# Robustness of the mhealthSurvey Midlet for Real-Time Biosruveillance

4th International Symposium on Medical Informatics and Communication Technology.

March 23, 2010
Grand Hyatt Hotel, Taipei, Taiwan

**Nuwan Waidyanatha**
LIRNE*asia*, China
Email: nuwan@lirneasia.net http://www.lirneasia.net/profiles/nuwan-waidyanatha
Mobile: +8613888446352 (cn)
+94773710394 (lk)

LIRNEasia
Learning Initiatives on Reforms for Network Economies

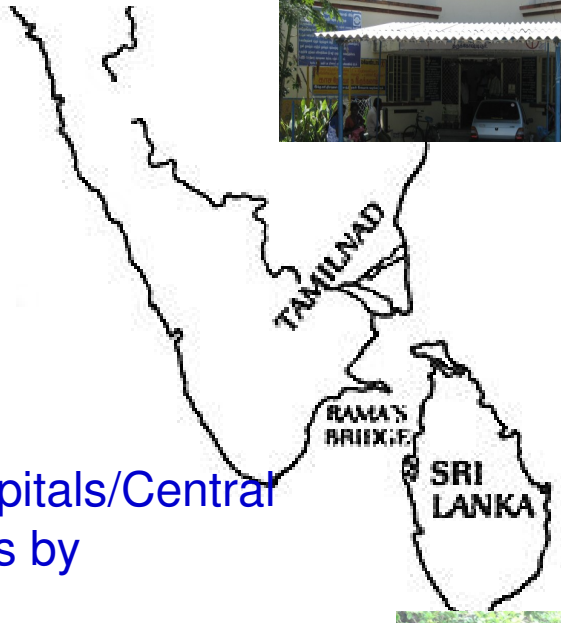
www.lirneasia.net

# Outline

- ***INTRODUCTION TO THE RESEARCH***
- ***DISEASE INFORMATION***
  - The system architecture
  - Determinants of Morbidity in India
  - Determinants of notifiable diseases in Sri Lanka
- ***RTBP COMMUNICATION TECHNOLOGY***
  - mHealthSurvey mobile application
  - T-Cube Web Interface
  - Sahana Messaging/Alerting Module
- ***mhealthSurvey Shortcomings***
  - Certification exercises
  - Real-Time vs Off-time
  - Semantics and syntax

www.lirneasia.net

# Our pilot in India and Sri Lanka




24 Health Sub Center Village Health Nurses;

4 Public Health Center Sector Health Nurses and 2 Data Entry Clerks

Thirupathur Block, *Sivaganga* District, state of *Tamil Nadu*, *India*

12 total Hospitals/Central Dispensaries by

15 Sarvodaya Suwadana Cente

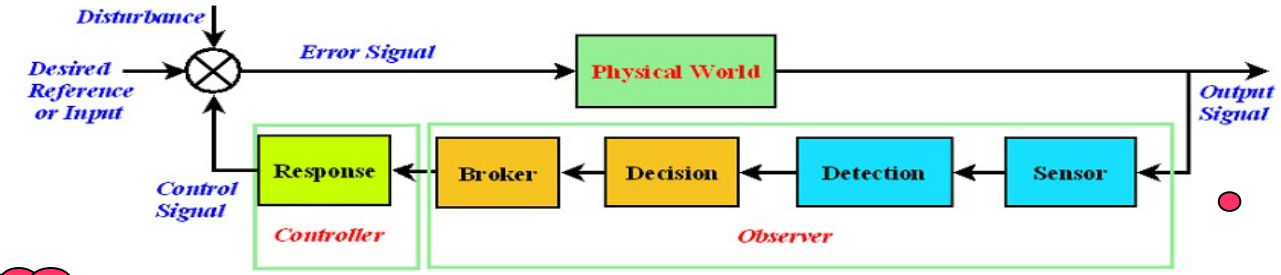
Research Assistants *Kurunega*

District, *North Western* Provinc

*Sri Lanka*

www.lirneasia.net

# Doctrine of Real-Time Biosurveillance (RTBP)




Health Disaster Management

RTBP?

Response

Physical World

Sensor

RTBP?

RTBP?

Broker

RTBP?

Decision

Affected Population

Health Providers, Relief Workers

RTBP m-HealthSurvey

Observe Relevant Data

Record and Transmit Data

GSM phone network

Store Data

Manage Relief Effort

Analysts, Health Officials, Epidemiologists, Decision Makers

RTBP Server and Database

Detection

RTBP?

Monitor Data

Automated Alerts

Internet, GSM network

RTBP Interactive Visualization, Analysis and Event Detection Software

Interactive Analytics

Internet

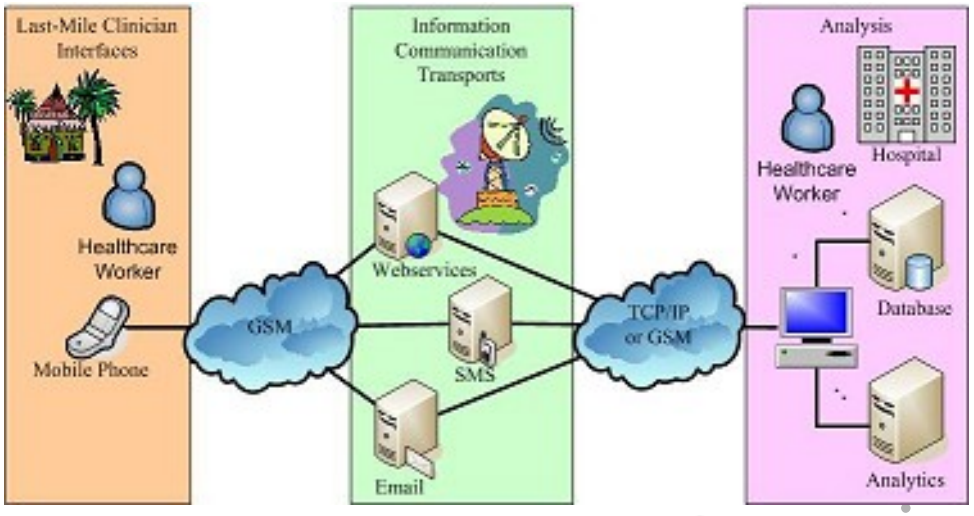
www.lirneasia.net

# Objective of the Research

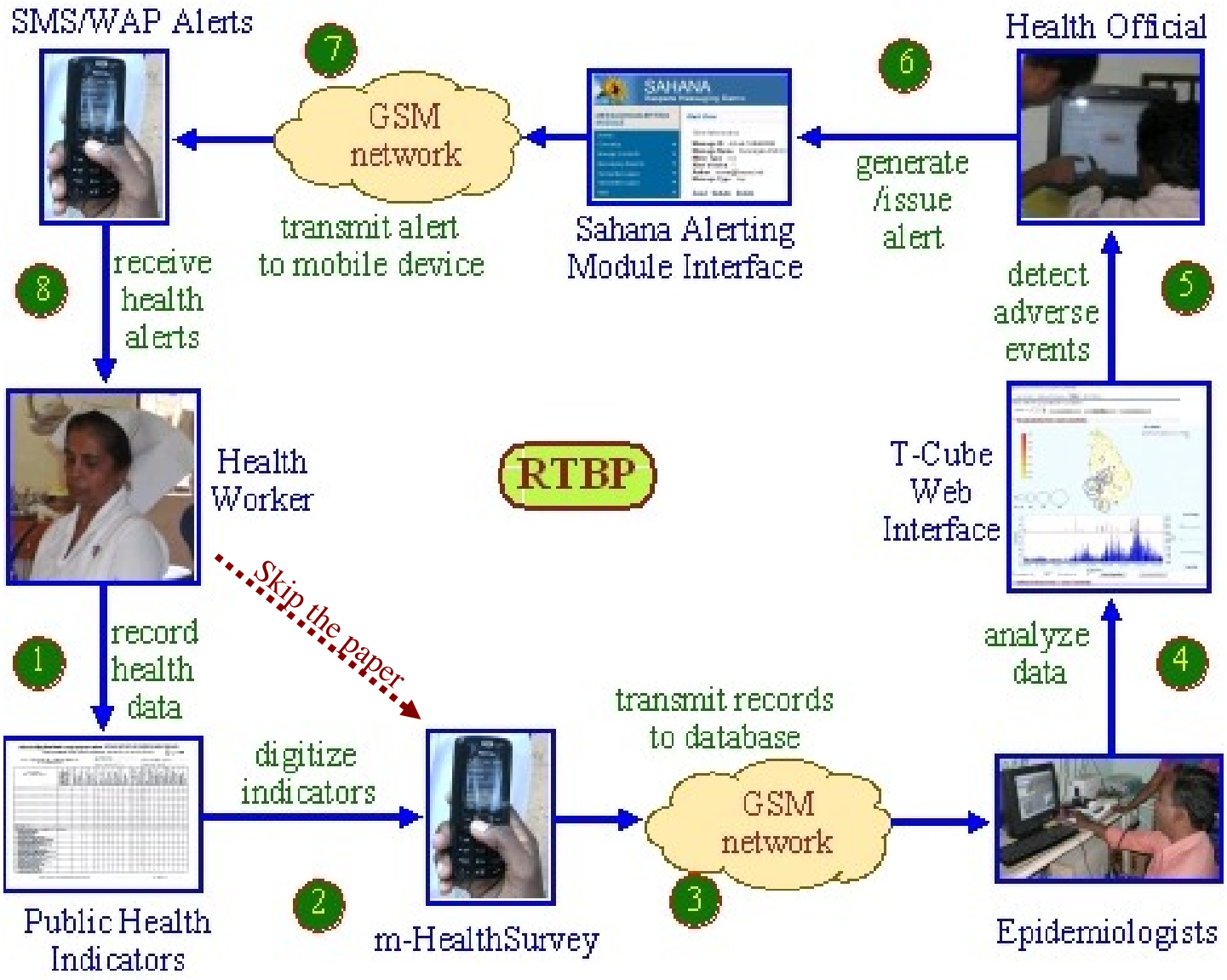
**Research Question**: "*Can software programs that analyze health statistics and mobile phone applications that send and receive the health information potentially be effective in the early detection and notification of disease outbreaks?*"

## Specific Objectives:

- Evaluating the effectiveness of the m-Health RTBP for detecting and reporting outbreaks
- Evaluating the benefits and efficiencies of communicating disease information
- Contribution of community organization and gender participation
- Develop a Toolkit for assessing m-Health RTBPs

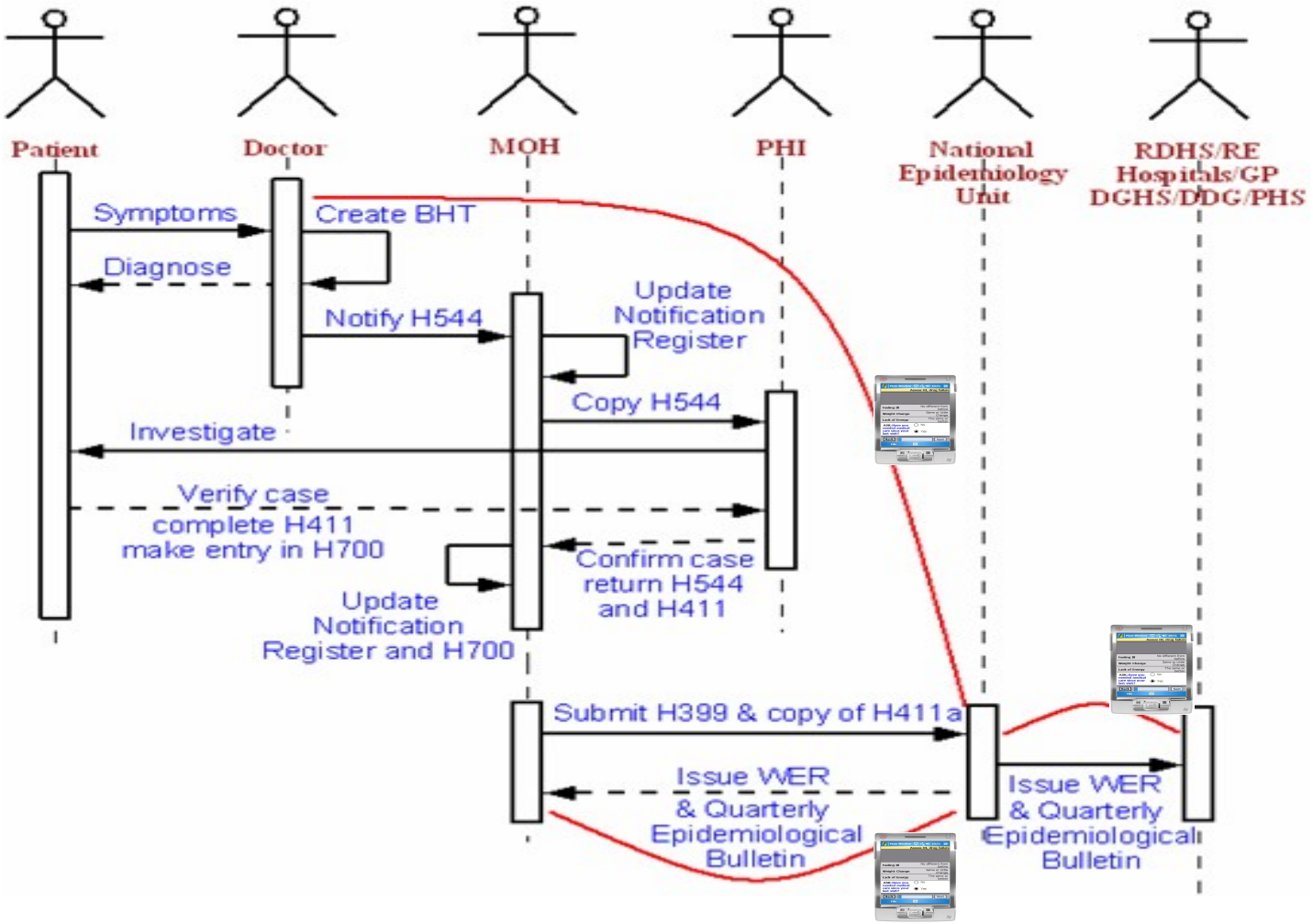


# Data collection, Event detection, and Situational-Awareness/Alerting in RTBP




www.lirneasia.net

# Sri Lanka Epidemiology and RTBP overlay

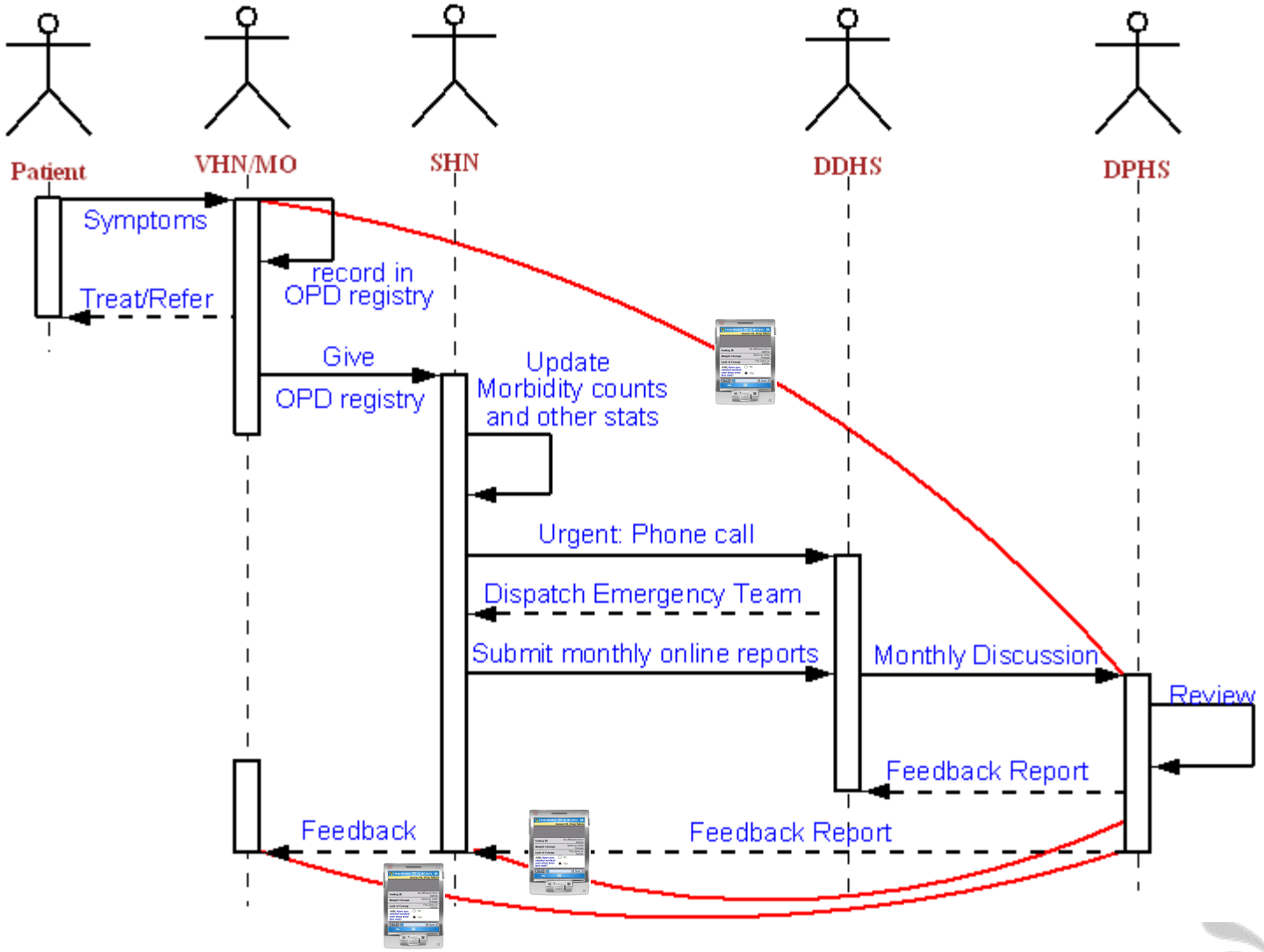



**Black arrows**: current manual paper/postal system for health data collection and reporting

**Red lines**: RTBP mobile phone communication system for heath data collection and reporting

www.lirneasia.net

# India morbidity reporting and RTBP overlay




**Black arrows**: current manual paper/postal system for health data collection and reporting

**Red lines**: RTBP mobile phone communication system for heath data collection and reporting

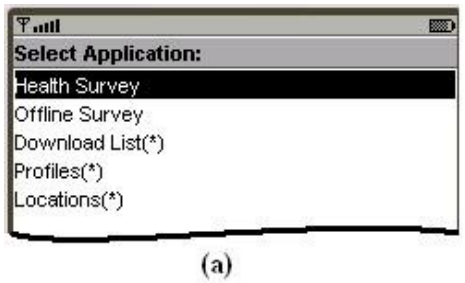
www.lirneasia.net

# mHealthSurvy software design

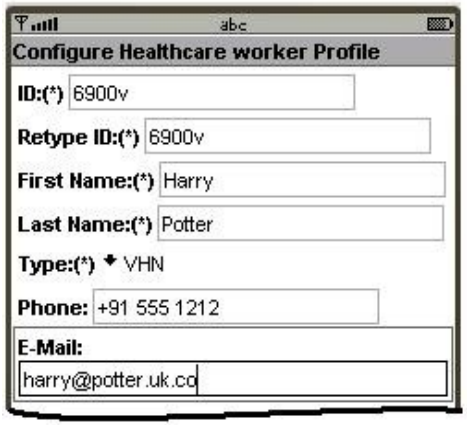
- J2ME: Built on Java 2 Micro edition
- CDC: works with CDC 1.1 and above (JSR)
- MIDP: works with MIDP 2.0 or above
- GPRS: transport technology
- Each record is 2kb and costs INR 0.01 or LKR 0.02 (USD 0.0002)
- Mobile phone around US$ 100
- Tested on Nokia3110c, Motorola SLVR L7, Gionee v6900. Amoi A636, Sony Ericsson s302c

www.lirneasia.net

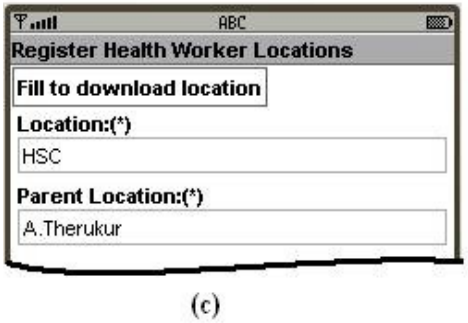
# mHealthSurvey Midlet



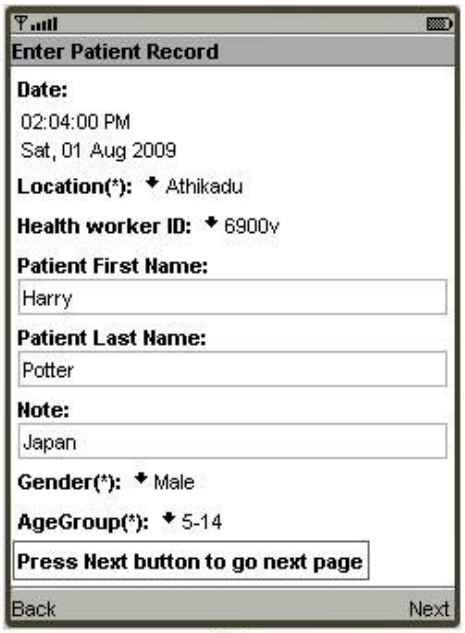

(a)



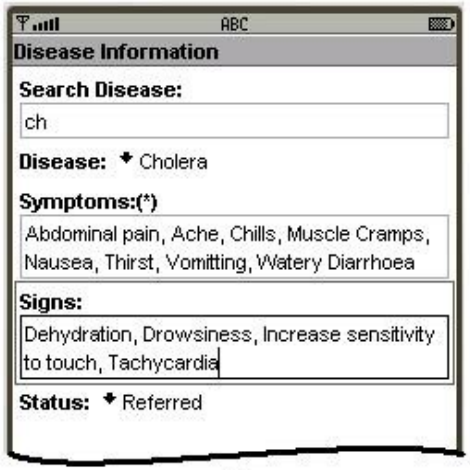

(b)




(c)




(d)




(e)

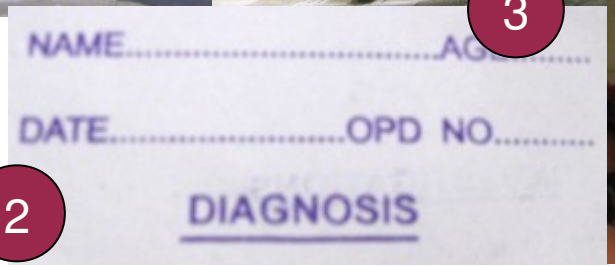
- (a) Main menu
- (b) Profile registration
- (c) Retrieve locations
- (d) Patient record screen I
- (e) Patient record screen II

www.lirneasia.net

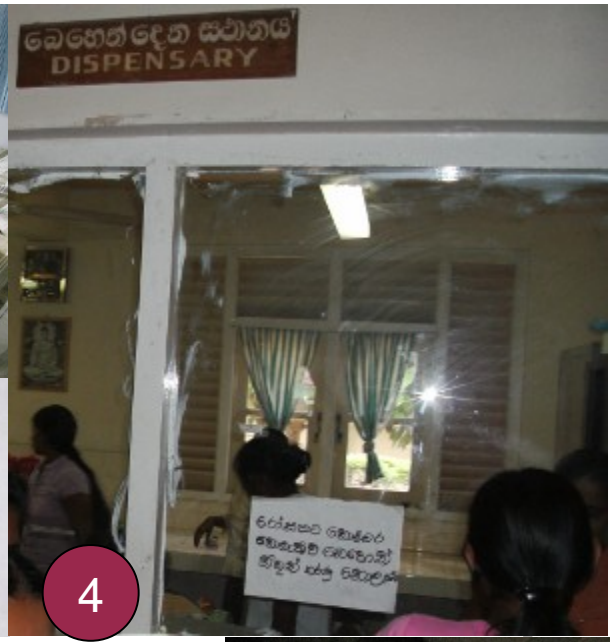
# Data collection process

1

3




2




4

(1) Patient is received by the Nurse

(2) Nurse issues a diagnosis chit to patient fills in Name, Age, Gender, and OPD No

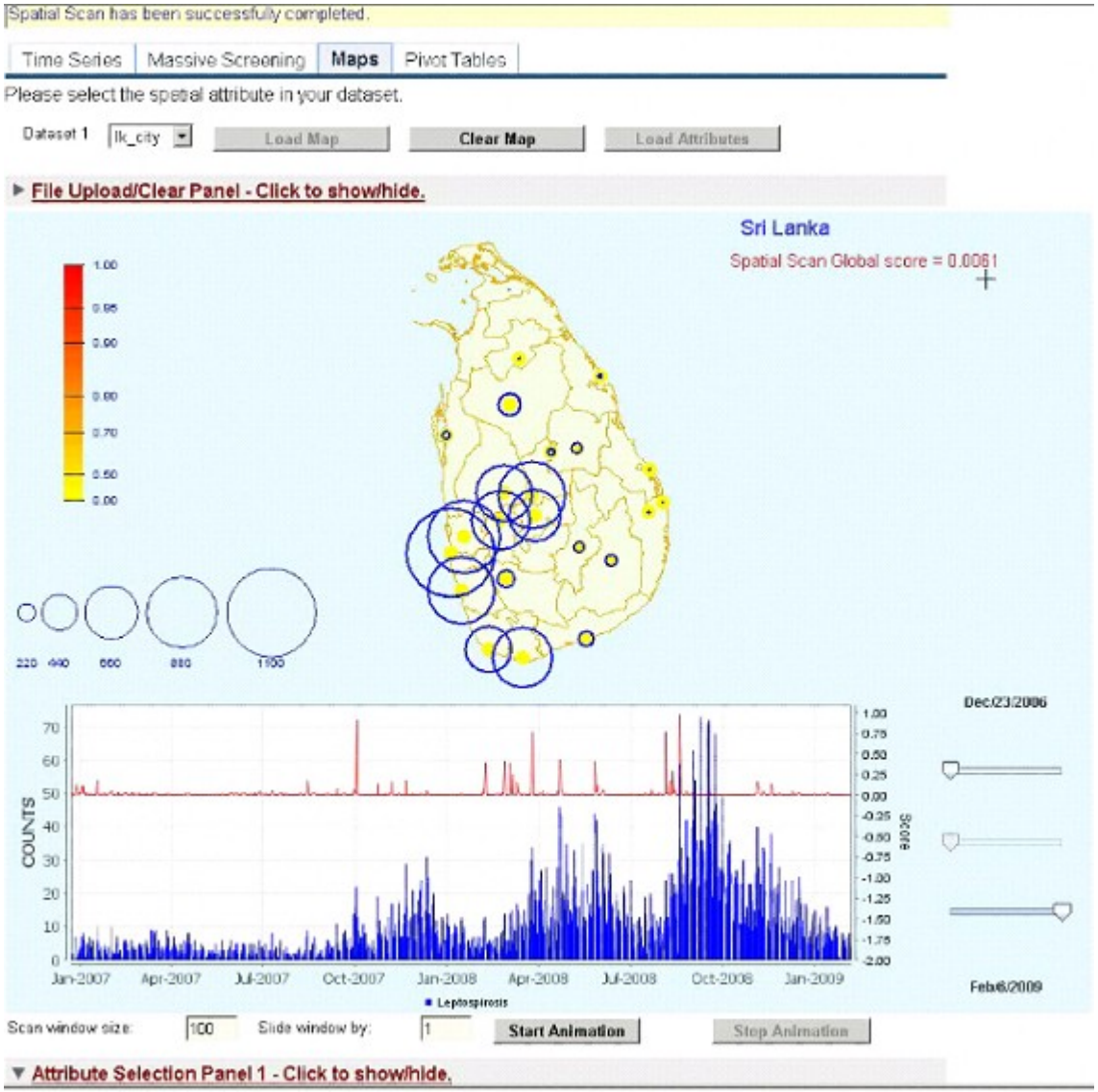
(3) Medical Officer fills in the chit with diagnosis and treatment

(4) Patient presents chit to pharmacy to receive medication

(5) Data Entry Operator digitizes and submits the data

5

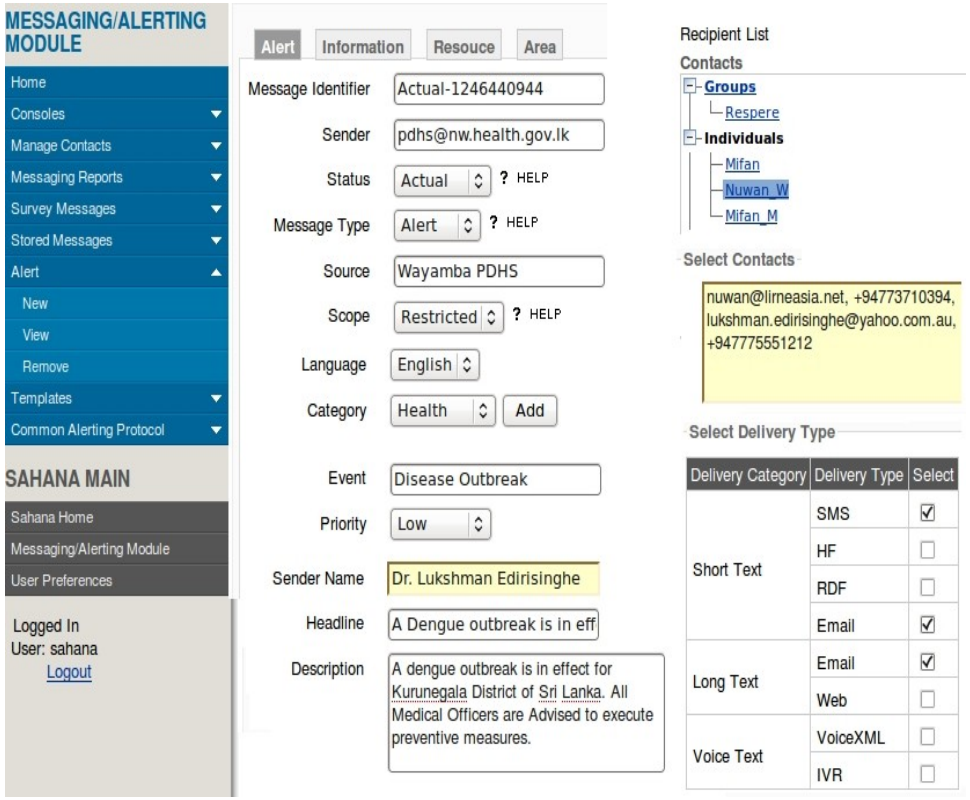
# T-Cube Web Interface [*Auton Lab*]




- AD Tree data structure
- Trained Bayesian Networks
- Fast response to queries
- Statistical estimations techniques
- Data visualization over temporal and spatial dimensions
- Automated alerts

www.lirneasia.net

# Messaging/Alerting CAP/EDXL Broker [*Sahana*]

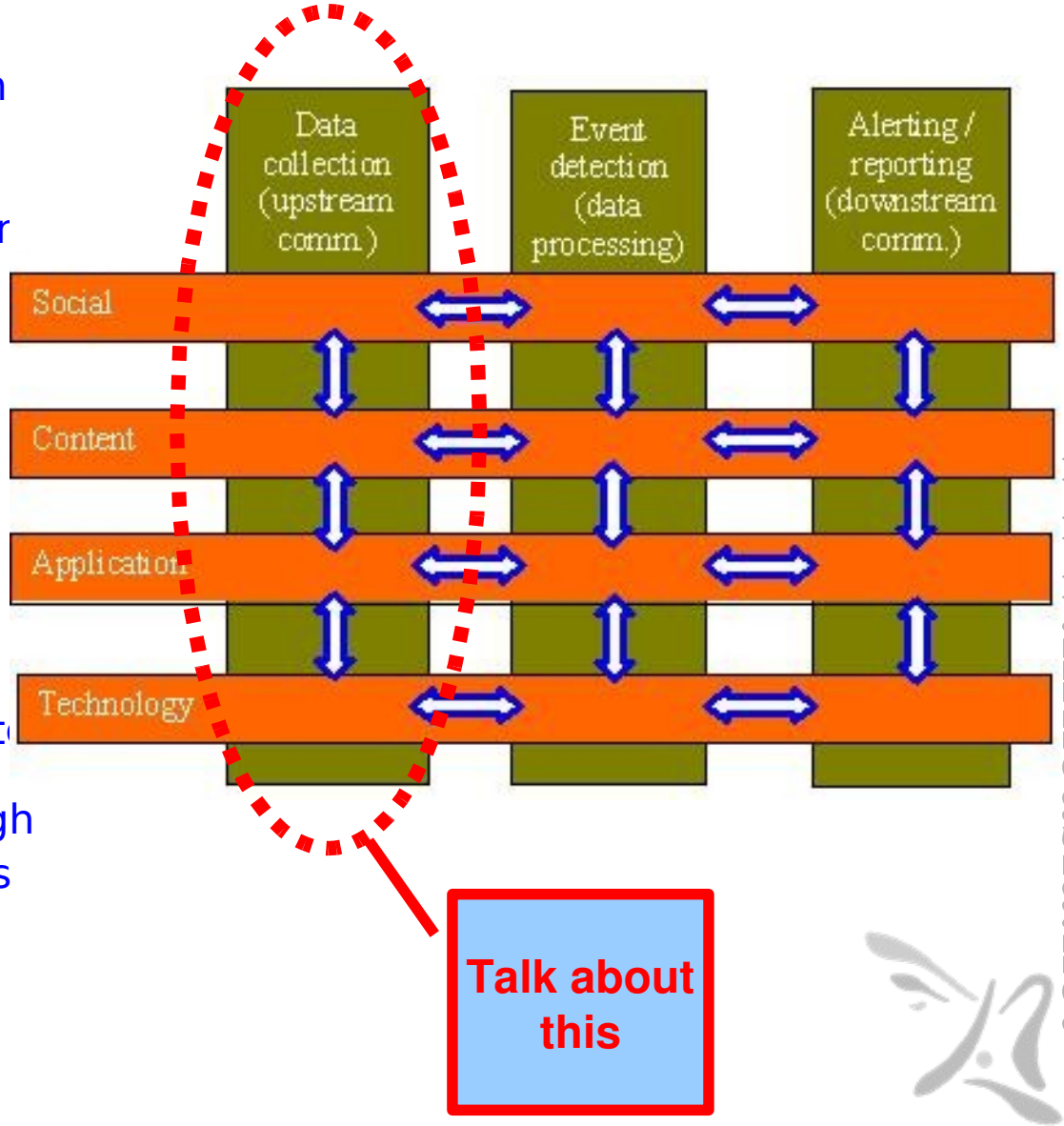


- Single input multiple output engine; channeled through multiple technologies
- Manage publisher /subscribers and SOP
- Adopt PHIN Communication and Alerting Guidelines for EDXL/CAP
- Relating the template editor with the SMS/Email Messaging module
- Do direct and cascading alert from a regional jurisdictional prospective
- Designing short, long, and voice text messages
- Addressing in multi languages

www.lirneasia.net

# Evaluation metric verticals and horizontals

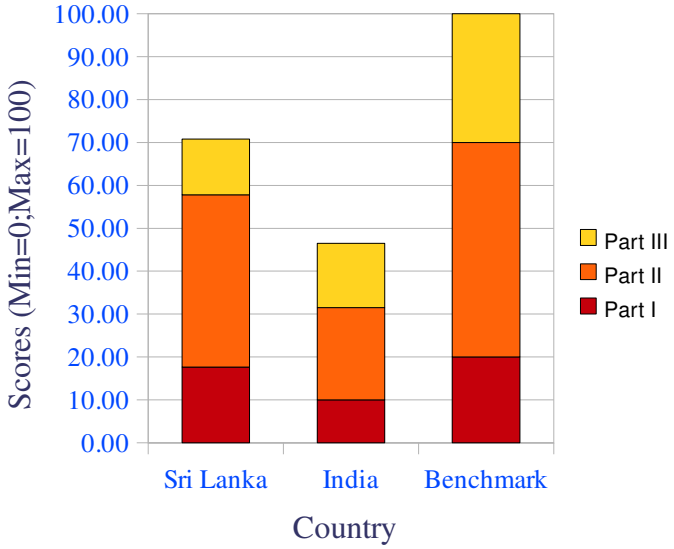
- Three verticals – data collection, event detection and reporting
- Four layers – social, conter application Technology
- Arrows showing the Interoperability between layers and verticals
- Objectively assess by calculating various indicators: costs, efficiencies, error rates, et
- Subjectively assess through interviews and simulations




www.lirneasia.net

# m-HealthSurvey Certification Exercise at the early stages

| Health Workers from → | Benchmark | Sri Lanka | India |
|---|---|---|---|
| Part I - average completion time: | 12.00 | 10.75 | 17.48 |
| Part II - average completion time: | 20.00 | 10.80 | 27.26 |
| Part III – SOP absence/Presence | 50.00 | 20.43 | 15.00 |
| Certified Trainers | | 2 of 14 | None |
| Certified Users | | 8 of 14 | 4 of 23 |
| Not certified | | 4 of 14 | 19 of 23 |



www.lirneas

# Fix the data collection shortcomings: noisy and off-time

From: 01-Sep-2009
To: 02-Feb-2010

From: 01-Jun-2009
To: 02-Feb-2010

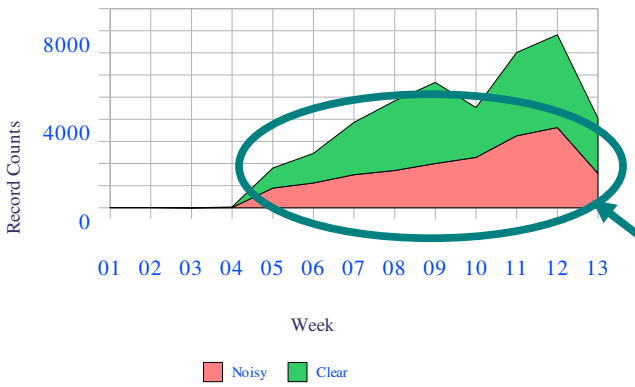
**Case Records:**
**106761**

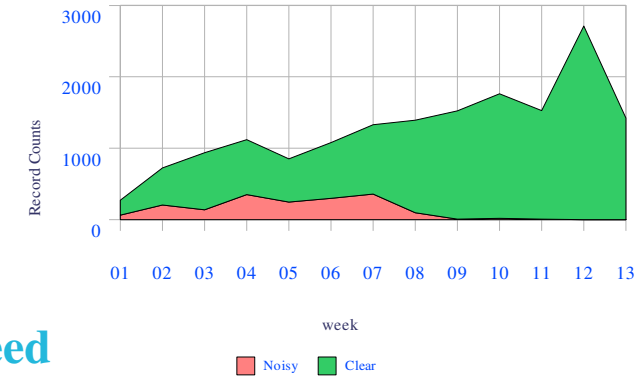
Sri Lanka

**Case Records:**
**41682**

India

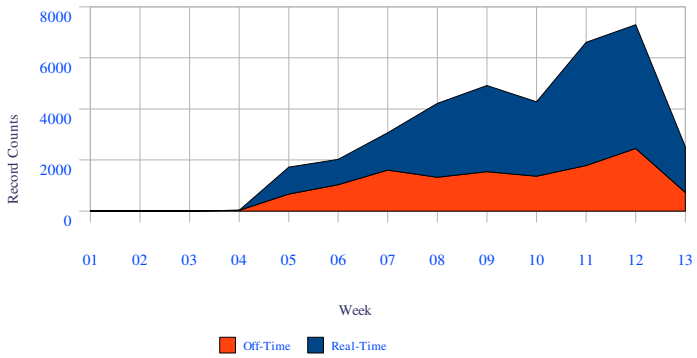
Noisy vs Clean data

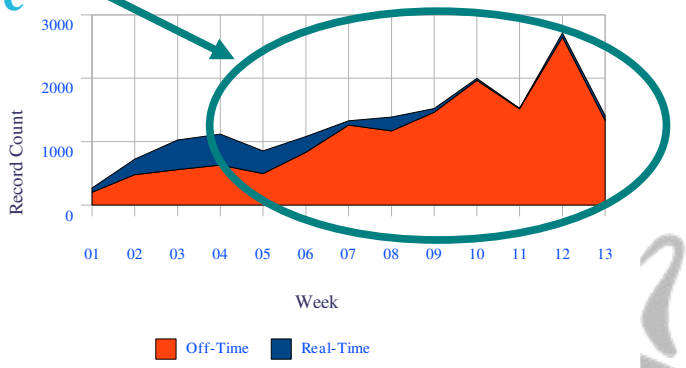



Need solutions here

Real-Time vs Off-Time



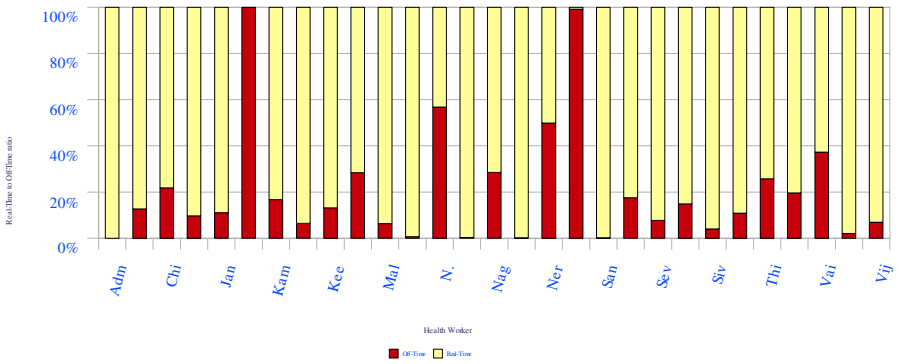




www.lirneasia.net

# Comparing real-time/off-time by Data collector

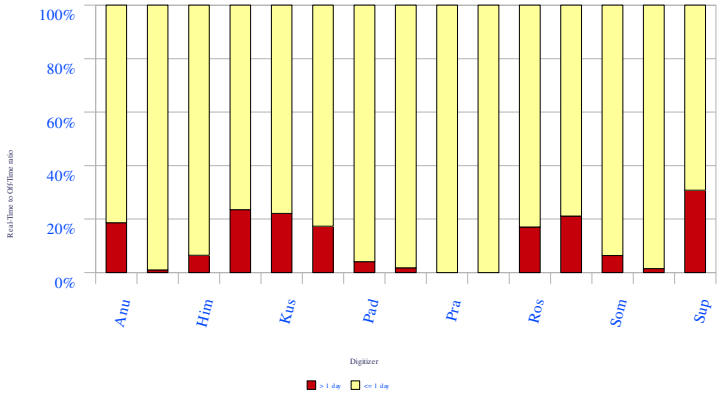
## India

- 2 Hired people are better
- 24 VHNs submit every 2 – 3 days
- 4 SHN are more disciplined enter on same day




## Sri Lanka

- All hired data entry ops
- Enter data on the same day
- If OPD volumes are high then have to enter the records the next day




www.lirneasia.net

# Content semantics, syntax problems

| Problem | Examples |
|---|---|
| Synonyms: | Gaol fever or Jail fever or Typhus Fever; dementia or memory loss; Enteric Fever vs Typhoid Fever; Encephalitis and Meningitis |
| Insertion of symbols: | Body ache vs body-ache; Body pain vs Body Pain |
| Order of words: | muscle weakness vs weakness in muscles; stomach pain vs Pain in the stomach; |
| Conjunction of Adjectives: | Severe memory loss vs memory loss |
| Tamil words: | Leg vettuthal |
| Disjunctions: | nasal stuffiness or sneezing; Over Bleeding with Abdaminal Pain |
| Long sentences: | Not able to identify colors |
| Mistake treatments: | Oral Pils Issue, Remove catheter |
| Instructions: | please specify details, specify symptoms |
| UK & USA spelling: | Diarrhoea vs Diarrhea; vomiting vs vomitting vs vommitting |
| Test results: | BP 140/90, BP 120/100, |
| Multiple instances: | coldness in the hands, coldness in hand, coldness in limbs |
| Natural language: | with headache, with fever, |

# Cost benefits

| Sl. No. | Particulars | RTBP ($USD) | Present system ($USD) |
|---|---|---|---|
| A | Data Collection | | |
| | a) Capital Expenses | 200.16 | 2748.30 |
| | b) Operational Expenses | 246.43 | 1525.67 |
| | Sub Total (A) | 446.59 | 4273.97 |
| B | Event Detection | | |
| | a) Capital Expenses | 142.59 | 0.00 |
| | b) Operational Expenses | 228.65 | 21.55 |
| | Sub Total (B) | 371.24 | 21.55 |
| C | Alert Notification | | |
| | a) Capital Expenses | 93.63 | 151.36 |
| | b) Operational Expenses | 0.00 | 54.05 |
| | Sub Total (C) | 93.63 | 205.41 |

Five Fold Reduction

www.lirneasia.net

# Conclusions

- mhealthSurvey is a worthy candidate for patient disease/syndrome digitization
- However, must be improved to minimize the noise and delays
- Need a better GUI if Medical Officers are to enter high volume real-time data opposed to a data entry clerk
- Need a compete and comprehensive standardized disease syndrome database
- Need to investigate other digitization techniques

www.lirneasia.net