Automated Mosquito Identification: Tools for Early Warning of Vector-borne Disease Outbreaks

Edward Anderson
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More than 300 million acute illnesses per year
2.7 million deaths per year
40% of the World’s population is at risk
Malaria transmission areas
Area with limited risk
No malaria

(WHO, 2001)
Malaria Epidemics

124.7 million people at risk from epidemic malaria

12.4 million cases/year

Results in 155,000 – 310,000 deaths / year

12-25% of annual worldwide malaria deaths

## Malaria Epidemics

<table>
<thead>
<tr>
<th>Location, Year</th>
<th>Population Exposed</th>
<th>Number of Cases</th>
<th>Deaths</th>
<th>Contributing Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madagascar Highlands, 1987-1988</td>
<td>2.5 Million</td>
<td>200,000 each year</td>
<td>15,000–30,000 /year</td>
<td>Abandonment of Indoor Residual Spraying Programme, Shortage of anti-malarials</td>
</tr>
<tr>
<td>Ethiopia Highlands, 1958</td>
<td>8-10 million</td>
<td>3 million</td>
<td>Over 150,000</td>
<td>High rainfall and Temperature</td>
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<tr>
<td>Ethiopia, Dec 1997- Feb 1998</td>
<td>45 million</td>
<td>Over 1 million</td>
<td>3271 reported</td>
<td>High Rainfall and Temperature</td>
</tr>
<tr>
<td>Burundi, Oct 2000 – May 2001</td>
<td>2 million in 6 months</td>
<td>15,000 *</td>
<td>Complex emergency, Chloroquine resistance, Expanded rice cultivation</td>
<td></td>
</tr>
</tbody>
</table>
1. Strengthened **surveillance / communication system**
2. Validation of diagnostic tools to confirm epidemics
3. Guidelines for epidemic investigation, prevention and control
4. Improving inter-sectoral collaboration
Early Warning Framework

- Surveillance
- Post-mortem Review & Report
- Early Warning Systems
- Forecasting
- Surveillance
- Control Investigation & Response
- EPIDEMIC

**Key Components**

1. **Forecasting**
   - Long range weather forecasting (~10 months)
   - Possible indicators: ENSO parameters

2. **Early Warning (2-6 months)**
   - Sea temperature
   - Possibility indicators: meteorological parameters

3. **Early Detection (2-4 weeks)**
   - Rainfall amount
   - Indicators: facility data

4. **Malaria Cases**
   - Recorded cases
   - Early detection

YEAR 1 - YEAR 4

**Early Warning Framework**

Designed by ATECmedia 2006
Early Warning Risk Maps

Accurate and timely Regional epidemic risk maps

Local reports and vulnerability maps

Courtesy: LSHTM / HIMAL
Forecasting & Early Warning

Surface Temperatures

Rainfall

Satellites beacons

District data Collection: Anomalous rainfall and temperature

Malaria epidemic risk: percent of malaria cases above the annual mean intantant malaria cases in Mahuru Hospital

Courtesy Dr A Githeko
Surveillance

Automatic Vector Monitoring:
Epidemic Indicators
Model Validation
Assessment of Control programme

Early detection and prevention by VECTOR MONITOR
Containment of epidemics confirmed by MORBIDITY INDICATORS

Cases

Time

Image Courtesy: IPM DC, Portland, Oregon (FAST ID Patent Pending)
Technologies

Signal Recoding and Processing

Classification

Levenberg-Marquardt Algorithm Testing
Application: Sentinel Huts

In Fauch Hut

In Lwanda Village

Field unit
Kisumu CDC/KEMRI/ICIPE Stakeholder Consultation

Team presentations & demonstration

More than 45 attendants Panel (WHO-KEMRI-ICIPE)
Data access and GIS

Novacom web portal
- Online consultation of data with historic and graphs
- Automatic Alerts via email or SMS

Station represented in red when threshold is reached

Number of mosquito recorded for the last day

Location of sentinel hut

Reference number of each sensor for one station
System components

ARGOS Data Transfer

GIS, Risk Modelling

Epidemic Prevention and Treatment

Field entomology

Meteorological station data, and Vector Monitoring

Remote Sites Sensors

Control Centre

Database

Malaria Information System

Epidemic Prevention and Treatment

Health Centre

Designed by ATECmedia 2006
System components

- Forecasting
  - Long term meteorological monitoring
  - GIS, Software, Risk Mapping
  - Epidemic Modelling, Risk Assessment
  - Vector behaviour, Field indicators
  - In-situ vector monitoring, Control Assessment

- Early Warning

- Surveillance

- Control Programme