Improved Monitoring of IRS coverage on Bioko Island through the use of GIS-Based Campaign Information Management System (CIMS)

Wonder Philip Phiri
Medical Care Development International
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• Bioko Island Malaria Control Project (BIMCP)
• BIMCP Indoor Residual Spraying (IRS)
• GIS-based Campaign Information Management System (CIMS)
Bioko Island, Equatorial Guinea

- Small volcanic Island about 2,000km²
- Main Island of Equatorial Guinea with a population of ~250,000
- Highly endemic, year round malaria transmission setting; primary health burden prior to control
BIMCP Integrated Malaria Control

- Island-wide IRS from 2004 -2014
  - 2015 focalized IRS

- LLIN distribution
  - Island-wide mass distributions in 2008, 2015, planned in 2018
  - Routine keep-up through antenatal clinics since 2009 + starting in 2016 through all primary schools

- Intermittent Preventive Therapy in Pregnancy through Government ANC

- Case management for uncomplicated malaria
  - Training of government health providers in diagnosis and treatment
  - Supply of RDTs, reagents for microscopy, and ACTs

- Monitoring and Evaluation
  - Robust vector monitoring system
  - Annual Malaria Indicator Surveys ($n_{2015} = 23408$ individuals, 5236 hh)
  - National Health Information System in Government health facilities
  - GIS based Campaign Information Management System (CIMS) since 2014
Impact of BIMCP control

• Malaria prevalence in 2-14 year old children declined from 45% pre intervention to 15% in 2015 (Source BIMCP)

• Moderate to severe anemia fell from 15% pre intervention to 2% in 2011 (Bradley et al., 2012)

• All cause under Five mortality declined from 152/1000 births to 55/1000 in the first four years post intervention. (Kleinschmidt et al., 2009)
Challenges in calculating IRS coverage

IRS coverage per Round

<table>
<thead>
<tr>
<th>Round</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 14</td>
<td>87%</td>
<td>51%</td>
<td>84%</td>
</tr>
<tr>
<td>R 16</td>
<td>81%</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>R 18</td>
<td></td>
<td>47%</td>
<td></td>
</tr>
</tbody>
</table>

SP1 MIS (Last 6 months)
GIS based CIMS

- System is linked to listing of geo-referenced households on Bioko Island
  - Every household on the Island ascribed a unique building identifier or UNIQUEBID for building(s) they reside in
    Ex: M335S42E128P1
  - Use Government’s political boundaries (Region, Province, District, Communities) as basis for geographical location hierarchy
Creating the UNIQUEBID - Map Areas

1 km² MAP AREAS are uniquely and sequentially numbered

M335S42E12P1
Defining UNIQUEBID - Sectors

MAP AREAS subdivided into 10,000m² SECTORS which are also sequentially numbered within each MAP AREA

M335 S42 E12 P1
Defining UNIQUEBID

<table>
<thead>
<tr>
<th>MAP AREA</th>
<th>SECTOR</th>
<th>BUILDING (Edificio)</th>
<th>FLOOR/LEVEL (Piso)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M335</td>
<td>S49</td>
<td>E128</td>
<td>P1</td>
</tr>
</tbody>
</table>
GIS based CIMS – District Level
GIS based CIMS – Sub District Level
GIS based CIMS – Community Level
GIS based CIMS – Household Level
Spray teams receive household listings for each locality based on the CIMS database.
Spray teams receive household listings for each community based on the CIMS database. Sprayers identify households on the list using maps on the tablet and the UNIQUEBID.
In the field, sprayers record data about each house sprayed on an SP1 card. Info includes:

- UNIQUEBID
- # and type of houses sprayed/unsprayed
- Individuals protected
- Initial response of household from IEC Advance team

Supervisors also receive lists of households that their teams are working. They can quickly track their team and conduct supervision. Results of supervisory visits are recorded based on the UNIQUEBID.
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Supervisors also receive lists of households that their teams are working. They can quickly track their team and conduct supervision. Results of supervisory visits are recorded based on the UNIQUEBID (SuperOjo).

Field supervisors input SP1 data into tablets daily using CIMS household lookup.

During this process, they can add new households, or note that a house has been destroyed or is currently uninhabited.
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Field supervisors input SP1 data into 15 tablets daily using CIMS household lookup. During this process, they can add new households, or note that a house was destroyed or is currently uninhabited.

Data is synchronized to a central cloud server, where it can be accessed by multiple users.
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Data is synchronized to a central cloud server, where it can be accessed by multiple partners.

Data are available at the end of the work day, allowing for:

- Report creation (spray coverage over-all and by area; sprayer productivity; % population protected, etc.)
- Updated lists of households not sprayed for follow-up by spray teams
- Lists or reported sprayed houses to conduct IQK verification. Monitoring team can accurately identify sprayed households
- Monitoring team can accurately identify sprayed households

Updated lists of households not sprayed for follow-up by spray teams
Coverage determination after the use of GIS based CIMS

Housing count by IRS team

- Total House Count
- Houses Sprayed

GIS based target house count
GIS based sprayed house count

<table>
<thead>
<tr>
<th>Year</th>
<th>Total House Count</th>
<th>Houses Sprayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>48,248</td>
<td>38,606</td>
</tr>
<tr>
<td>2011</td>
<td>51,056</td>
<td>46,188</td>
</tr>
<tr>
<td>2011</td>
<td>49,304</td>
<td>39,972</td>
</tr>
<tr>
<td>2012</td>
<td>53,612</td>
<td>37,628</td>
</tr>
<tr>
<td>2012</td>
<td>55,053</td>
<td>39,992</td>
</tr>
<tr>
<td>2013</td>
<td>46,278</td>
<td>42,312</td>
</tr>
<tr>
<td>2014</td>
<td>67,841</td>
<td>38,548</td>
</tr>
</tbody>
</table>
BIMCP IRS Program

Spray Coverage per Spray Round

<table>
<thead>
<tr>
<th>Year</th>
<th>Round</th>
<th>Coverage 1</th>
<th>Coverage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>R13</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>R14</td>
<td>87%</td>
<td>51%</td>
</tr>
<tr>
<td>2012</td>
<td>R15</td>
<td>74%</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>R16</td>
<td>81%</td>
<td>60%</td>
</tr>
<tr>
<td>2014</td>
<td>R17</td>
<td>79%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R18</td>
<td>84%</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>R19</td>
<td></td>
<td>57%40%</td>
</tr>
</tbody>
</table>

- **SP1**
- **MIS (last 6 months)**
## IRS v. MIS comparison

<table>
<thead>
<tr>
<th>SP1 reported coverage Rd. 19</th>
<th>MIS 6-month recall self-reported spray data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprayed</td>
<td>2720</td>
</tr>
<tr>
<td>Not Sprayed</td>
<td>479</td>
</tr>
<tr>
<td>Not Sprayed</td>
<td>206</td>
</tr>
<tr>
<td>Sprayed</td>
<td>1112</td>
</tr>
</tbody>
</table>

- **Sensitivity**: 85.0%
- ** Specificity**: 84.4%
- **Accuracy**: 84.8%
Benefits of GIS-based CIMS for IRS

- Improved planning and management
  - Accurate house count and ability to add or delete houses in real time (subject to mapping team verification) improved basis for planning and budgeting
  - Detailed maps (most based on satellite imagery) improved efficiency of resource deployment in space and time.
  - Ability to easily and readily locate and verify houses reportedly sprayed eliminated substantial falsification of data by spray teams.
  - Targeted mop-up rendered substantially more efficient (IEC Agents, community representatives and sprayers able to readily locate specific non-compliant houses).

- Improved data management and monitoring and evaluation
  - Same day data processing. Next day data cleaning.
  - Secure central storage allowing both IRS managers and M&E team to access data
  - Remote same or next day progress monitoring by managers.
  - Rapid continuous updating of IRS performance indicators.
  - Real time quality assurance

- IRS service data integrated with other control intervention data down to individual household level.
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- Liverpool School of Tropical Medicine