

# Sahana Alerting Software for Real-Time Biosurveillance in India and Sri Lanka

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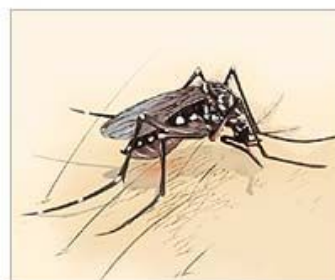


# Early detection and mitigation of common diseases and pandemics



Dengue fever is characterized by:

- Fever
- Rash
- Muscle and joint pains



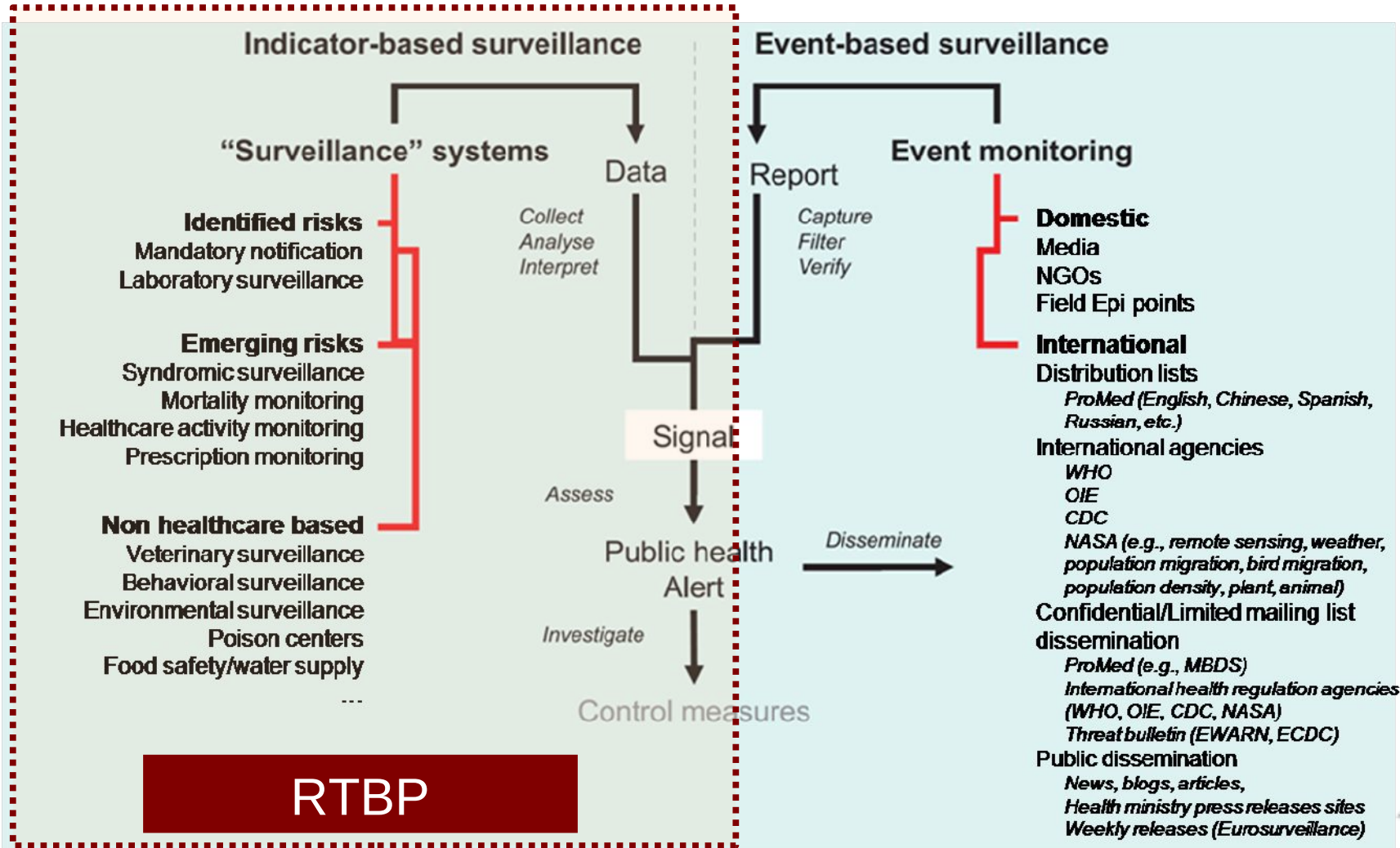
*Aedes aegypti* mosquito



## Real-Time Biosurveillance Program to Revolutionize disease surveillance and notification

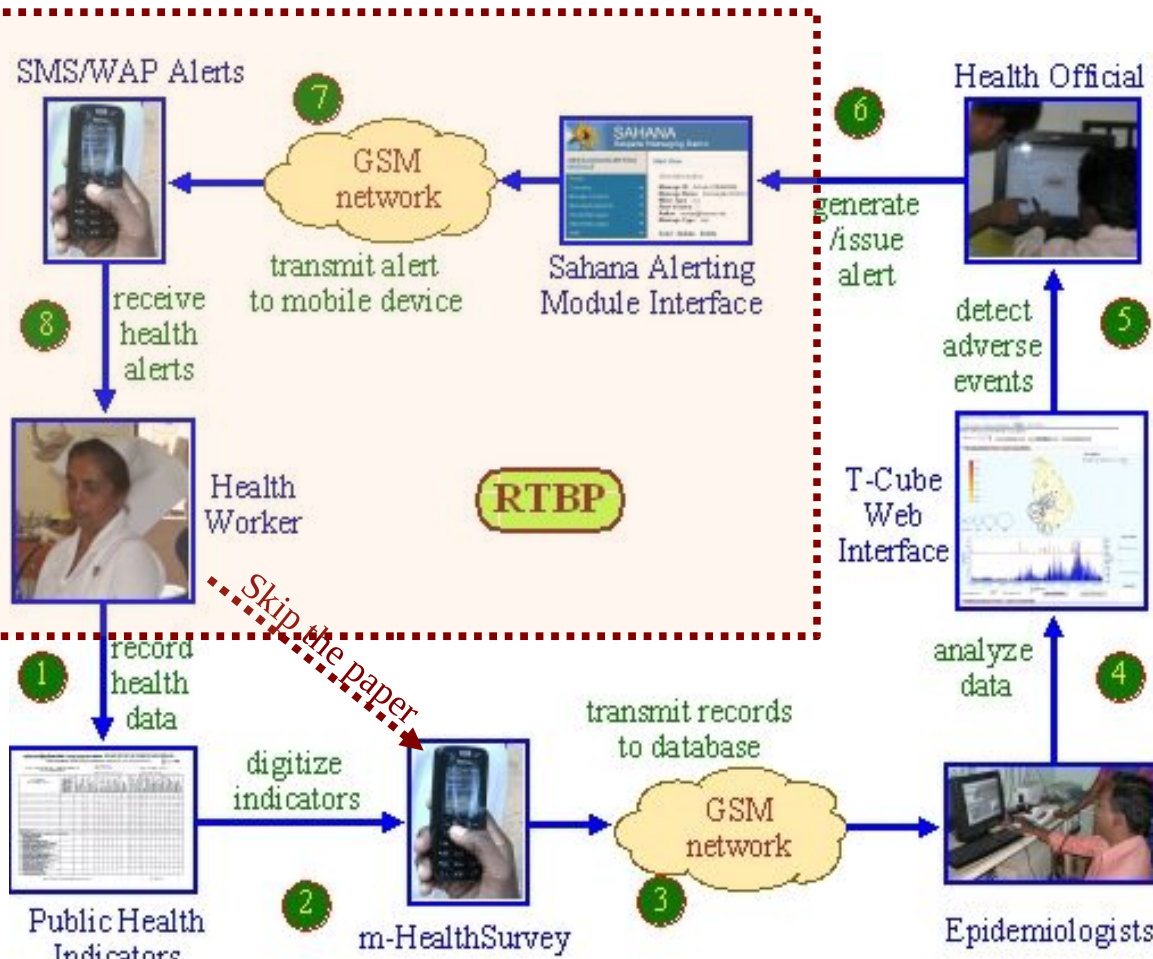


# Disease Surveillance




# RTBP high level system diagram

Actors, processes, and information flow of the proposed data collection, event detection, and situational-awareness/alerting real-time program

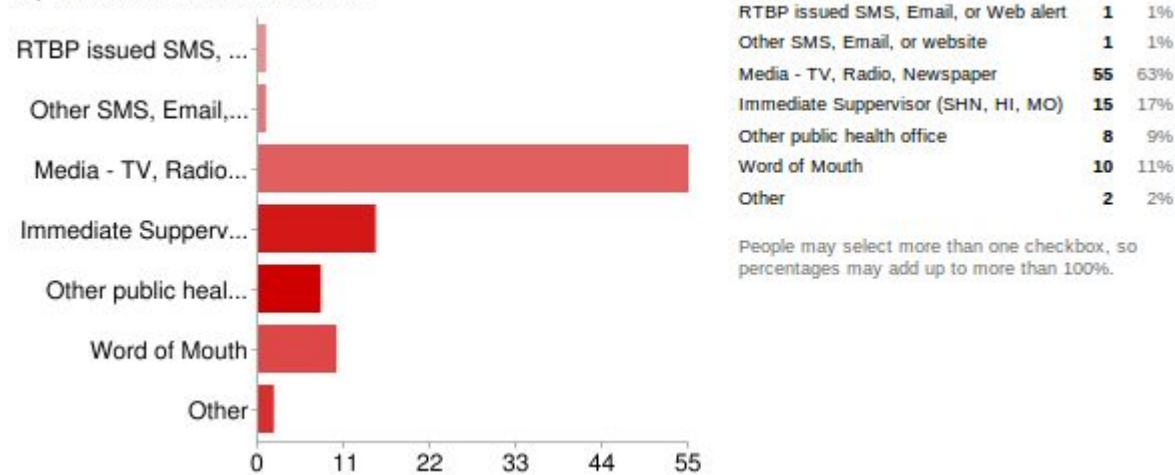


1. Health records first entered in paper
2. Then digitized by health workers using mobile phones.
3. Disease, symptoms, and demographic information transmitted across GSM mobile network to central database.
4. Data analyzed by trained staff at the disease surveillance units; In addition, automated event detection algorithms process a daily ranked set of possible disease outbreaks, which are presented to the staff.
5. List of possible outbreaks examined by epidemiologist to determine likelihood of an adverse event.
6. Confirmed adverse events disseminated to medical officers, health inspectors, nurses, and other health officials, within affected geographic area.
7. Condensed version of the alert pushed through SMS over GPRS channels to get immediate attention of the recipients.
8. More descriptive message emailed and published on the web (also accessible through mobile phone).

# Existing methods of receiving health alerts

 Survey responses from 28 health workers from June 2009 to March 2010

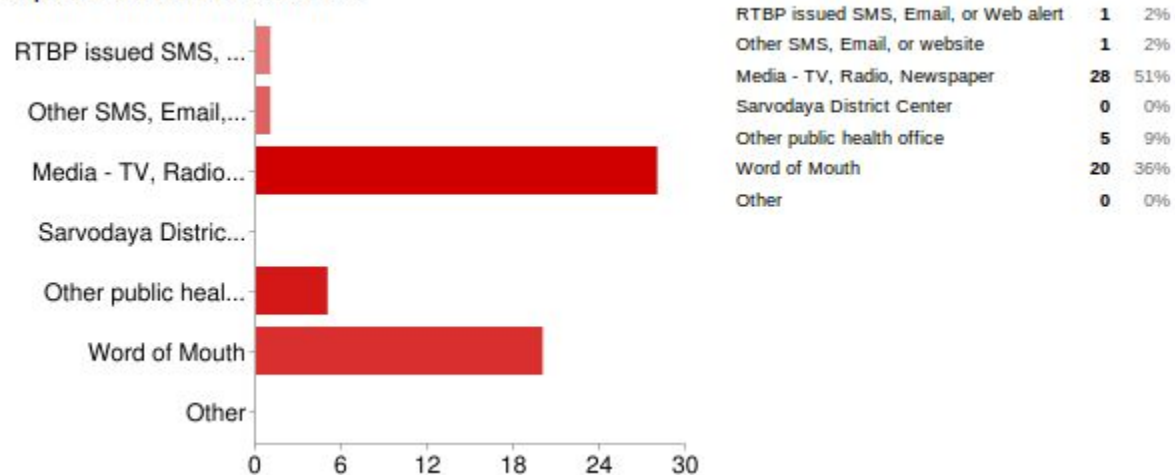
Reports received on disease outbreaks



At present health workers learn of adverse health events through **MEDIA** and **WORD-OF-MOUTH**, in some cases from **PEERS**

 Survey responses from 15 health workers from June 2009 to March 2010

Reports received on disease outbreaks



No formal Government method for sharing health risk information with health workers

## Problem to solve

- *How do we integrate the **subscribers and publishers**?*
- *How do we deliver early warnings in **local language**?*
- *How do we use existing **market available technologies**?*
- *How do we disseminate alerts over **multiple channels**?*
- *How do we **inter-operate** between incompatible systems?*
- *How do we **effectively** communicate the optimal content?*
- *How do we address the communication **strategy**?*
- *How do we accommodate **upstream-downstream** alerting?*



# Common Alerting Protocol Overview

- All you want to know in “CAP Cookbook”
- XML** Schema and Document Object Model
- Interoperable** Emergency Communication Standard
- Specifically geared for Communicating **Complete Alerts**
- Capability for Digital encryption and signature X.509
- Developed by **OASIS** for “**all-hazards**” communication
- Adopted by ITU-T for Recommendations X.1303
- Incubated by W3C Emergency Information Interoperability Framework
- Used by USA, USGS, WMO, Gov of CA
- Can be used as a **guide** for structuring alerts



# CAP Document Object Model

Bold elements are mandatory

Bold elements in `<Alert>` segment are qualifiers

Others elements are optional

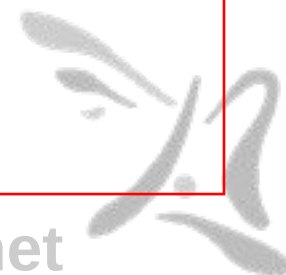
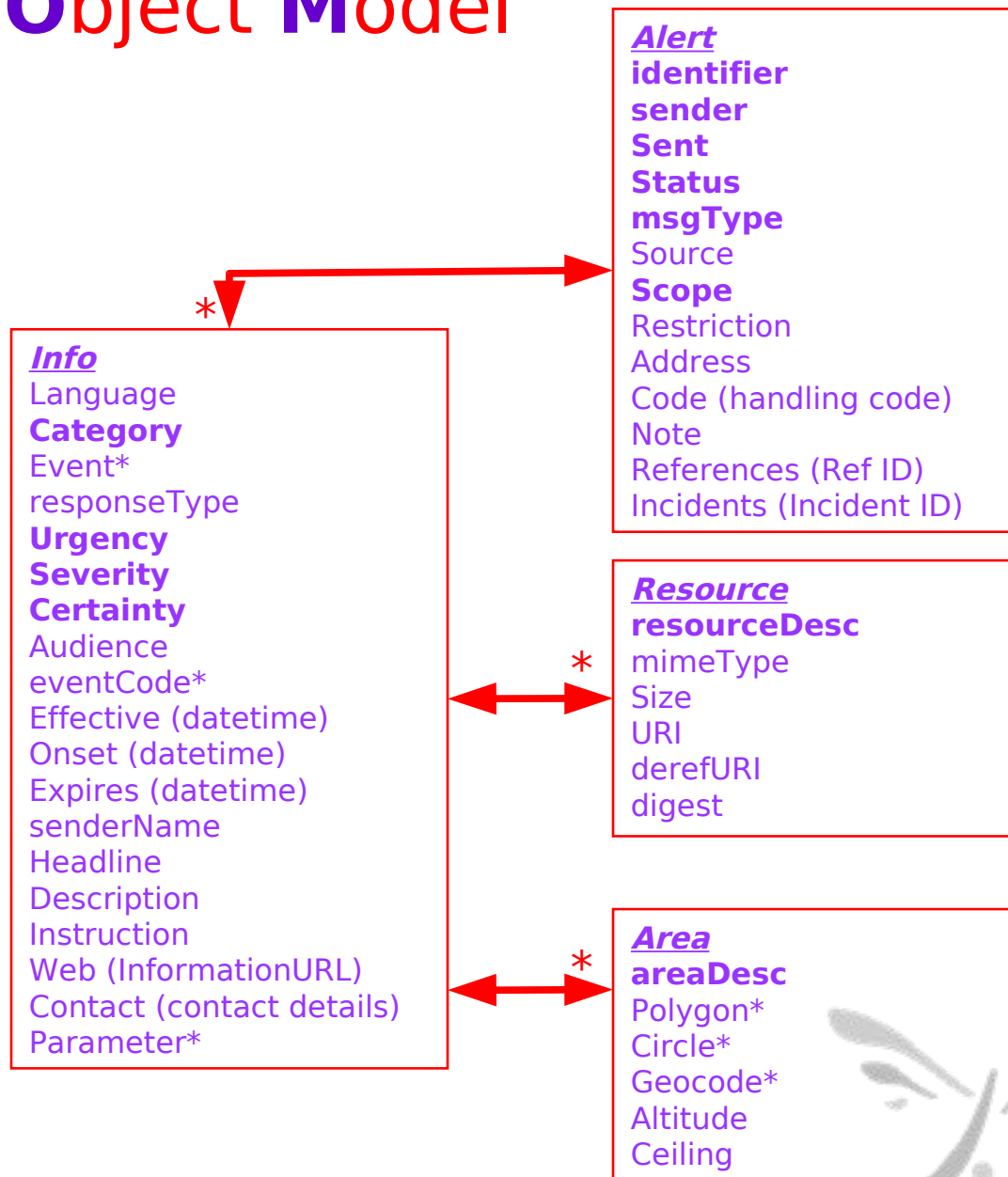
Profile may specify other mandatory elements from optional list

Single `<Alert>` segment

Multiple `<Info>` segments inside `<Alert>` segment

Multiple `<Area>` and `<Resource>` segments inside a `<info>` segment

(\*) indicates multiple instances are permitted



# Predefined values

<b><i>CAP Element</i></b>	<b><i>Predefined Values</i></b>
<i>&lt;Status&gt;</i>	Actual, Exercise, System, Test, Draft
<i>&lt;msgType&gt;</i>	Alert, Update, Cancel, Ack, Error
<i>&lt;Scope&gt;</i>	Public, Restricted, Private
<i>&lt;Language&gt;</i>	en, fr, si, tm, ...  codes ISO 639-1
<i>&lt;Category&gt;</i>	Geo, Met, Safety, Security, Rescue, Fire, Health, Env, Transport, Infra, CNRNE, Other
<i>&lt;responseType&gt;</i>	Shelter, Evacuate, Prepare, Execute, Monitor, Assess, None
<i>&lt;Urgency&gt;</i>	Immediate, Expected, Future, Past, unknown
<i>&lt;Severity&gt;</i>	Extreme, Sever, Moderate, Minor, Unknown
<i>&lt;Certainty&gt;</i>	Observed, Likely, Possible, Unlikely, Unknown
<i>&lt;Area&gt;</i>	b-WGS 84



# Prioritizing Messages in CAP

Priority	<urgency>	<severity>	<certainty>
Urgent	Immediate	Extreme	Observed
High	Expected	Severe	Observed
Medium	Expected	Moderate	Observed
Low	Expected	Unknown	Likely

Select value

Priority

Auto populate

Urgency

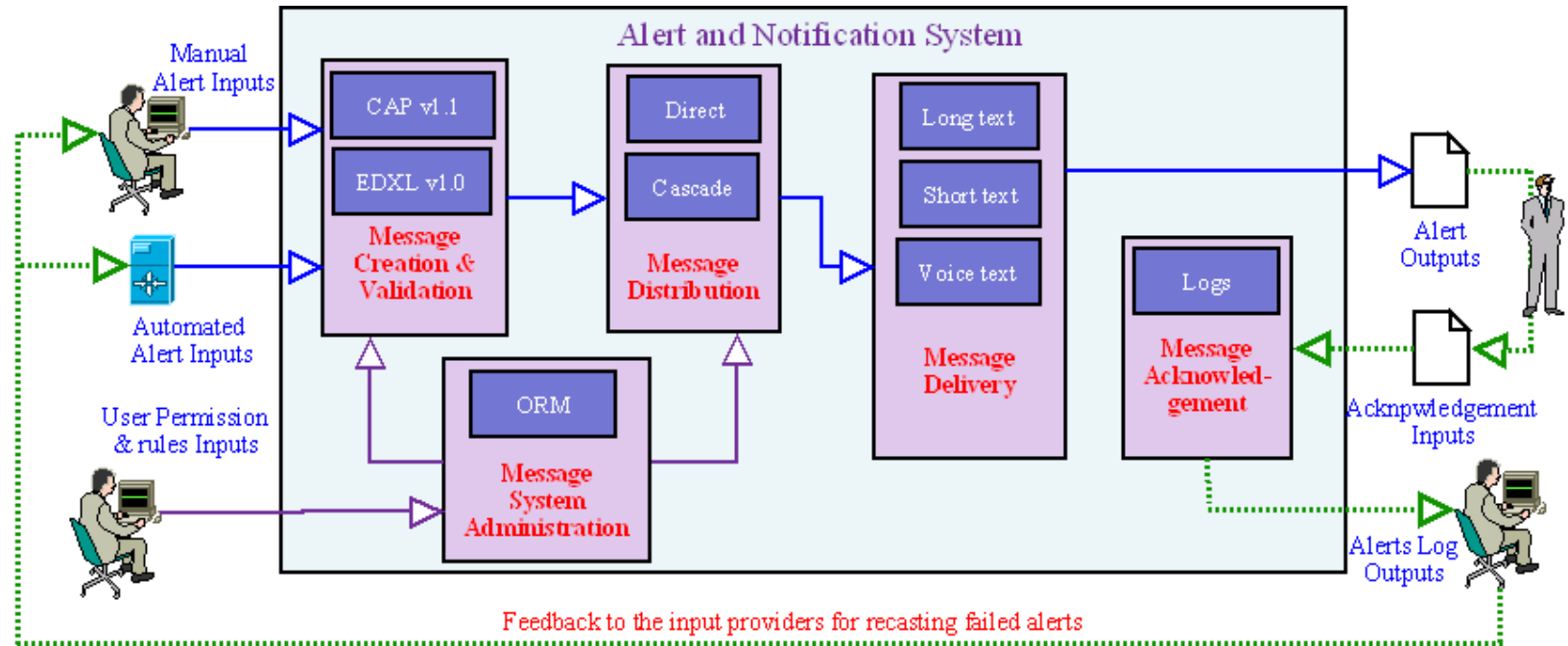
Severity

Certainty

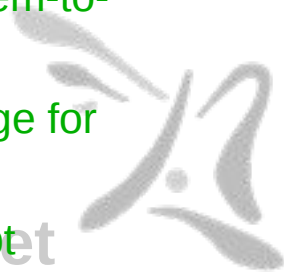
```
<info>  
<language>en-US</language>  
<category>Met</category>  
<event>Category 4 Cyclone</event>  
<responseType>Shelter</responseType>  
<urgency>Expected</urgency>  
<severity>Sever</severity>  
<certainty>Observed</certainty>  
<effective>2006-12-11T08:30:00 0000000+06:00</effective>  
<expires>2006-10-11T12:00:00 0000000+06:00</expires>
```



# Sahana Alerting Broker (SABRO) Subsystems



- Inputs can be manual or automated
- Message creation & validation uses CAP v1.1 and EDXL 1.0 data standards
- Access control (permissions) and user rules are governed through the Organization Resource Manager (ORM)
- Direct alerts are sent to end user recipients and Cascade alerts are a system-to-system communication determined by the message distribution method
- Long-text, Short-text, and Voice-text are different forms of full CAP message for the ease of message delivery to various end-user terminal devices
- Message acknowledgement logs the recipient messages confirming receipt



# Sahana Messaging/Alerting CAP/EDXL Broker by Respere

- ❑ Single input multiple output engine; channeled through multiple technologies
- ❑ Manage publisher /subscribers and SOP
- ❑ Templates help with standardizing the messages and speeding up the creation and issuing
- ❑ 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

**MESSAGING/ALERTING MODULE**

- Home
- Consoles
- Manage Contacts
- Messaging Reports
- Survey Messages
- Stored Messages
- Alert
- New
- View
- Remove
- Templates
- Common Alerting Protocol

**SAHANA MAIN**

- Sahana Home
- Messaging/Alerting Module
- User Preferences

Logged In  
User: sahana  
[Logout](#)

Alert Information Resource Area

Message Identifier: Actual-1246440944

Sender: pdhs@nw.health.gov.lk

Status: Actual ? HFI P

Message Type: Alert ? HEL P

Source: Wayamba PDHS

Scope: Restricted ? HELP

Language: English

Category: Health Add

Event: Disease Outbreak

Priority: Low

Sender Name: Dr. Lukshman Edirisinghe

Headline: A Dengue outbreak is in eff

Description: A dengue outbreak is in effect for Kurunegala District of Sri Lanka. All Medical Officers are Advised to execute preventive measures.

Recipient List

Contacts

- Groups
- Respere
- Individuals
- Mfan
- Nuwan\_W
- Mfan\_M

Select Contacts

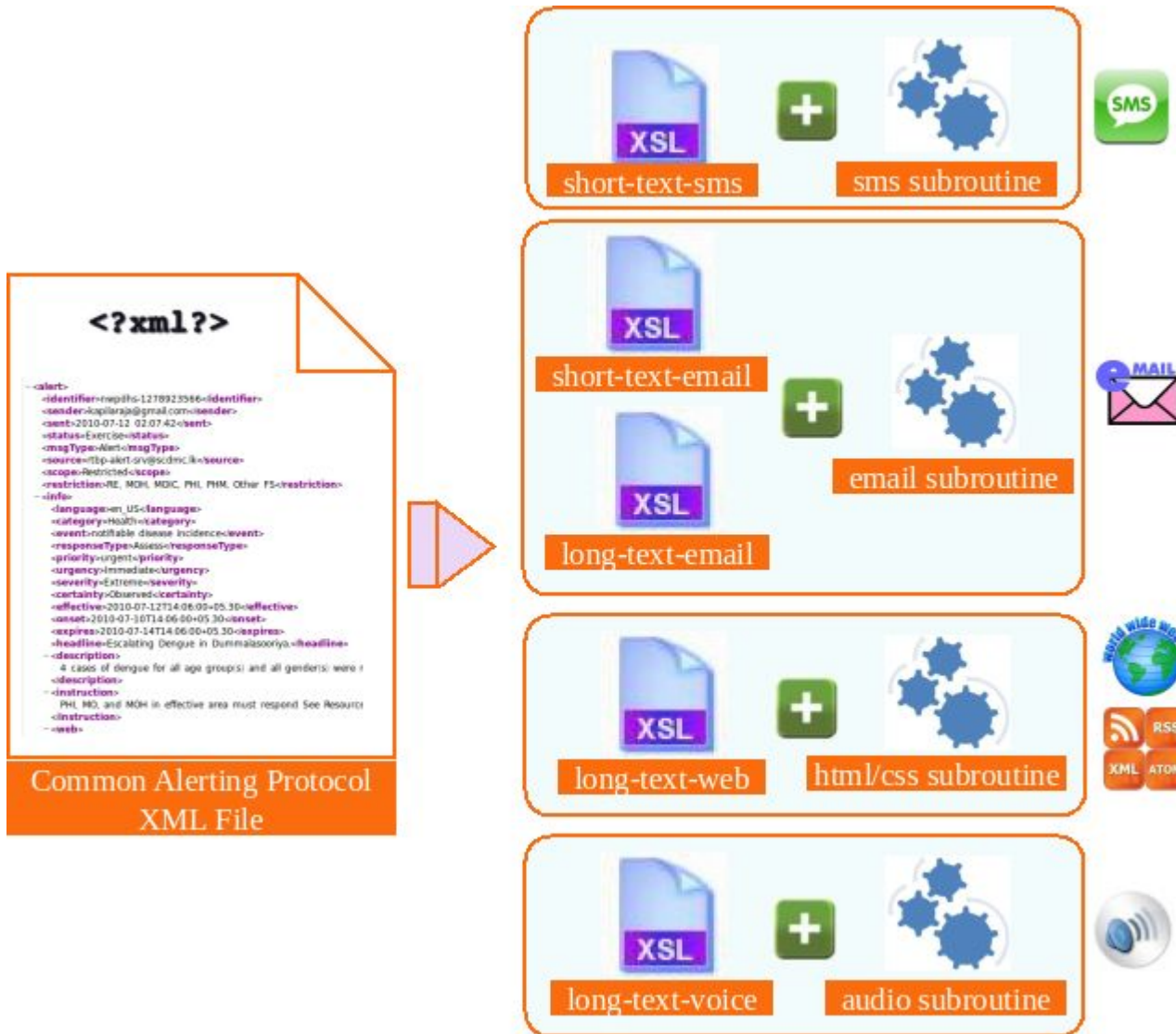
nuwan@lirneasia.net, +94773710394,  
lukshman.edirisinghe@yaleu.com.au,  
+947775551212

Select Delivery Type

Delivery Category	Delivery Type	Select
Short Text	SMS	<input checked="" type="checkbox"/>
	HF	<input type="checkbox"/>
	RDF	<input type="checkbox"/>
Long Text	Email	<input checked="" type="checkbox"/>
	Web	<input type="checkbox"/>
Voice Text	VoiceXML	<input type="checkbox"/>
	IVR	<input type="checkbox"/>



# CAP (XML) → uses XSL to transform → delivery method



# Example of style sheet template for SMS

<*headline*> : <*status*>

<*msgType*> for <*areaDesc*> area with  
<*priority*> priority <*event*> issued by  
<*senderName*>.

Msg: <*identifier*> sent on <*sent*>

Desc: <*description*>

More details

Web: <*web*>

Call: <*contact*>



# Example output of style sheet generated SMS

*Escalating mumps in Kurunegala district : Exercise Update for Wariyapola-PHI area with low priority notifiable disease outbreak issued by Dr Hemachandra.*

Msg : *nwpdhs-1281246871* sent on *2010-08-08 11:08:57.*

Desc : *2 cases of Mumps for 15-20 age group and all genders were reported in Munamaldeniya.*

More Details

Web [www.scdmc.lk](http://www.scdmc.lk)

Call **2395521**



# Evaluation of the CAP enabled Sahana Alerting Broker

- **Policy and Procedures** :: who should receive what information when and how; ability to adopt CAP to fit the public health notification requirements, studied through focus-group discussions and face-to-face interviews
- **Reliability and Effectiveness** :: was it ready to use at the time of need, what were the shortcomings of the technology, and what response actions followed receipt of message
- **Competency exercise** :: usability assessment with those creating and issuing messages; comprehension, credibility, persuasiveness, and validity exercise conducted with those message recipients
- **Utility** :: actual utilization and frequency of use in real scenarios; study the benefits
- **Economic analysis** :: compare the efficiency gains and cost effectiveness relative to the present alerting or notification systems in the pilot countries



# Steps for setting up a CAP Profile

- determining the policy and procedures -

## **Audience** <*Scope*>

Alert **First Responders** only (i.e. closed user group)

Example: police, health workers, civil society, public servants

Alert **Public** (entire population)

**Combination** of First Responders and Public

step 1: alert First-Responders to give them time to prepare

Step 2: warn public

## **Geographical Descriptions** <*Area*>

Country wide

Province or State

District

Other - Geocodes or GPS polygons

## **National** <*Languages*>

English only or Chinese only or Malay only

English, Hindi, Chinese, and Malay

## **Communications Technology?**

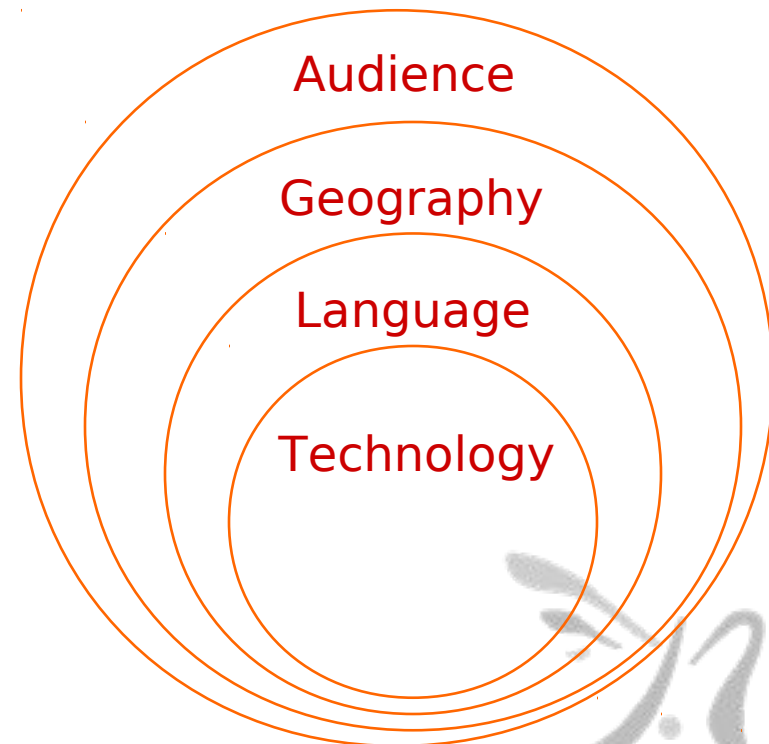
Mobile phones - SMS, Cell Broadcast, Email, Applet

TV - Text, Audio, Visual

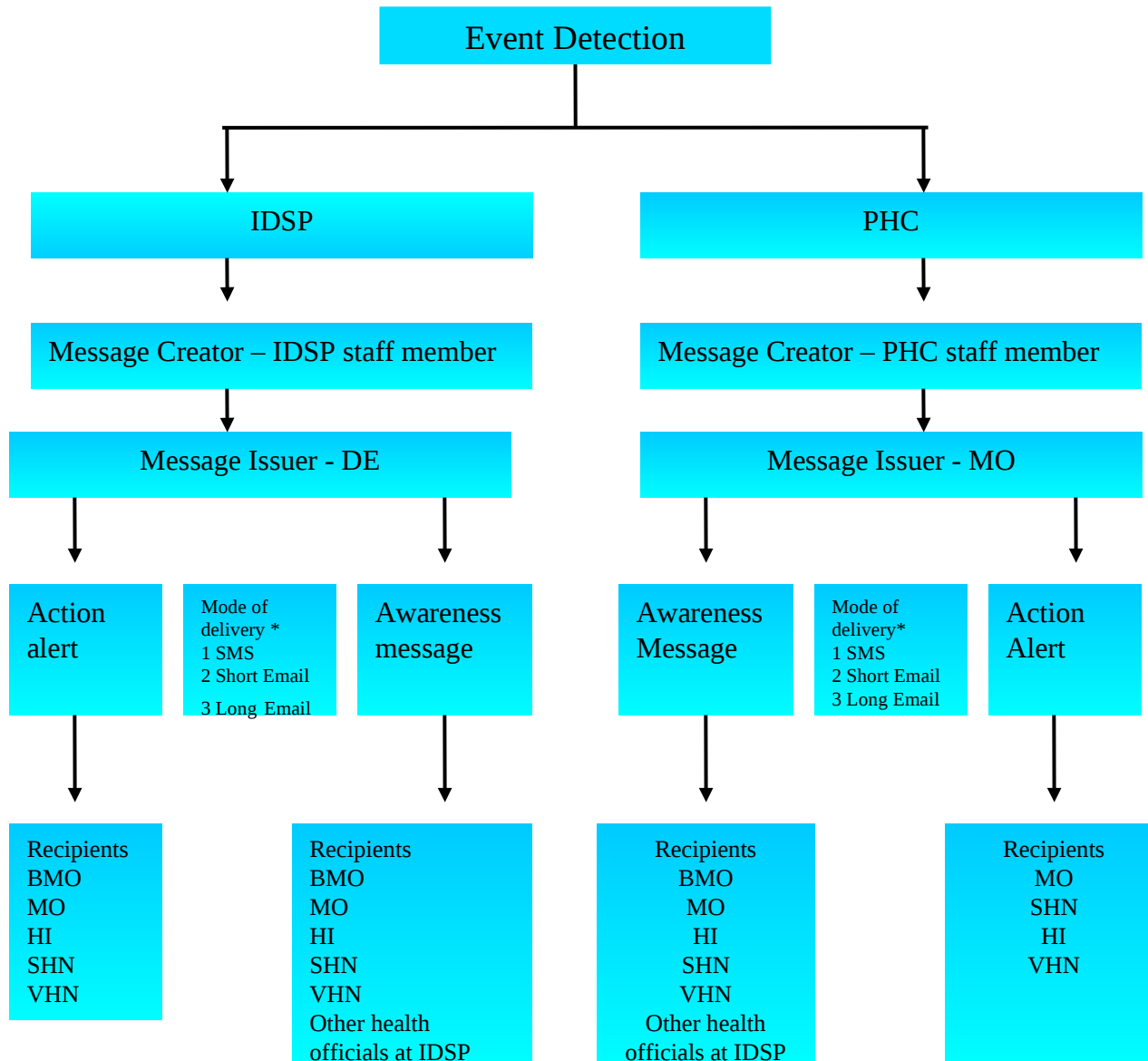
AM/FM Radio - Text, Audio

VHF/UHF Radio - Audio

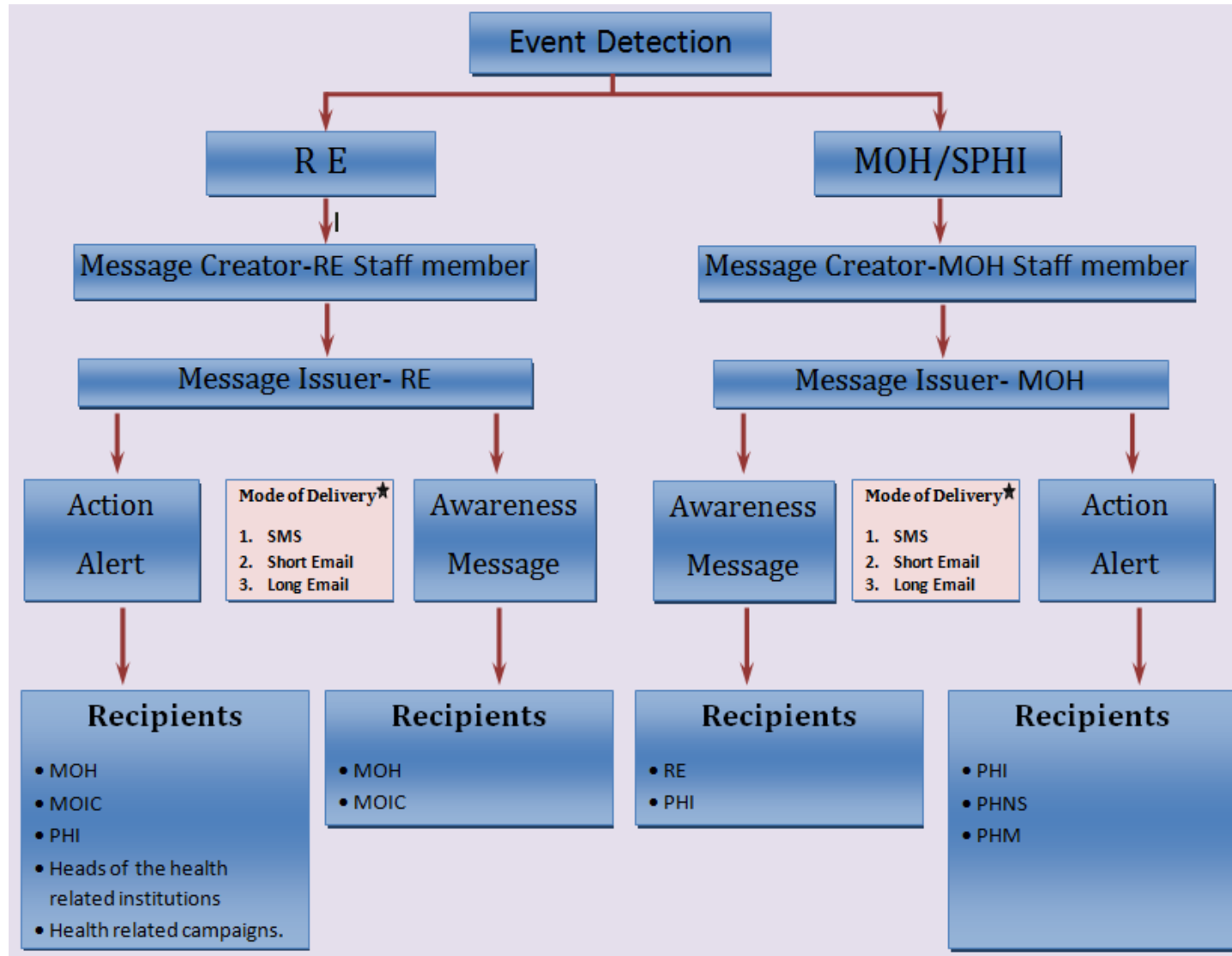
Internet - HTTP, Email, Webservices



# Downstream messaging structure - INDIA

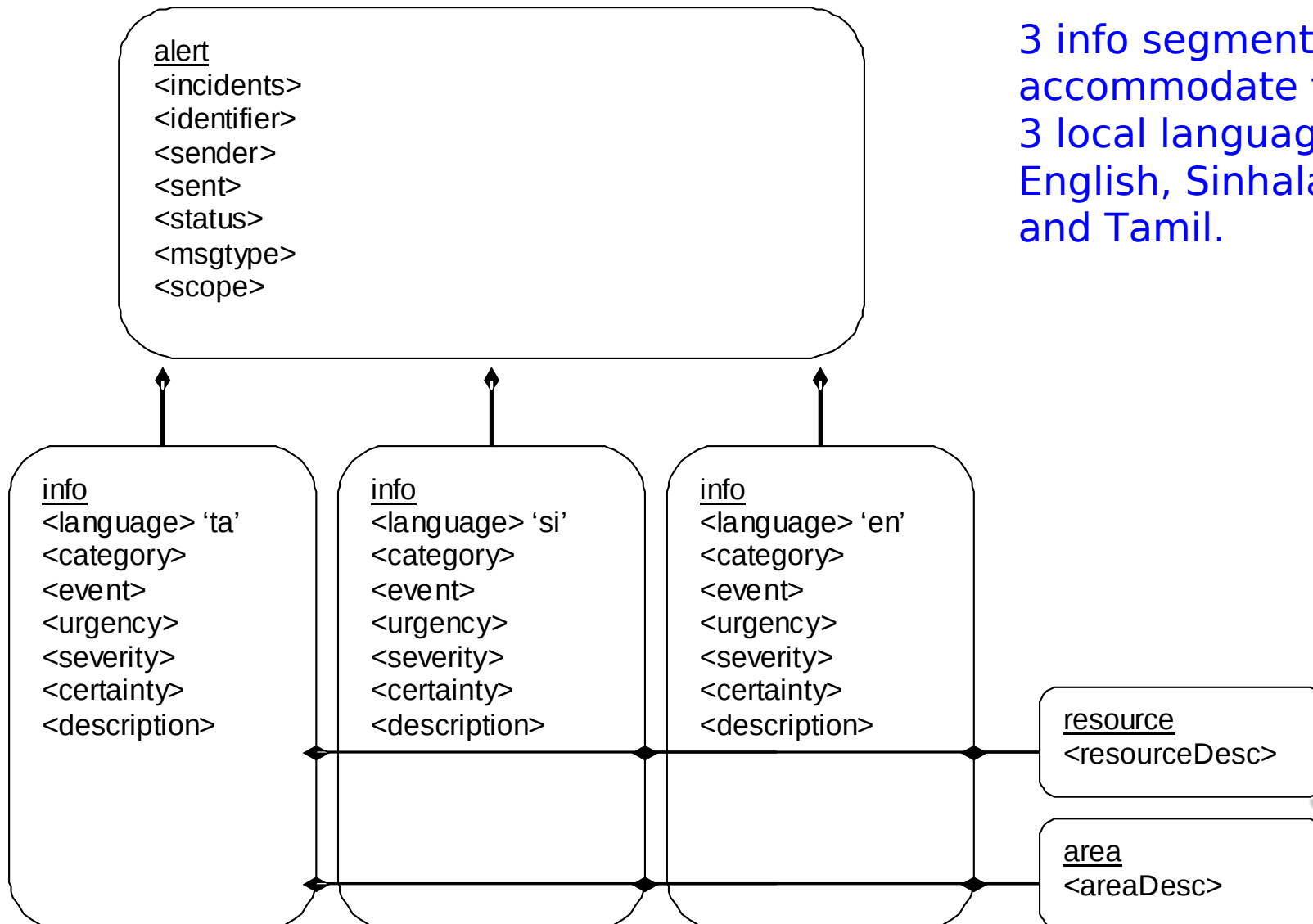


# Downstream messaging structure – SRI LANKA



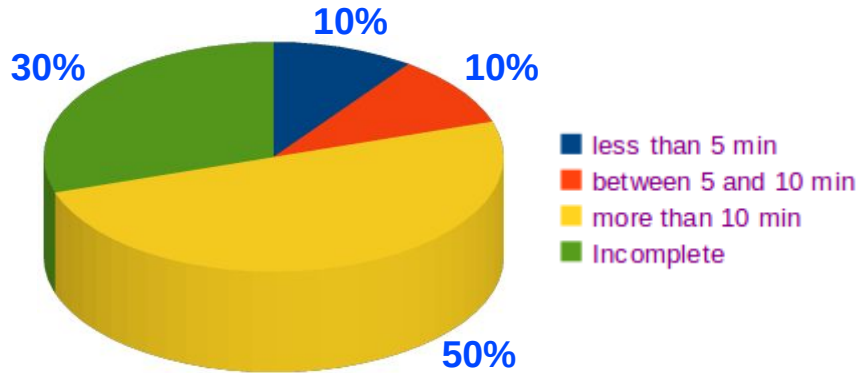
# CAP Profile for Sri Lanka

3 info segments to accommodate the 3 local languages: English, Sinhala, and Tamil.



# Messaging exercises with Sahana Alerting Broker

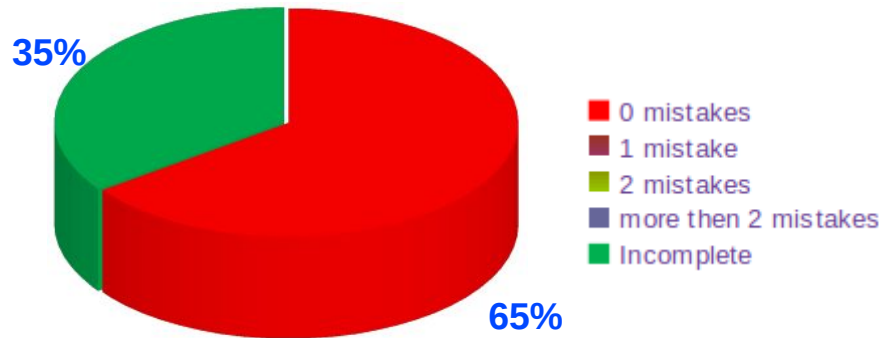
3 users in India and 5 users in Sri Lanka participated in the message dissemination exercises. Each user was presented with four varying scenarios in relation to escalating cases of diseases identified through TCWI and other sources.



Percentage of messages sent on-time (benchmark time-to-completion was 5 minutes)

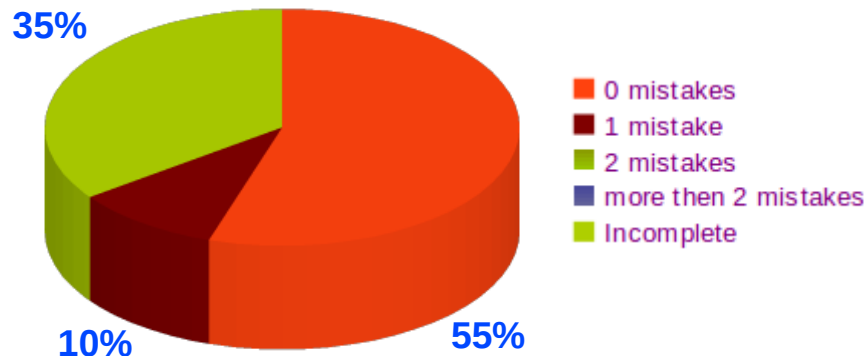
The security policy of the software, by default, is set to expire the session after 5 minutes to prevent unauthorized use, which forced the user to restart.

Accuracy of creating the messages with populating the common alerting protocol attributes of the software



Templates with pre-populated values and a clear structure helped the users with creating the messages

Correctly selecting the appropriate delivery channels targeting the intended recipients



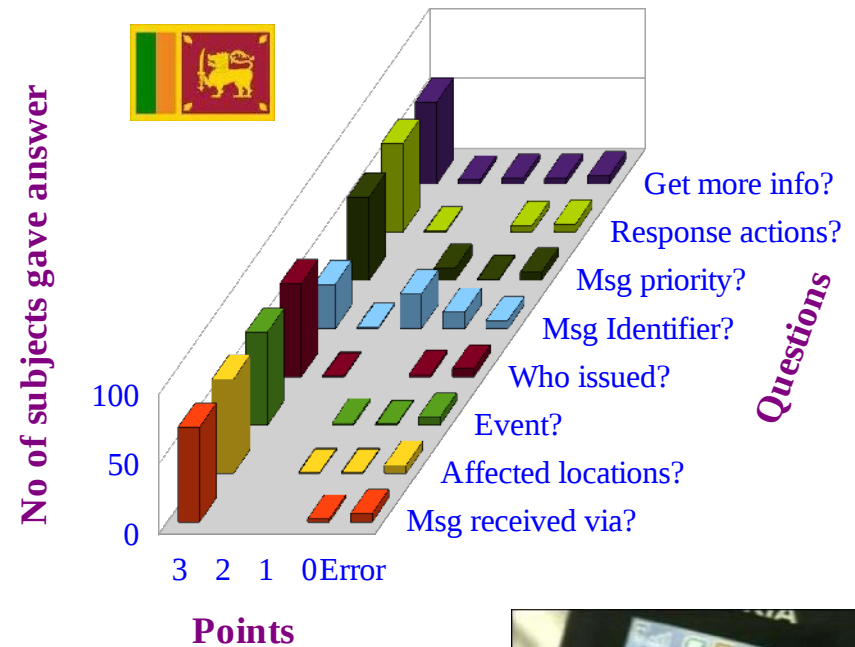
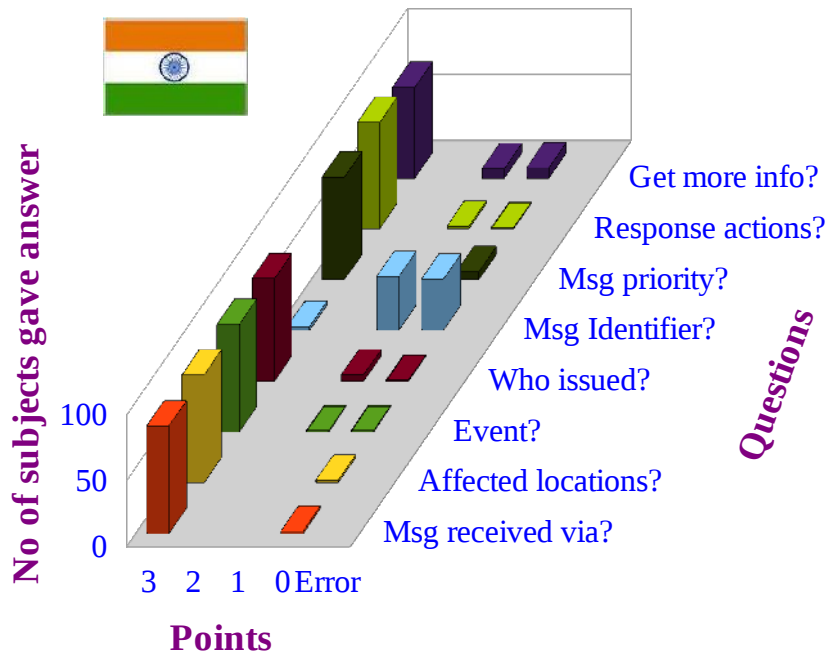
It was easier to comprehend issuing of alerts but not the the same with issuing situational awareness messages such as the weekly top 5 diseases reports.



INDIA Exercises were incomplete; no results to discuss



# CAP SMS Alert/Situ-aware comprehension exercises



## Assessment design

- Participants receive 4 SMS text with varying values of the CAP attributes
- India = 23 and Sri Lanka = 19 health workers participated in the exercise

## Outcomes

- Everyone did quite well in the exercises except for 1 or 2 exceptional cases
- Both India and Sri Lanka having trouble with msg-identifier; could be because msg-identifier getting truncated by the 160 char SMS constraint
- Recommendation :: put msg- identifier in subject header (but may cutoff rest due to 160 char SMS); use the term “reference number” instead or both

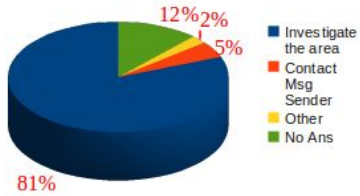


# Credibility, Persuasiveness, Validity

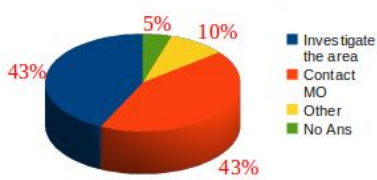


CAP Short-text message over SMS, 84 responses for 4 different messages

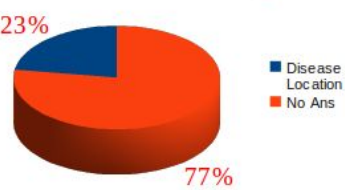
Message Authenticity?



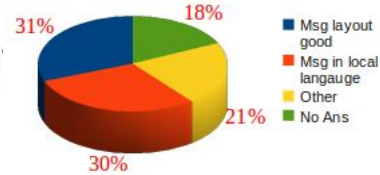
Verify Authenticity?



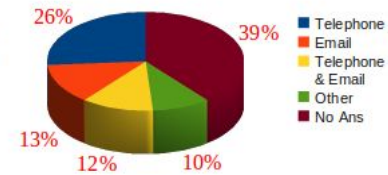
Summarize Message



Recommendations:

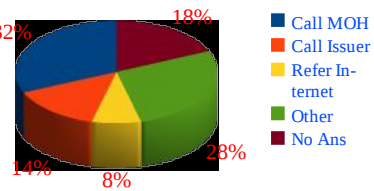


Other delivery:

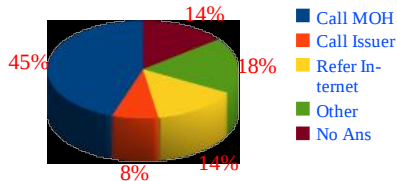


CAP Short-text message over SMS, 76 responses for 4 different messages

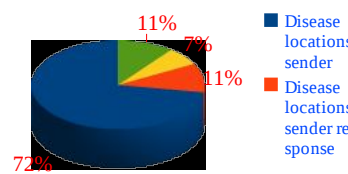
Message Authenticity



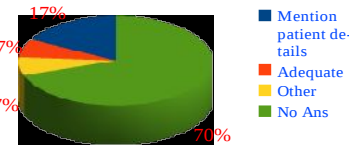
Verify Authenticity?



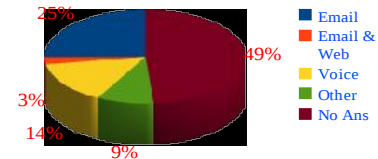
Summarize message:



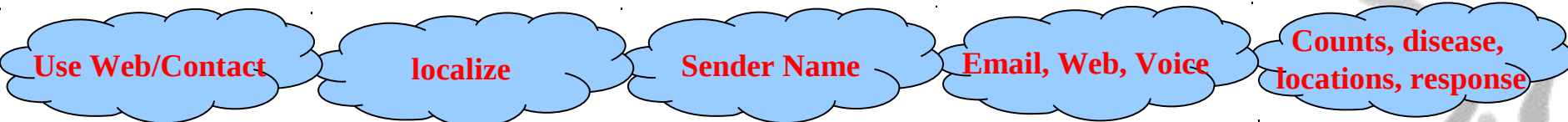
Recommendations:



Other Delivery



Expected response

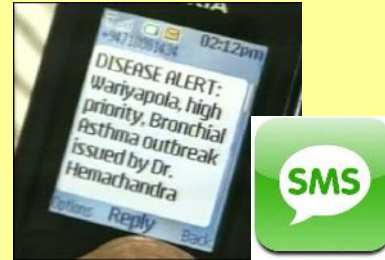


# Example of Cascade alerting with community

**Government  
Regional Epidemiology and  
Medical Officer of Health  
departments**

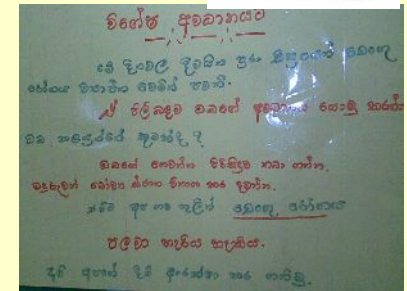
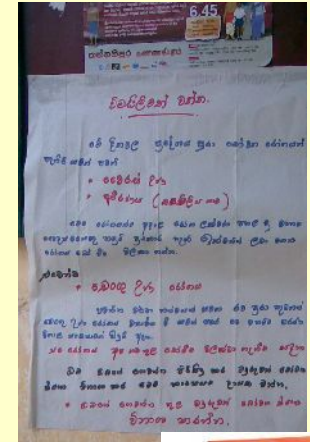
SAHANA  
Disaster Management System

**Government  
Regional Epidemiology and  
Medical Officer of Health  
departments**



MAIL

**Community  
Suwadana Health Centers**



**Single Input Multiple Output Mass Messaging;  
towards a publisher subscriber model**

## Sahana Alerting Broker: Some Feedback

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“Sahana messaging is a **quicker and easier method** for alerting multiple medical officer and public health inspectors at once, it is user friendly, and is capable of tracing the alerts to follow up.” - *Public Health Inspector, Kurunegala District, Sri Lanka, consulted (15.05.10).*

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“In addition to issuing outbreak alerts, Sahana Alerting is **being improvised to send notifiable disease investigation information** to Public Health Inspectors.” - *Public Health Inspector, Kurunegala District, Sri Lanka, consulted (15.05.10).*

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“Currently Medical Officer of Health departments already have a computer and Internet, also mobile phones are available with all Public Health Inspectors, Nurses, and Medical Officers, there is **no chance of misplacing the records** because it will be on the mobile; it is also very cost effective.” - *Public Health Inspector, Kurunegala District, Sri Lanka, consulted (15.05.10).*

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“Outbreaks such as Dengue Fever should be **disseminated to public and private general practitioners** in those areas because patients with fever like symptoms are not prescribed Non-steroidal Anti-inflammatory Drugs at the first visit and are subject to full blood counts on the 3rd day to confirm whether it is Dengue” - *Medical Officer (Kuliyapitiya), Kurunegala District, Sri Lanka, consulted (12.07.10).*

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“Sahana alerting is **similar to “way2sms” free portal** used for disseminating SMS but Sahana alerting **is a comprehensive tool** for issuing standardize warning, alerts, and situational awareness messages.” - *Data Entry Operator, Deputy Director of Health Services, Sivaganga, India, consulted (30.09.10).*

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## Conclusions

- ❑ Sahana Alerting Broker (SABRO) with Common Alerting Protocol as the underlying data standard has proven to be **adoptable for health risk information sharing**.
- ❑ SMS, Email, and Web messaging works well but **need to extend to Voice**
- ❑ Some technology issues with **unreliable GSM modems** but can be rectified easily
- ❑ Offer **localization** with Natural Language Translations
- ❑ Include Emergency Data Exchange Language Distribution Element (**EDXL-DE**) for the traceability of recipients and audit trails
- ❑ The organization Resource Manager (ORM) must be enhanced to strengthen the publisher subscriber model with individualized instances such a “**MySABRO**” approach
- ❑ **National Policies must be reformed** adopt these technologies and procedures
- ❑ Before the cost benefits can take affect the **laws and regulations must be changed** to move beyond the paper based systems, first

