EMR systems for developing countries: OpenMRS

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Summary

• Motivation for EMR systems in developing countries
• The OpenMRS story
• OpenMRS in Rwanda
• eHealth success and failure factors and evaluation

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
Status of Global eHealth

- Rapid development over the last 3 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

Original problem:
Can MDR-TB and HIV 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?

Chronic disease management

1. Identifying patients requiring treatment
2. Starting patients on the correct medication
3. Ensuring stable and economical supply of medication
4. Ensuring compliance with treatment
5. 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
Requirements for general purpose medical record system

- Web based (but can also be run locally)
- Multiple computing platforms
- Simple to setup
- Local users can create forms and reports
- Open standards - HL7, LOINC, SNOMED, ICD10
- Fully open source
  - supported by a community of programmers and organizations
  - 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, Indiana 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

The concept dictionary

<table>
<thead>
<tr>
<th>Concept Form</th>
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<tbody>
<tr>
<td>**Previews</td>
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- **Id**: 1207
- **Local**: Dutch, French
- **Name**: FUNCTIONAL REVIEW OF SYMPTOMS
- **Short Name**: REVIEW
- **Description**: Review of symptoms on presentation by different systems
- **Synonyms**: Question
- **Datatype**: Coded
- **Answers**: WEIGHT LOSS GREATER THAN TEN PERCENT (7925)
  - COUGH LASTING MORE THAN THREE WEEKS (7430)
  - DIARRHEA MORE THAN OR EQUAL TO 1 MONTH (8423)
  - SEVERE BACK PAIN (8135)
  - FEVER (7028)
  - AFORE (1729)
  - GONORRHEA (7006)
  - ARTHRITIS (7040)
  - MALNUTRITION (7050)
  - DEHYDRATION (8004)
  - URINARY TRACT INFECTION (8420)
  - NIGHT SWEATS (2290)
  - PERNICIOUS ANEMIA (2700)
  - RASH (7027)
  - CYSTIC FIBROSIS (8541)
  - HERNIA (8705)

Disease-specific EMR (MDR-TB)
OpenMRS-Google Maps–SMS-Integration, Karachi

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 24 PIH–supported MOH health centers
- Data for patients with HIV, TB, primary care and heart failure
- Over 16,000 patients tracked (Dec. 2010)
- Rwandan data officers and data managers
- Many sites have their own server and maintain a synchronized copy of the entire database
- Using laptop servers and GPRS network

Evaluating CD4 Access

- 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 ensure up to date results

Clinical Alerts (Rwinkwavu, Rwanda)

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;160:337-41
The OpenMRS EMR system at AMPATH in Western Kenya was used to generate printed patient summaries including reminders for ordering repeat CD4 counts.

The computerized reminder system identified 717 encounters (21%) with overdue CD4 tests.

In the intervention clinic with computer-generated reminders, CD4 order rates were significantly higher compared to the control clinic: 53% vs 38%, OR =1.80, CI 1.34 to 2.42, p<0.0001.

When comparison was restricted to encounters where summaries with reminders were actually printed, order rates in intervention clinic were even higher (63%).

Initial Rwanda ehealth architecture

Potential components of integrated national eHealth architecture in Rwanda

Government of Rwanda EMR roll out

- The Government of Rwanda has decided to use OpenMRS for the national roll out to over 400 health centers
- 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
  - Is integrated into the national ehealth architecture
- First new government site started January 2011

Developer training, Rwanda

- 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
- 34 graduates over 3 years- Dec11
- They support OpenMRS rollout as well as building software development capacity in Rwanda
**PIH OpenMRS Timeline**

- Lesotho
- Malawi
- Rwanda
- Haiti
- Peru

- First meeting
- Start programming
- First use at AMPATH
- Modules
- Cohort builder
- HTML forms
- Synchronization
- New reports

- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011

**Community: OpenMRS Wiki**

- Impact of health care investments
- Success and failure factors

![Graph showing impact of health care investments](image)

- Teaching Hospital
- Operating room
- Medical training
- New hospital
- Supply chain
- CHWs
- Nurse training
- Mobile clinics
- Vaccines

![Graph showing success and failure factors](image)
Impact of Ehealth Investment?

- Power, Hardware, Networking,
- Staffing, Software, Training,
- Leadership

Impact

Investment

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100
The PRISM Framework

Inputs
- RHIS Determinants
  - Technical Factors
    - Complexity of the reporting form, procedures, HIS design, Computer software, IT complexity
  - Behavioral Factors
    - Data demand, Data quality checking skill, Problem solving for HIS tasks, Competence in HIS tasks, Confidence levels for HIS tasks, Motivation
  - Organizational Factors
    - Governance, Planning, Availability of resources, Training, Supervision, Finances, Information, distribution, Promotion of culture of information

Processes
- RHIS Processes
  - Data collection, Data transmission, Data processing, Data analysis, Data display, Data quality checking, Feedback

Outputs
- Improved RHIS Performance
- Improved Health System Performance
- Improved Health states

Outcomes
- Improved Health systems

Impact
- MOH
- Dist
- Clinic
- Village CHW

The importance of local data use

Impact of E-health Investment?

Impact
- Power, Hardware, Networking
- Staffing, Software, Training
- Leadership

Good Data
The importance of local data use

Avoid systems that just suck!

1. Identify the key requirements to improve maternal health and information needed
2. Agree to a small set of outputs: reports, patient summaries, DSS etc.
3. Define and agree the core data set that will allow you to create those outputs → forms
4. Share the data set and tools and designs with the larger collaboration
5. Document all the details and evidence: http://www.maternalconceptlab.com

Jonathan Payne, PIH

Maternal Health Forms?

Avoid the form vortex

PAHO
JEMBI
MVP
Gor
 размещен
MOTECH
PIH
DiMagi

One successful system beats 10 nearly there…

• Prioritize requests by what is feasible
• Get success with low hanging fruit live access to lab data, confirmed in evaluation studies
  – Access to TB lab data in Peru
  – Access to CD4 data in Rwanda
• Don’t have 10 things on the go before one has succeeded!
Power supply, backups and protection

- Must invest in adequate power infrastructure especially with local server
- Low power devices make solar and backup systems more viable
- Laptop servers are a big win in many sites
- Who is responsible?

Confidentiality and data ownership

- Technical solutions exist to ensure security and encryption of medical data
- Training and supervision of staff is essential
- Lack of national policies and laws is a major concern in most developing countries including Haiti

Evaluate your successes and your failures...

- Limited literature to date but some solid studies support eHealth in developing countries
- Formative evaluations valuable in adapting systems and making course corrections
- Justify systems to local staff, funders, and governments
- Include data quality and user satisfaction

Conclusion

- OpenMRS is now used clinically in at least 42 countries
- We are making progress in creating to movement for open source in developing countries
- It is still very challenging to establish information systems in the most resource poor environments
- We need to include formative and impact evaluation in all projects