection and processing time

• Users’ Preference
  – All users wanted to end study and expand use of system
  – All users felt system was perceived positively by health center personnel
  – Cost of moving system to new sites
PDA system, cost analysis

- The total cost and time to develop and implement the intervention - US$26,092 and 22 weeks (add on to EMR).
- The cost to extend the system to cover nine more districts - $1125
- Cost to implement collecting patient weights - $4107.

Blaya et al, INT J TUBERC LUNG DIS 12(8):921–927
Baseline problems with DST data

- 10% of results took > 60 days to arrive at clinic
- 16% of patients waited > 100 days to start treatment
- (17%) of DSTs were duplicates
Laboratory Reporting System

1. Connects laboratories to health centers
   – Email notifications to health center personnel
2. Tools to improve data quality
3. Reporting functions for laboratory personnel

*cluster randomized controlled trial of 1846 patients recently completed*

Joaquin Blaya, PhD student, Harvard-MIT HST program
eChasqui study results: error rates

• Intervention HCs showed:
  – 82% less errors compared to controls in reporting for drug susceptibility tests
    (2.1 vs. 11.9%, p<0.001)
  – 87% fewer errors compared to controls for cultures
    (2.0 vs. 15.1%, p<0.001)

• eChasqui allowed missing results to be viewed online:
  – these accounted for at least 72% of all errors

• 66% of control and 55% of intervention HC users responded they were missing at least 10% of paper results

## MDR-TB Drug Regimen Design

<table>
<thead>
<tr>
<th>Regimen choices</th>
<th>Taking now</th>
<th>Warning</th>
<th>Contra-indications</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firstline drugs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isoniazid: DST, Prev,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rifampicin: DST, Prev,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethambutol: Prev,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrazinamide: DST, Prev,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Injectables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streptomycin: Prev,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capreomycin:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kanamycin: Prev,</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Amikacin:</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Quinolones</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxin:Prev,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ofloxacin:</td>
<td></td>
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<tr>
<td>Levofloxacin:</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Sparfloxacin:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moxifloxacin:</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Other secondline drugs</strong></td>
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</tr>
<tr>
<td>PAS:</td>
<td></td>
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<tr>
<td>Cycloserine:</td>
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<tr>
<td>Ethionamide: Prev,</td>
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<tr>
<td>Prothionamide:</td>
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<td>Thiacetzone:</td>
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<tr>
<td>Clofazamine:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Amox/Clav:</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Clarithromycin:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rifabutin:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Prev* = previous regimen drugs; *Alg* = Allergic; *DX* = previous diagnosis may contra-indicate
Evaluation of impact of order entry system on drug data accuracy

- Prospective and historical controlled study
- Drug regimen quality and timeliness were surveyed in two districts in Lima, Peru
- Drug errors per patient

<table>
<thead>
<tr>
<th></th>
<th>Callao (EMR)</th>
<th>Lima Este (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>17.4%*</td>
<td>8.6%**</td>
</tr>
<tr>
<td>After</td>
<td>3.1%*</td>
<td>6.9%**</td>
</tr>
</tbody>
</table>

*P= 0.0075         **P= 0.66,

## Stock Card - Amox-Clav (500 mg Tablet)

<table>
<thead>
<tr>
<th>Date</th>
<th>Origin</th>
<th>Destination</th>
<th>Lot Number</th>
<th>Expiration Date</th>
<th>Quantity</th>
<th>Total</th>
<th>Entered by</th>
<th>Confirmed by</th>
<th>Action</th>
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<tbody>
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<td>04/12/2008</td>
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<td>2675</td>
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<td>Israel Esther</td>
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</table>
Pharmacy and Warehouse Stock Tracking

Reduction in product-days of stocked out medication (daily report – a method of triangulation)

System was set up in 2005 but scaled in 2006.

<table>
<thead>
<tr>
<th></th>
<th>Q1 2006</th>
<th>Q4 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. Days stocked out</td>
<td>1569</td>
<td>634 (P&lt;0.001)</td>
</tr>
<tr>
<td>Prod. Days</td>
<td>60,608</td>
<td>58,576</td>
</tr>
<tr>
<td></td>
<td>2.6%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

“Stop the Stock-outs”, Kenya

- Led by Health Action International, Oxfam and local civil society organizations
- “Stop the Stock-outs” used a system developed by Frontline SMS
- Patients to send text messages to a server if the drug they had been prescribed was stocked out at the clinic’s pharmacy
- Data is linked to mapping software

“Stop the Stock-outs”

- The group was able to map the levels of stockouts of essential medications in more than 100 clinics in Kenya
- **Stockouts rates of 50-60% were documented for essential medications**
- This data was publicized and led to the Kenya parliament voting for increased funding for drug supply
  - The system is also being used in Malawi, Zimbabwe and Uganda
Supporting HIV treatment
“Thus, 12 months after delivery, only a fraction (19% in one study in Malawi) of HIV positive mothers who received antiretroviral drugs will attend health services to have their infant tested for HIV.”

“Clearly, this may have lethal consequences for those children who become HIV positive.”

(Reithinger et al, BMJ June 1st 2007)

A review in 2007 of adult HIV treatment programs in Africa estimated that only 61% of patients were still in care 2 years after starting treatment. (Other studies suggest ~85%) 

### Consultation, 04 Nov 2006

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Attend?</th>
<th>Weight</th>
<th>New weight</th>
<th>Food support today?</th>
<th>Alerts</th>
<th>CD4</th>
<th>TB (current regimen, TB start date)</th>
<th>arv (current regimen, initiation, last change)</th>
<th>accompagnateur</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>37</td>
<td>Y</td>
<td>54 kgs @19 Jan 06</td>
<td>54 kgs @19 Jan 06</td>
<td>Y</td>
<td>N</td>
<td>151 @23 Jan 06</td>
<td>Triomune-40 (1 Co. 2/j)</td>
<td>MBUZUKONGIR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td>64 kgs @12 Jul 06</td>
<td>64 kgs @12 Jul 06</td>
<td>N</td>
<td></td>
<td>344 @11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td>66 kgs @9 Aug 06</td>
<td>66 kgs @9 Aug 06</td>
<td>Y</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>61 kgs @16 Feb 06</td>
<td>61 kgs @16 Feb 06</td>
<td>Y</td>
<td>N</td>
<td></td>
<td>late CD4</td>
<td>237 @27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>Y</td>
<td>60 kgs @19 Jan 06</td>
<td>60 kgs @19 Jan 06</td>
<td>Y</td>
<td>N</td>
<td>43 @23 Jan 06</td>
<td>Triomune-40 (1 Co. 2/j)</td>
<td>URAYENEZA Maurice</td>
<td></td>
</tr>
</tbody>
</table>
CD4 Access, Rwinkwavu, Rwanda

- We evaluated whether the ID physicians had access to the latest CD4 count for their patients in Rwinkwavu, Rwanda.
- The physicians record the result they have on the follow-up form based on paper lab result forms.
- We checked if they were up to date before and after a new lab component was added to the EMR to generate results forms.
Results – Access to CD4 counts

• The proportion of CD4 counts conducted within the past 60 days but unknown to the clinician at the time of consultation was:
  • 24.7% in the pre-intervention period
  • 16.7% in the post intervention period
  • This is a 32.4% reduction in CD4 loss (p=.002)
• We are now extending direct clinician access to the EMR

Amoroso et al, Stud Health Technol Inform. 2010; :
Evaluation 4:

**Patient Information**
- **IMID**: ************
- **HIVEMPH-V1**: 10257
- **Gender**: Male
- **Age**: 39 yrs (°Jan 1, 1970)
- **HIV Program**: Adult HIV Program
- **Group**: 10
- **On Antiretrovirals**: Yes
- **Last Visit**: 4 months ago (Jan 7, 2009)
- **Adult Return Visit by**: **

**Medical History**
- **No chest x-ray**
- **No CD4 in the last 6 months**

**Recent Symptoms**
- **Fever**: Jan 27, 2007
- **Night sweats**: Jan 27, 2007
- **Cough**: Jan 27, 2007
- **Productive cough**: Jan 27, 2007
- **Night sweats for less than 3 weeks**: Jan 27, 2007

**Drug Orders**
- **Tenofovir 300**: 1 tab(s) 2/day n 7 days/week Aug 12, 2008
- **TDF/3TC 300/160**: 1 tab(s) 1/day n 7 days/week Aug 16, 2006
- **Tenofovir 40 stopped**: 1 tab(s) 2/day n 7 days/week Jul 26, 2006 Aug 12, 2008 TREATMENT GUIDELINES CHANGED

**Labor Tests**
- **CD4**
  - 7/25/06: 20.8
  - 8/14/06: 265.0
  - 1/10/07: 30.64
  - 5/30/07: 227.0
  - 9/19/07: 262.0
- **AST**: 13.5
- **ALT**: 24.15
- **Cr**: 85.8

**Graphs**
- **Weight (Kg)**
  - Jan-07: 65
  - Jan-08: 70
  - Jan-09: 75
- **CD4 Count**
  - Jan-07: 100
  - Jul-07: 150
  - Jan-08: 200
  - Jul-08: 250
  - Jul-09: 300

**Comments**
- No adverse effects
- No opportunistic infections
- No previous diagnoses
Usage Statistics

Patient record usage by role

<table>
<thead>
<tr>
<th>Role</th>
<th>Active users</th>
<th>All usages</th>
<th>Creates</th>
<th>Encounters</th>
<th>Updates</th>
<th>Voids</th>
<th>Last usage</th>
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## Usage Statistics

### Patient record usage by role

<table>
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<tr>
<th>Role</th>
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<th>Creates</th>
<th>Encounters</th>
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### Usage Statistics

#### Patient record usage by user

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</tbody>
</table>

From 01/06/2010 until 10/09/2010 in location [ ] with Clinician [ ] role and [Any] actions [ ].
Evaluation of PDA system for Home Based Care at AMPATH in Kenya

- Developed a Palm Pilot PDA application, very similar technology to Peru TB study
- Data collected:
  - patient registration, HIV testing, TB screening, maternal care, vaccinations
- Reported data on 14,648 households, 40,111 patients, mean of 12 new patient records per day
- 899 (45%) pregnant women not receiving AN care
- 693/1131 (61.3%) HIV+ patients never been tested
- User satisfaction was high, technical issues rare
- Cost to cover 2 million patients, $0.15/patient

Broader evaluation perspectives
An evaluation of the District Health Information System in rural South Africa

• Outcomes: assessed data quality, the utilisation for facility management, perceptions of work burden, and usefulness of the system to clinic staff.

• Results. A high perceived work burden associated with data collection and collation.
• Some data collation tools were not used as intended.
• There was good understanding of the data collection and collation process but little analysis, interpretation or utilisation of data.
• Feedback to clinics occurred rarely.

Garrib, et al., SAMJ, Vol. 98, No. 7, p 549-552
In the 10 clinics, **2.5% of data values were missing**, and **25% of data were outside expected ranges** without an explanation provided.

There was **no computerisation of data collection** and no facility for electronic submission of data in any clinic.

Clinic staff and supervisors reported that even if the data did not look correct, checking it was rarely done due to lack of time.

**Little analysis of data occurred at the clinic** or by clinic supervisors.

**Data were not discussed in staff meetings** nor analysed by them.
Malawi Patient Management System (Baobab)

- Touch screen data entry system
- Low cost, robust flat screen terminals
- Large numbers of patients registered (>300,000)
- May be best example of direct data entry system in a developing country

Report CDC Malawi, presented at PHIN2009
“Mateme” Touchscreen Registration

Darius Jazayeri

National id: P1750-0000-0072
Birthdate: 18/Feb/1976
Mother’s Surname: 
Home Village: Donda
Current Village: Esangalo

Registration
Patient was seen at the registration desk at 09:02

Vitals
70.0, 170.0

Treatment
Triomune-30: morning: 1 dose; afternoon: None; evening: None; night: None; (30 total)

Appointment
22/Jun/2009

Credit: Jeff Rafter (Baobab), Evan Waters (PIH)

Courtesy Jeff Rafter and Evan Waters. Used with permission.
CDC Pilot Study: Objectives

- The pilot EDS will be evaluated using a set of criteria:
  - Usability
  - Sustainability
  - Reliability
  - Availability
  - Accessibility
  - Maintainability
  - Deployability

- Impact of the introduction of the EDS being assessed at multiple user levels
  - Clinician
  - Health facility
  - MOH
Systematic review of evaluation studies

*Blaya, Fraser, Holt, Health Affairs 2010, 29;2: 244-251*

Surveyed 2043 articles and reports
Used 45 in final analysis
## Summary of the Key Studies

<table>
<thead>
<tr>
<th>eHealth Category</th>
<th>Qualitative</th>
<th>Quantitative</th>
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<td>Descriptive Studies</td>
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<tr>
<td>Electronic Health Record (EHR)</td>
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<td>Monitoring, Evaluation and Patient Tracking Systems</td>
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<td>Clinical Decision Support Systems (CDSS)</td>
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<td>Patient Reminder Systems</td>
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<td>Research or Data Collection Systems</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>15</strong></td>
<td><strong>8</strong></td>
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Findings of the Review

Key functions supported by “initial” evidence:

- Tracking patients through treatment initiation, monitoring adherence, and detecting those at risk for loss to follow-up
- Decreasing time to create administrative reports
- Tools to label or register samples and patients
- Collection of clinical or research data using PDAs
- Reduction in errors in laboratory and medication data
- Reminding patients of health care actions
What has been invested in eHealth?

• Recent world bank study showed that over $480M has been awarded to ehealth projects by World Bank for current projects

• 3 other major development agencies also funding at high levels:
  – USAID
  – PEPFAR
  – GFATM

• Little if any evaluation has been carried out on those projects
Collaborators and Funders

- Partners In Health
- Regenstrief institute
- Medical Research Council, South Africa
- World Health Organization
- US Centers for Disease Control
- Brigham and Women hospital
- Harvard Medical School
- University of KwaZulu-Natal
- Millennium Villages Project
- International Development Research Centre, Ottawa
- Rockefeller Foundation
- Fogarty International Center, NIH
- Boston Consulting Group
- Google Inc
## Patient Status Tracking - Patients On ARVs

### Site: Thomonde

**Visit / Med Pickup within last 2 months**

- **Submit**

---

(Hold mouse pointer over bar for description of each group; click on a bar to view included patients)

**Patients on ARVs with both a visit and a med pickup within the last 2 months (166/194 patients)**

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</tbody>
</table>
PIH-EMR history

• 2001 web based EMR system to support the scale up of MDR-TB treatment in Peru
• 2003 created a version of PIH-EMR to support HIV treatment in rural Haiti
• 2004 made the decision to create a new, general and flexible platform to build EMR systems for developing countries
• OpenMRS first used in early 2006 in Kenya and then Rwanda and South Africa
Methods used in Malawi

- **Surveys, semi-structured interviews** with system users, including facility level health care workers and central level staff involved in M&E/supervision.
- **Time-flow analyses** (pre- and post-introduction of system)
- **Analysis of information entered onto patient master cards** and into the electronic system to assess the accuracy of information entered.
- Technical review of system
- **System logs** of problems (e.g. power or system outages, etc.)

Found that 70% of clinicians preferred the touch screen system to the paper system
South Africa (HUPA) Study

HIV Counselors ask a series of questions leading to a patient assessment.

Courtesy Neal Lesh