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

Real-Time Biosurveillance Program to Revolutionize disease surveillance and notification
Disease Surveillance

**Indicator-based surveillance**
- Identified risks
  - Mandatory notification
  - Laboratory surveillance
- Emerging risks
  - Syndromic surveillance
  - Mortality monitoring
  - Healthcare activity monitoring
  - Prescription monitoring
- Non healthcare based
  - Veterinary surveillance
  - Behavioral surveillance
  - Environmental surveillance
  - Poison centers
  - Food safety/water supply

**Event-based surveillance**
- Domestic
  - Media
  - NGOs
  - Field Epi points
- International
  - Distribution lists
    - ProMed (English, Chinese, Spanish, Russian, etc.)
  - International agencies
    - WHO
    - OIE
    - CDC
    - NASA (e.g., remote sensing, weather, population migration, bird migration, population density, plant, animal)
  - Confidential/Limited mailing list dissemination
    - ProMed (e.g., MBDS)
    - International health regulation agencies
      - WHO, OIE, CDC, NASA
    - Threat bulletin (EWARN, ECDC)
  - Public dissemination
    - News, blogs, articles
    - Health ministry press releases sites
    - Weekly releases (Eurosurveillance)

**RTBP**
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

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

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
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

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>&lt;urgency&gt;</th>
<th>&lt;severity&gt;</th>
<th>&lt;certainty&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urgent</td>
<td>Immediate</td>
<td>Extreme</td>
<td>Observed</td>
</tr>
<tr>
<td>High</td>
<td>Expected</td>
<td>Severe</td>
<td>Observed</td>
</tr>
<tr>
<td>Medium</td>
<td>Expected</td>
<td>Moderate</td>
<td>Observed</td>
</tr>
<tr>
<td>Low</td>
<td>Expected</td>
<td>Unknown</td>
<td>Likely</td>
</tr>
</tbody>
</table>

Select value

Auto populate
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
CAP (XML) → uses XSL to transform → delivery method
Example of style sheet template for SMS

\(<\text{headline}>\) : \(<\text{status}>\)

\(<\text{msgType}>\) for \(<\text{areaDesc}>\) area with \(<\text{priority}>\) priority \(<\text{event}>\) issued by \(<\text{senderName}>\).

Msg: \(<\text{identifier}>\) sent on \(<\text{sent}>\)

Desc: \(<\text{description}>\)

More details

Web: \(<\text{web}>\)

Call: \(<\text{contact}>\)
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
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

Event Detection

IDSP

- Message Creator – IDSP staff member

- Message Issuer - DE

  - Action alert
  - Awareness message

  - Recipients: BMO, MO, HI, SHN, VHN
  - Other health officials at IDSP

PHC

- Message Creator – PHC staff member

- Message Issuer - MO

  - Awareness Message

  - Action Alert

  - Recipients: MO, SHN, HI, VHN

  - Other health officials at IDSP

Mode of delivery:
1 SMS
2 Short Email
3 Long Email
Downstream messaging structure – SRI LANKA

**Event Detection**

**RE**
- Message Creator: RE Staff member
- Message Issuer: RE
  - Action
    - Alert
  - Recipients: MOH, MOIC, PHI, Heads of health related institutions, Health related campaigns.

**MOH/SPHI**
- Message Creator: MOH Staff member
- Message Issuer: MOH
  - Awareness
    - Message
      - Mode of Delivery:
        1. SMS
        2. Short Email
        3. Long Email
  - Recipients: MOH, MOIC, PHI

- Action
  - Alert
  - Recipients: PHI, PHNS, PHM

**Mode of Delivery**

1. SMS
2. Short Email
3. Long Email
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.

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.

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

It was easier to comprehend issuing of alerts but not 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?**
  - Investigate the area: 12%
  - Investigate the area: 3%
  - No Answer: 81%

- **Verify Authenticity?**
  - No Answer: 43%
  - Other: 5%

- **Summarize Message**
  - Disease, location, sender: 23%
  - No Answer: 77%

- **Recommendations**
  - Other: 31%
  - Private in local language: 18%

- **Other delivery**
  - Telephone: 26%
  - Email & Web: 12%

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

- **Message Authenticity**
  - Call MOH: 32%
  - Call Issuer: 14%
  - Refer Internet: 14%

- **Verify Authenticity?**
  - Call MOH: 45%
  - Call Issuer: 18%

- **Summarize message**
  - Disease, locations, sender: 11%
  - Disease, locations, sender response: 11%

- **Recommendations**
  - Mention patient details: 17%
  - Adequate other: 7%

- **Other Delivery**
  - Email: 26%
  - Email & Web: 12%

Expected response

- Use Web/Contact: localize
  - Sender Name: Email, Web, Voice
  - Counts, disease, locations, response
Example of Cascade alerting with community

Single Input Multiple Output Mass Messaging; towards a publisher subscriber model
“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).

“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).

“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).

“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).

“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).
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.