Global Health Informatics

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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

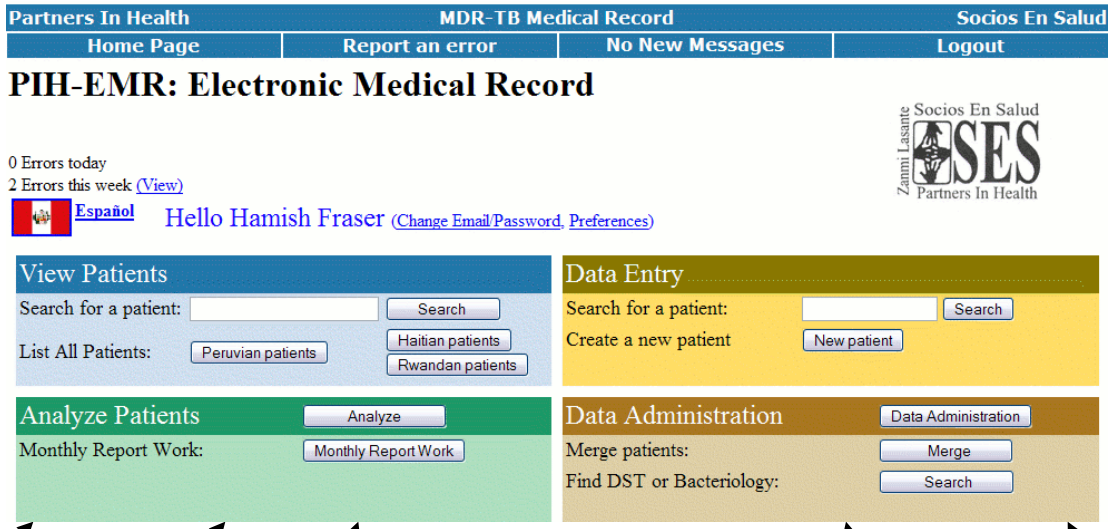
DOTS = directly observed therapy short course

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

Fraser HSF, et al. Evaluating the impact and costs of deploying an electronic medical record system to support TB treatment in Peru. Proc AMIA Symp 2006: 264-268

PIH-EMR Data



Smears
Cultures
Drug sensitivity (DST)

Biochem.
Hematology

Registration form
History/exam
Previous Rx
Previous Dx
Contacts

Follow up
Chest X-ray

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

Partners In Health

Regenstrief Institute

Medical reseach council SA

The concept dictionary

Concept Form

Previous | Edit | Next | New Search:

Id	1293
Locale	English | French
Name	FUNCTIONAL REVIEW OF SYMPTOMS
Short Name	
Description	Review of symptoms on presentation by different systems
Synonyms	
Class	Question
Datatype	Coded
Answers	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)

OpenMRS sites - fall 2010

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

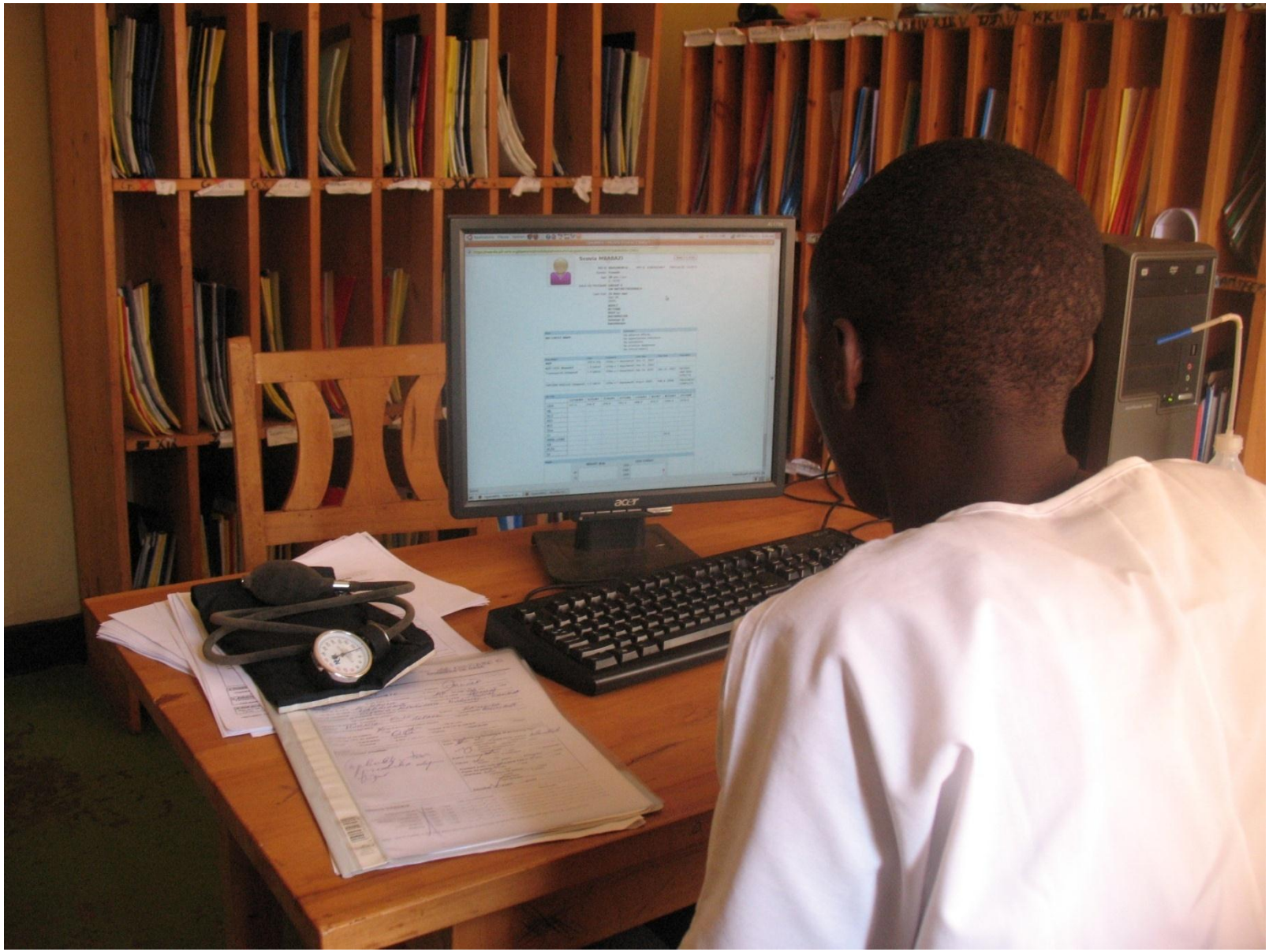
- A small central African country:
  - Population 9 M people
  - Highest population density in Africa, 85% rural

- 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%

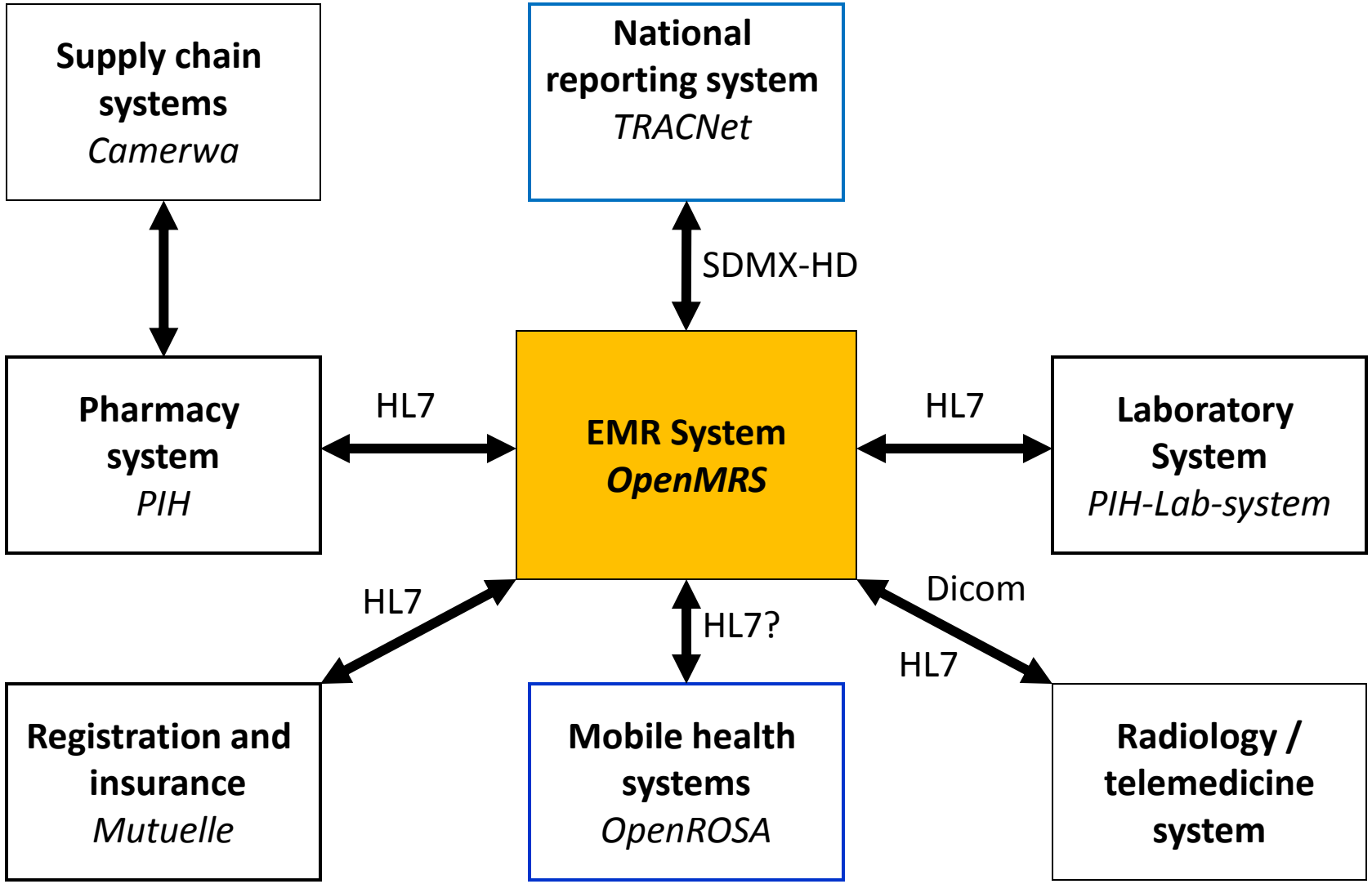
OpenMRS at PIH sites in Rwanda

- 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

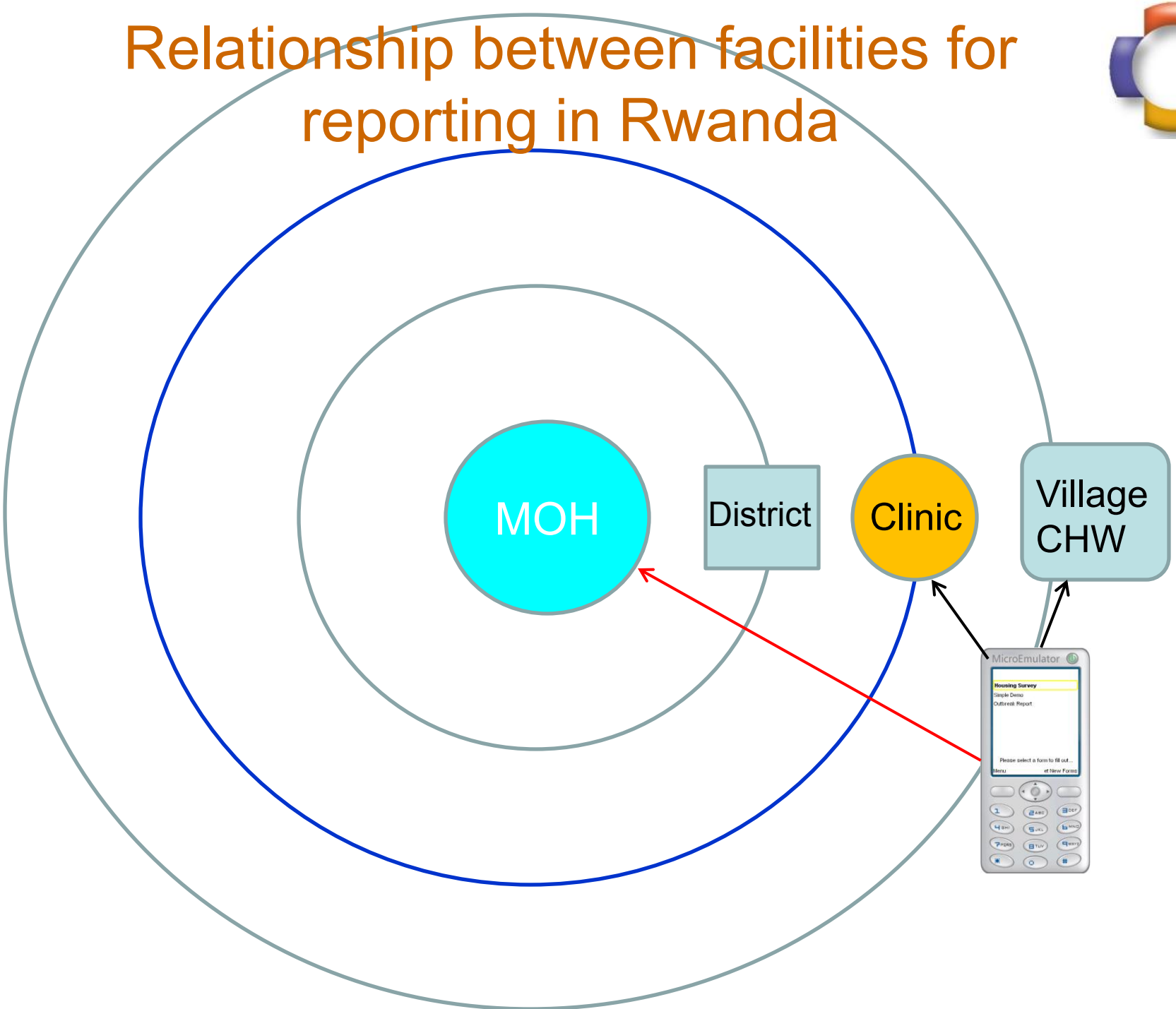
Physician looking up ARV patient



Potential components of integrated national eHealth architecture in Rwanda



Relationship between facilities for reporting in Rwanda



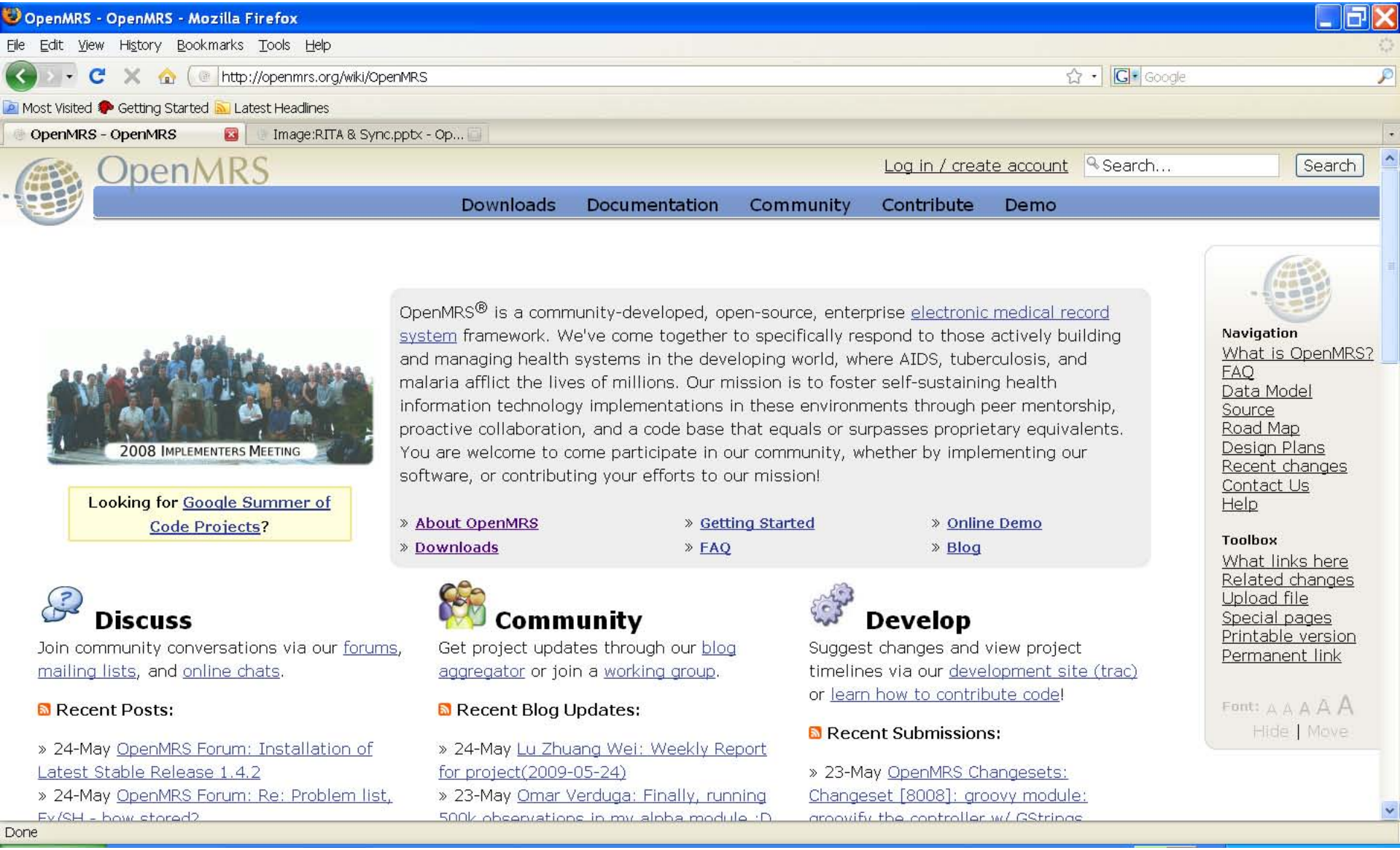
Government of Rwanda EMR roll out

- 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

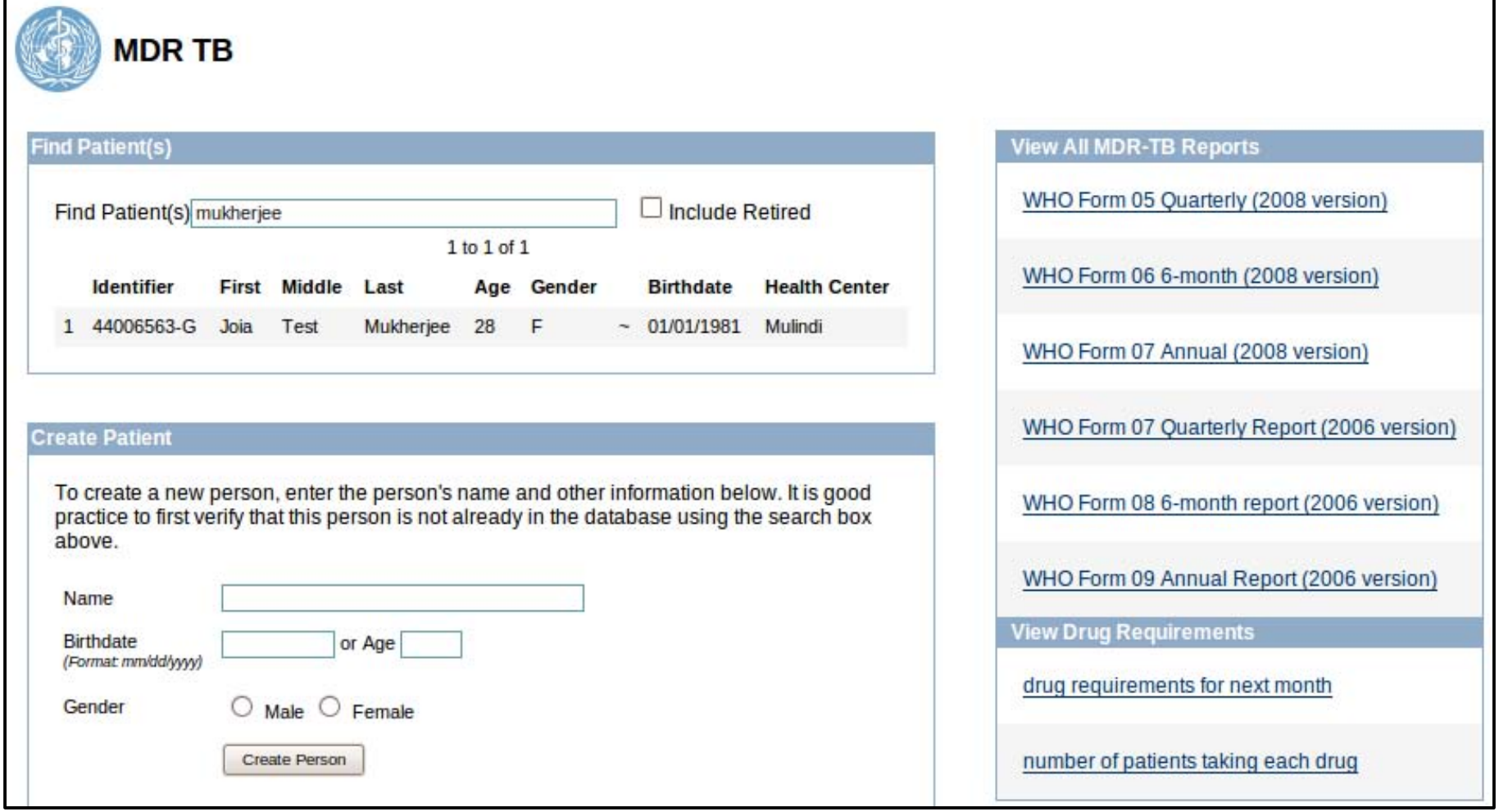
Developer training, Rwanda

- 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
- Ten students graduated last week
- They will support OpenMRS rollout as well as building software development capacity in Rwanda

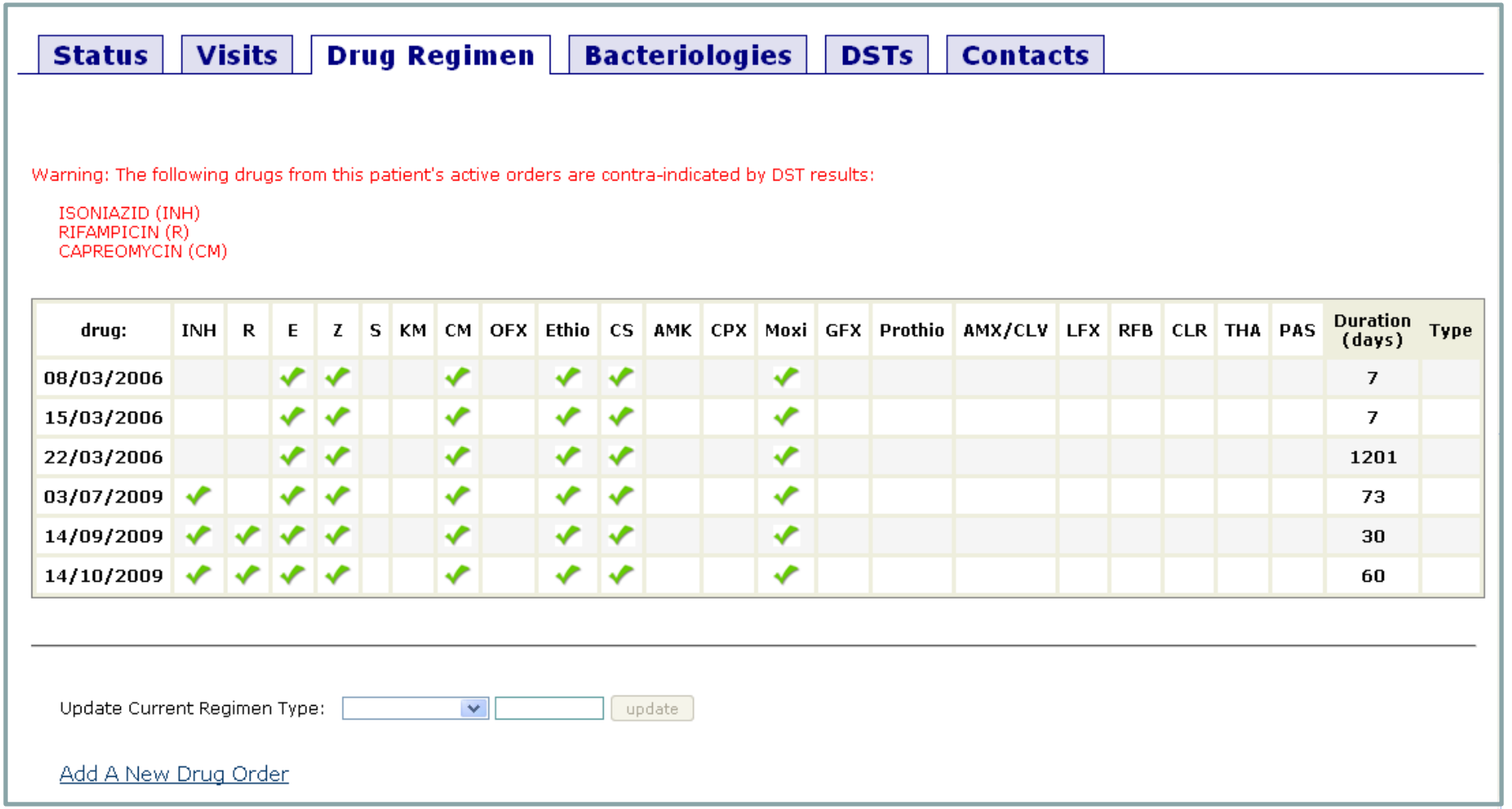
Community: OpenMRS Wiki



Disease-specific EMR (MDR-TB)



Previous drug prescriptions and decision support tools



Status | Visits | Drug Regimen | Bacteriologies | DSTs | Contacts

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

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

drug:	INH	R	E	Z	S	KM	CM	OFX	Ethio	CS	AMK	CPX	Moxi	GFX	Prothio	AMX/CLV	LFX	RFB	CLR	THA	PAS	Duration (days)	Type
08/03/2006			✓	✓			✓		✓	✓			✓									7	
15/03/2006			✓	✓			✓		✓	✓			✓									7	
22/03/2006			✓	✓			✓		✓	✓			✓									1201	
03/07/2009	✓		✓	✓			✓		✓	✓			✓									73	
14/09/2009	✓	✓	✓	✓			✓		✓	✓			✓									30	
14/10/2009	✓	✓	✓	✓			✓		✓	✓			✓									60	

Update Current Regimen Type: update

Add A New Drug Order

Alternative alerts and warnings view

MDR-TB treatment history flowsheet

Charles Virunga MDR-TB Program Identifier: **44**

35 yrs (~01-Jan-1975) Health Center: **Cange**

BMI: 24.7 (Weight: 67.5 kg , Height: 165.0 cm)

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

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**

Overview | Visits | Specimens | Regimen | Status

Find Patient(s)

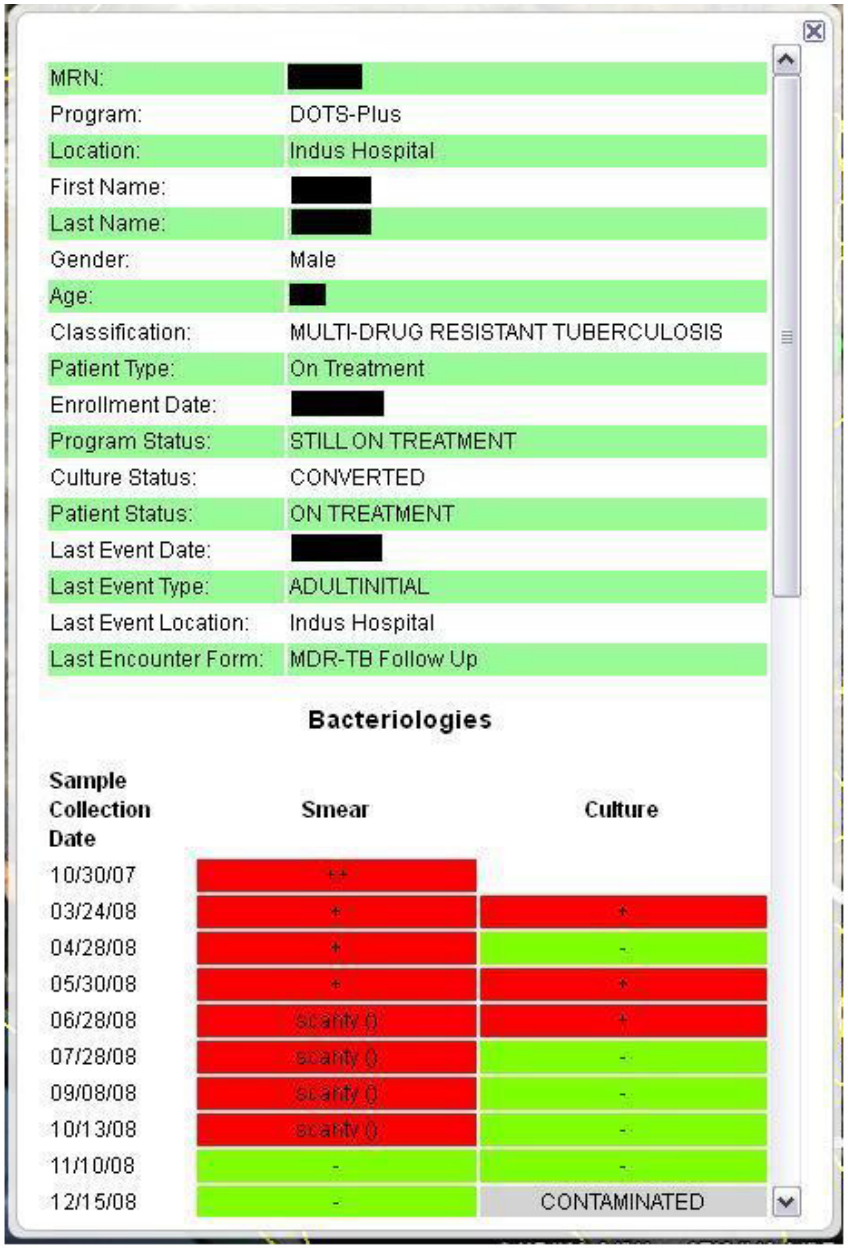
Patient Overview

Patient Enrollment Date: 05/04/2007

View Main Patient Dashboard | Edit Patient Information (Short Form) | Edit Patient Information (Long Form)

Month	Date Collected	Smears	Cultures	Bacteria	INH	E	S	KM	CM	Ethio	CPX	R	Z	LFX	AMK	CFZ	CS	CLR	RFB	PAS
PRIOR																				
BASELINE																				
0	05/04/2007	Treatment Start Date																		
1	01/06/2007	POSITIVE/++ N/A	++ N/A	M. TUBERCULOSIS COMPLEX	R	R	S	S	S	S	S	R	S				S			
2	04/06/2007	POSITIVE/POSITIVE N/A																		
	03/07/2007	- N/A																		
3	04/07/2007	-/- N/A																		
4	16/08/2007	-/- N/A																		
	17/08/2007	- N/A																		
5																				
6																				
7	10/11/2007	- N/A																		
	12/11/2007	-/- N/A																		
	20/11/2007	- N/A																		
	21/11/2007	-/- N/A																		

OpenMRS-Google Maps–SMS-Integration, Karachi



MRN:	[redacted]
Program:	DOTS-Plus
Location:	Indus Hospital
First Name:	[redacted]
Last Name:	[redacted]
Gender:	Male
Age:	[redacted]
Classification:	MULTI-DRUG RESISTANT TUBERCULOSIS
Patient Type:	On Treatment
Enrollment Date:	[redacted]
Program Status:	STILL ON TREATMENT
Culture Status:	CONVERTED
Patient Status:	ON TREATMENT
Last Event Date:	[redacted]
Last Event Type:	ADULTINITIAL
Last Event Location:	Indus Hospital
Last Encounter Form:	MDR-TB Follow Up

Bacteriologies

Sample Collection Date	Smear	Culture
10/30/07	++	
03/24/08	+	+
04/28/08	+	-
05/30/08	+	+
06/28/08	scanty ()	+
07/28/08	scanty ()	-
09/08/08	scanty ()	-
10/13/08	scanty ()	-
11/10/08	-	-
12/15/08	-	CONTAMINATED

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

Credit: Owais Ahmed, Aamir Khan

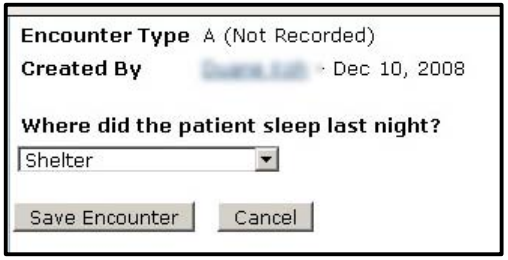
TB in homeless patients in Los Angeles

Credit: Monica Waggoner

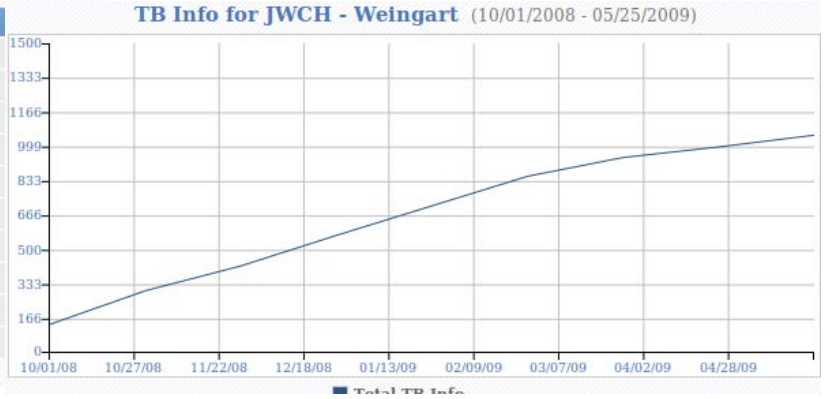
Site: All Sites Graph: Patients

From Date: 10/01/2008 To Date: 05/25/2009

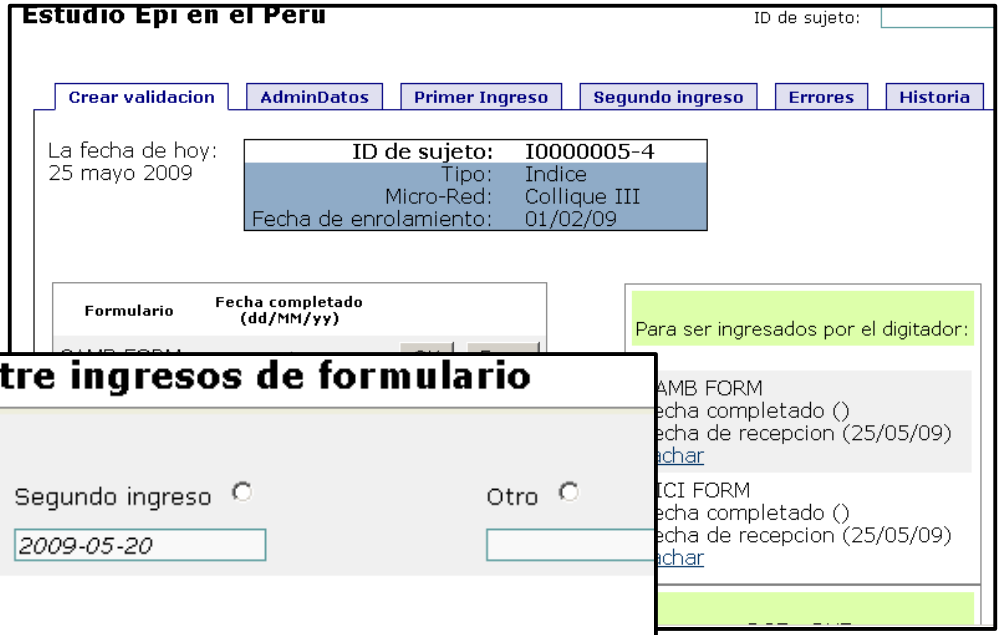
Reload Graphs

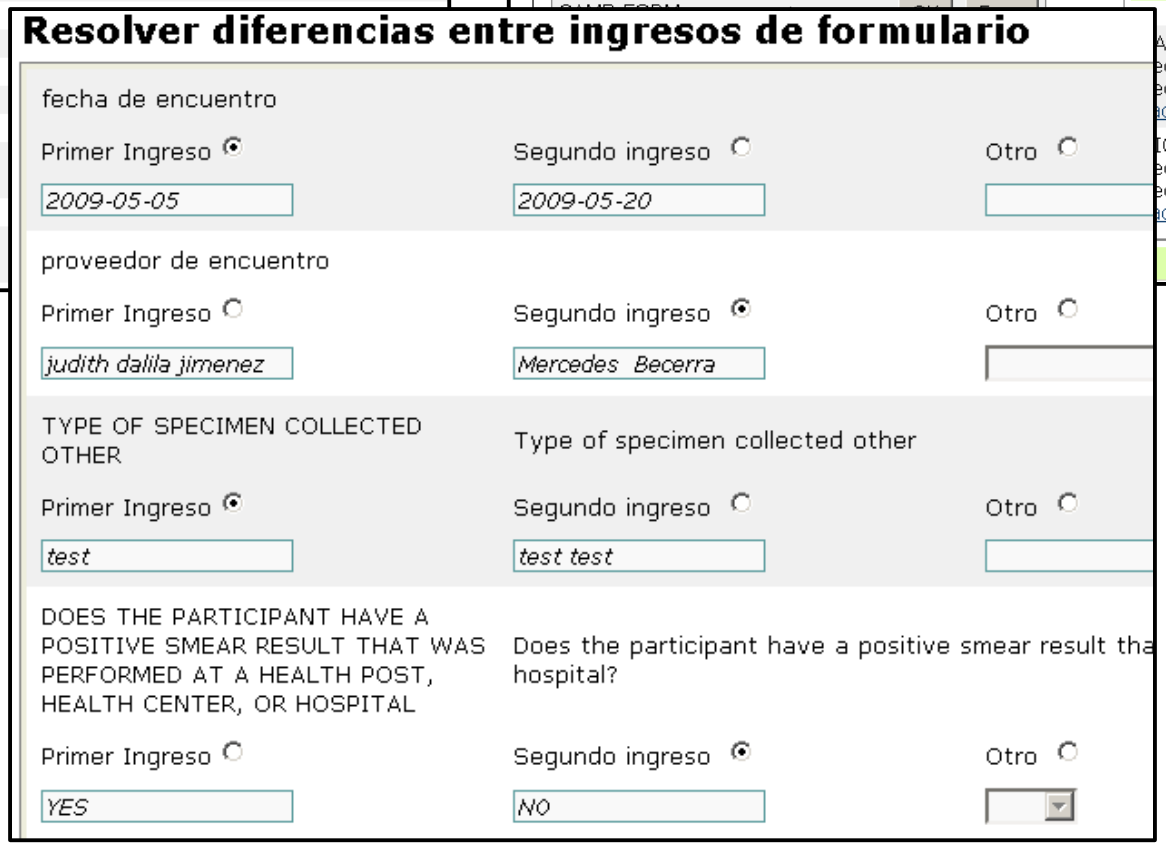


Collection Date	Total Patients
10/01/08	167
10/27/08	598
11/22/08	1232
12/18/08	1616
01/13/09	2043
02/09/09	2429
03/07/09	2758
04/02/09	2956
04/28/09	3170
05/25/09	3170



Research Data Coordination

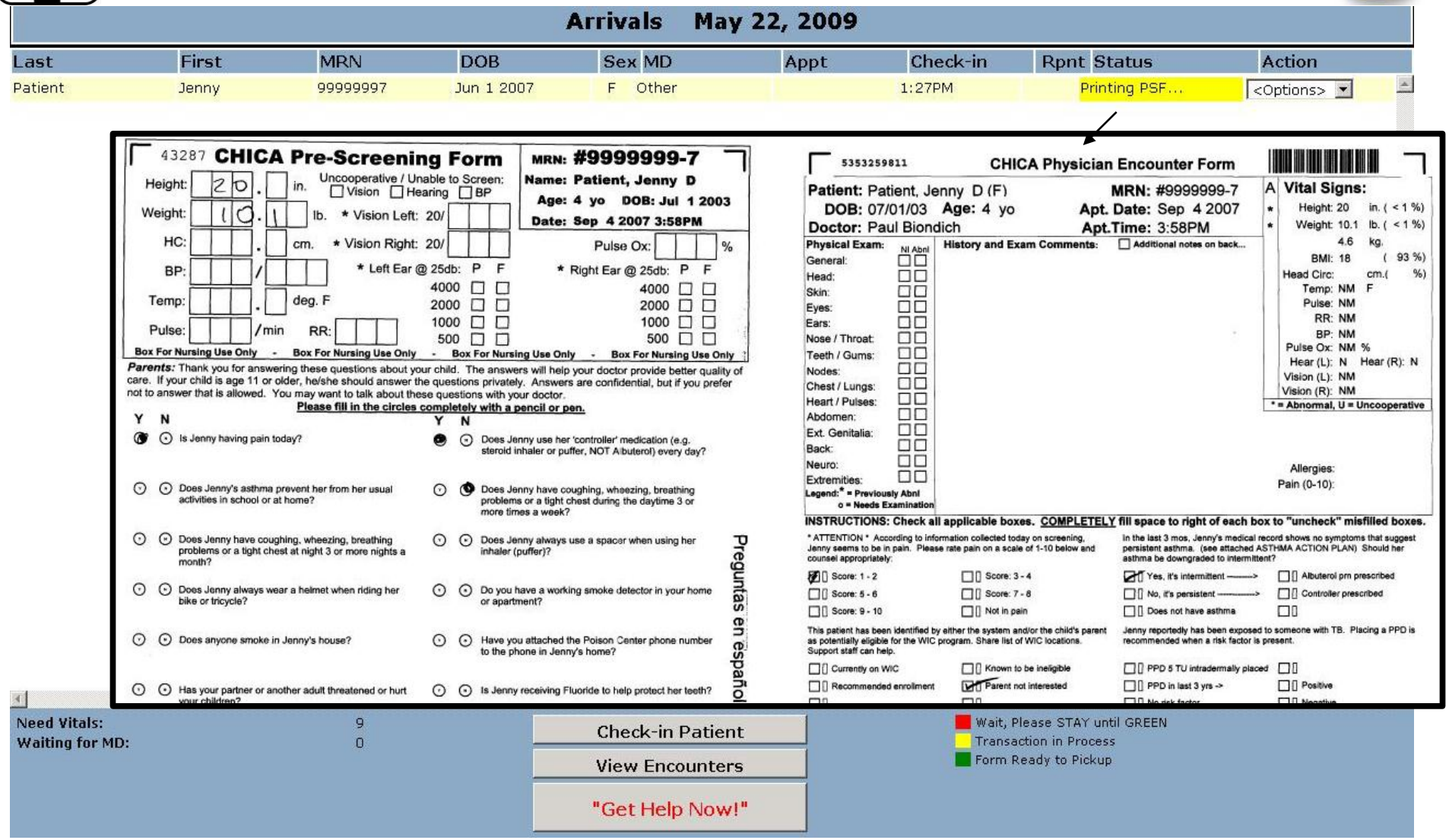




Credit:
Dave Thomas

Courtesy of Dave Thomas.
Used with permission.

Adaptive Turnaround Documents



Credit: Vibha Anand, Paul Biondich (Regenstrief)

Credit: Child Health Informatics Research and Development Lab (CHIRDL) and Children's Health Services Research (CHSR) Program. Courtesy of Vibha Anand, Paul Biondich. Used with permission.

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

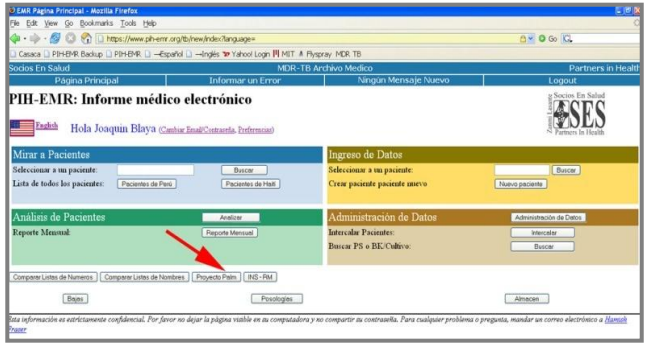
PDA Data Management

Collecting lab data in sites without internet

Palm Pilot

Sync through local PC

Processing & Verification



PIH-EMR

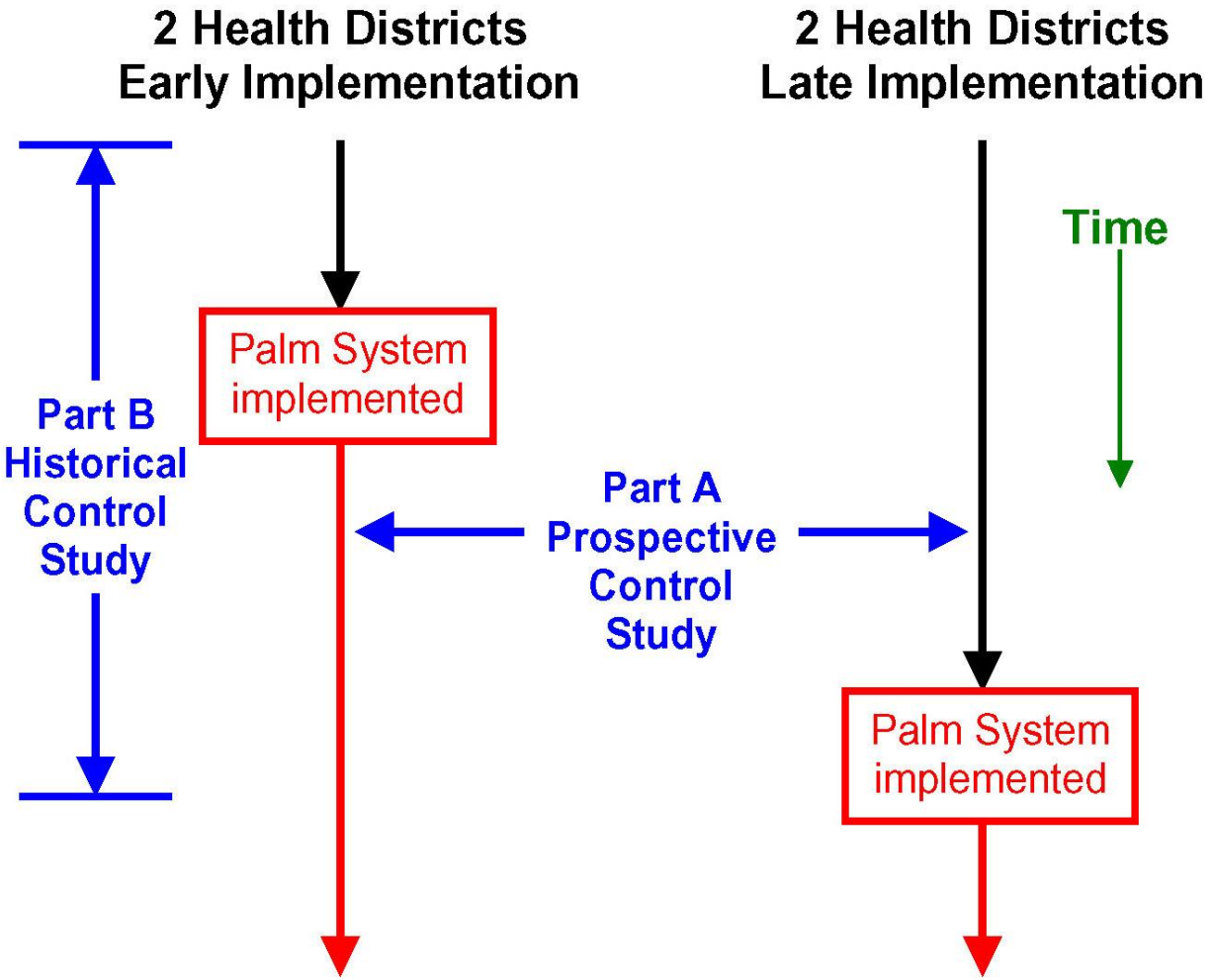
Processing Section

clinical Bacteriology Section

Palm Project: Study Design

Controlled study

- (A) Prospective
- (B) Historical



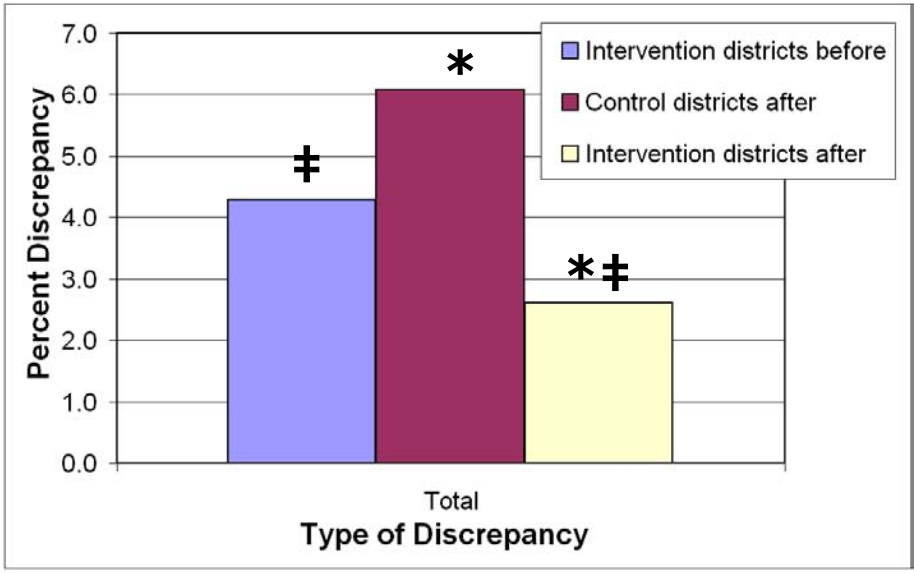
Palm Project: Study Results

Median processing time

	Intervention Districts days (n)	Control Districts days (n)
Pre-Palm	**30.5 (4876)***	**30.8 (5954)**
Post-Palm	**7.7 (2890)*†**	**22.7 (3263)†**

* 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

Drug Sensitivity Lab Data Flow

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

Yagui et al. Int J Lung Dis 2006

E-CHASQUI logo removed due to copyright restrictions.

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

Blaya J et al, Int J Tuberc Lung Dis. 2010 Aug;14(8):1009-15

MDR-TB Drug Regimen Design

Start Date: 04-Sep-2001 **Patient status:** active **Cultures status:** NEG 10 months | Show all

Regimen choices (Edit Regime) ☑ **Taking now** ∅ **Warning** **Contra-indications** **Resistance**

Firstline drugs	Injectables	Quinolones	Other secondline drugs
☐ Isoniazid: **DST, Prev,**	☑ Streptomycin: **Prev,**	☑ Ciprofloxin: **Prev,**	☑ PAS:
☐ Rifampicin: **DST, Prev,**	☐ Capreomycin:	☐ Ofloxacin:	☑ Cycloserine:
☑ Ethambutol: **Prev,**	☐ Kanamycin: **Prev,**	☐ Levofloxacin:	☑ Ethionamide: **Prev,**
☑ Pyrazinamide: **DST, Prev,**	☐ Amikacin:	☐ Sparfloxacin:	☐ Prothionamide:
		☐ Moxifloxacin:	☐ Thiacetazone:
			☐ Clofazamine:
			☐ Amox/Clav:
			☐ Clarithromycin:
			☐ Rifabutin:

"Prev" = previous regimen drugs; **"Alg"** = Allergic; **DX** = previous diagnosis may contra-indicate

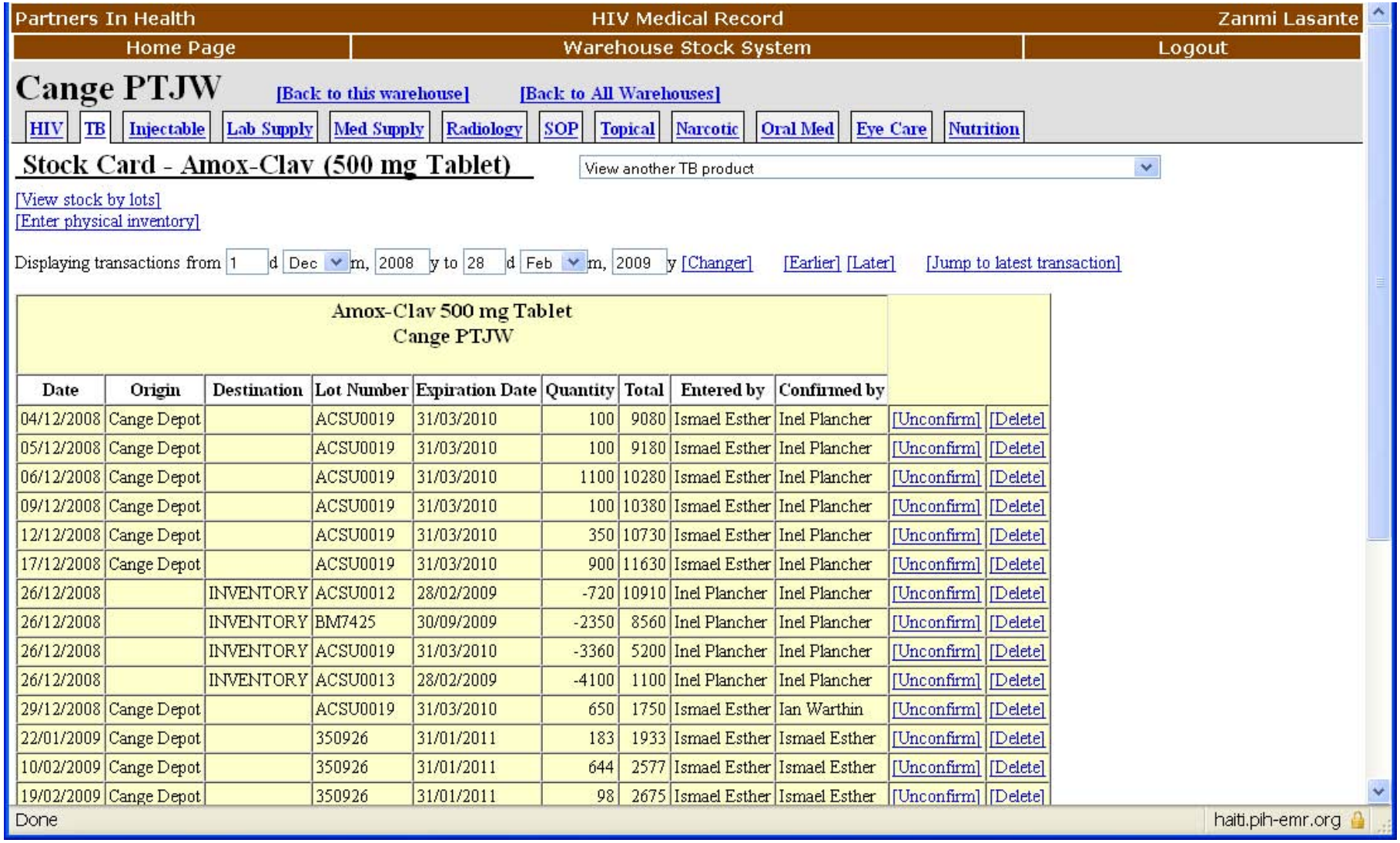
Evaluation of impact of order entry system on drug data accuracy

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

	Callao (EMR)	Lima Este (control)
Before	17.4%*	8.6%**
After	3.1%*	6.9%**
	*P= 0.0075	**P= 0.66,

Choi S, et al. Proc. Medinfo2004, 11: 202-206

Stock Card



Partners In Health | HIV Medical Record | Zanmi Lasante

Home Page | Warehouse Stock System | Logout

Cange PTJW

[Back to this warehouse] [Back to All Warehouses]

HIV | TB | Injectable | Lab Supply | Med Supply | Radiology | SOP | Topical | Narcotic | Oral Med | Eye Care | Nutrition

Stock Card - Amox-Clav (500 mg Tablet)

View another TB product

[View stock by lots]
[Enter physical inventory]

Displaying transactions from 1 d Dec m, 2008 y to 28 d Feb m, 2009 y [Changer] [Earlier] [Later] [Jump to latest transaction]

Amox-Clav 500 mg Tablet
Cange PTJW

Date	Origin	Destination	Lot Number	Expiration Date	Quantity	Total	Entered by	Confirmed by		
04/12/2008	Cange Depot		ACSU0019	31/03/2010	100	9080	Ismael Esther	Inel Plancher	[Unconfirm]	[Delete]
05/12/2008	Cange Depot		ACSU0019	31/03/2010	100	9180	Ismael Esther	Inel Plancher	[Unconfirm]	[Delete]
06/12/2008	Cange Depot		ACSU0019	31/03/2010	1100	10280	Ismael Esther	Inel Plancher	[Unconfirm]	[Delete]
09/12/2008	Cange Depot		ACSU0019	31/03/2010	100	10380	Ismael Esther	Inel Plancher	[Unconfirm]	[Delete]
12/12/2008	Cange Depot		ACSU0019	31/03/2010	350	10730	Ismael Esther	Inel Plancher	[Unconfirm]	[Delete]
17/12/2008	Cange Depot		ACSU0019	31/03/2010	900	11630	Ismael Esther	Inel Plancher	[Unconfirm]	[Delete]
26/12/2008		INVENTORY	ACSU0012	28/02/2009	-720	10910	Inel Plancher	Inel Plancher	[Unconfirm]	[Delete]
26/12/2008		INVENTORY	BM7425	30/09/2009	-2350	8560	Inel Plancher	Inel Plancher	[Unconfirm]	[Delete]
26/12/2008		INVENTORY	ACSU0019	31/03/2010	-3360	5200	Inel Plancher	Inel Plancher	[Unconfirm]	[Delete]
26/12/2008		INVENTORY	ACSU0013	28/02/2009	-4100	1100	Inel Plancher	Inel Plancher	[Unconfirm]	[Delete]
29/12/2008	Cange Depot		ACSU0019	31/03/2010	650	1750	Ismael Esther	Ian Warthin	[Unconfirm]	[Delete]
22/01/2009	Cange Depot		350926	31/01/2011	183	1933	Ismael Esther	Ismael Esther	[Unconfirm]	[Delete]
10/02/2009	Cange Depot		350926	31/01/2011	644	2577	Ismael Esther	Ismael Esther	[Unconfirm]	[Delete]
19/02/2009	Cange Depot		350926	31/01/2011	98	2675	Ismael Esther	Ismael Esther	[Unconfirm]	[Delete]

Done haiti.pih-emr.org

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.

	Q1 2006	**Q4 2006**
Prod. Days stocked out	1569	634 *(P<0.001)*
Prod. Days	60,608	58,576
	2.6%	1.1%

Berger L, et al, Proc. AMIA SYMP. 2007:46-50

“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

http://www.scidev.net/en/news/software-allows-public-to-map-medicine-shortages-.html

“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

Consequences of Inadequate Patient Tracking for PMTCT and ARV programs

"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%)

(Rosen S, PLoS Med 2007 Oct 16;4(10):e298)

Clinical Alerts (Rwinkwavu, Rwanda)

Consultation, 04 Nov 2006

e	Age	Attend?	Weight	New weight	Food support today?	Alerts	CD4	TB (current regimen, TB start date)	arv (current regimen,initiation, last change)	accompangateur
	37	Y N	54 kgs@19Janv06	.	Y N		151 @23Janv06		Triomune-40 (1 Co, 2/j)	MBUZUKONGIR

Consultation, 04 Nov 2006

end?	Weight	New weight	Food support today?	Alerts	CD4
N	54 kgs@19Janv06 64 kgs@12Juil06 66 kgs@9Aug06	.	Y N	-	151 @23 344 @11
N	61 kgs@16Fevr06 65 kgs@22Aug06 69 kgs@18Sep06	.	Y N	late CD4	237 @27
	35	Y N	60 kgs@19Janv06 65 kgs@19Juil06 65 kgs@9Aug06	.	Y N	.	43 @23Janv06 153 @11Aug06	.	Triomune-40 (1 Co, 2/j) 20Janv06	URAYENEZA Maurice

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:

V patients

[redacted]

Back Print

IMB ID [redacted] HIVEMR-V1: 10257
Gender **Male** TRACnet ID: [redacted]
Age **39 yrs** (~Jan 1, 1970)
Adult HIV PROGRAM **GROUP 19 ON ANTIRETROVIRALS**
Last Visit **4 months ago** (Jan 7, 2009)
ADULT RETURN VISIT by [redacted]@ Kirehe

Alerts
NO CHEST XRAY
NO CD4 IN THE LAST 6 MONTHS

Comments
No adverse effects
No opportunistic infections
No previous diagnoses

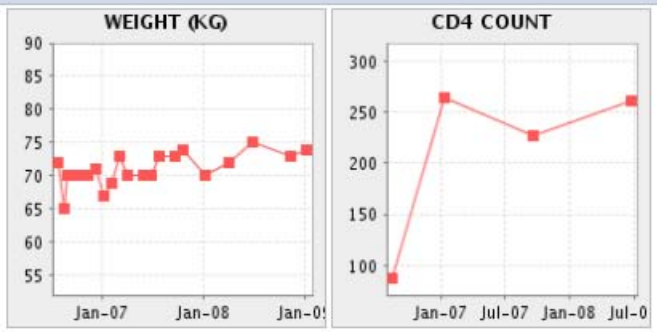
Recent Symptoms	Date
FEVER	Jun 27, 2007
NIGHT SWEATS	Jun 27, 2007
COUGH	Jun 27, 2007
PRODUCTIVE COUGH	Jun 27, 2007
NIGHT SWEATS FOR LESS THAN 3 WEEKS	Jun 27, 2007

Drug Orders	Dose	Frequency	Start Date	Stop Date	Comments
Triomune-30	1.0 tab(s)	2/day x 7 days/week	Aug 12, 2008		
TMP/SMX 800/160	1.0 tab(s)	1/day x 7 days/week	Aug 18, 2006		
Triomune-40 (stopped)	1.0 tab(s)	2/day x 7 days/week	Jul 26, 2006	Aug 12, 2008	TREATMENT GUIDELINES CHANGED

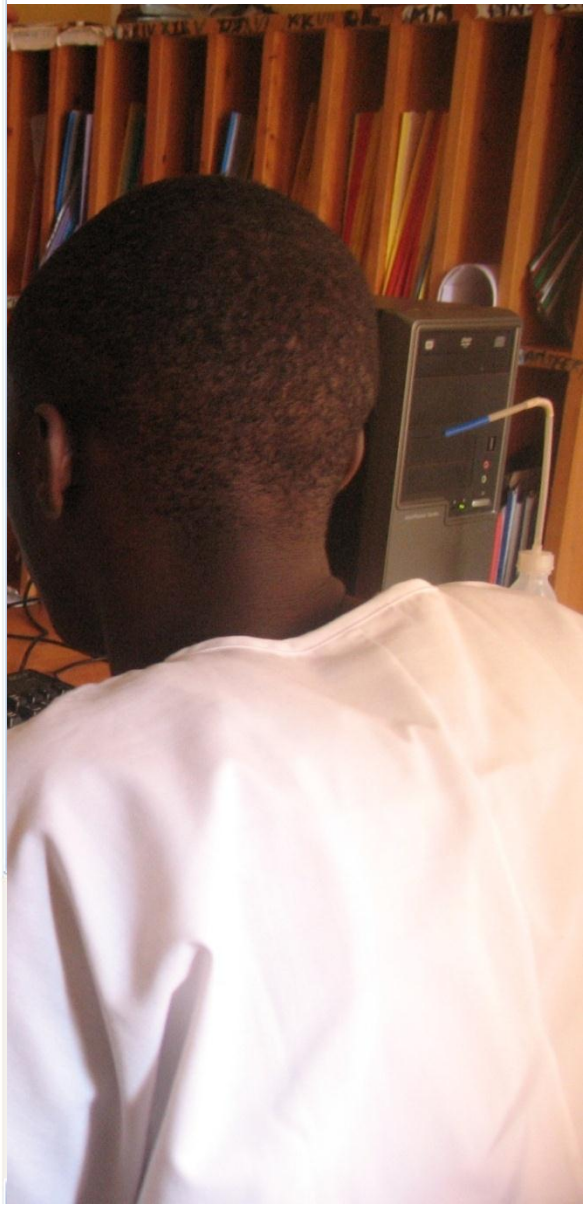
Lab Tests

	7/25/06	8/14/06	1/10/07	5/30/07	9/19/07	6/25/08
CD4		88.0	265.0		227.0	262.0
AST	20.8			50.64		
ALT	18.5			24.15		
Cr	55.51			89.8		

Graphs



Clinical Notes Date Clinician



Usage Statistics

Patient record usage by role

From 01/06/2010 until 10/09/2010 in location [ ] with <Any> actions Update Export

Role	Active users	All usages	Creates	Encounters	Updates	Voids	Last usage
Adherence Research Encounters Admin	1	23	0	0	0	0	30/08/2010
Clinician	10	839	0	0	0	0	09/09/2010
Data Assistant	10	3722	21	1088	113	0	09/09/2010
Data Manager	3	258	1	6	11	1	03/09/2010
Informatics Manager	5	267	1	6	11	1	09/09/2010
Manage Passwords	1	131	0	3	0	0	27/08/2010
Program Manager	7	3632	82	1002	48	1	09/09/2010
Provider	14	872	0	0	0	0	09/09/2010
Run Reports	5	2917	6	737	43	1	09/09/2010
Safe Everything	24	13395	344	9387	216	1	09/09/2010
System Developer	10	316	0	0	212	0	09/09/2010

Admin | View Quick Reports | View Database Changes | Usage Statistics

Usage Statistics

Summary | Time and day | Locations | Roles | Users | Searches | Usages | Configure

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Usage Statistics

Summary | Time and day | Locations | Roles | **Users** | Searches | Usages | Configure

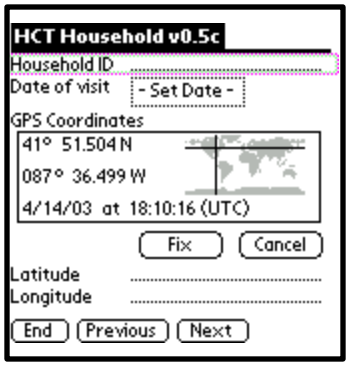
Patient record usage by user

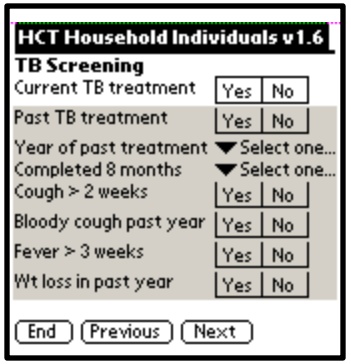
From 01/06/2010 until 10/09/2010 in location [ ] with Clinician role and <Any> actions Update Export

User	All usages	Creates	Encounters	Updates	Voids	Last usage
	1	0	0	0	0	18/06/2010
	172	0	0	0	0	02/09/2010
	77	0	0	0	0	07/09/2010
	65	0	0	0	0	07/09/2010
	15	0	0	0	0	02/09/2010
	296	0	0	0	0	09/09/2010
	9	0	0	0	0	10/08/2010
	1	0	0	0	0	09/06/2010
	73	0	0	0	0	14/07/2010
	130	0	0	0	0	08/09/2010

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





Were et al, Stud Health Technol Inform. 2010;160:525-9.

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**

A Garrib, et al , SAMJ , Vol. 98, No. 7, p 549-552

DHIS

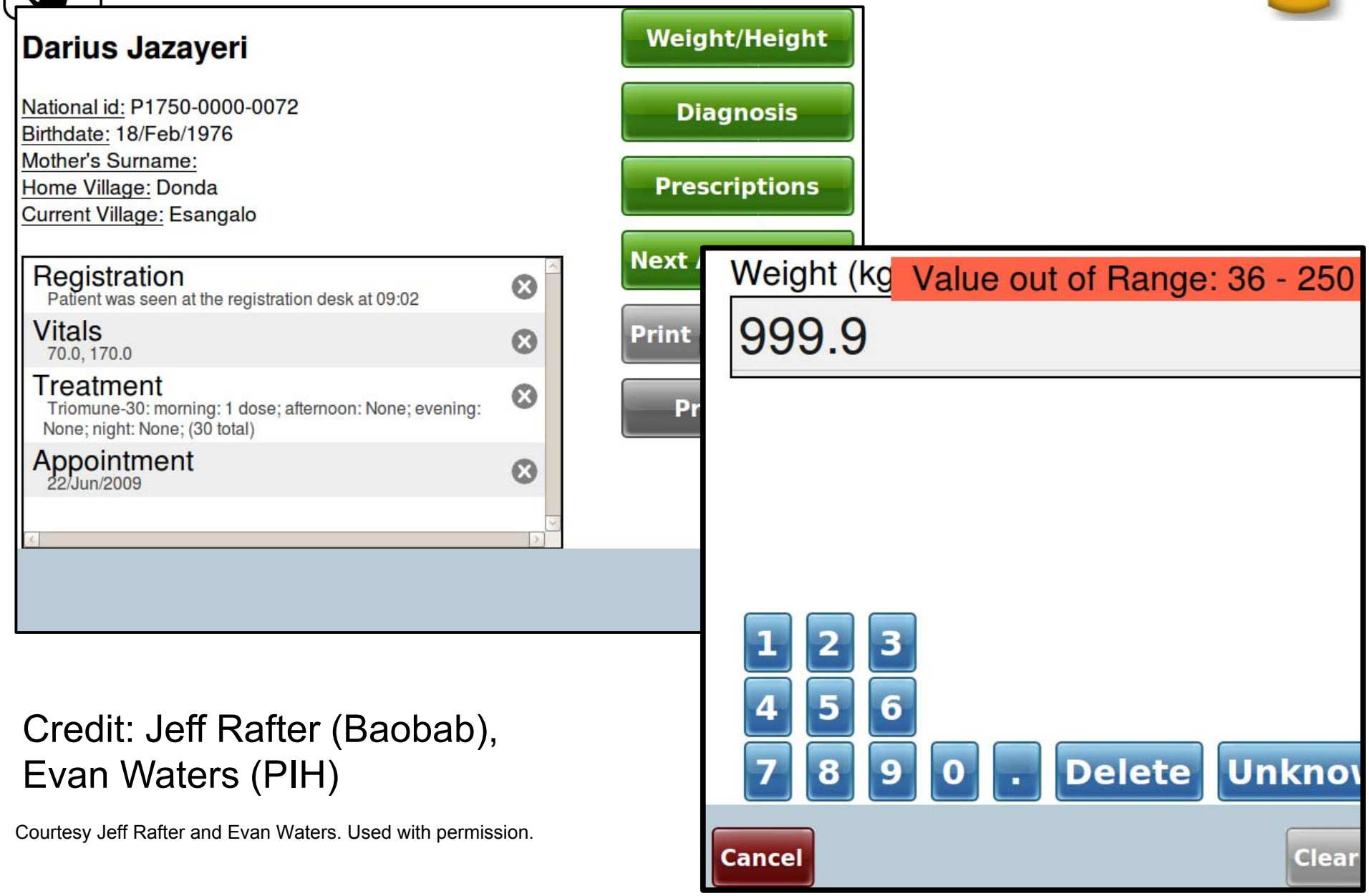
- In the 10 clinics, **2.5% of data values were missing**, and **25% of data were outside expected ra**nges without an explanation provided.
- There was **no computerisation of data collection** and no facility for electronic submission of data in any clinic.
- Clinic staff and supervisors reported that 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



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

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

eHealth Category	Qualitative	Quantitative	
		Descriptive Studies	Controlled Studies
Electronic Health Record (EHR)	5	1	5
Laboratory Information Management Systems (LIMS)	0	1	2
Pharmacy Information Systems	4	2	3
Patient Registration or Scheduling Systems	1	0	2
Monitoring, Evaluation and Patient Tracking Systems	0	2	4
Clinical Decision Support Systems (CDSS)	1	0	3
Patient Reminder Systems	0	1	3
Research or Data Collection Systems	5	1	11
TOTAL	**15**	**8**	**32**

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 Tracking Patient Set

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)

Thomonde (166)

EMR ID	No. Dossier	gender	health_center	birth_date	treatment_status
3236	10-21A8370-2	f	Thomonde	29/02/1936	actif, sous arvs
12157	10-01-a23-436-2	f	Thomonde	22/09/1981	actif, sous arvs
3642	10-01-8285-2	f	Thomonde	11/04/1971	actif, sous arvs
4180	10-03-A13087-2	f	Thomonde	28/10/1967	actif, sous arvs
5024	10-01-2295-2	m	Thomonde	25/08/1954	actif, sous arvs
5208	700061	m	Thomonde	26/04/1969	actif, sous arvs
262	10-01-79085-2	m	Thomonde	17/06/1968	actif, sous arvs

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

Courtesy of Neal Lesh. Used with permission.

HST.950J / 6.872 Biomedical Computing

Fall 2010