



Global m/eHealth: An example using the Millennium Villages Global Network (MVG-Net)

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Introduction and Disclosure

- ✚ Direct Columbia International eHealth Lab
- ✚ Department of Biomedical Informatics
- ✚ Department of Epidemiology/MSPH
- ✚ Board Member/Dir. Clinical Integration for Intelligent Medical Objects (IMO)
- ✚ Imm. Past Pres. Physicians for Social Resp.



Agenda

- ✚ Introduction to Millennium Village Project
- ✚ Origin of MVG-Net/Global Health & MDGs
- ✚ Terminology Management/Interoperability
- ✚ Description of MVG-Net and Examples
- ✚ Challenges/Lessons Learned



Millennium Villages Project

- ✚ Partnership between the Earth Institute Columbia University, UNDP, Millennium Promise and national governments.
- ✚ Primarily operates in 10 countries in 14 agro-ecological zones in Sub-Saharan Africa
- ✚ Integrated development at \$120 pc/y
- ✚ Covers about 500,000 people
- ✚ Each cluster of villages has around 40,000 people and 3-6 clinics



Millennium Villages

- ✚ Koraro, Ethiopia
- ✚ Bonsaaso, Ghana
- ✚ SADA, Ghana*
- ✚ Dertu, Kenya
- ✚ Sauri, Kenya
- ✚ Gumalira, Malawi
- ✚ Mwandama, Malawi
- ✚ Tiby, Mali
- ✚ Timbuktu, Mali
- ✚ Ikaram, Nigeria
- ✚ Pampaida, Nigeria
- ✚ Mayange, Rwanda
- ✚ Potou, Senegal
- ✚ Mbola, Tanzania
- ✚ Ruhiira, Uganda

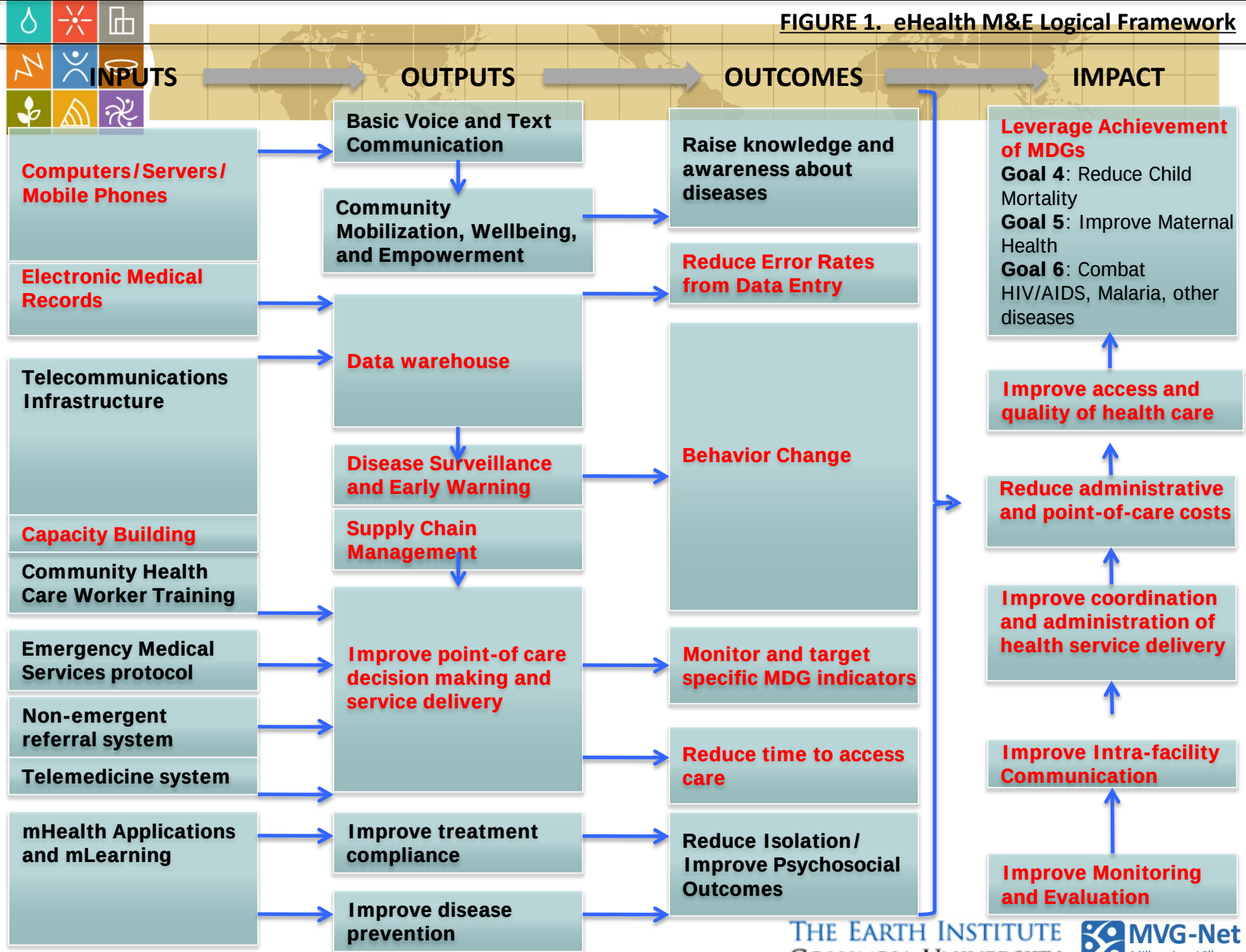


Role of Health Information



- ✚ Three of eight MDGs are health-related
- ✚ MVP establishes one clinic per 5000 people
- ✚ Improve care
- ✚ Assess impact and effectiveness of program at village level

FIGURE 1. eHealth M&E Logical Framework





MVG-Net Principles

- ✚ Open Source
- ✚ Standards-based
- ✚ Integrated application platform allowing exchange of data, information, knowledge
- ✚ Field worker, to clinic, to Ministry and Academia
- ✚ Maturity model allowing for change in content, technology, etc.

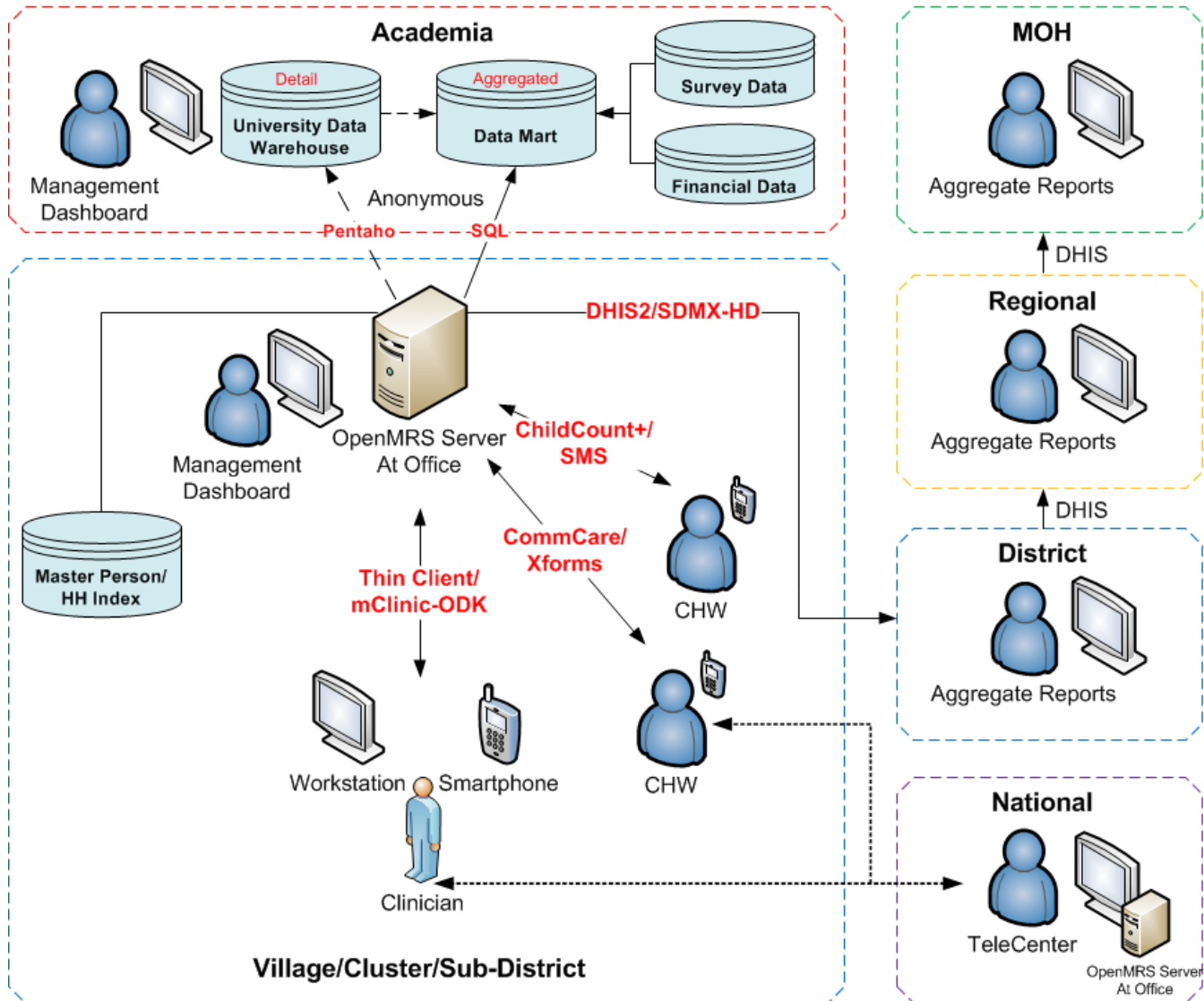


MVG-Net Components

- ✚ **OpenMRS** is core longitudinal record
- ✚ **CommCare** or **ChildCount+** for CHEWs
- ✚ **ODK** (mClinic/ODK collect) for clinics
- ✚ **Telemedicine** applications for CHEWs/CHNs/etc
- ✚ **MoTeCH** for decision support and messaging
- ✚ **DHIS-2** for data aggregation
- ✚ **Pentaho** for data warehousing



Millennium Villages Global Network (MVG-Net)



MVG-Net

THE EARTH INSTITUTE
COLUMBIA UNIVERSITY

MVG-Net
Millennium Villages



MVG-Net Statistics (as of 3/8/2013)

Database Statistic	Count
Servers	13
Patients	436,398
Children < 5 y.o.	97,295
ChildCount+ Encounters	1,047,067
All Encounters	1,514,433
Observations	15,507,737







Monthly Serial Number	Registration number		New Patient					Seen within 4 weeks of appointment	Treatment / Advice	Service fee/ Card charge change
	new	Renew	Name	Address	Age	Sex	Diagnosis			
567 7145			[REDACTED]	Mukwapeh	9 1/2	F	Malaria	32	Spr 8ant pcrmt 4d	
568 7146			[REDACTED]	Muwoni	24	F	UATI	8	Cotr 11 b1	
569 7147			[REDACTED]	ong a	25	F	TIV	31	Flagul 11 8ant	
570 7148			[REDACTED]	Sariti	20	M	Sore throat	11	DCW 1 b1	
571 7149			[REDACTED]	Majawo	32	M	Wounds	36	Alband 1 d1	
572 7150			[REDACTED]	Mukwapeh	1	M	UATI	8	Cotrix b1 pcrmt 4d	
573 7151			[REDACTED]	Mukwapeh	3	F	Conjunct	23	TEO Refor to ZCH	
574 7152			[REDACTED]	Mwamadi	20	F	Dyspep	46	Magnest 11s pcrmt 4d	
575 7153			[REDACTED]	Mwapeh	29	F	U n 11	8	Cotr 11 b1 pcrmt 4d	
576 7154			[REDACTED]	Thandwe	7	F	Malaria	36	ap 11 b1 pcrmt 4d	
577 7155			[REDACTED]	"	35	M	U n 11	8	DCW 1 b1	
578 7156			[REDACTED]	"		F	Aneurysm	15	HS 1 b1	
579 7157			[REDACTED]	Gandi	23	F	Dyspep	49	Magnest 11s pcrmt 4d	
580 7158			[REDACTED]	KBulla	32	M	U n 11	8	DCW 1 b1 pcrmt 4d	
581 7159			[REDACTED]	a KBulla	16	M	Malaria	36	ap 11 b1 pcrmt 4d	
582 7160			[REDACTED]	Mallalla	27	M	U n 11	8	DCW 1 b1 pcrmt 4d	
583 7161			[REDACTED]	Etramu	18	F	U n 11	8	Cotr 11 b1 pcrmt 4d	
584 7162			[REDACTED]	ba Gandi	1	M	U n 11	11	Cotr 11 b1	
585 7163			[REDACTED]	Thandwe	6	F	Dyspep	49	Magnest 11s pcrmt 4d	
586 7164			[REDACTED]	Ganjilla	1	M	U n 11	11	Cotr 11 b1 pcrmt 4d	

History of Present Illness	Physical Exam
Chief complaint:	

IMPRESSIONS/DIAGNOSES:

Problems Added:	Add New Problem	Problems Removed:	Remove Problem From List
1.		1.	
	Delete		Delete

☐ Alcohol Abuse	☐ Gastroenteritis	☐ Measles	☐ Tetanus
☐ Anemia	☐ Hypertension	☐ Meningitis	☐ Trauma/Injury
☐ Asthma	☐ HIV Infection	☐ Pneumonia	☐ Trichomoniasis
☐ Conjunctivitis	☐ Intestinal Parasites	☐ Pulmonary TB	☐ Urinary Tract Inf.
☐ Diarrhea	☐ Malaria	☐ Upper Resp. Tract Infect.	☐ Vaginal Bleeding
☐ Fever of Unknown Origin	☐ Malnutrition	☐ Skin Disorders	Other:

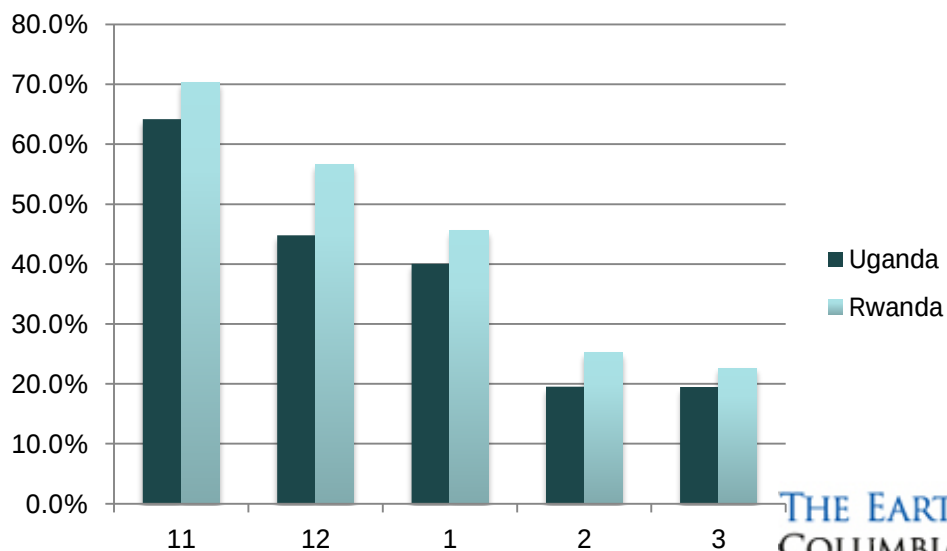
Lab Orders:	Lab Results:	Radiology:
☐ Malarial Smear	Malaria ☐ - ☐ + ☐ ++ ☐ +++ ☐ ++++	
☐ Urine Pregnancy Test	AFB ☐ - ☐ + ☐ ++ ☐ +++ ☐ ++++	
☐ Blood Sugar (Glucose)	Pregnancy ☐ Neg. ☐ Pos. ☐ Indeterminate	
☐ HIV Test	Stool O&C ☐ Neg. ☐ Pos.	
☐ Haemoglobin	HIV Test ☐ Neg. ☐ Pos. ☐ Indeterminate	
☐ Syphilis (VDRL)	Sputum ☐ Neg. ☐ Pos.	Blood Sugar: mmol/dL
☐ Urinalysis	Gram Stain ☐ Other:	Haemoglobin: g/dL
☐ Sputum AFB ☐ Gm Stain	VDRL ☐ Non-Reactive	Hematocrit: %
☐ Stool O&C	☐ Reactive	Other:
☐ Other:		

Recommendations	Pharmacy	Referrals



Comparable and Timely Data

Month	Year	Cases	Treated	Smears	Neg Smears	Neg Smears Tx'd (%)
11	2008	308	408	481	455	292 (64.1758)
12	2008	248	251	428	393	176 (44.7837)
1	2009	644	789	514	457	183 (40.0438)
2	2009	541	561	816	728	142 (19.5055)
3	2009	292	343	443	406	79 (19.4581)
11	2008	115	159	175	168	118 (70.2381)
12	2008	97	111	152	136	77 (56.6176)
1	2009	99	108	142	123	56 (45.5285)
2	2009	64	68	161	143	36 (25.1748)
3	2009	43	38	123	115	26 (22.6087)





Quantitative Comparison: Paper vs SMS

	Paper	SMS	Diff	P-value	Odds Ratio	OR 95 % CI
Proportion of patients receiving “on-time” routine visits						
Under-5's receiving MUAC reading within 90 days	78.2 %	91.5 %	13.3 %	0.00	3.00	[2.80, 3.21]
Mean Days:	56	35	(21)	0.00		
N:	80,058	10,302				
Pregnant Women receiving visit within 42 days	62.6 %	70.4 %	7.8 %	0.00	1.42	[1.25, 1.62]
Mean Days:	38	23	(15)	0.00		
N:	9,242	917				
Proportion of patients receiving “on-time” follow-up for previous referrals or treatment						
Patients receiving follow-up for referrals or treatment within 3 days	25.6 %	48.0 %	22.4 %	0.00	2.70	[2.39, 3.04]
Median Days:	21	4	(17)	0.00		
N:	18,439	1,131				



Terminology About Terminology

- ✚ **Administrative-** classification for administration of health care (e.g., ICD, CPT®)
- ✚ **Reference-** concept-based, controlled terminology for complex organization and aggregation of information (e.g., SNOMED®CT, RxNorm™, LOINC)
- ✚ **Interface-** terms or phrases which support clinician entry of patient data into computer systems (e.g., Problem (IT), “Concept Names”)



Interoperability Requires...

- ❖ Controlled Medical Terminology (CMT) or Concept Dictionary
- ❖ Standard codes and terms for semantic interoperability (Reference Terms)
- ❖ Hierarchical representation to address different levels of specificity
- ❖ Administrative codes for reporting and reimbursement



CIEL Concept Dictionary

- ✚ Contains most diseases, procedures and medications (>48,000 concepts)
- ✚ Mapped to SNOMED CT, ICD-10, 3BT, RxNorm, LOINC and CVX codes.
- ✚ Several Languages:

– 66,253 en – 2,027 fr – 30 rw
– 32,626 es – 239 sw – 52 ti
– 11,760 nl – 13 am – 7 om

SNOMED CT	48,528
ICD-10-WHO	39,915
RxNORM	5,589
LOINC	317
3BT	7,703



Global Reach- Multilingual data

- Forms can be multilingual
- Data elements translated into multiple languages
- Allows integration into current workflow
- Customized but standardized

 Currently logged in as Doctor Super User | [Log out](#) | [My Profile](#) | [Help](#)

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Viewing Concept **MALARIA**

[Previous](#) | [Edit](#) | [Stats](#) | [Next](#) | [New](#)

Id	116128
Locale	English Spanish French Italian Portuguese Tigrinya
Name	MALARIA
Short Name	
Description	A protozoan disease caused by four species of the genus PLASMODIUM (P. falciparum (MALARIA, FALCIPARUM), P. vivax (MALARIA, VIVAX), P. ovale, and P. malariae) and transmitted by the bite of an infected female mosquito of the genus Anopheles. Malaria is endemic in parts of Asia, Africa, Central and South America, Oceania, and certain Caribbean islands. It is characterized by extreme exhaustion associated with paroxysms of high fever, sweating, shaking chills, and anemia.
Synonyms	
Class	Diagnosis
Datatype	N/A
Mappings	SNOMED CT: 61462000 ICD-10-WHO: B54 SNOMED NP: 105649009
Version	
Retired	false



Millennium Global Village-Net - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://127.0.0.1:8080/openmrs/index.htm

Most Visited Yahoo! Mail (andy_ka... Millennium Global Villa... EI Mail IMO Mail Millennium Global Villa...

OPENMRS Currently logged in as Doctor Super User | [Log out](#) | [My Profile](#) | [Help](#)

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Hello, Doctor. Welcome to Millennium Global Village-Net.

English (United States) | [English \(United Kingdom\)](#) | [français](#) | [español](#) | [português](#) | [italiano](#) Last Build: Feb 20 2009 01:50 PM Version: 1.3.4.00

Done



Looking up Patients...

Patient Search

Find Patient(s)

Patient Identifier or Patient Name: Include Verbose ☐

Results for "jane". Viewing 1-1 of 1

Identifier	Given	Middle	Family Name	Age	Gender	Birthdate	Resides in Cluster	Telephone Number
1. 1DM5	Jane		Doe	28		≈ 01/01/1982	YES	555-1212

[Add New Patient](#)

or

Create Patient

To create a new person, enter the person's name and other information below first to double-check that they don't already have a record in the system.

Name

Birthdate or Age
(Format: mm/dd/yyyy)

Gender ☐ Male ☐ Female



Prior Encounters...

Jane Doe

Health ID: **1DM5**



28 yrs (~Jan 1, 1982)

Clinic ID: 44444

Last encounter: **Verbal Autopsy @ Unknown Location, Feb 24, 2010**

[Overview](#) | [Regimens](#) | [Encounters](#) | [Demographics](#) | [Graphs](#) | [Forms](#) | [XForms](#)

Encounters

All Encounters							
Edit	View	Encounter Date	Encounter Type	Provider	Form	Location	Enterer
		02/24/2010	CHERA Visit	Doctor Super User	CC+ Household Visit Form	Sauri Clinic	Doctor Super User
		02/24/2010	Verbal Autopsy	Jonathan Dick	Verbal Autopsy Adult Form	Unknown Location	Doctor Super User
		02/23/2010	CHERA Visit	Doctor Super User	CC+ Individual Visit	Sauri Clinic	Doctor Super User
		02/19/2010	Verbal Autopsy	Doctor Super User	Verbal Autopsy Neonatal Form	Kabuyanda HC4	Doctor Super User
		02/18/2010	Verbal Autopsy	Doctor Super User	Verbal Autopsy Adult Form	Kabugu HC3	Doctor Super User
		02/07/2010	CHERA Visit	Doctor Super User	CC+ Over 5 Form	Marenzo Clinic	Doctor Super User
		02/07/2010	CHERA Visit	Doctor Super User	CC+ Individual Visit	Kabugu HC3	Doctor Super User
		02/07/2010	CHERA Visit	Doctor Super User	CC+ Individual Visit	Sauri Clinic	Doctor Super User
		02/05/2010	CHERA Visit	Doctor Super User	CC+ Over 5 Form	Sauri Clinic	Doctor Super User
		02/05/2010	CHERA Visit	Doctor Super User	CC+ Under 5 Form	Sauri Clinic	Doctor Super User
		02/05/2010	CHERA Visit	Doctor Super User	CC+ Over 5 Form	Kanywamaizi HC3	Doctor Super User
		02/05/2010	Verbal Autopsy	Doctor Super User	Verbal Autopsy Neonatal Form (French)	Kabuyanda HC4	Doctor Super User
		01/22/2010	CHERA Visit	Doctor Super User	CC+ Over 5 Form	Sauri Clinic	Doctor Super User
		01/10/2010	CHERA Visit	Doctor Super User	CC+ Over 5 Form	Kabuyanda HC4	Doctor Super User
		01/02/2010	CHERA Visit	Doctor Super User	CC+ Under 5 Form	Kanywamaizi HC3	Doctor Super User
		01/02/2010	CHERA Visit	Doctor Super User	CC+ Under 5 Form	Marenzo Clinic	Doctor Super User
		01/02/2010	CHERA Visit	Doctor Super User	CC+ Under 5 Form	Kabugu HC3	Doctor Super User



View Prior Encounters



[Home](#) | [Find/Create Patient](#) | [Dictionary](#) | [Cohort](#)

Demographics

Immunization History Form

Encounter Date

Location of clinic

Provider/Interviewer

IMMUNIZATION HISTORY

Immunizations

Immunization Seq. Number

Vaccination date

Immunizations up-to-date?

Last Vitamin A treatment MONTH

Last Vitamin A treatment YEAR

Birth Weight (kg)

Birth Weight, Qualitative



French

Jane Doe | 28 yrs | Health ID: 1DM5 | Clinic ID: 44444

Rencontre: **CHERA Visit le 24/02/2010 at Sauri Clinic** [\[Close Window \]](#)

Fiche: **CC+ Household Visit Form** [\[Modifier \]](#)

4.0 Any household member available for visit/interview: **Oui**

4.1 TOTAL CHILDREN UNDER 5YO VISITED IN HOME: **3.0**

4.2 **SUIVI NUTRITIONNEL**
Education/Conseil: **CONSEIL POUR L'UTILISATION DES MOUSTIQUAIRES**
CONSEIL POUR LE PLANNING FAMILIAL

5.0 TOTAL WOMEN 15-49YO SEEN IN HOUSEHOLD: **4.0**

5.1 TOTAL WOMEN 15-49YO SEEN IN HOUSEHOLD USING MODERN FAMILY PLANNING METHOD: **3.0**

6.0 Long-lasting insecticidal mosquito nets (LLINs): **3.0**

6.1 NUMBER OF SLEEPING SITES IN PATIENT'S HOUSEHOLD: **4.0**

English

Jane Doe | 28 yrs | Health ID: 1DM5 | Clinic ID: 44444

Encounter: **CHERA Visit on 02/24/2010 at Sauri Clinic** [\[Close Window \]](#)

Form: **CC+ Household Visit Form** [\[Edit \]](#)

4.0 Any household member available for visit/interview: **YES**

4.1 TOTAL CHILDREN UNDER 5YO VISITED IN HOME: **3.0**

4.2 **NUTRITION COUNSELING**
EDUCATION/COUNSELING ORDERS: **BEDNET COUNSELING**
FAMILY PLANNING COUNSELING

5.0 TOTAL WOMEN 15-49YO SEEN IN HOUSEHOLD: **4.0**

5.1 TOTAL WOMEN 15-49YO SEEN IN HOUSEHOLD USING MODERN FAMILY PLANNING METHOD: **3.0**

6.0 NUMBER OF FUNCTIONING BEDNETS IN THE HOUSEHOLD: **3.0**

6.1 NUMBER OF SLEEPING SITES IN PATIENT'S HOUSEHOLD: **4.0**

Same Data in
multiple languages



Immunization Decision Support

Immunization Test

 4 yrs (~31-Jul-2008) Household ID: 01-001

BMI: ? (Weight: , Height:) CD4: | Regimen:

Last encounter: **Adult @ Ethiopia Koraro, 17-Aug-2012**

[Overview](#) [Regimens](#) [Encounters](#) [Demographics](#) [Graphs](#) [Form Entry](#) [Immunization](#)

Immunization Status

Series	Status	Sequence	Next Due Date
HEPB	Not Up to Date	1	11/09/2012
VITA	Not Up to Date	1	11/09/2012
TD	Not applicable		
BCG	Complete	-	
IPV	Not Up to Date	1	11/09/2012
HIB	Not Up to Date	1	11/09/2012
DTAP	Complete	-	
MMR	Complete	-	

Immunization History

Immunization	Admin Date	Sequence No.	Valid?
BCG	22/07/2012	4	NO
MMR	03/07/2012	1	YES
BCG	29/05/2012	3	NO
BCG	26/04/2012	2	NO
DTAP	29/09/2011	3	YES
DTAP	31/07/2010	2	YES
DTAP	31/07/2009	1	YES
BCG	31/07/2009	1	YES



ODK for VAVS

SH0C6PB02376

Record Explore Open Url

ODK Collect > Verbal Autopsy Child Form

Patient Demographics

Please tell me at which of the following places/facilities s/he received treatment during the illness that led to death:

- ☒ From Community Health Worker (CHW) at home
- ☒ From friend at home
- ☒ From relative at home
- ☐ Traditional Healer
- ☐ Health clinic or post

Home Menu Back Search Call End call

ODK Collect > Verbal Autopsy Child Form

PROBABLE CAUSE OF DEATH

Allow the respondent to tell you about the illness in his or her own words. Do not prompt except for asking whether there was anything else after the respondent finishes. Keep prompting until the respondent says there was nothing else. While recording, underline any unfamiliar terms.

- ☐ Accident
- ☐ Acute upper respiratory infection
- ☐ Congenital abnormality



CommCare:

- CHW enters birth registration form on mobile phone
- Submit form in household
- Encounter appears in OpenMRS
- Reports can be run instantly

Jane Doe

27 yrs (~Jan 1, 1982) Health Center: Sauri Clinic

Last encounter: **Birth Registration @ Sauri Clinic, Jul 26, 2009**

[Overview](#)

[Regimens](#)

[Encounters](#)

[Demographics](#)

[Graphs](#)

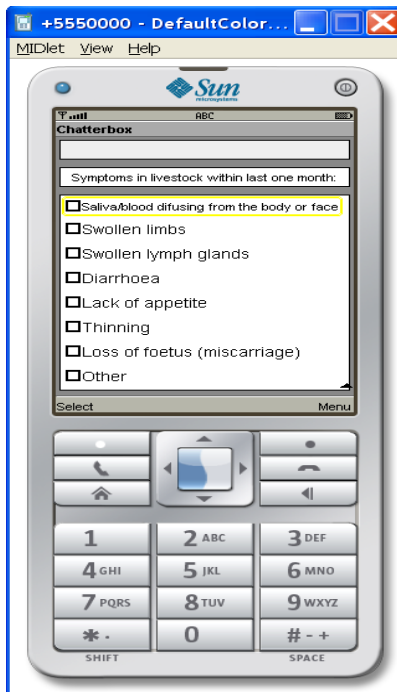
[Forms](#)

[Reports](#)

[View Patient Flowsheet](#)

Encounters

All Encounters				
Edit	View	Encounter Date	Encounter Type	Provider
		07/26/2009	Birth Registration	Doctor Super User



Jane Doe | 27 yrs | Clinic ID: 44444
Encounter: Birth Registration on 07/26/2009 at Sauri Clinic
Form: Birth Registration Form

NEWBORN DETAILS			
BIRTH WEIGHT	CHILD STILL ALIVE	BCG VACCINE GIVEN AT BIRTH	POLIO VACCINE GIVEN AT BIRTH
4.5	YES	YES	YES

METHOD OF DELIVERY: **SPONTANEOUS VAGINAL DELIVERY**

HIV Test
ANTENATAL SERVICES: **TETANUS TOXOID
FOLATE / IRON
INTERMITTENT PREVENTIVE TREATMENT IN PREGNANCY WITH**

LOCATION OF BIRTH: **HEALTH CLINIC/POST**

PARITY: **3.0**

DELIVERY ASSISTANT: **NURSE
FAMILY MEMBER**

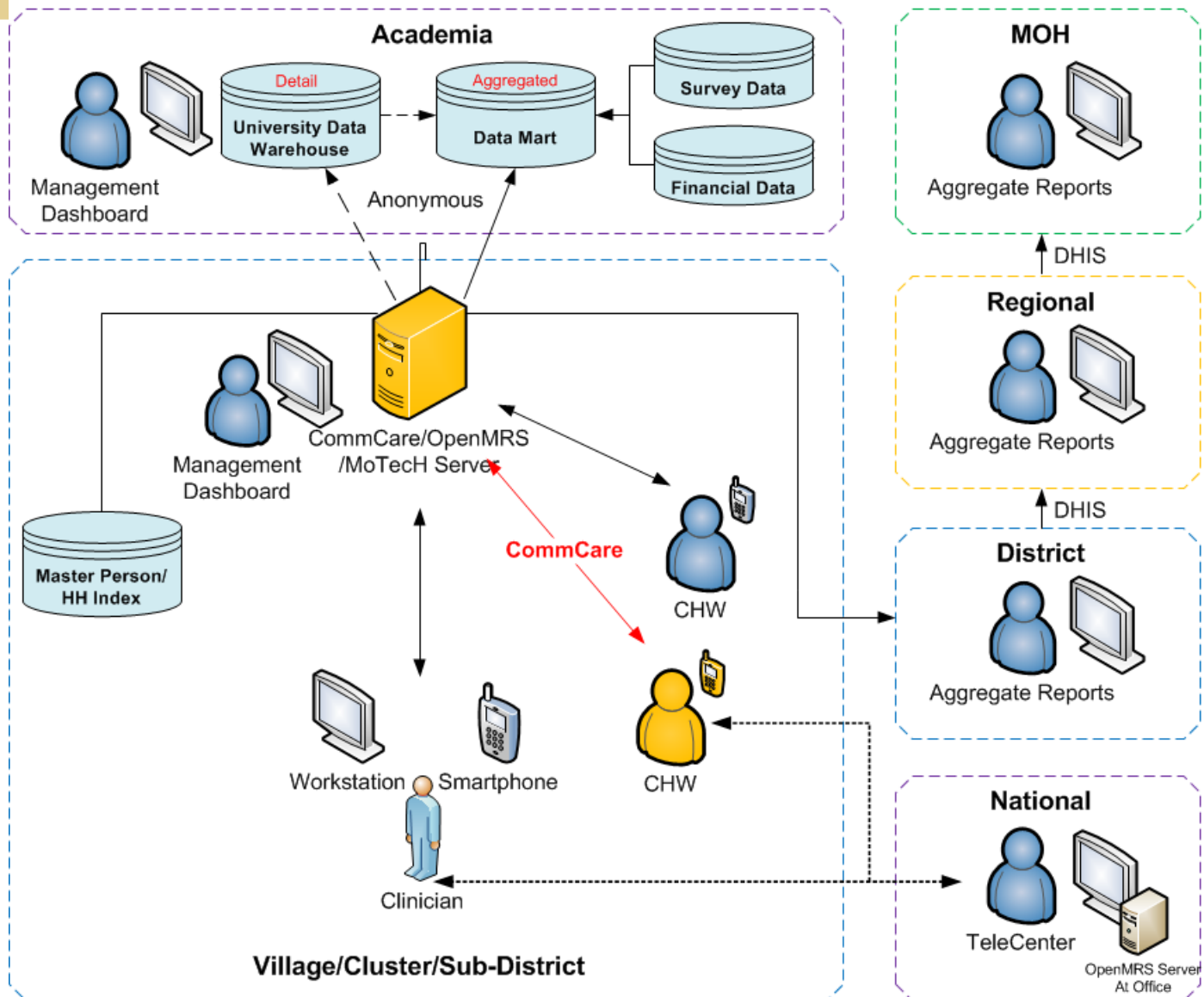
INFANT FEEDING METHOD: **BREASTFED EXCLUSIVELY**

DATE OF PREVIOUS DELIVERY: **Aug 3, 2008**

ANTENATAL VISIT NUMBER: **3.0**



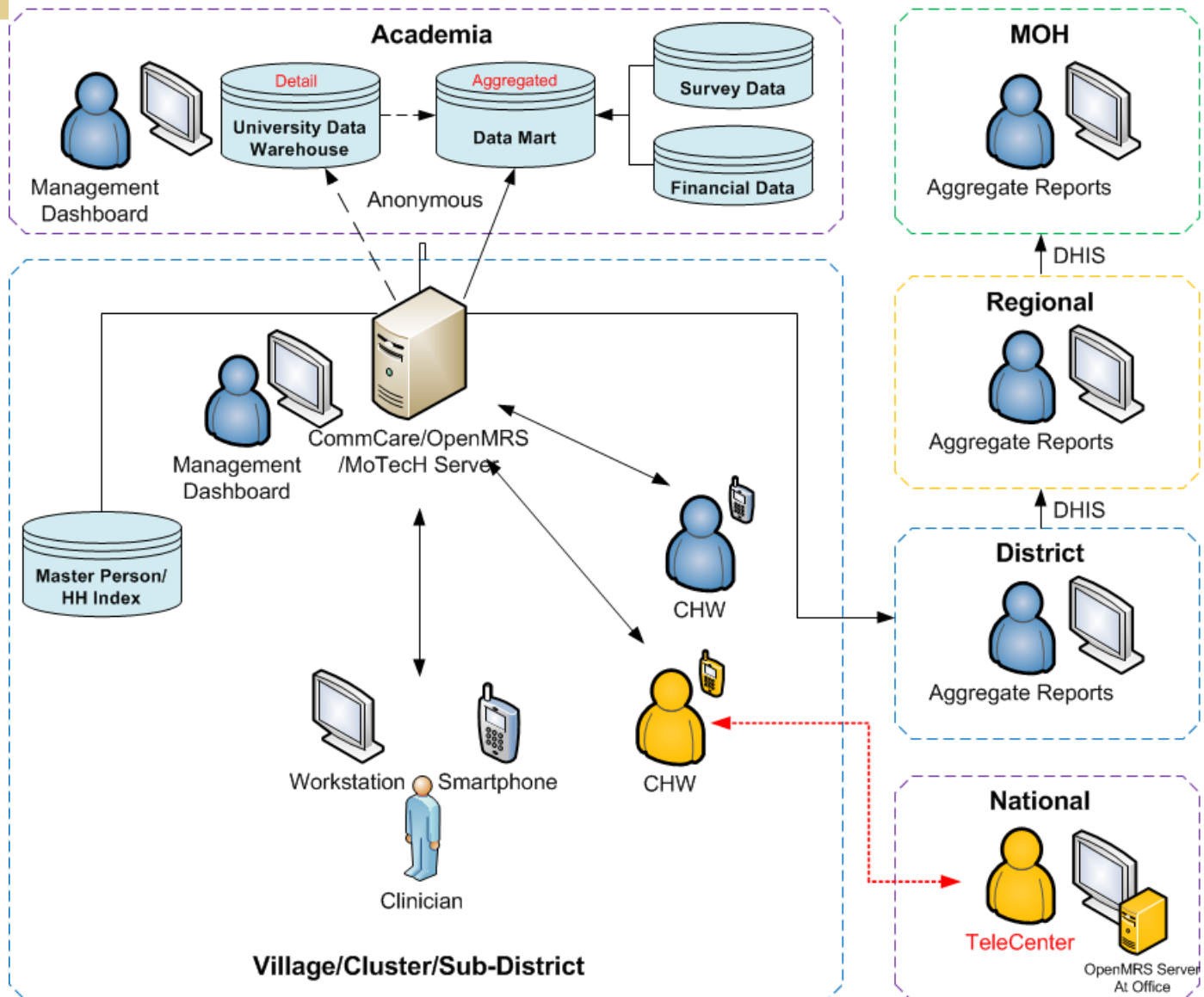
Millennium Villages Global Network (MVG-Net)



Future MVG-Net



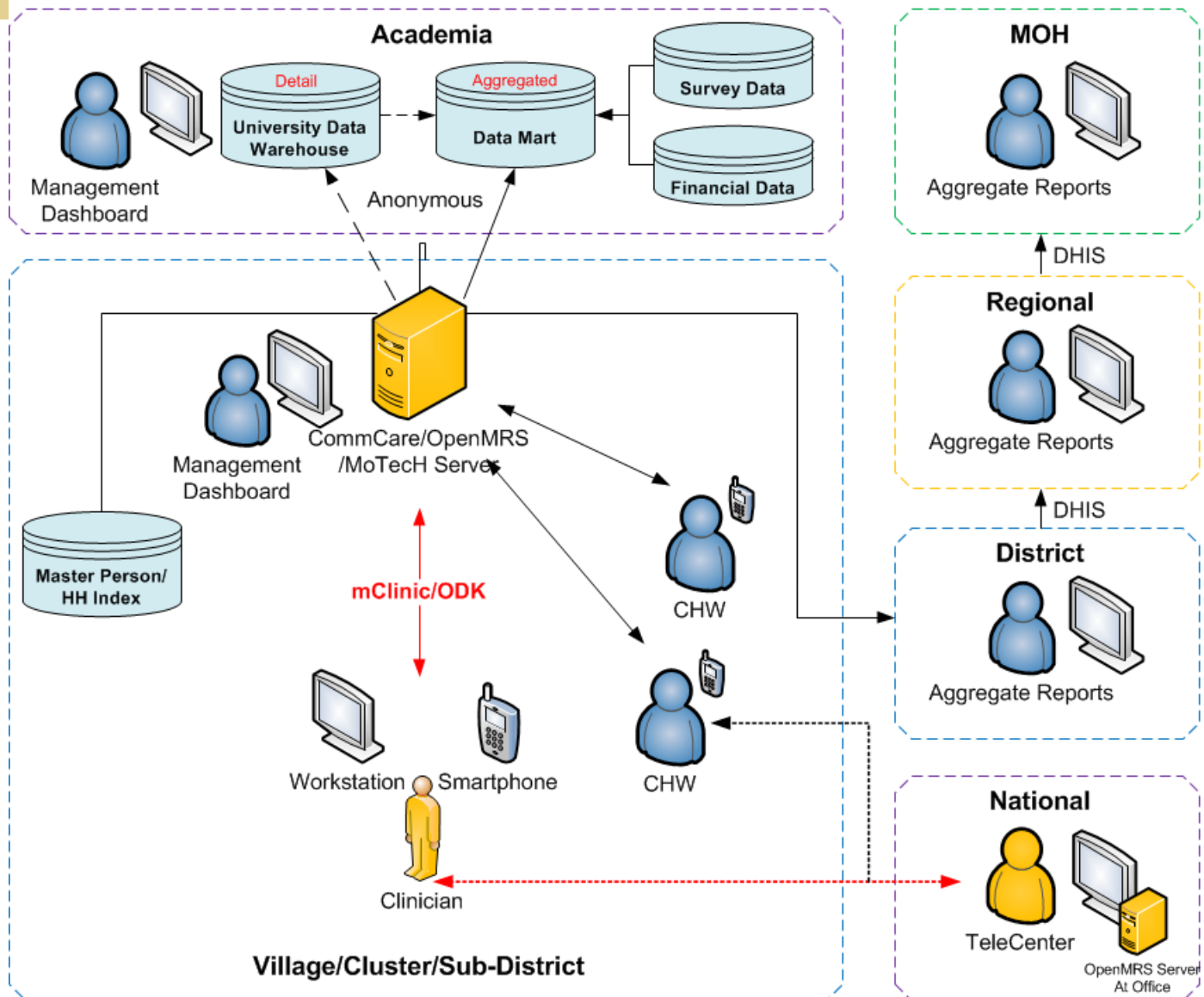
Millennium Villages Global Network (MVG-Net)



Future MVG-Net



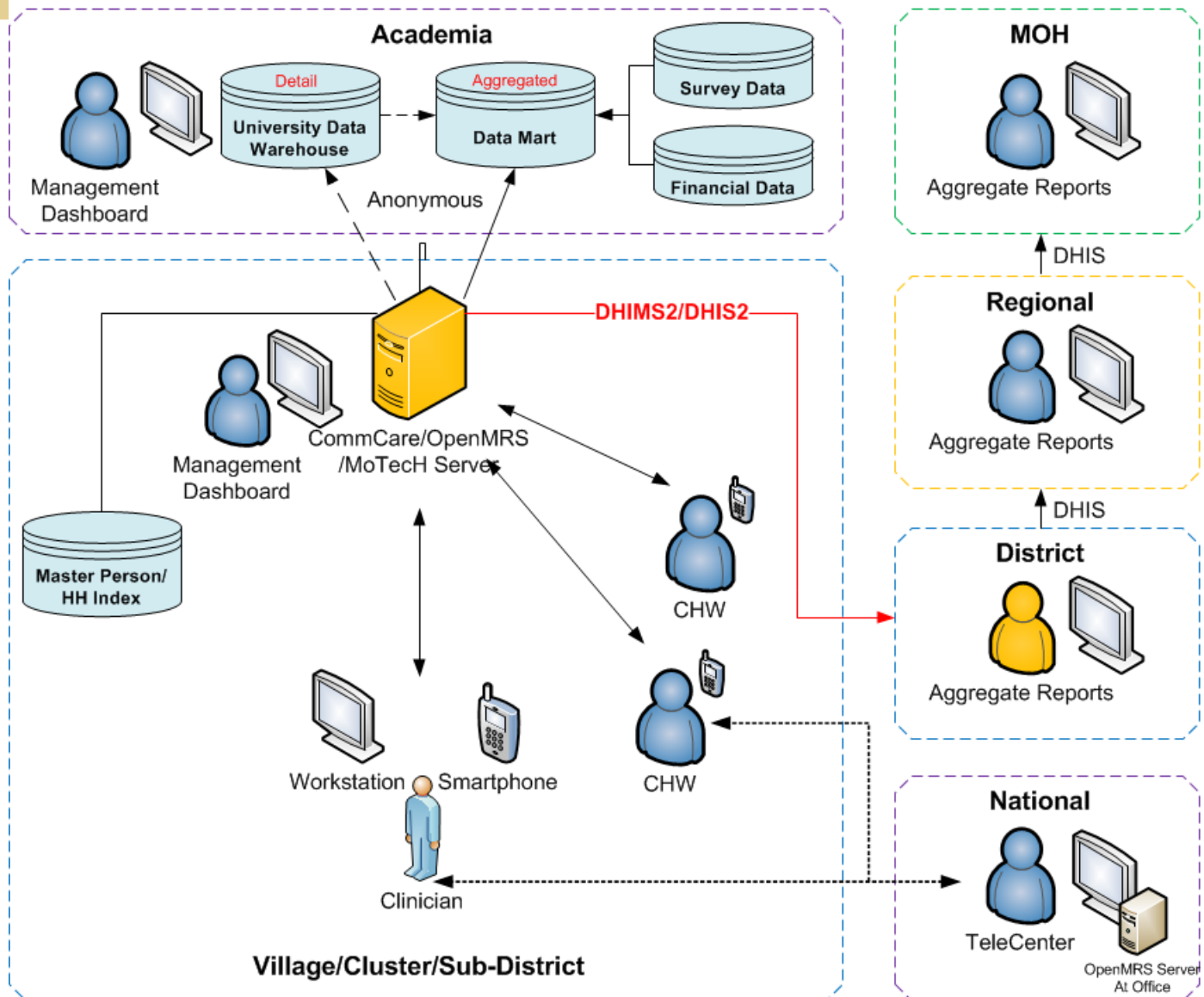
Millennium Villages Global Network (MVG-Net)



Future MVG-Net



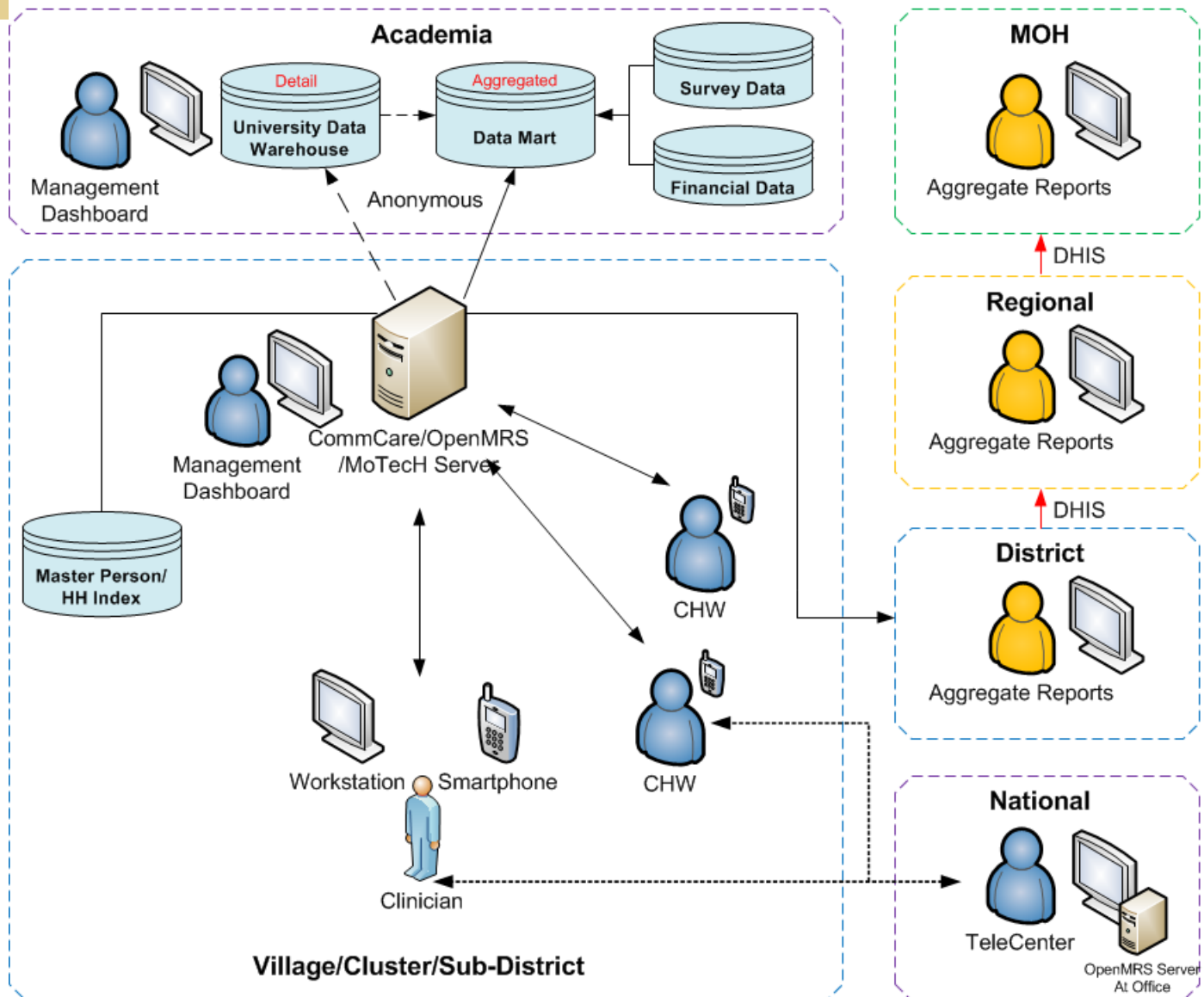
Millennium Villages Global Network (MVG-Net)



Future MVG-Net



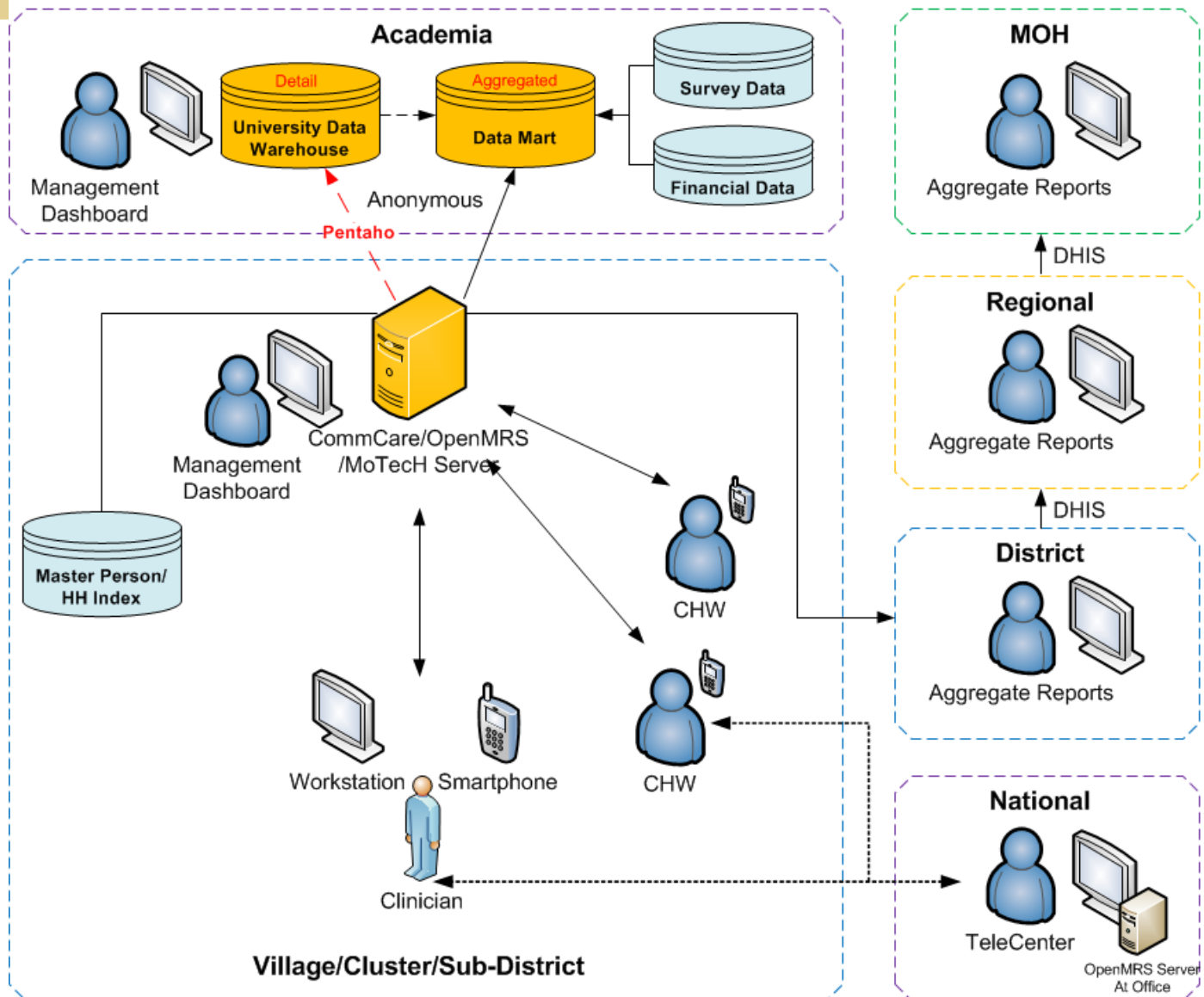
Millennium Villages Global Network (MVG-Net)



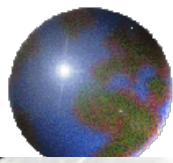
Future MVG-Net



Millennium Villages Global Network (MVG-Net)



Future MVG-Net



Google Maps Integration

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

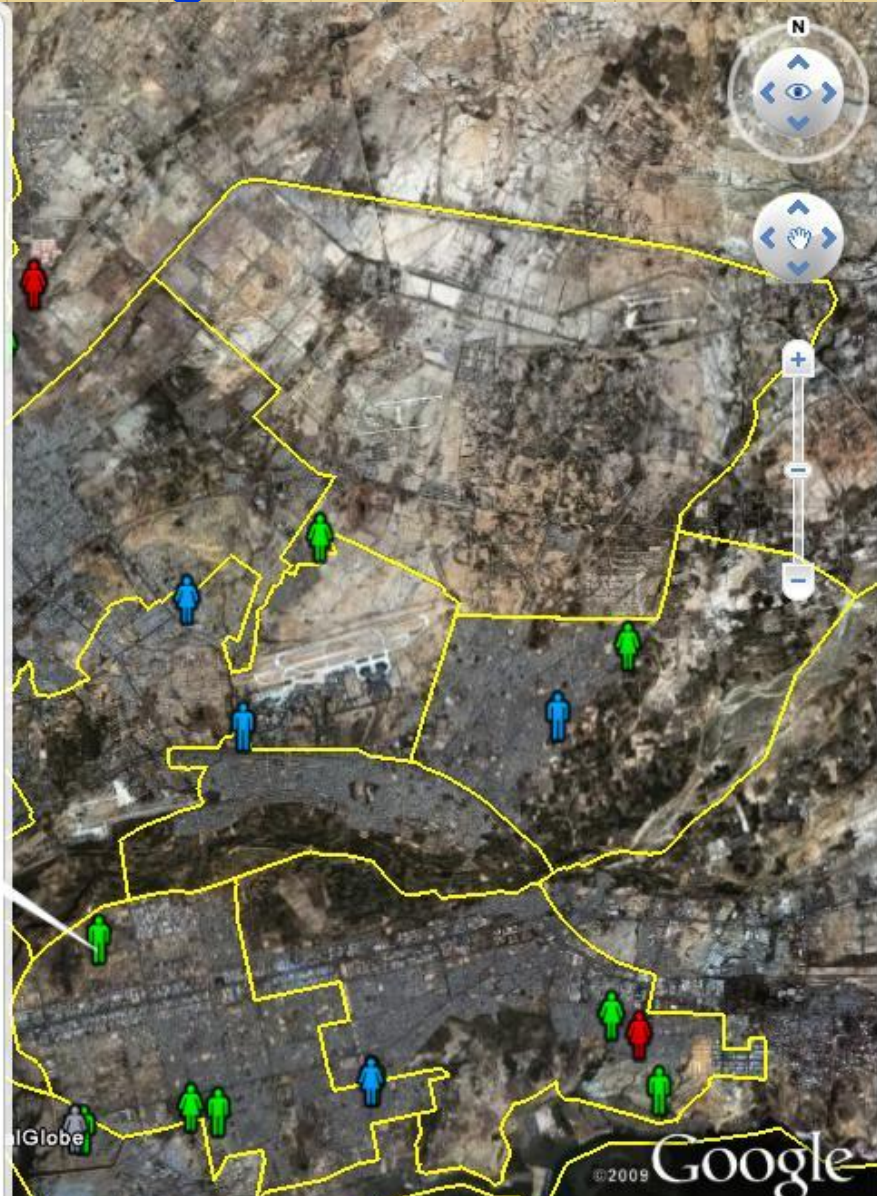
Bacteriologies

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

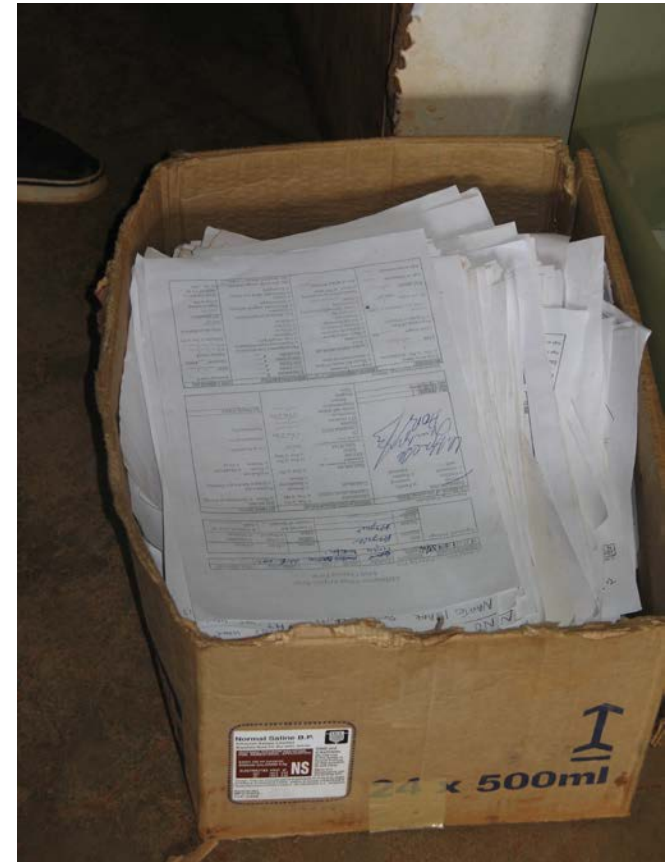


Credit: Owais Ahmed.



The African Opportunity

- ❖ Lack of substantial legacy systems requiring integration
- ❖ Interface Terminology allows for integrated, comprehensive solutions empower communities
- ❖ Rapid expansion of phones (and these do help improve care!)
- ❖ Sharing of experience





Challenges and Lessons Learned



- ⊕ Human Capacity
- ⊕ Clinician Engagement
- ⊕ Reliable electricity
- ⊕ Computers
- ⊕ Connectivity
- ⊕ Gov't Policies