Module 2. NTD Strategies

Session 5. Vector Control
Overview

1. Definition of vectors, epidemiology and categories
2. Main vector control strategies used for the PC-NTDs
3. Strengths and weaknesses of each strategy
4. Effective and complementary to the PC
5. Collaboration with the water and sanitation sector
6. Co-endemicity of malaria and LF and the potential for integrated vector control interventions and entomological surveillance
WHAT IS A VECTOR?
In epidemiology, a vector is an insect or any living carrier that transmits an infectious agent.
Definitions of “Vectors”

- **Biologic vector**: transmits a pathogen from one host to another and is required as part of the pathogen's development and transmission.

- **Mechanical vector**: vehicle for transporting pathogens mechanically from one infected organism to another, but is not required for disease life cycle.

- **Intermediate hosts (carriers)**: required for development or multiplication of pathogen. Infection can potentially occur by ingestion of intermediate host.
## Vectors of NTDs Targeted by PC

<table>
<thead>
<tr>
<th>NTD</th>
<th>Vector category</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Biologic</td>
<td></td>
</tr>
<tr>
<td>LF</td>
<td>Mosquito</td>
<td><em>Culex, Anopheles, Aedes, Mansonia, Ochlerotatus</em></td>
</tr>
<tr>
<td>Oncho</td>
<td>Black fly</td>
<td><em>Simulium damnosum, Simulium neavei</em></td>
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<tr>
<td></td>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>Trachoma</td>
<td>Flies</td>
<td><em>Musca sorbens</em></td>
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<tr>
<td></td>
<td>Intermediate Host</td>
<td></td>
</tr>
<tr>
<td>Schisto</td>
<td>Fresh water snails</td>
<td><em>Biomphalaria, Bulinus, Oncomelania, Ferrissia and Tricula</em></td>
</tr>
<tr>
<td>Oncho</td>
<td>Fresh water crabs*</td>
<td>Phoretic host of <em>Simulium neavei</em></td>
</tr>
</tbody>
</table>
## Vectors of NTDs targeted by PC

<table>
<thead>
<tr>
<th>NTD</th>
<th>Intermediate Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasciola, Opisthorchis, Clonorchis, Paragonimus</td>
<td>Fresh water snails, <em>Limnea</em>, <em>Bithynia</em>, <em>Bulinus</em>, Thiaridae</td>
</tr>
<tr>
<td>Opisthorchis, Clonorchis, Paragonimus</td>
<td>Fresh water fishes, Fresh water crabs, <em>Cyprinidae</em>, <em>Salmonidae</em>, <em>Potamon</em></td>
</tr>
</tbody>
</table>
## Vectors of NTDs targeted by PC

<table>
<thead>
<tr>
<th>NTDs</th>
<th>Vector Category</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dengue and Chikungunya</td>
<td>Mosquito</td>
<td>Aedes</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>Sand Fly</td>
<td>Phlebotamine</td>
</tr>
</tbody>
</table>
The Role of Vector Control in NTDPs

• To compliment PC strategies by reducing the number of vectors and intermediate hosts that are capable of spreading infections, or disrupting PC activities (e.g. Loa loa).
• To reduce the transmission potential between vectors and hosts to prevent new infections and re-infections.
• To encourage environmental improvement.
• Suppress vectors as a biting nuisance.
• To control NTDs not targeted by PC.
Elements of Integrated Vector Management

• Advocacy, social mobilization and legislation
• Collaboration within the health sector and with other sectors
• Integrated approach
• Evidence-based decision-making
• Capacity-building
Integrated Vector Management

Multi disease approach

A rational decision-making process for the optimal use of resources for vector control

The goal is to make a significant contribution to the prevention and control of vector-borne diseases.
WHO Position Statement on Integrated Vector Management to Control Malaria and LF

- **Targets multiple diseases**
  - Two important vector-borne diseases: Malaria and LF

- **Global Malaria Program (GMP) and GPELF**
  - Large proportions of target population, similar goals and strategies

- **Added value of joint vector-control interventions**
  - MDA infrastructure for ITN coverage in hard-to-reach (HTR) areas.
  - ITN universal coverage enhance transmission interruption.

- **Conditions**
  - Co-endemic for malaria and LF
  - Vector control intervention affect vectors of both malaria and LF
Coverage of LLITNs and PC for LF

**LLITNs in GMP**

**PC for LF**

- Countries implementing with 100% geographical coverage
- Countries completed 5 or more rounds with 100% geographical coverage
- Ongoing interventions
- Interventions not started
- Stopped interventions achieving MF rate less than 1%
- Not required interventions, MF rate less than 1%
Integrated Vector Management and LF

- Integrated vector management can contribute to elimination of LF transmitted by Anopheles mosquitoes (e.g. Solomon Islands).
- Integrated vector management can significantly complement and sustain gains made by PC (e.g. PNG).
- Integrated vector management is essential for achieving LF elimination by 2020.
Vector Control in Areas Co-endemic for Onchocerciasis and Loa Loa

- 40% prevalence of history of eye worm passage as measured by RAPLOA suggests an increased risk for SAEs for the treatment of oncho with IVM.
- Where RAPLOA prevalence is ≥40%, a modified PC strategy is recommended.
- To reduce the risk of SAEs in high L.loa prevalent areas, a range of control and prevention strategies should be considered including control of Chrysops and Simulium.
Chrysops: The Transmission Machine

High uptake of mf
Low immunity to infection
High larval survival rate in insect
High L3 production

Extraordinary transmission potential:
>200,000 L3s/person/month in rainy season

*Chrysops silacea*, the vector of Loa loa in Cameroon, Republic of Congo, DRC, Central African Republic, Nigeria, Gabon, Equatorial Guinea, Angola, Benin, Chad, Southern Sudan and Uganda is an extremely efficient biological vector.

>90% reduction in vector density may be required to achieve a meaningful reduction in its transmission potential for loiasis.
Mosquito Control 1

Indoor Residual Spraying (IRS)

• Strength:
  – Potential for integration with malaria control

• Weakness:
  – Development of insecticide resistance,
  – Frequent re-treatments necessary, every 6-months
  – Higher logistical and operational costs
Mosquito Control 2

LLIN

• Strengths
  – Effective
  – Potential for integration with malaria control
  – Inexpensive

• Weakness
  – Less effective for LF transmitted by Culex and Aedes species
  – Effectiveness dependent on proper use
Blackfly Control

Larvicides

• Strengths
  – Proven use in controlling Simulium neavei by targeting intermediate host freshwater crabs and
  – Simulium damnosum through aerial and ground spraying

• Weakness
  – Long term costs
Snail Control

Molluscicides (Niclosamide)

Biological Control Agents (trematodes)

• Strengths:
  – Use in snail-infested water bodies at main human contact points

• Weaknesses:
  – Cost
  – Safety
  – Few chemicals are commercially available
  – Effects on fish species
Fly Control

- Improved sanitation
- Construction and use of latrines
- Moving domestic animals to stables outside the household compound

**Strengths**
- Reduces fly density

**Weaknesses**
- Behavior changes still needed in addition to improved hygiene and sanitation, including availability of potable water
WHAT ARE THE CURRENT VECTOR CONTROL ACTIVITIES IN YOUR COUNTRY?
WHAT ARE THE KEY MESSAGES OF THIS SESSION?
Key Messages

- Vector control activities have a history in controlling/disrupting NTD transmission.
- Vector control can be complementary to PC activities.
- Some interventions such as bed nets are easily amenable to integration with PC.
- Close collaboration with malaria programs should be explored in countries co-endemic for LF.
- Vector control encompasses in-country collaboration with the water and sanitation departments and projects.
- Strategies need to be monitored and researched to develop more effective and efficient tools.