

Public Health Informatics Tools for Electronic Disease Surveillance in Resource-Limited Settings

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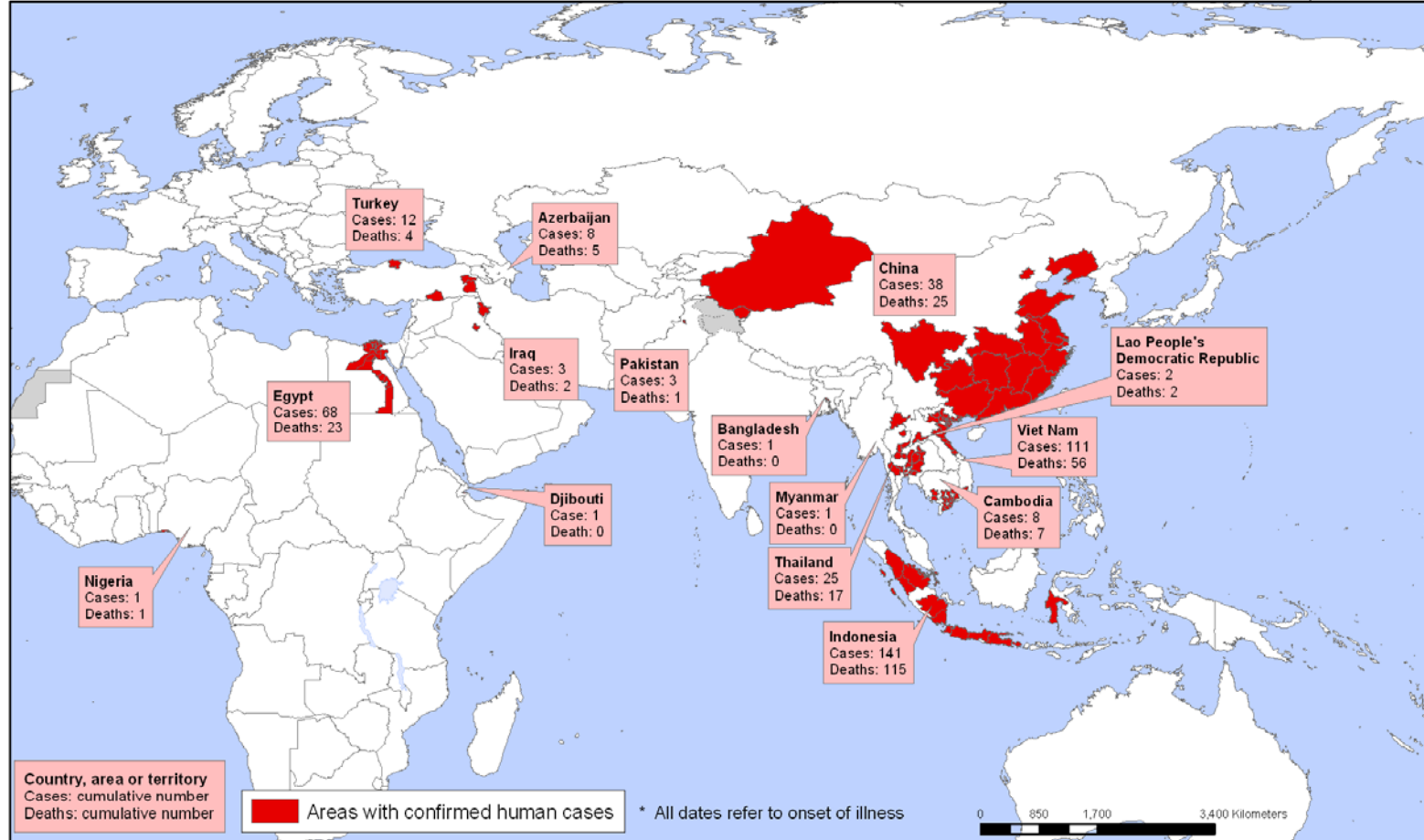


Background

H5N1 Confirmed Cases and Deaths since 2003

Areas with confirmed human cases of H5N1 avian influenza since 2003 *

Status as of 6 May 2009
Latest available update



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2009. All rights reserved

Data Source: WHO
Map Production: Public Health Information and Geographic Information System (GIS)
World Health Organization



Concept

GOAL:

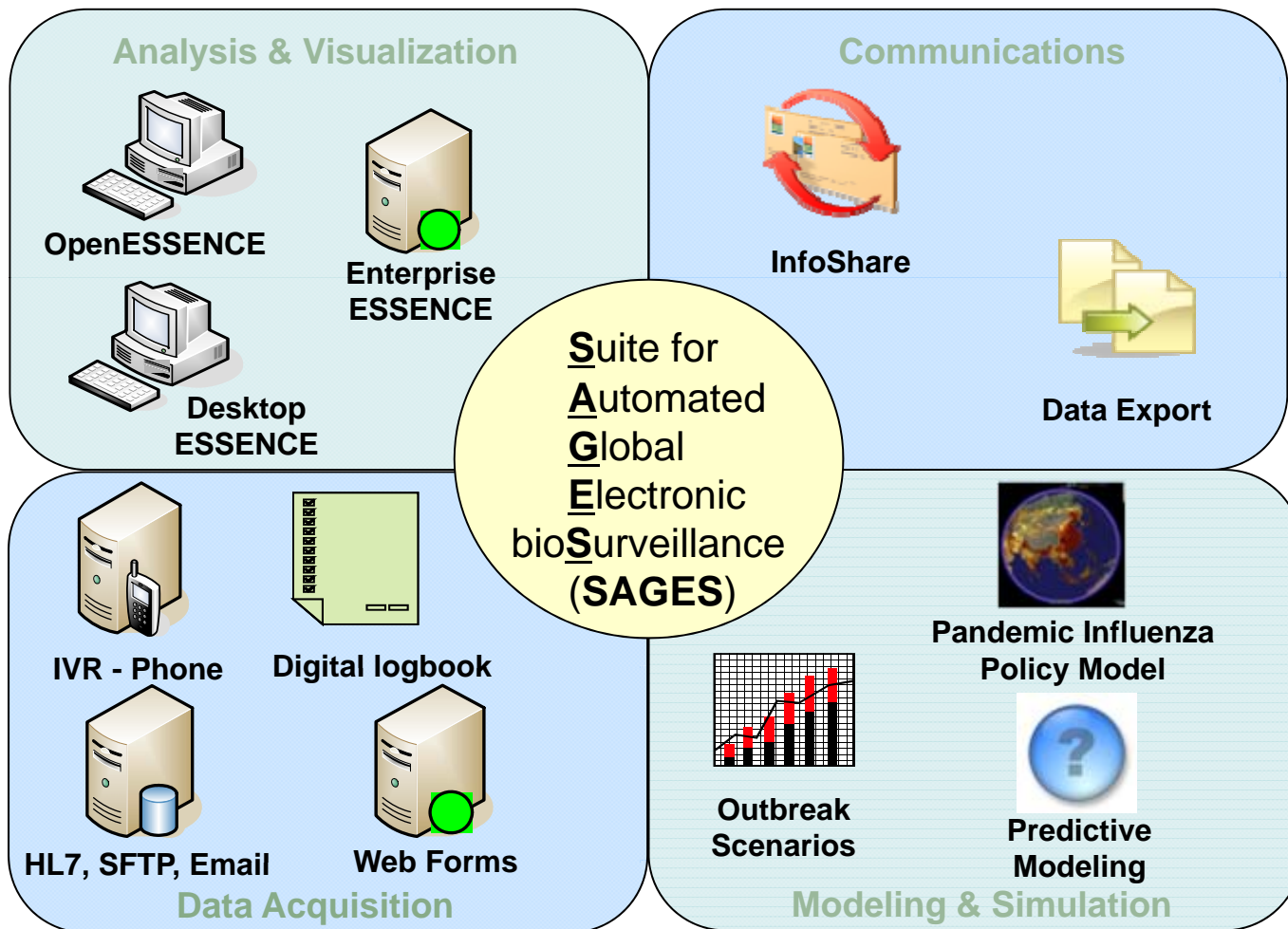
- Improve the timeliness and accuracy of health data collection and analysis in resource limited countries.
- Implement and evaluate low cost technology solutions appropriate for the target user community.

OBJECTIVE:

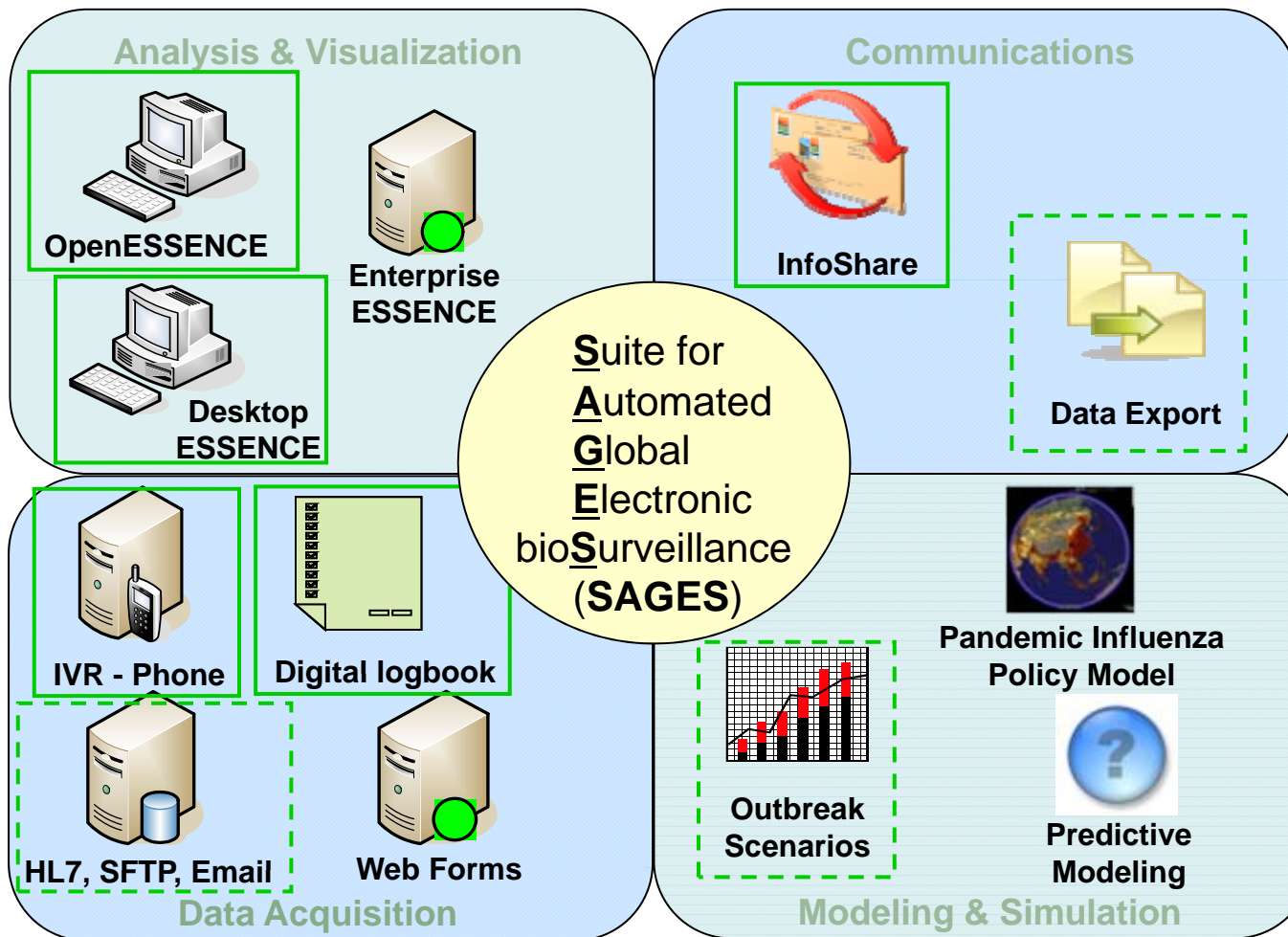
- Maximize the use of Open Source and free software components
- Minimize licensed and proprietary elements
- Design for sustainability
- Minimize recurring costs



Concept *(continued...)*



Concept *(continued...)*



Concept *(continued...)*

DoD GEIS is currently funding projects in Peru and the Philippines to develop open-source tools.

PERU

- Develop open-source tool for remote data collection.
- Pair the remote data collection tool with an open-source, web-based analysis tool.

PHILIPPINES

- Work with AFRIMS/PAVRU to develop an electronic surveillance capability for the Ministry of Health National Epidemiology Center.
- Develop open-source tool to collect data at the clinic level.
- Pair with an open-source desktop tool for data analysis and detection.



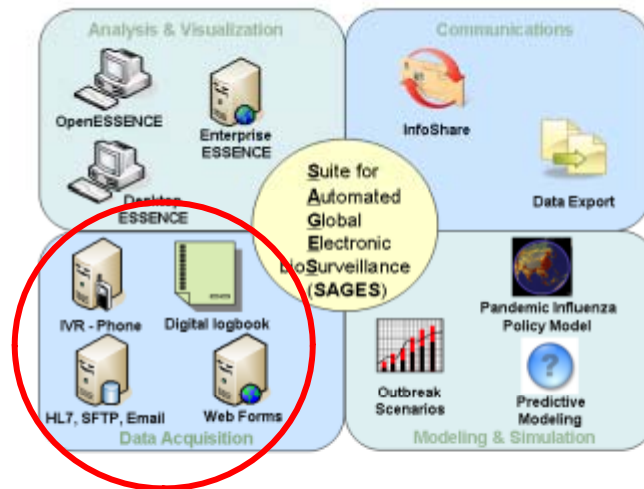
Data Collection

Interactive Voice Response (IVR)

- Enable remote data collection using telephones. This tool is being piloted in Peru in conjunction with NMRCD.

Clinic Data Entry System

- Simple data entry tool created with the Open Office Database application that is designed to be used at the health clinic or health station level. This tool is being piloted in the Philippines in conjunction with AFRIMS/PAVRU.



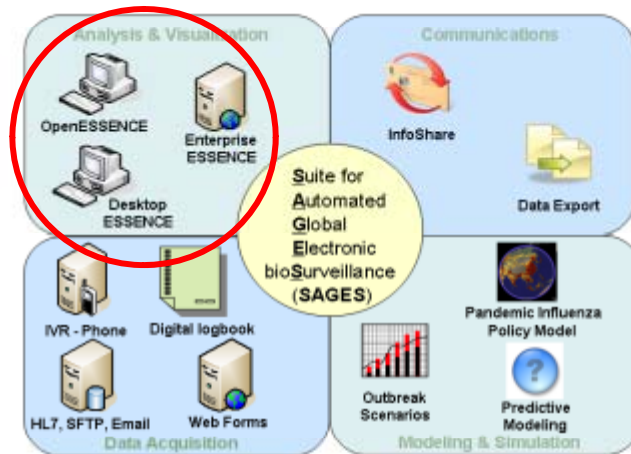
Analysis Tools

OpenESSENCE

- Open-source, web-based version of ESSENCE.

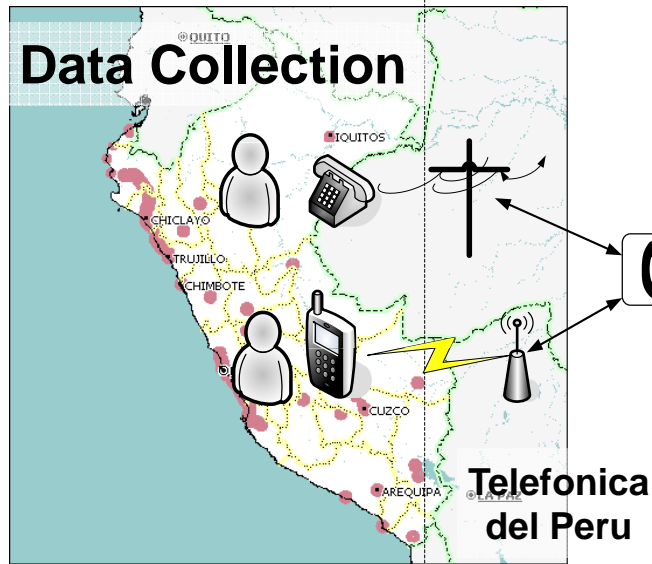
ESSENCE Desktop Edition (EDE)

- Open-source, desktop version of ESSENCE which does not require internet connectivity.

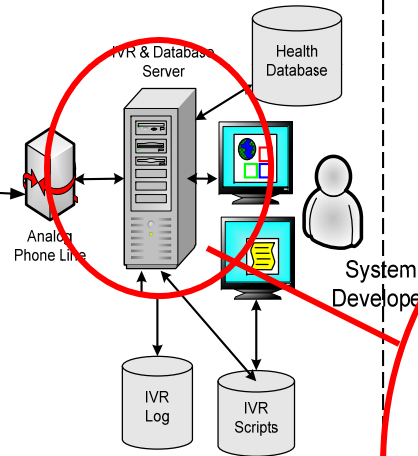


Remote Data Capture

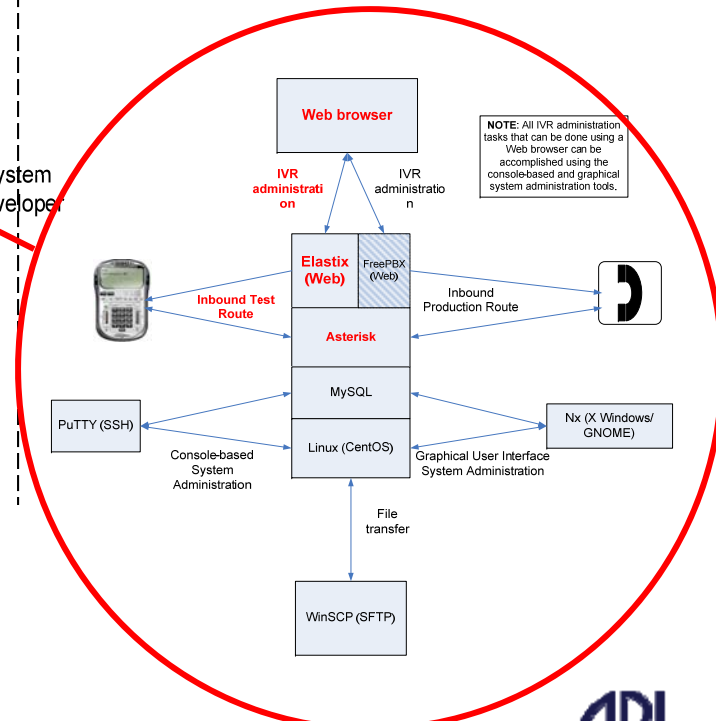
IVR Prototype Evaluation in Peru



NMRCD

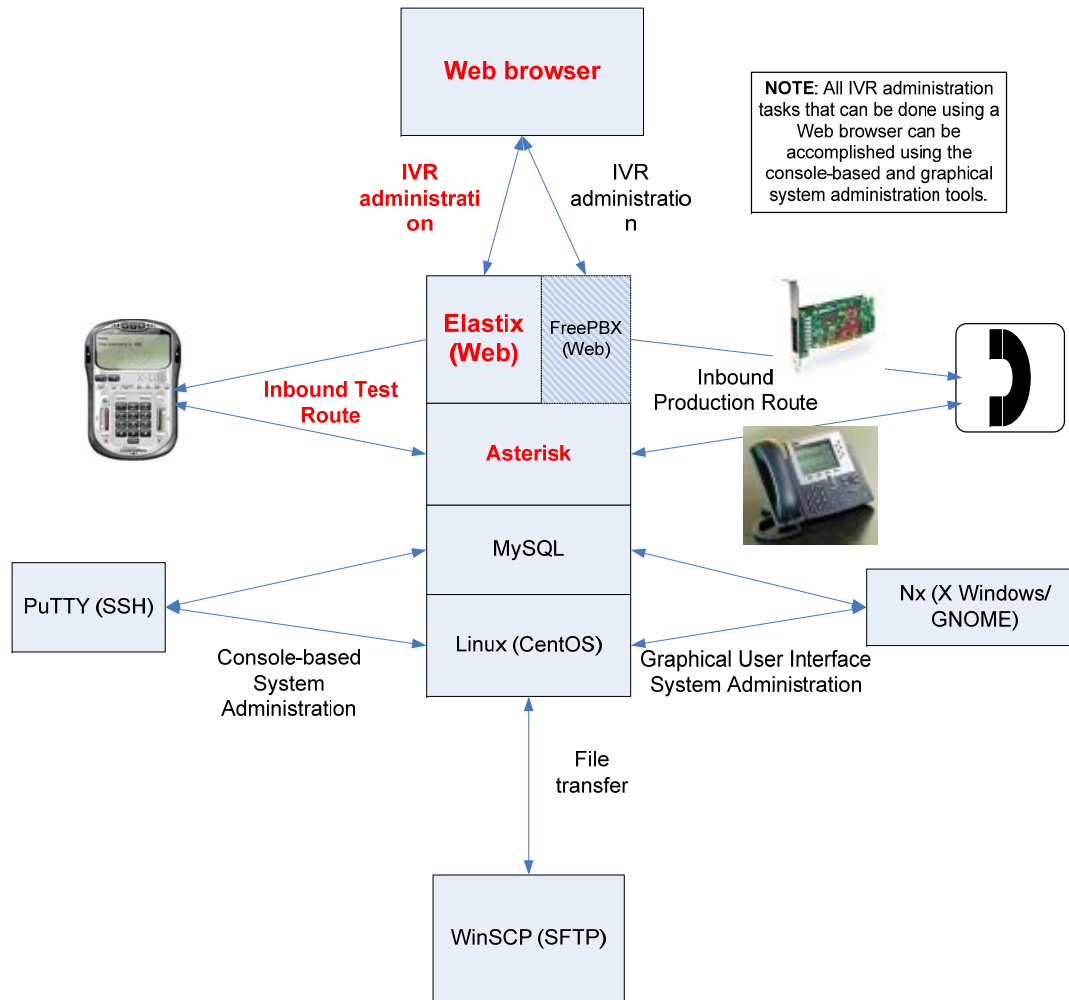


Remote Data Capture IVR Software



Remote Data Capture

IVR Software & Component Integration

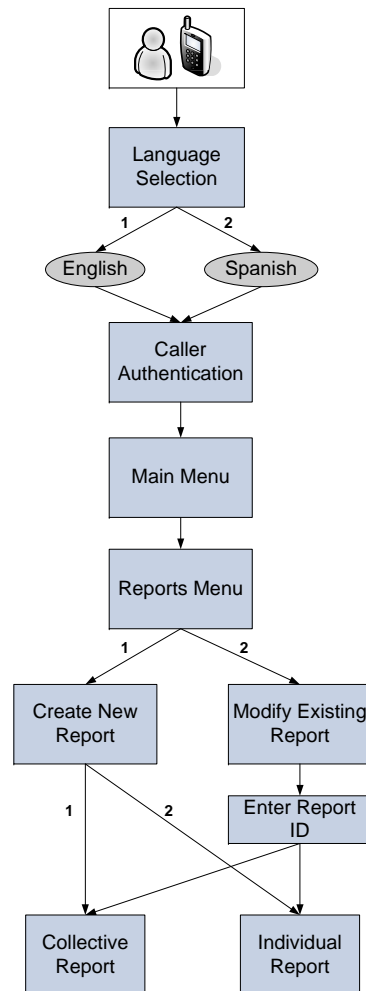


Disease Surveillance IVR Implementation

- **Several types of reports, including:**
 - Individual (patient-level)
 - Collective (aggregate)
- **Features**
 - Supports prompts for multiple languages
 - Responds to/stores caller selections
 - Inputs patient counts
 - Records caller voice messages
 - Plays back report confirmation
 - Saves data to a MySQL database

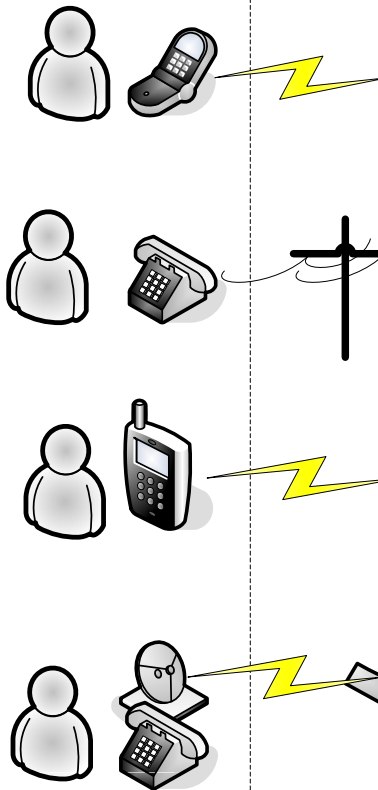


IVR Reporting Overview

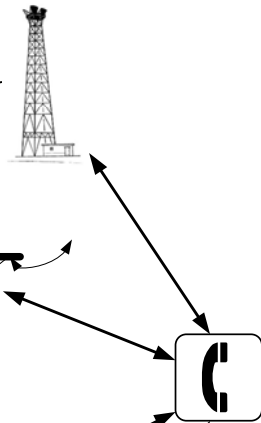


IVR and OpenESSENCE Integration

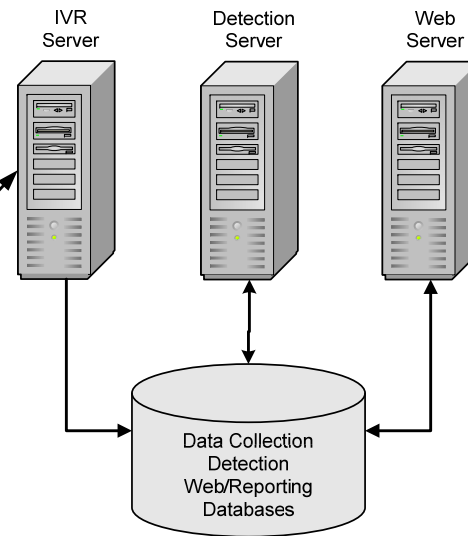
Support a Plurality of Voice Phone Devices



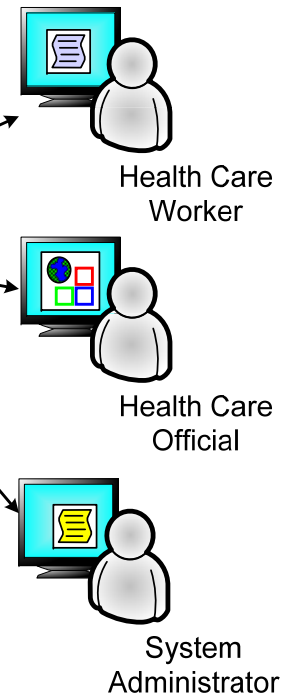
Independent of Intermediate Transmission Medium



Backend Phone and Web Interface Servers and Database Servers



Analysts, Administrators, and Users



OpenESSENCE

- **OpenESSENCE** functionality is derived from APL's Enterprise ESSENCE which is currently operational in both CONUS and OCONUS for the U.S. DoD and in CONUS civilian health departments.
 - Features include anomaly detection, data visualization, query tool, ability to handle different languages, etc.
- Currently under development and will be piloted with the IVR software in Peru in the spring of 2009.
- Initial capability is focused on NMRC/Peru requirements
- Specifically designed for further extension
- Integrates APL's experience in data analysis and reporting systems
- Includes lessons learned from current and past work in disease surveillance



OpenESSENCE

- **Design**

- Incorporates extensive biosurveillance and information system experience
- Deployed software incorporates only open source components
- Intended to be released as open source (APL's integrated application)
- Includes security required features for authentication and encryption
- Industry standard technologies (Java EE, Apache & Tomcat servers)

- **Extensibility**

- Flexible design
 - Data driven query, reporting, and visualization
 - Database independence
- Plug-in API for detection algorithms
 - Open source and proprietary algorithms



OpenESSENCE

- **Features**

- Configurable database and data sources
- Synchronization with IVR system database, or any other data source
- Language internationalization capability for user interface elements
- Time series view with export
- Data details view with Excel/CSV export



OpenESSENCE

Sample Query Portal

ESSENCE - [Redacted] Data Query

Current Data Query Selections			
Data Source	Patient	Geography System	Region
Region	[Redacted]	Medical Grouping System	Syndrome

Next Selections:			
Select Syndrome:	<ul style="list-style-type: none">All SyndromesBot_LikeFeverGIHem_III	Select Detector:	Regression/EWMA 1.1
Select Age Group:	<ul style="list-style-type: none">All Age GroupsUnknown00-0405-1718-44	Select Sex:	<ul style="list-style-type: none">All SexesUnknownMaleFemale
Select Start Date:	06 Feb 06	Select End Date:	07 May 06
<input type="button" value="Submit"/>		<input type="button" value="Adv Qry"/>	

[Questions or Problems?](#)

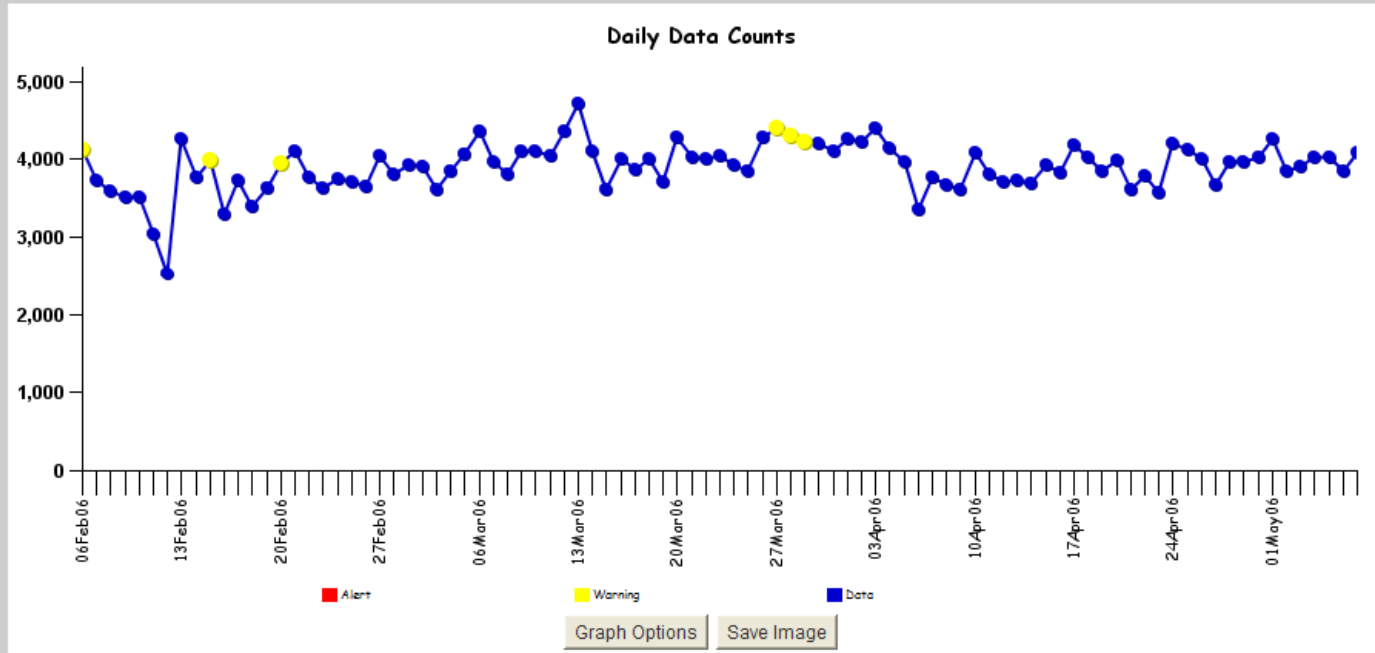


OpenESSENCE

Sample Time Series

ESSENCE - Time Series

- Description
- Configuration Options
- Graph



[\[Enhanced Graph \(requires java 1.4.x plug-in\) | Basic Graph \]](#)

- Popup Options

[\[Time Series | Data Details | Map View \]](#)



OpenESSENCE

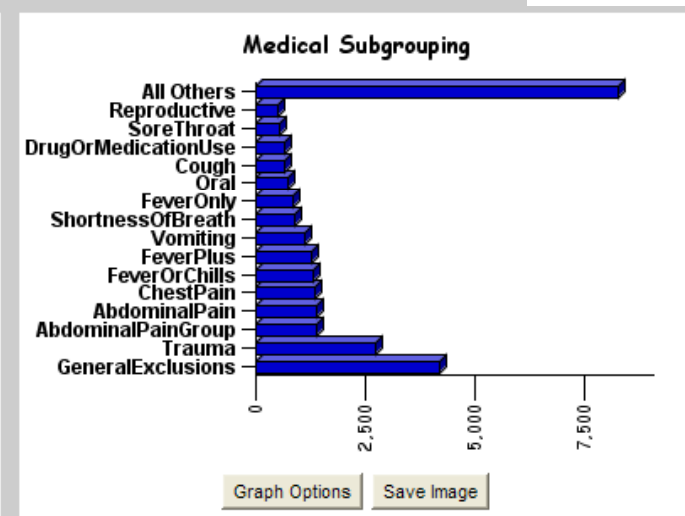
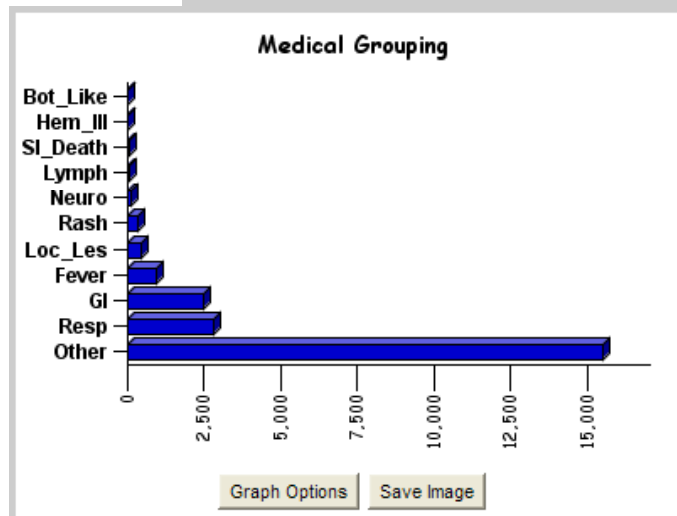
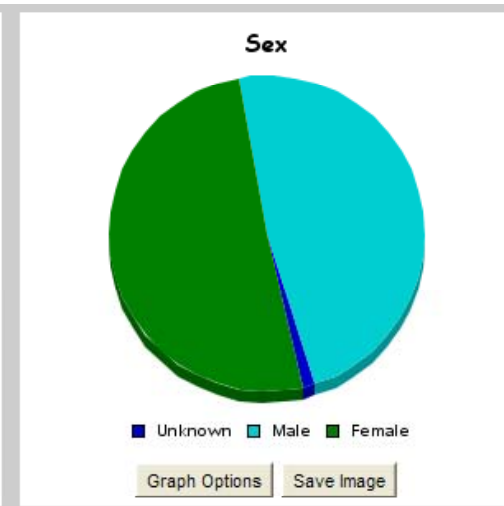
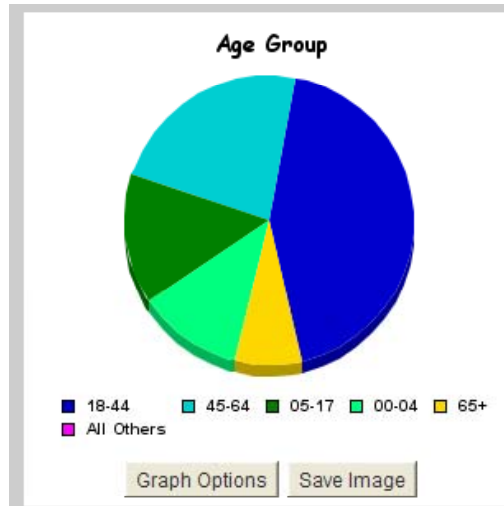
Sample Time Series Counts

Data Table					
Data Link	Map Link	Date	Data	Expected	Detection
Data Details	Map View	07May06	66	81.464	0.901
Data Details	Map View	06May06	57	81.821	0.803
Data Details	Map View	05May06	101	81.964	0.091
Data Details	Map View	04May06	75	81.929	0.591
Data Details	Map View	03May06	83	82.643	0.43
Data Details	Map View	02May06	92	83.786	0.276
Data Details	Map View	01May06	93	84.893	0.328
Data Details	Map View	30Apr06	72	85.429	0.853
Data Details	Map View	29Apr06	65	87.643	0.945
Data Details	Map View	28Apr06	76	89.679	0.835
Data Details	Map View	27Apr06	56	90.714	0.97
Data Details	Map View	26Apr06	79	92.107	0.767
Data Details	Map View	25Apr06	91	93.321	0.599
Data Details	Map View	24Apr06	71	94	0.897
Data Details	Map View	23Apr06	81	95.714	0.791
Data Details	Map View	22Apr06	89	98.107	0.741
Data Details	Map View	21Apr06	73	99.25	0.936
Data Details	Map View	20Apr06	59	74.421	0.86
Data Details	Map View	19Apr06	96	80.635	0.14



OpenESSENCE

Sample Graphs



OpenESSENCE

Sample Data Details

<u>Date</u>	<u>Time</u>	<u>Zipcode</u>	<u>Orig Zipcode</u>	<u>Region</u>	<u>AgeGroup</u>	<u>Age</u>	<u>Sex</u>	<u>ChiefComplaintOrig</u>	
07May06	10:32 PM				18-44	18	Male	Lac On Head	
07May06	06:55 PM				18-44	35	Male	Mouth Bleed	
07May06	04:38 PM				18-44	31	Male	SPLIT UPPER LIP	
07May06	11:55 PM				18-44	30	Male	HYPERGLYCEMIA	
07May06	11:23 PM				00-04	3	Female	LIP LAC	
07May06	11:05 PM				18-44	27	Male	HEAD INJ	
07May06	10:40 PM				05-17	16	Female	SOB/CP/COUGH/ASTHMA/PREGNANT/ABD PAIN	
07May06	09:54 PM				18-44	24	Female	HA	
07May06	08:53 PM				18-44	31	Male	R SHOULDER/BACK PAIN/CP	
07May06	08:11 PM				18-44	38	Female	VAG BLEEDING/ABD PAIN/LIGHTHEADED/DIZZY	
07May06	07:52 PM				18-44	43	Male	MVC	
07May06	06:36 PM				05-17	5	Male	SOB/CP/COUGH/ASTHMA	
07May06	06:52 PM				45-64	48	Male	HA/NECK/SHOULDER/COUGH/CP/SOB	
07May06	06:48 PM				05-17	17	Male	R ANKLE INJ/FLU LIKE	
07May06	05:49 PM				18-44	42	Male	HEAD LAC/FALL	
07May06	06:03 PM				18-44	23	Male	R FOOT INJ/INF/STOMPED ON NAIL	
07May06	05:52 PM				05-17	10	Male	FALL	
07May06	05:19 PM				45-64	60	Male	EYES/PENIS/DETOX	
07May06	05:02 PM				18-44	33	Male	SEIZURE/HA	



Disease Surveillance in the Philippines

August 2007

National



Regional



Data Entered
& Analyzed



Regional
Statistics

City



Data Entered
& Analyzed



City/Municipal
Statistics

Local



Disease/Procedure
Tallies



Notifiable Disease
Reports

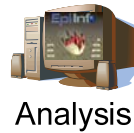


**Sentinel
Surveillance Sites**



Proposed Enhancements to Philippines Surveillance Program

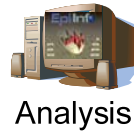
National
Epidemiology
Center



EDE



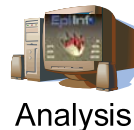
Regional Health
Department



EDE



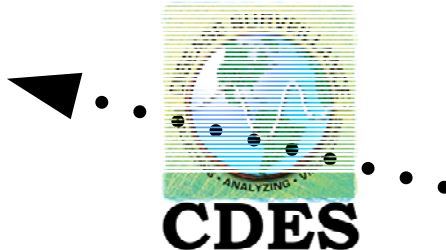
City Health
Department



EDE



Local Clinic



CDES Software
**Timely Acquisition
and Transmission of
Health Clinic Surveillance Data**

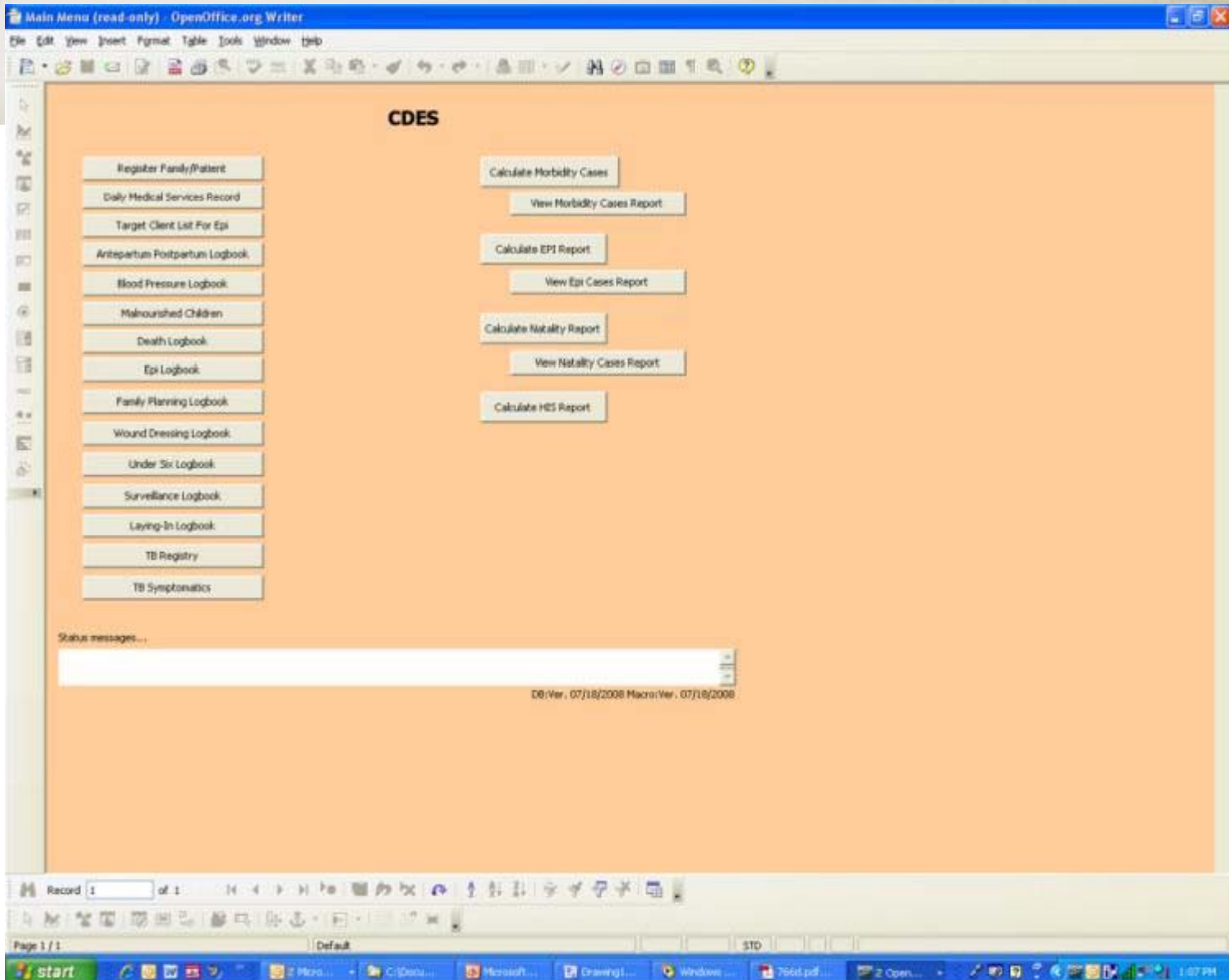
EDE Application
**Identification of Unusual
Disease Trends**

Clinic Data Entry System (CDES)

- **CDES is a software application used to enter clinic visit data**
 - Written in Open Office Database application (freeware)
 - Contains an electronic version of each clinic logbook
- **Used in conjunction with their logbook system**
 - Enter cases at the end of each day in the electronic 'logbook'
 - Produce daily tallies electronically instead of by hand
- **Produces data summaries, statistics and forms needed by Municipal Epidemiology Surveillance Units (MESU)**
- **Enable electronic transfer of data from clinic to MESU**
- **Create a database easily integrated into current surveillance software, that will work with electronic disease monitoring applications, and provides the clinic with a patient database**



Clinic Data Entry System



UNDER SIX LOGBOOK

UFC	FN	Name of Child	Father	Age	Mother	Age	Address	DOB	Place of Birth	Partur	Plt	Wt	Birth	Birth	Feeding	Date of Hospitalization
1474	1904							12-15-07	Hospit	M.D.			3rd			Dec. 19, 2007
1475	1901							12-17-07	GHC	PHN			4th			"
1476	2001							12-7-07	Home	Hilot			6th			"
1477	2086							12-6-07	Hospit	M.D.			3rd			"
1478	2087							12-4-07	"	M.D.			1st			"
1479	1961							12-4-07	Ball Family	Chlorin			3rd			"
1480	1998							10-8-07	Hospit	M.D.			1st			"
1481	876							11-8-07	GHC	PHN			3rd			"
1482	1957							11-28-07	Home	Hilot			1st			"
1483	T							12-10-07	Hospit	M.D.			2nd			"
1484	S11							12-4-07	Home	Denie			4th			"
1485	T							11-7-07	Home	Doria			2nd	Mixed		"
1486	2088							11-9-07	Hospit	M.D.			8th			"
1487	T							9-7-07	"	M.D.			3rd			"

Under Six Logbook (read-only) - OpenOffice.org Writer

File Edit View Insert Format Table Tools Window Help



Under Six Logbook

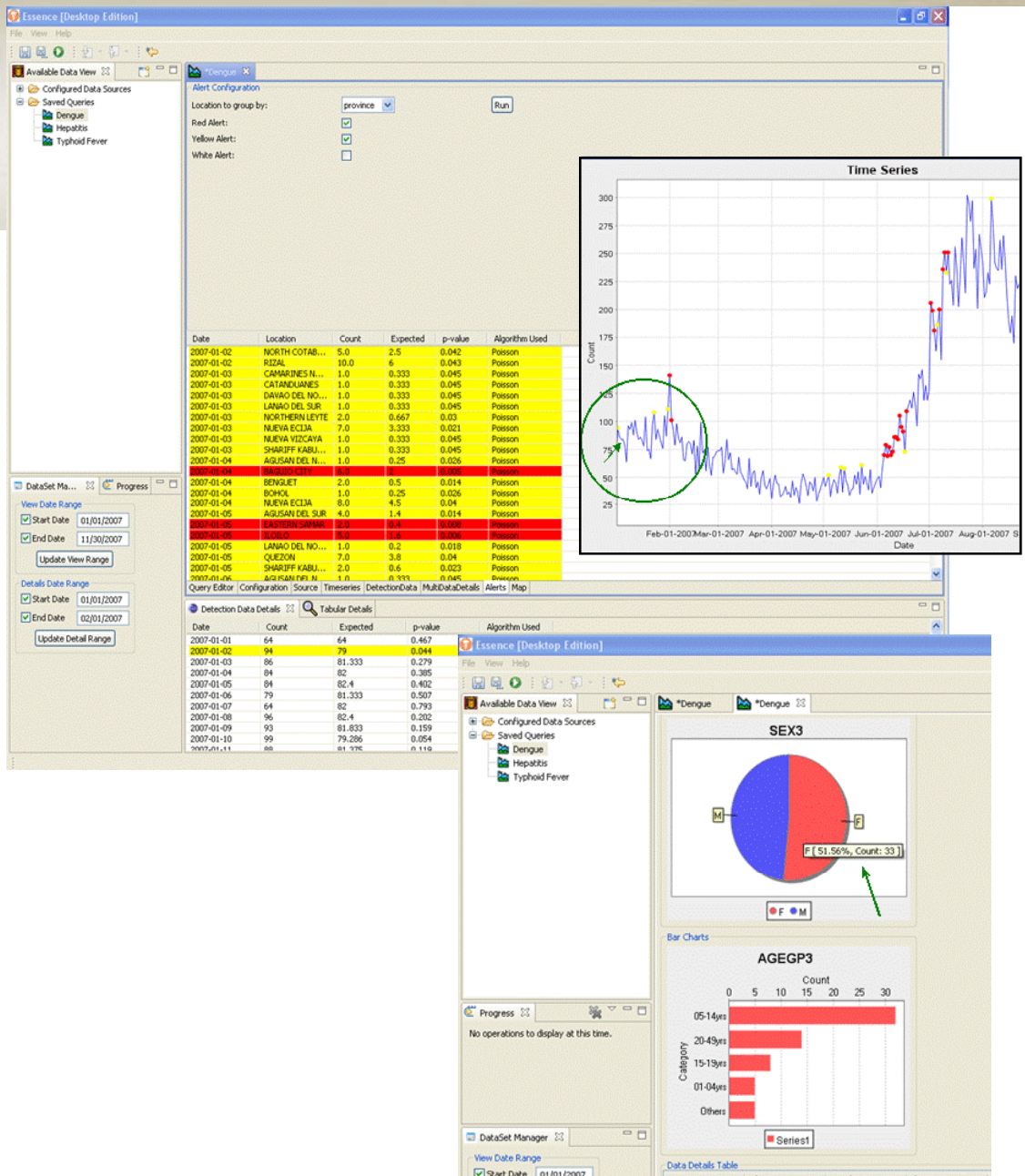
RowID	Patient Selector	PatientRowID	Family Number	Name	Father's Name	Father's Age	Mother's Name	Mother's Age	Address	Date of Birth	Place of Birth	Birth Weight	Risk
	Los Angeles^Two^F 6		F0002	Los Angel		0.00		0.00	Address 2	01/01/81			
1	San Francisco^Seco 1		F0001	San Franc		0.00		0.00		10/15/89		0.00	
2	Los Angeles^Two^F 6		F0002	Los Angel		0.00		0.00	Address 2	01/01/81		0.00	
3	Chicago^One^F00C 29		F0006	Chicago, I		0.00		0.00		05/13/80		0.00	
	AutoField>												



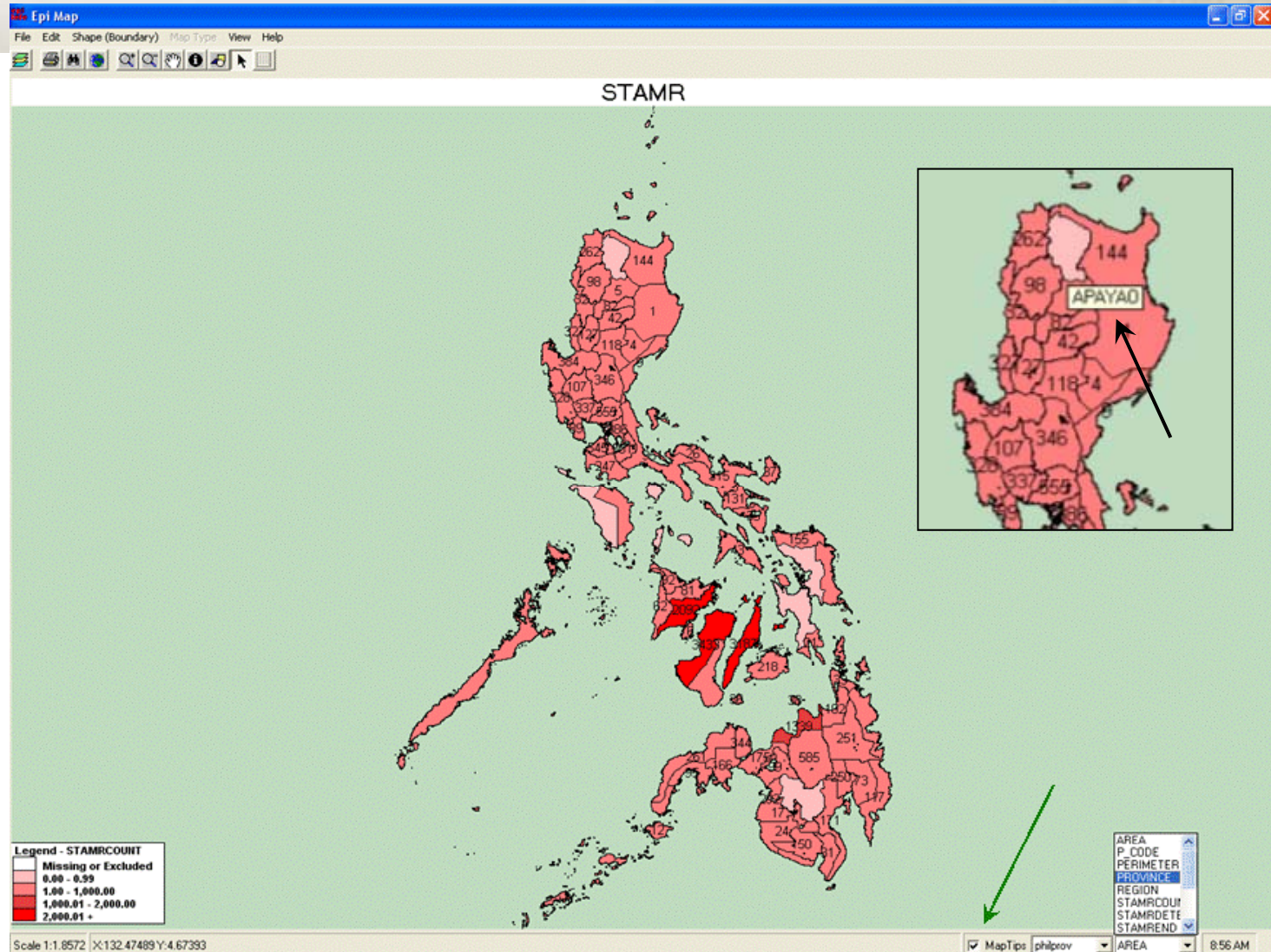
ESSENCE Desktop Edition (EDE)

- EDE is a stand-alone software application that examines surveillance data for unexpected increases in disease/syndrome trends.
- Extracts data from several different databases, taking variable names and characteristics directly from the file.
- Applies customized algorithms to variables like disease & syndrome counts. The current algorithms work best with case-level data.
- Produces time series, with 'alerts' when observed cases counts of a disease/syndrome exceed the expected.
- Produces graphs describing selected variables & allows direct examination of record level data.





EDE Map Made with EpiMap© Application, with Map Tips Pull-Downs



Dengue SMS Surveillance Project

- A protocol that uses Short Message Service (SMS) texts to send daily, person-based dengue surveillance data from the local health clinics (BHCs) to the MESU.
- BHCs in Cebu City, RP record id codes, age, sex, onset date and presenting signs/sx for each patient meeting the RP clinical dengue case definition.
- This information is sent to the MESU daily in a single SMS text message. Texts are transferred to an EpiInfo data file at the MESU. EDE is used to look for changes in case count.
- Success will be measured by the agreement between the EDE time series for the clinical cases and that from the RP hospital-based sentinel surveillance system.



Conclusions

- The suite of tools described here are freely available public health informatics tools that can be integrated to develop an end-to-end surveillance capability.
- The overarching goal of our work is to facilitate the development or enhancement of local, regional and national disease surveillance systems in resource-poor areas of the world.



Acknowledgements

Philippines Team

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