Global Insecticide Resistance and Vector Control trends and their implications for new tools, with a focus on impact and resistance monitoring

Sylvester Coleman – VCWG Kigali Rwanda, 15 April 2024
Widespread and increasing reports of insecticide resistance

- **Increasing Pyrethroid Resistance Intensity**

<table>
<thead>
<tr>
<th>Year</th>
<th>Moderate/High intensity</th>
<th>Low intensity</th>
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</thead>
<tbody>
<tr>
<td>2021</td>
<td>64%</td>
<td>(44)</td>
</tr>
<tr>
<td>2020</td>
<td>88%</td>
<td>(181)</td>
</tr>
<tr>
<td>2019</td>
<td>92%</td>
<td>(240)</td>
</tr>
<tr>
<td>2018</td>
<td>77%</td>
<td>(248)</td>
</tr>
<tr>
<td>2017</td>
<td>77%</td>
<td>(234)</td>
</tr>
<tr>
<td>2016</td>
<td>77%</td>
<td>(86)</td>
</tr>
<tr>
<td>2015</td>
<td>58%</td>
<td>(26)</td>
</tr>
<tr>
<td>2014</td>
<td>56%</td>
<td>(18)</td>
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</tbody>
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Data source: WHO Malaria Threats Map. Updated August 2022

- **Chlorfenapyr: Variability in IR tests across sites**

- **Clothianidin: resistance reported in some sites**

**Key findings:** High mortality rates in chlorfenapyr-selected mosquitoes 10th Gen.

- Some indications of possible resistance in the field in some countries; need to confirm
Validated/Putative mechanisms facilitated by different factors
Operational Impact of IR and needs to address IR

What we know from literature

• **Reduced efficacy of intervention**
  - Space spraying (*Sudsom et al., 2015*)
  - Reduced Temephos/Larviciding for *Aedes* control (*Sivabalakrishnan et al., 2023*)
  - Household aerosolized insecticides products efficacy reduces (*Grey et al., 2018*)
  - Reduced efficacy of Standard ITNS (*Strode et al., 2014, Churcher et al 2016*)
  - Malaria resurgence in Uganda — possibly linked to IR to Clothianidin (*Epstein et al., 2023*)

• **Sublethal Effects and Alternatives**
  - Delayed mortality and reduced fecundity in resistant vectors may partially counteract resistance.
    (*Nwankwo, 2021; Grigoraki et. al., 2021; Mwagira-Maina et al., 2021*)

• **New Tools showing varying efficacy**

Feedback from key informant interviews

• **NMEPs (East West and Southern Africa)**
  - Capacity building, lack of granularity of data-linked to inadequate funding & challenges effective IRM
  - Community engagement to adapt traditional methods

• **Researchers/Academia**
  - Need to revisit standardized tests, Increased funding, Entomological surveillance should be seen as an intervention

• **Program Implementers & Funders**
  - Promote community adaptations in VC interventions; Need to develop predictive tools for IR

• **Product Manufacturers**
  - Challenges in R&D: narrow market profit margins, lengthy and costly approval processes
  - Donor fatigue: demonstrate impact of interventions
  - Propose shared insecticide deployment in both agricultural and public health sectors
Insecticide Treated Nets

- **Insecticide Resistance**: Limited chemical options for ITNs increase costs; high investment and time are required to market new products.

- **Durability and quality perception issues**
  - With some ITNs lasting less than two years, creating significant coverage gaps.
  - Durability more policy-related than technical.

- **Innovation Hurdles**: Economic risks deter first-in-class innovations; "me too" approvals are easier and less costly.


Indoor Residual Spraying

- **Need to demonstrate efficacy**: Need to document IRS' epidemiological and economic benefits to justify its use and investment.

- **Cost Challenges**: The shift to more expensive non-pyrethroid insecticides has led to a significant decrease in IRS coverage, from 5.5% in 2010 to just 2.4% in 2021.

- **Innovative Implementation**: Exploring district or community-based IRS strategies could offer cost-effective alternatives to large-scale

- **Private Sector Engagement**: The potential for IRS expansion, offers a promising avenue to expand coverage and effectiveness.
Attractive Targeted Sugar Baits

- **Intellectual Property and Development:** The pace of ATSB development is influenced by Intellectual Property challenges
  - There's significant potential for *Aedes* control in urban settings.

- **Technical and Market Challenges:** Refining attractants and toxicants is crucial, with the need for rigorous trials for approval, posing hurdles for rapid deployment.

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Larval Source Management (LSM) - Integrating into National Malaria Programs

- **Challenges in Scaling LSM:** LSM faces barriers including limited funding, fragmented implementation, and complex execution, hindering its integration into national malaria control strategies.

- **Technological Advances:** Recent innovations in larvicide application technology offer effective, wide-area coverage, addressing "few, fixed, findable" habitat limitations and expanding LSM's applicability.

- **Opportunities for Integration:** LSM's role in resistance management and urban malaria control is increasingly recognized, necessitating its inclusion as a core intervention in vector control programs.
Expanding vector control for Humanitarian Emergencies: Selected tools with high potential

- Larval control
- ATSBs
- Targeted IRS

Improved targeting and delivery

- Passive emanators
- Treated textiles

Source: IVCC/UCSF
Acknowledgements