Unlocking the human factor to increase effectiveness and sustainability of vector control tools

April Monroe, PhD
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VCWG Annual Meeting
Expanding the Vector Control Toolbox Workstream
Background

• Despite gains, progress has stalled
• New tools provide cause for optimism
• People will be key to their success
01 Increase impact of core interventions

02 Identify and characterize gaps in protection

03 Integrate social and behavioral research in evaluation of new tools

04 Build resilience to sustain gains
01: INCREASE IMPACT OF CORE INTERVENTIONS
Examples of behaviors that can increase effectiveness of core interventions

**ITNs**
1. Access through available channels
2. Use consistently
3. Care for appropriately

**IRS**
1. Accept sprayers in home
2. Consent to remove household possessions
3. Avoid post-spray wall modifications

*Photo: Miss Lilibet Msangi courtesy of Mr. Joseph Madata*

*References:*
3. Opiyo et al. 2020. ‘We spray and walk away’: wall modifications decrease the impact of indoor residual spray campaigns through reductions in post-spray coverage.
Example: Social and Behavior Change for ITNs

Net acquisition
- Register in mass campaigns
- Attend ANC or EPI
- Request a net from a CHW
- Purchase a net

Net care
- Tie up when not in use
- Handle gently
- Keep away from children and pests
- Wash in a basin with mild soap
- Repair when torn

Net use
- Sleep under a net in both dry and rainy seasons
- Use nets regardless of shape, color, etc.
- Sleep under a net indoors and outdoors
- Use nets in high and low transmission settings

Net end of life
- Patch other ITNs
- Turn ITNs into curtains or screens
- Stuff ITNs into open eaves

The Malaria Behavior Survey is a cross-sectional household survey of malaria-related behaviors and the factors that drive or inhibit them. The survey uses a theory-driven and standardized methodology to produce data to inform malaria social and behavior change interventions.

https://malarialbehaviorsurvey.org/
02: IDENTIFY AND CHARACTERIZE GAPS IN PROTECTION
A small set of human behavioral data can improve understanding of when and where gaps in protection occur

- Indoor and outdoor biting rates alone often used to estimate human-vector contact
- Risk depends on overlap with human behavior and intervention use over the course of the night e.g.
  - home versus away
  - indoors versus outdoors
  - awake versus asleep
  - using an ITN/personal protection or not

A. Directly measured biting rate and human location

B. Behavior-adjusted biting rate for an unprotected individual

A. Unprotected individual

Behavior-adjusted bites per person per hour

B. ITN user

Behavior-adjusted vector bites occurring outdoors

Behavior-adjusted vector bites occurring indoors while awake

Behavior-adjusted vector bites occurring indoors while sleeping

Bites prevented by using an ITN

Legend

\[ \pi_{I,u} = 97\% \]

\[ \pi_{S,u} = 84\% \]

\[ \pi_{I,p} = 87\% \]

\[ P_S^* = 79\% \]
Characterize who is at risk and what they’re doing during those times to determine how to improve protection

- Small but growing number of studies on nighttime human behavior
- Common activity categories
  - Routine activities
  - Special events
- Higher-risk groups
  - Mobile populations
  - Night time occupations
  - Internally displaced persons and refugees

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03: INTEGRATE SOCIAL AND BEHAVIORAL RESEARCH IN EVALUATION OF NEW TOOLS
Complementary tools will depend on end-users to be successful

- Improved housing
- Larval source management
- Mosquito release technologies
- Topical repellents
- Insecticide-treated clothing
- Insecticide-treated hammocks
- Spatial repellents
- Push-pull systems
- Eave tubes and eave baffles
- Attractive targeted sugar baits
- Anti-parasitic drugs e.g. Ivermectin
<table>
<thead>
<tr>
<th>Vector control intervention</th>
<th>Example end-user behaviors</th>
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<tbody>
<tr>
<td><strong>Larval source management (LSM)</strong></td>
<td>Accept LSM in community</td>
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<td></td>
<td>Participate in activities to treat and/or eliminate breeding sites</td>
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<td><strong>Housing Improvements</strong></td>
<td>Accept/embrace mosquito-proof housing designs</td>
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<td></td>
<td>Purchase materials and labor needed to make housing improvements</td>
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<td><strong>Mosquito release technologies</strong></td>
<td>Accept to have mosquitoes released</td>
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<td>Assist in release of mosquitoes</td>
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<td>Host and monitor mosquitoes traps</td>
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<td>Participate in local progress monitoring committees</td>
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<td><strong>Insecticide-treated hammocks</strong></td>
<td>Seek out hammock from employer or other source</td>
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<td>Carry hammock when spending night away from home</td>
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<td></td>
<td>Use hammock when sleeping outdoors</td>
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<tr>
<td><strong>Topical repellents and insecticide treated clothing</strong></td>
<td>Purchase topical repellent/IT clothing (or seek out if distributed)</td>
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<td></td>
<td>Use consistently when not under an ITN</td>
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<tr>
<td><strong>Spatial repellents</strong></td>
<td>Purchase spatial repellent (or seek out if distributed)</td>
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<td>Install spatial repellent according to specifications</td>
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<tr>
<td></td>
<td>Replace spatial repellent regularly according to specifications</td>
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<tr>
<td><strong>Attractive Targeted Sugar Baits (ATSB)</strong></td>
<td>Accept ATSB in home (or seek out if distributed)</td>
</tr>
<tr>
<td></td>
<td>Replace ATSB regularly according to specifications</td>
</tr>
<tr>
<td><strong>Anti-parasitic drugs e.g., Ivermectin</strong></td>
<td>Accept to have cattle treated (or treat cattle according to specifications)</td>
</tr>
<tr>
<td></td>
<td>Accept to take drug</td>
</tr>
<tr>
<td></td>
<td>Take drug according to specifications</td>
</tr>
</tbody>
</table>

Reference: Monroe et al. Under Review. Unlocking the human factor to increase effectiveness and sustainability of malaria control and elimination efforts.
Include social and behavioral research when evaluating new tools

• How are people currently protecting themselves and what are the gaps?
• How does this new approach fit into people’s lives?
• What are the factors that could make it easier or harder to use?
• How might patterns of exposure change with this intervention in place?
• What are the considerations for large-scale implementation?

Advancing Evidence for Global Implementation of Spatial Repellents (AEGIS)
Social science team training
Elevate role of human behavior in policy review process

+ key human behavioral factors?
04: BUILD RESILIENCE TO SUSTAIN GAINS
Expand use of human-centered design to develop and scale-up new solutions in vector control

- Engages end-users in co-creation process
- Empathetic research methods to uncover insights
- Rapid idea generation, prototyping, and testing of promising solutions

Photo: Private Sector Malaria Prevention project, Ghana. ITN outfitted with features identified as most important to end-users through a human-centered design process.
Human-centered design examples

- Improving malaria outcomes in mining communities in Guyana
- Improving water storage in Jamaica to reduce *Aedes* breeding sites
- Encouraging health providers in Nigeria to test for malaria and only treat those with positive tests

https://breakthroughactionandresearch.org/sbc-flow-chart/
Build resilience to sustain gains

Behavioral Resilience
Build habits around prevention behaviors; address barriers to engagement; integrate health education for disease control in school and community programs

Structural and Environmental Resilience
Improve homes and environments to sustainably suppress mosquitoes

Economic Resilience
Ensure households have resources to meet basic needs; increase domestic financing for health

Health Systems Resilience
Functional services and interventions within reach of all; ownership and use of data at the local level
Potential Workstream Opportunities

- Bring together groups working on this topic
- Produce recommendations for human behavior in vector control development, evaluation, and implementation
- Identify entry points for considering human behavior in policy review and guidelines
- Develop research agenda and case studies for human centered design in vector control
Thank you!

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