Mobile Technology Applications for Verbal Autopsy

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Outline

- Verbal Autopsy Instrument
- Context
- Choice of Data Collection Interface
- Cost
- Effectiveness
VERBAL AUTOPSY INSTRUMENT
AIM: Standardization of Vital Statistics Data

International Statistical Classification of Diseases and Related Health Problems (ICD)

- Adopted and published by WHO
- Only cases seen by physician
- Ideal source for international comparison
- International standard classification:
  - Epidemiology
  - Health management purposes
# Cause of Death

## INTERNATIONAL FORM OF MEDICAL CERTIFICATE OF DEATH

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Approximate interval between onset and death</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Disease or condition directly leading to death *)</td>
<td>a) ............................................. due to (or as a consequence of)</td>
</tr>
<tr>
<td>Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last</td>
<td>b) ............................................. due to (or as a consequence of)</td>
</tr>
<tr>
<td></td>
<td>c) ............................................. due to (or as a consequence of)</td>
</tr>
<tr>
<td></td>
<td>d) .............................................</td>
</tr>
<tr>
<td>II. Other significant conditions contributing to the death, but not related to the disease or conditions causing it</td>
<td></td>
</tr>
</tbody>
</table>

*This does not mean the mode of dying, e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.*
Verbal Autopsy

- Used in areas lacking:
  - Civil registration system
  - Medical certification of cause of death

- Goal: *to obtain probable cause of death*

- Users:
  - Researchers
  - Policy-makers
  - Monitoring & evaluation
  - Civil registration & vital statistics systems
Verbal Autopsy (cont’d)

- **Method:**
  - Interview with family member or caregiver of deceased

- **To obtain details on:**
  - Signs
  - Symptoms
  - Complaints
  - Medical history
  - Events in period before death
Standard Verbal Autopsy Questionnaires

- Developed to:
  - Permit certification and ICD coding
  - Ascertain certain causes of death

- Expert review for consensus on standard questions

- 3 Questionnaires
  1. Death of a child aged under 4 weeks
  2. Death of a child aged 4 weeks to 14 years
  3. Death of a person aged 15 years and above
Common Elements in Verbal Autopsy Questionnaires

- General information (first page)
  - Key identifying info
  - Form management data fields
  - Respondent info
  - Sociodemographic info of deceased
  - Death info
- Hx of medical conditions, injury or accident
- Treatment & health service used
- Generalized signs & symptoms during final illness
- Abstracted data from household records
Age- & Sex- Specific Sections:

- Distinguish among age-related:
  - Conditions
  - Causes of death

- Specific signs & symptoms during final illness

- Age-specific modules
A shortened questionnaire...

- Currently in development by WHO

- Aim: max 120 questions
  - Yes/No
  - Digits (time intervals)

- 2G / SMS text compatible
Analysis of Verbal Autopsy Findings

- Physician-certified verbal autopsy (PCVA)
- Various automated statistical approaches
- New methods continually developed
Limitations of Verbal Autopsy

- Cannot ascertain all causes of death
- Does not perform equally well for all causes
- May be subject to recall bias
- Local adaptation may:
  - Affect standardization
  - Bias results
CONTEXT
Our Context

- Civil Registration & Vital Statistics System
  - Permanent system > need storage
  - Legal system: confidential but *not* de-identified

- International, low-resource settings
  - CHW mobile phone ownership: ~95%

- Narrative: “Can you tell me about the illness/events that led to his/her death?”
Homa Bay County, Kenya

- 6 districts
- ~2,500 Community Health Workers (volunteers)
- ~175 Community Health Extension Workers (CHEW, paid)

Population:
- ~1.07 million
- ~221,000 households

~555 deaths / month:
~3-6 VAs / month for each CHEW
Why mobile data collection is now a reality:

afroRise.
## Other Mobile VA Projects

<table>
<thead>
<tr>
<th>Group</th>
<th>Sites</th>
<th>Device</th>
<th>Configuration</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millennium Villages Project (MVP)</td>
<td>14 sites in sub-Saharan Africa</td>
<td>Android phone</td>
<td>ODK / cloud server</td>
<td>Deployed in all sites – September 2011</td>
</tr>
<tr>
<td>Int’l Health Metrics Evaluation (IHME)</td>
<td>10 sites: India, China, Zambia, Vietnam, Tanzania, Philippines</td>
<td>Site-specific; Galaxy Tab</td>
<td>ODK / server: site-specific</td>
<td>Currently deploying</td>
</tr>
</tbody>
</table>
Millennium Villages Project

Opening a new form
Millennium Villages Project

Conducting a verbal autopsy......closed-ended questions
Millennium Villages Project

Skip logic questions

Did s/he receive any treatment for the illness that led to death?
- Yes
- No
- Don't know

Please tell me at which of the following places/facilities s/he received treatment during the illness that led to death:
- From Community Health Worker (CHW) at home
- From friend at home
- From relative at home
- Traditional Healer
- Health clinic or post

Why did (NAME) not receive treatment for this illness/condition?
- Personal/religious objection
- No MONEY for TRANSPORT
- No MEANS for TRANSPORT
- No PHONE to call for transport
Millennium Villages Project

Saving a completed VA and uploading VA data
Choice of Data Collection Interface

Operation * Effectiveness * Cost

CHOICE OF DATA COLLECTION INTERFACE
Death at HH

CHW sends SMS to CHEW via district server

CHEW to HH for VA interview w/ mobile device

CHW = Community Helath Worker (volunteer)
CHEW = Community Health Extension Worker (paid, supervisor)
Operation: Hardware / Device

- 2G phone (CHW’s)
- 3G/4G Smartphone
- Tablet PC
## Operation: Software – Open Source Platform

<table>
<thead>
<tr>
<th>Platform</th>
<th>Device</th>
<th>Configuration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Data Kit (ODK)</td>
<td>Android</td>
<td>Web-based system</td>
<td>Admin support in Swahili, French, English</td>
</tr>
<tr>
<td>JavaRosa</td>
<td>Java-enabled</td>
<td>ODK Build / openX data / XForms</td>
<td>Useable on low-resource devices</td>
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Operation: Features / Customization
(options vary by device)

- Multiple languages
- GPS
- Camera
- Voice recording for narrative:
  - Network coverage / cost of service
  - Quality: clarity / conciseness / background noise
  - Privacy
  - Linking to data file / device storage space
- Monitoring capabilities
- Durability & minimal glare (for outside use)
Operation: Data Transmission

- **Must be encrypted**

- **Depends on platform, but most likely:**
  - GPRS
  - Wi-Fi
  - Computer connection

- **Frequency**
  - Need to store data until connection available OR
  - Data collectors return to central point (with server)
Operation: Analysis, Back Up & Storage

- **Analysis:**
  - Local level: feedback for health planning
  - National level: national summaries

- **Back-up:**
  - Paper forms
  - Remote location (additional servers, external storage)

- **Storage:** need *encryption*
  - Local server at district level (6 in county; 140 in Kenya)
  - SQL server at national level
  - Cloud server?
Operation: Security

www.safermobile.org
## Encryption Features of Various Tools

<table>
<thead>
<tr>
<th>Platform</th>
<th>Encrypted Data Transmission</th>
<th>Verified Receiver</th>
<th>Encrypted Storage on Phone</th>
<th>Server Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontline SMS Forms</td>
<td>SMS sent in condensed form, not encrypt.</td>
<td>Yes, by phone #</td>
<td>No</td>
<td>No explicit security features; database in particular is not secured.</td>
</tr>
<tr>
<td>RapidSMS</td>
<td>No</td>
<td>Yes, by phone #</td>
<td>No</td>
<td>Database server can be secured.</td>
</tr>
<tr>
<td>JavaRosa</td>
<td>Yes (https)</td>
<td>Yes (https)</td>
<td>No</td>
<td>Depends on server; generally DB server can be secured.</td>
</tr>
<tr>
<td>OpenXData</td>
<td>Yes (https)</td>
<td>Yes (https)</td>
<td>No</td>
<td>Yes (although you need to set it up); access permissions on server also available.</td>
</tr>
<tr>
<td>Open Data Kit (ODK)</td>
<td>Yes (https)</td>
<td>Yes (https)</td>
<td>No (yes in future release)</td>
<td>Hosted solution; various server options if you can host and secure your own server.</td>
</tr>
</tbody>
</table>
Operation: Other Considerations

- **Power source / battery life**
  - Solar
  - Extra battery supply if removable battery
  - Recharge at central location

- **User**
  - User preference / previous experiences
  - Education level
  - Paid employee

- **Training:** *ESSENTIAL!*
## Cost

<table>
<thead>
<tr>
<th>Device &amp; Functional Requirements</th>
<th>Fixed One Time Costs</th>
<th>Ongoing/Variable Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment:</strong></td>
<td><strong>Device</strong></td>
<td><strong>Replacement</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Server</strong></td>
<td><strong>Maintenance</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Connectivity</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Software (open source)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Useage</strong></td>
<td><strong>-</strong></td>
<td><strong>GPRS &lt; SMS over long run</strong></td>
</tr>
<tr>
<td><strong>Personnel</strong></td>
<td><strong>Software configuration</strong></td>
<td><strong>Data management</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Technical support</strong></td>
<td><strong>Technical support</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Training</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TRAINING</strong></td>
<td><strong>Thorough up front</strong></td>
<td><strong>Ongoing training</strong></td>
</tr>
</tbody>
</table>
Effectiveness

- Monitoring / audit trail
  - Flags for completeness
  - GPS – interviewer location
  - Time stamping

- Accuracy of data entry
  - Logic / range checks

- Speed of data entry (depends on device)
  - Collection & entry combined
  - Skip patterns / data flow

- Operational risk: accidental deleting
Summary of Advantages of Mobile Data Collection

- Potentially improves timeliness of data production
- Enhanced data quality
- Monitoring interviewer
- Additional features (e.g. GPS, camera, voice recording)
Thank you!

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
Comparison of Mobile Data Collection Tools

- ODK
  - Requires Android phones

- JavaRosa
  - Java enabled phones

- Open X Data

Similarities (licensing- open source, language, data type, network, cost (free software), tools for configuration, software completely customizable, support)

Differences (device/cost, data storage, connectivity not required for data collection, operating systems)