Larval Source Management in Africa: A lost opportunity to strengthen the evidence base on cost effective malaria control

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Background

• Sub-Saharan Africa still bears the 90% of malaria cases and deaths

• Larval Source Management (LSM) is a WHO-recommended primary vector control tool for dengue, chikungunya, yellow fever and Zika; it is considered a supplementary measure for malaria

• LSM costs around the same per person protected as long lasting insecticide treated nets (LLIN) or Indoor Residual Spraying (IRS) and can be as cost-effective

• Malaria transmission can persist even where high coverage with LLINs and IRS has been attained
Challenges with LSM

• Controlling larval-stage mosquitoes is arguably more challenging than controlling adult mosquitoes

• LSM is a range of options and assessing which approach to use and implement is complicated and can lead to mistakes

• Some interventions may need to be reviewed and re-applied frequently

...many countries include LSM as part of their strategy to tackle malaria
Number of African countries included in the World Malaria Reports (2012-2017) compared to the number who have LSM as a policy/strategy

- **2012**: LSM: 9, Total: 45
- **2013**: LSM: 20, Total: 45
- **2014**: LSM: 21, Total: 45
- **2015**: LSM: 24, Total: 44
- **2016**: LSM: 22, Total: 45
- **2017**: LSM: 19, Total: 44
Why do a policy analysis?

• Complex epidemiological, socio-economic, political environment and wide range of stakeholders risk that implementation of a potentially effective solutions such as LSM could be hampered

The aims of the study were to:

1. Document the policy and implementation status of LSM in malaria endemic African countries and understand the drivers and challenges influencing this

2. Identify the impact and cost-effectiveness of this intervention when implemented by National Malaria Control Programmes (NMCP), in comparison with Indoor Residual Spraying (IRS).
Country inclusion criteria

- African countries which reported LSM as a policy/strategy and provided an adoption date (2016 WMR)
- Anglophone countries (policy likely to be in English)
- Standardized the context by selecting countries where malaria endemic

Six countries met the inclusion criteria: Eritrea, Ghana, Nigeria, South Sudan, Uganda and Zanzibar
Identifying polices and supplementary literature

Reviewed the policy context set by the world health organization

Searched the Ministry of Health website for each country to find the current National Malaria Strategy and related documents or requested them via in-country contacts

Supplemented policy documents with a literature review by country, larv* and malaria

Searched the Global Fund website for most recent concept note and grant allocations

- 15 documents
- 34 documents
- 385 papers identified through database searching
- 40 papers included in the policy review
- 12 documents

Papers by country:
- Papers by country: Eritrea: 8, Ghana: 8, Nigeria: 6, South Sudan: 4, Uganda: 7, Zanzibar: 3
Theoretical framework

<table>
<thead>
<tr>
<th>Concept</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actors</td>
<td>Who makes and influences the decisions and who is involved in the implementation</td>
</tr>
<tr>
<td>Context</td>
<td>The situational factors that influence policy (Global policy agenda and national policy agenda)</td>
</tr>
<tr>
<td>Content</td>
<td>A description of the policy and its reach (Country level)</td>
</tr>
<tr>
<td>Process</td>
<td>How is the policy is developed and implemented and challenges faced (Country level)</td>
</tr>
</tbody>
</table>

Analytical Approach: Framework Analysis

1. Familiarise yourself with the data
2. Generate themes and subthemes
3. Use thematic framework to label and categorise the data
4. Develop and refine the categories
5. Identify patterns, associations, clusters, explanations
Main actors acknowledged in the strategic plan

- **Policy makers:** World Health Organization (6 countries), Ministry of Health
- **Funders:** Global Fund (4 countries), USAID, DfID, UNICEF, and the World Bank
- **Implementers:** Malaria Control Programme (4 countries), Malaria Elimination Programme (2 countries)
  - Other departments: finance and planning and environment, maternal and child health and information and research
  - Community involvement (all six countries)
- **Private sector:** involved in promoting vector control (3 countries), however barriers were noted such as lack of partnership and transparency
Results: Global policy drivers

- Malaria elimination
- Insecticide resistance management
- Residual transmission
- Integrated vector management:

WHO: control multiple vector-borne diseases using multiple interventions and collaboration between a wide range of stakeholders

- Two countries had an accessible IVM strategy (Eritrea and Ghana)
- Eritrea included other vector borne diseases in its IVM strategy
Results: Country policy drivers

- Concerns about insecticide resistance posing a limitation to LLIN and IRS were common to all six countries
- Residual transmission was a driver in five of six countries
- In three countries (Eritrea, Nigeria and Zanzibar) LLINs and or IRS were thought to have contributed to a change in vector behaviour
- Three countries sited man made environments had contributed to the increase in malaria therefore environmental management also the solution
- Other: risk of outbreaks, history of success, nuisance biting
Results: Timing, targets and phase

**Timing:** Both Eritrea and Ghana adopted LSM around the same time as introducing ITNs/LLINs; in 1995 and 1999 respectively. Four countries introduced LSM during or after 2010.

**Targeting:** County wide (Eritrea), selected regions, urban settings (cities), areas where there are high levels of breeding, residual breeding, or in the dry season when less breeding sites.

**Phase:** Eritrea is in implementation, South Sudan is in the planning phase, in Nigeria, Uganda and Zanzibar LSM is still being piloted (Uganda still awaiting results to inform further planning), in Ghana activities have been suspended: unable to validate the evidence from provider and lack of funds.
## Results: Type of LSM

<table>
<thead>
<tr>
<th>Country</th>
<th>Eritrea</th>
<th>Ghana</th>
<th>Nigeria</th>
<th>South Sudan</th>
<th>Uganda</th>
<th>Zanzibar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larvicide</td>
<td>Temephos, and Bacillus thuringiensis (Bt) or Bacillus thuringiensis israelensis (Bti)</td>
<td>Not specified (oils and fungicides)</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Temephos, and Bacillus thuringiensis (Bt) or Bacillus thuringiensis israelensis (Bti)</td>
<td>Not specified (insect growth regulator)</td>
</tr>
<tr>
<td>Environmental management</td>
<td>filling, levelling and draining</td>
<td>filling up of borrow pits, ditches, irrigation ponds and canals</td>
<td>closing up community land ponds and borrow pits</td>
<td>Drain or cover containers, potholes and footprints</td>
<td>improving of drainage, reduction or alteration of sites</td>
<td>household surroundings clean and free from stagnant water</td>
</tr>
<tr>
<td>Other</td>
<td>Environmental health officers (law)</td>
<td>household level</td>
<td>household level</td>
<td>household level</td>
<td>household level</td>
<td></td>
</tr>
<tr>
<td>Country</td>
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</tr>
<tr>
<td>LSM (IRS) is in the national strategy</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
</tr>
<tr>
<td>LSM (IRS) in Global Fund application</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes (Yes)</td>
<td>Yes [once] (Yes)</td>
<td>Yes (Yes)</td>
</tr>
<tr>
<td>Total funding for LSM (IRS), strategic plan</td>
<td></td>
<td>$415,136,206 ($480,199,306)</td>
<td>$1,003,800 ($15,525,572)</td>
<td>$2,460,000 ($96,690,000)</td>
<td></td>
<td>$1,268,097 ($667,032)</td>
</tr>
<tr>
<td>Total requested from Global Fund for LSM (IRS)</td>
<td>$3,125,765 ($4,012,939)</td>
<td>0 ($15,527,355 - $15,527,355)</td>
<td>0 ($7,123,932 to $545,691,409)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>$145,860 ($219,886 - $1,517,078)</td>
</tr>
<tr>
<td>Total received from GF for LSM (IRS)</td>
<td>[yes ?]</td>
<td>($23,060,609)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>[No ?]</td>
</tr>
<tr>
<td>Indicators for LSM (IRS) in Strategic Plan</td>
<td>Larvicides, environmental management (Yes)</td>
<td>- (Yes)</td>
<td>Larvicides (Yes)</td>
<td>Larvicides, environmental management (Yes)</td>
<td>Larvicides (Yes)</td>
<td>Larvicides (Yes)</td>
</tr>
<tr>
<td>IRS monitored by Global Fund</td>
<td>- (Yes)</td>
<td>- (Yes)</td>
<td>-</td>
<td>-</td>
<td>- (Yes)</td>
<td>- (Yes)</td>
</tr>
</tbody>
</table>
Discussion: Financing issues

- There are indications international funders have been resistant to funding LSM. For example, in 2016, PMI supported all aspects of the Zanzibar strategic plan, except for environmental management and larviciding, our research could not identify a reason for this.

- Difficulties securing funding was a reason given for not being able to progress from piloting to implementation.

- Yet it is possible to secure funding for LSM; Eritrea appeared to secure funding from GF and the PMI request for applications now includes LSM.

- Eritrea are a good example to learn from as their funding request articulated a rationale in line with WHO policy by including IVM and ‘few fixed and findable’ whilst also clearly outlining costs and deliverables.

GF: Global Fund, PMI: Presidents Malaria Initiative
Results: Monitoring and evaluation

- Monitoring in strategic plan:
  - All countries include indicators for IRS
  - Five countries have an indicator to measure the proportion of sites treated with larvicides
  - Only Eritrea and South Sudan include an indicator environmental management

- Global Fund grant performance reports:
  - There are indicators for LLINs and medicines for the 6 countries,
  - IRS indicators only found for four countries (Eritrea, Ghana, Uganda and Zanzibar)
  - No indicators were found for LSM

- Data was available from three countries on the effectiveness of LSM. However, in each instance, the data was from several years ago, and appears to be of poor quality
Results: Barriers to implementation

• Barriers to implementation did not appear to be documented in Eritrea’s strategic plan.

• The main barriers identified by the other five countries were:
  • Dependence on external agencies /financial considerations (5 countries)
  • Lack of evidence (4 countries)
  • Problems with coordination (3 countries)
  • Feasibility (2 countries)

• However, where LSM has been suspended it seems that lack of funding and evidence are the two insurmountable barriers.
Discussion: the need for other interventions

- There is still residual transmission even with high coverage with LLINs, IRS and chemoprophylaxis
- Insecticide resistance is a concern for all 6 countries
- LSM is part of Intergraded Vector Management
- There are indications environmental measures should be given increasing prominence
  - Man made causes should have man made solutions
  - 40% is the estimated proportion of malaria which could be eliminated through environmental management
  - Its sustainable and can reduce the negative impacts of chemical use, including larvicides
  - Some aspects of environmental management may have health benefits beyond vector borne diseases
  - There may be a community cohesion benefit of LSM above the other measures
Discussion: Lack of joined up policy making

• With the exception of Eritrea, when IVM is mentioned in applications to donors and in national policy, it is in the context of malaria

• IVM is not mentioned in the World Malaria Reports

• Currently, international funders for vector control tend to fund disease specific interventions

• LSM is not always feasible, such as many or unpredictability of breeding sites, however IRS and LLINs weren’t always feasible either and challenges remain with these interventions

• If the private sector are involved, ensure they are working in partnership with the government and that impact can be validated
Discussion: Catch 22 of evidencing effectiveness

• Monitoring of LSM is complex because it is a package of interventions, the ‘package may vary’ and change depending on the vector and environmental conditions.

• Monitoring and evaluation of LSM is poor both at country level and donor, particularly for environmental management.

• Even if countries secure funding for LSM there is no current system of accounting for spend on LSM. Thus, performance measures for LSM need to be identified and agreed urgently.
Limitations:

• There were difficulties obtaining the most up to date national polices; there were eight years difference between the oldest and most recent policy documents

• We were not able to look at trends data as focused on the most recent Global Fund Concept Notes

• Although we used a framework for the policy analysis we did not find a detailed example in the literature, therefore others using the same framework may have focused on different findings and or categorised things differently

• It is possible things were missed or misreported due to the length of some of the documents

• It is possible the errors occurred when copying text across to the framework and during the process of synthesisation

• It was difficult to ascertain information on ‘actors’ from a desktop analysis
Conclusions:

• Additional malaria control tools are required to maintain control and achieve elimination

• A substantial number of African countries are adopting LSM, however where implementation has taken place, it has tended to be in poorly monitored and evaluated

• Integrated Vector Management is not cross-referenced in World Malaria Reports and is not funded by GF or other large funders

• Environmental management should be given greater prominence as it is sustainable and can be highly effective

• The lack of international support is out of step with country policy, it represents a missed opportunity for generating additional much needed evidence to support challenging resource allocation decisions in the control of malaria and other vector borne diseases
Questions and contact details

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