



turning knowledge into practice

ZEPRS: Zambian Electronic Perinatal Medical Records System

Presenter: Niamh Darcy
Date: September 2007
Time: 14:00 – 14:30

RTI International is a trade name of Research Triangle Institute



Funding for this work graciously provided by the

BILL & MELINDA
GATES foundation

Context: 2002

- Maternal mortality rate 940/1000
- Lifetime risk of death in pregnancy 1/25
- Disability Adjusted Life Years (DALY) at birth 30.7
- Virtually all modern health care for 2 million women in Lusaka provided by 23 clinics and the University Teaching Hospital (UTH)
- 13 of 23 clinics provide antenatal care, 9 with labor wards
- 47,000 estimated total obstetric cases (2002)
- All medical records on paper
- Patients may move among clinics, but limited sharing of patient records
- No central database for monitoring patient population or quality of care



*Children outside Chainda Clinic,
Lusaka*

Scope, Funding, Client

- **Scope**

- Lusaka, Zambia
- 23 public health clinics – ZEPRS
- University teaching hospital
- Central Board of Health
- Center for Infectious Disease Research in Zambia (CIDRZ)
- Lusaka Urban District Health Management Team (LUDHMT)

- **Donor**

- Bill & Melinda Gates Foundation –

- **Client Funding**

- University of Alabama Birmingham – US \$2.7 million (2002-Sept 2006); US \$70K (Oct 2006 – present)



Key Problems & Proposed Solution

Key Problems

- Almost impossible to systematically assess care delivery
- Surveillance data limited to simple cross-sectional statistics, such as how many stillbirths or pregnancy-attributable maternal deaths occur in a given month
- Even available statistics were suspect
- Occasional failure to test and frequent failure to follow up patients diagnosed with STDs
- Limited sharing of patient records between facilities
- No central database for monitoring patient population or quality of care

Proposed solution

- Electronic-first perinatal record system
- Patient records shared among facilities
- Centralized patient records database



Patient file storage at University Teaching Hospital, Lusaka

In 2005 only one-quarter of office-based physicians in the U.S. used a fully or partially electronic medical record system. (Burt, Catharine W., Hing, Esther, and Woodwell, David. U.S. National Center for Health Statistics, 2005.)

Challenges

Telecommunications

- Weak landline infrastructure
- Congested 2.4GHz wireless segment

Clinics

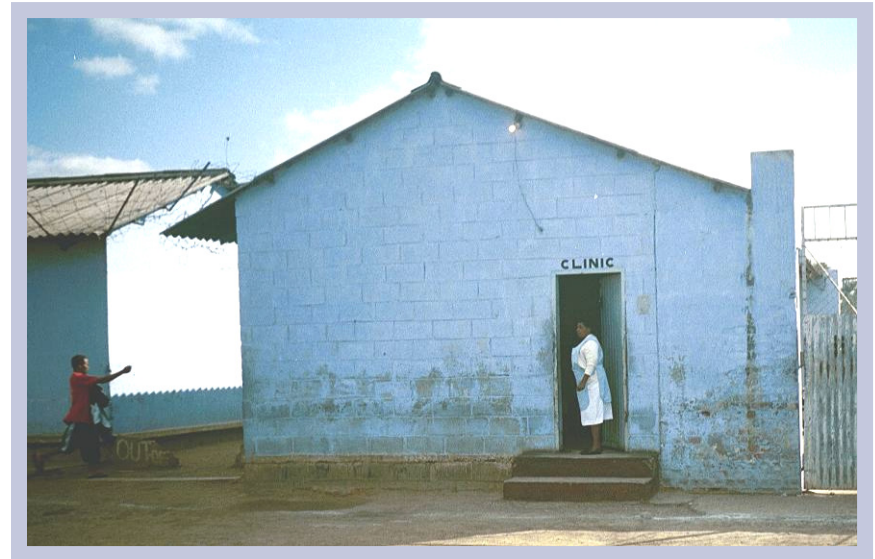
- Dusty, congested
- 7 of 23 clinics had telephone lines
- All clinics with VHF radio for voice

Personnel

- Low computer literacy
- Very stressed due to patient load
- High medical staff turn-over

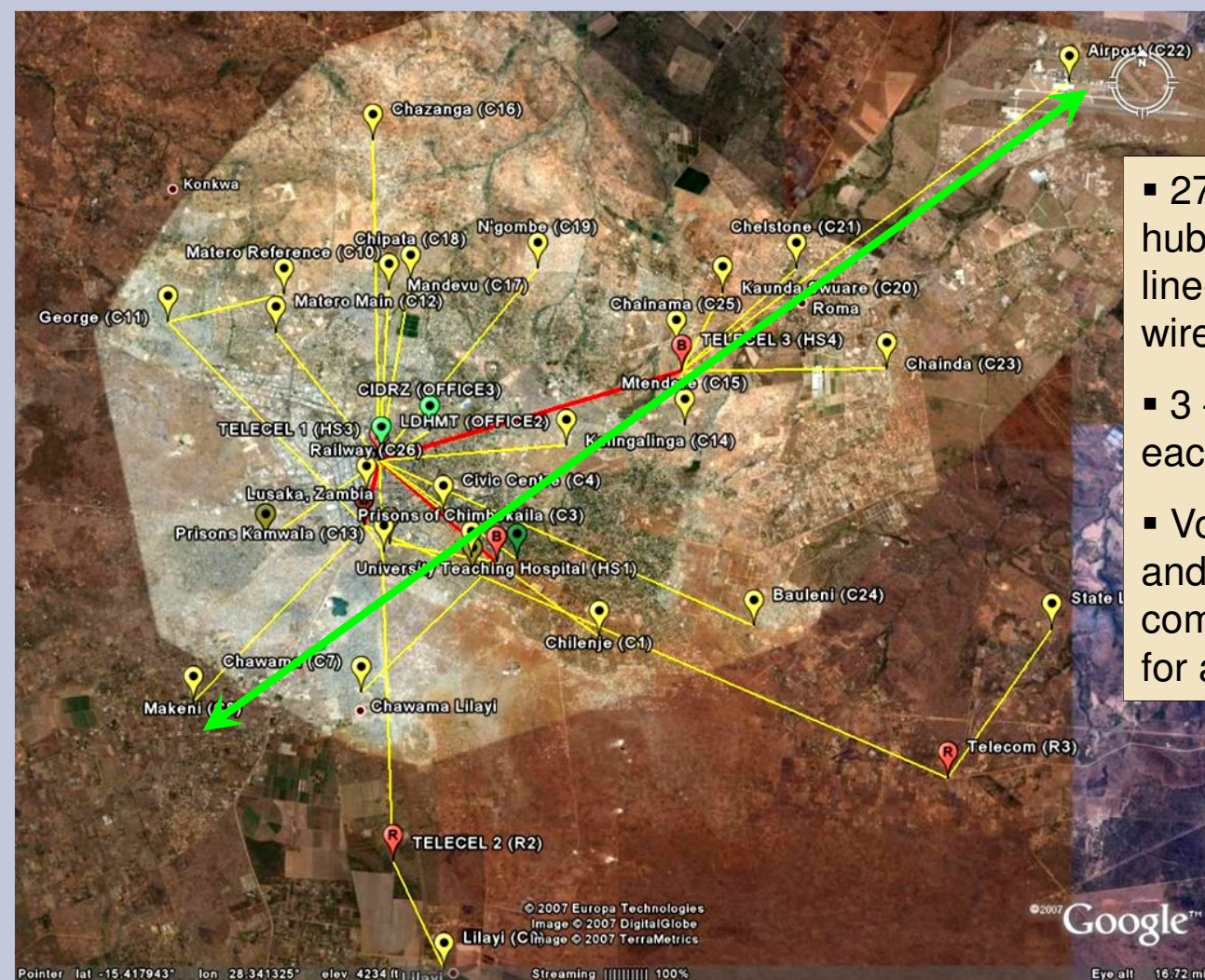
Electrical

- Inadequate electrical systems at all points, no backup power, No lightening protection
- Poorly regulated grid (Frequent power outages)



Clinician at the door of the Prisons Kamwala Clinic in 2002.

Wireless Network



- 27km diameter hub-and-spoke line-of-sight wireless network
- 3 – 9 PCs in each clinic
- Voice (VoIP) and data communication for all facilities

Satellite image of Lusaka showing ZEPRS wireless network links



ZEPRS Key Concepts

- Guides medical personnel through Zambian standard of perinatal care
- Concept of “flows” within the system and related data (user driven)
- Shared terminal usage
- Usage of ZEPRS data for quality assurance and supervision (export to SPSS, SAS..)
- Patient confidentiality
- Adaptability/Extensibility of ZEPRS system – open source (HIV/ART, Safe Motherhood)
- Using mini applications to build computing skills

ZEPRS Key medical features

- Safe Motherhood
- Pregnancies linked together
 - Convert typical visit to problem visit
 - Graphical Partograph (matches WHO partograph)
 - Patient Referral System
 - Use of EDD/EGA calculation and update in display (with options for manual over-ride) – very useful automation for nurses
 - Antenatal and Postnatal card generation (supports patient mobility)
 - Infants linked to mother for each separate pregnancy
- Reports
- Problem Management including problems across multiple pregnancies

ZEPRS Home page

ZEPRS
Airport

Staff
Admin, ZEPRS

Date/Time
19/06/07 21:48:52

Home

New Patient

Reports

Referrals

Help

Setup

Webmail

Training

Admin

Logout

Search for
Patient

First letter of surname: **A B C D E F G H I J K L M N O P Q R S T U V W X Y Z** **Labour**

Airport

Search

Search keywords: family name, first names, ZEPRS ID, NRC number, and the username of the health worker who last modified the patient's record.

☐

Search term: *All Patients*, sorted by date record last modified

Patient	Mother	NRC Number	ZEPRS ID	Age	EDD	Dead?	SMC	Address	Health Worker	Last Site	Firm	Last Modified
P B			5040		06/02/08					in	Airport	16 May 07
P P			5040		Delivered					in	Airport	15 May 07
P B	P P		5040							in	Airport	15 May 07
M k			5040		28/07/07					Airport	B	09 May 07
M g			5040		15/10/07		R			Airport		30 Apr 07
			5040							Airport		26 Apr 07
			5040		14/08/07		R			Airport		24 Apr 07
		5	5040		10/08/07		R			Airport		11 Apr 07
M J	M J		5040							Airport		07 Apr 07
M M	M M		5040							Airport		07 Apr 07
S B	S B		5040							Airport		07 Apr 07
J J	J J		5040							Airport		07 Apr 07

NEXT

Patient Status

ZEPRS
Airport

Staff
Admin, ZEPRS

Patient
Patient2028,PosSingle1

NRC Number

District ID
5040-332-00232-7

Date/Time
19/06/07 21:55:17

- Home
- Demographics
- History/Dating
- Antepartum
- Safe Motherhood
- Labs
- Medications
- Problem or Labor Visit
- Partograph
- Postnatal/
Delivery Summary
- UTH Registry
- Problem List
- Ultrasound
- Children
- Patien,Baby1
- Referrals
- Reports
- Help
- Webmail
- Training
- Admin
- Logout

Delivery Summary/Postnatal

Form	Status	Staff Member	Site	Visit Details
<input checked="" type="checkbox"/> Delivery Summary	Done	Admin, ZEPRS	Airport	19 Jun 2007 21:53
<input checked="" type="checkbox"/> Baby1 Patient2028 Newborn Evaluation Sex: Female	Started	Admin, ZEPRS	Airport	19 Jun 2007 21:53
<input type="checkbox"/> Puerperium	Recent Entry:	Admin, ZEPRS	Airport	19 Jun 2007 21:53
<input checked="" type="checkbox"/> Maternal Discharge Summary	Done	Admin, ZEPRS	Airport	19 Jun 2007 21:53
<input checked="" type="checkbox"/> Postnatal Maternal Visit	Done	Admin, ZEPRS	Airport	19 Jun 2007 21:53
<input type="checkbox"/> Postnatal Maternal Visit	Available			
<input type="checkbox"/> Postnatal Maternal Problem Visit	Not Done			
<input type="checkbox"/> Pregnancy Conclusion	Not Done			

Problem List

Active Problems	
Problem	Date
SYSTEM-GENERATED OUTCOMES	
Hb Lab Results: Hb below 10	19 Jun 07
Hb Lab Results: Hb below 10	19 Jun 07
Systolic blood pressure is ≥ 150 : Consider referral to UTH	19 Jun 07
Lab Results: Urinalysis Albumin $\geq 1+$	19 Jun 07
Lab Results: Urinalysis Glucose $> 1+$.	19 Jun 07
Urinalysis Acetone $\geq 2+$ - Need to request diabetes test.	19 Jun 07
Urinalysis Protein $\geq 2+$ - Need to request diabetes test.	19 Jun 07
Urinalysis Protein $\geq 2+$ - Need to request diabetes test.	19 Jun 07
Small stature (≤ 150 cm) : Consider referral to UTH.	19 Jun 07
Temperature is above 37.5.	19 Jun 07
Consider referral to UTH if Thyroid is not "Normal"	19 Jun 07
Lab Result: Reactive	19 Jun 07
Hypertension: Medical/Surgical History - Consider referral to UTH.	19 Jun 07
Patient had a C/S delivery: Consider referral to UTH.	19 Jun 07

Chart: Routine Antenatal visits


Routine Antenatal Visits

Date	20/06/2007 X	20/06/2007 X	20/06/2007
Site	Airport	Airport	
EGA	5, 1/7	6, 0/7	6, 0/7
Fundal Ht. (cm)	13	14	-- ▾
Lie	Longitudinal	Longitudinal	-- ▾
Pres.	Cephalic	Cephalic	-- ▾
Descent		3/5	-- ▾
Oedema	2+	1+	-- ▾
FHR (bpm)	120 - 160	120 - 160	-- ▾
FH Rhythm	Reg.	Reg.	-- ▾
BP: Sys. (mm/hg)	180	150	No Information ▾
BP: Dia. (mm/hg)	80	80	No Information ▾
Weight (KG (xxx.xx))	55.0	57.0	
Ace.	1+	Tr.	-- ▾
Alb.	3+	0 (-)	-- ▾
Glu.	2+	0 (-)	-- ▾
Deworming	Yes	Yes	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
Folate	Yes	Yes	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
Iron	Yes	Yes	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
Malaria SP	SP1	SP2	-- ▾
Next Appt.			Date:
Problem?			<input type="checkbox"/>
			Password: <input type="text"/> Done

Safe Motherhood: Regimen Results

Safe Motherhood | Labs | RPR | Counsel | ARV | Hematology | Chemistry | Liver Function | Urinalysis

Regimen Given Today

Date of Regimen Visit:  19/06/2007	Received Regimen?: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A	Regimen: No Information ▼	# of Days of AZT given: days
Phase of Pregnancy: No Information ▼	Tested for CD4?: <input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A	WHO Screen: No Information ▼	Referred to ART Clinic?: No Information ▼

Password:

Submit

Regimen Given Today Records

Phase of Pregnancy column is only used for the mother. Please disregard for infant records.

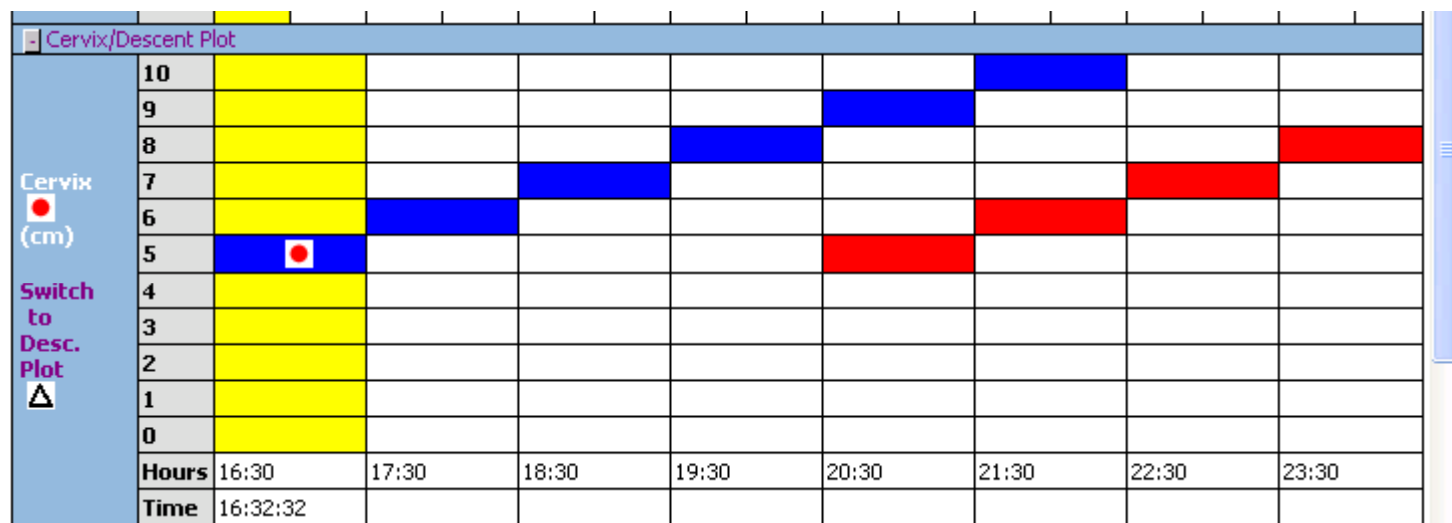
Date of Regimen Visit	Received Regimen?	Regimen	# of Days of AZT given	Phase of Pregnancy	Tested for CD4?	WHO Screen	Referred to ART Clinic?	Del.
2007-06-19	Yes	NVP + AZT		Antenatal	Yes	Positive	Yes - Non-urgent appointment in 1-2 months	X

Problem List

Active Problems	
Problem	Date
MISSING LAB RESULTS	
CD4 Count	
SYSTEM-GENERATED OUTCOMES	
Lab Result: Reactive	19 Jun 07
Lab Results: Urinalysis Acetone > 1+.	19 Jun 07
Systolic blood pressure is ≥ 150 : Consider referral to UTH	19 Jun 07
Diabetes: Medical/Surgical History: Consider referral to UTH.	19 Jun 07
Patient had a C/S delivery: Consider referral to UTH.	19 Jun 07
LONG-TERM PROBLEMS	
Patient had a C/S delivery: Consider referral to UTH.	19 Jun 07

Partograph: Complex data entry with simple user interface

Tracking Cervix/Decent plot



Elapsed Time: 0:02:13
Cervix Elapsed: 0:00:25

Entering data:

Contractions/Oxytocin

Contr. per 10 mins.

Oxy

U/L:

dpm

del. Mild Medium Strong

Result:

Contractions/Oxytocin

Contr. per 10 mins.

Oxy

U/L:

dpm

Contractions/Oxytocin

Contr. per 10 mins.

Oxy

U/L:

dpm

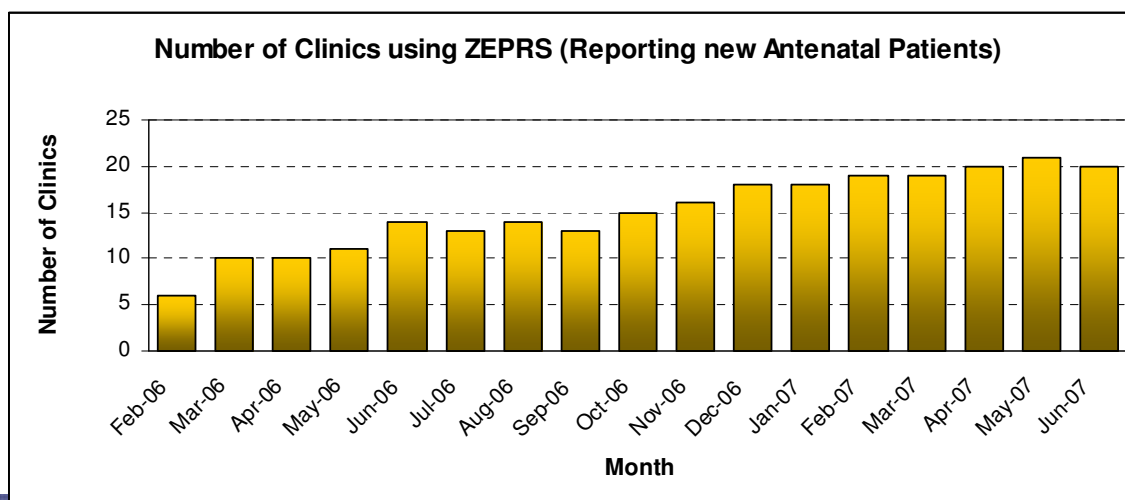
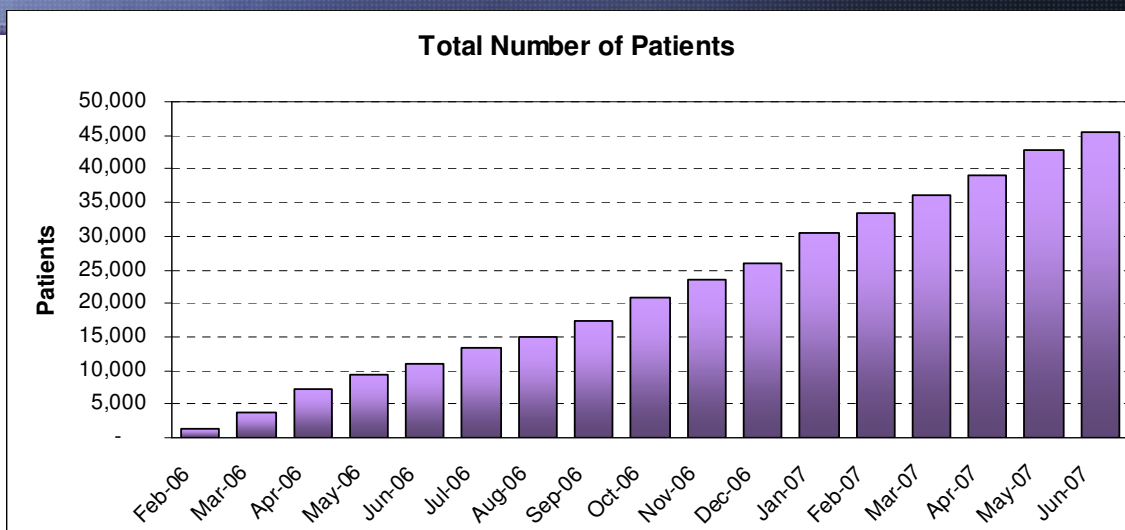
ANC Monthly Report

Date	New ANC Client	Missing ANC Forms	Revisits	Counseled New ANC	Counseled Revisit	Pre-Test Counseled	HIV Tested New ANC	HIV Tested Revisit	Total Tested	Refused Testing	Received Results	Uncollect. Results	HIV Positive:	HIV Negative	HIV Indeterm.
TOTAL	153	1	204	137	9	146	138	9	147	0	143	3	36	110	0
2007-05-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007-05-02	12	0	13	8	1	9	9	1	10	0	11	0	4	7	0
2007-05-03	7	0	6	7	0	7	7	0	7	0	6	1	2	5	0
2007-05-04	3	0	1	2	0	2	2	0	2	0	2	1	0	3	0
2007-05-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007-05-06	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0
2007-05-07	12	0	7	11	0	11	11	0	11	0	11	0	5	6	0
2007-05-08	18	0	34	16	0	16	16	0	16	0	16	0	7	9	0
2007-05-09	7	0	3	7	0	7	7	0	7	0	7	0	0	7	0
2007-05-10	2	0	23	2	0	2	2	0	2	0	2	0	1	1	0
2007-05-11	7	0	22	7	0	7	7	0	7	0	7	0	2	5	0
2007-05-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007-05-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007-05-14	16	0	5	16	0	16	16	0	16	0	16	0	4	12	0
2007-05-15	8	0	8	9	0	9	9	0	9	0	9	0	0	9	0
2007-05-16	8	0	8	8	0	8	8	0	8	0	8	0	2	6	0
2007-05-17	4	0	7	4	0	4	4	0	4	0	4	0	0	4	0

Results: Patient Records Managed

20 clinics and more than 45,000 patients (June 2007)

Average of
2,608 new
antenatal
patients/month



System role-out
at average rate
of 1 new
clinic/month.

ZEPRS Summary - Critical Success Factors

- Close collaboration with health workers and UAB
- Thorough testing
- Effective user training
- User acceptance and participation
- Reliability and performance of network
- Reliability of computers in facilities
- Project management
- Use of on-line tools, and IM for remote project support

Software Platform

Platform Component	Selected Solution
Operating System	Red Hat Enterprise 3 (Currently CentOS 4.2)
Server Backup	Arkeia Backup 5.2
Wireless Authentication	AEGIS Premium Server 1.1.4
Relational Database	MySQL 3.23 (currently MySQL 5.0)
Web Application Server	Apache (httpd) 2 Tomcat 5 (servlet container)
E-mail	Cyrus IMAP, Postfix, Spam Assassin
E-mail Web Interface	Squirrel Mail
Firewall	SonicWALL
Client Anti-virus	McAfee
E-mail Server Anti-virus	AMaVIS

ZEPRS Team

RTI Development Team

Eileen Reynolds, Project Manager
Chris E. Kelley, Senior Software Developer
Niamh Darcy, Senior Technical Advisor
Pablo Destefanis, Senior Networking and
Telecommunications Specialist
Gordon M. Cressman, Senior Project Advisor

Lusaka Technical Support Staff

Dennis Nkula, Zambia Project Coordinator
Francis Banda, Technical Support Specialist
Jamie Mwanza, Technical Support Specialist

Center for Infectious Disease Research in Zambia

Dr. Jeffrey Stringer, MD, Director, Co-
Investigator
Dr. Perry Killam, MD, Project Advisor
Harmony Fusco, Project Manager
Chafye Siulata, Project Assistant

UAB Team

Dr. Robert L. Goldenberg, MD, Principal
Investigator
Dr. Dwight Rouse, MD, Co-Investigator
Dr. Sten Vermund, MD, Co-Investigator
Dr. Francis Nuthalpathy, Health Informatics
Advisor
Dr. Alan Tita, Health Informatics Advisor

Zambian Medical Advisors

Dr. Moses Sinkala, MD
Dr. Elwyn Chomba, MD
Dr. Ben Chirwa, MD
Dr. Henri Phiri, MD
Dr. Christopher Ngandwe, MD
Dr. Chipeco Kankasa, MD
Dr. Macha, MD
Dr. Mpundu Makasa, MD

For further information: www.idg-rti.org