# ALTERNATIVES TO THE HUMAN LANDING CATCH

Fatima Al-Shimari, Mohamed Albirair, Ramya Kumar, Jairam Lingappa

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START CENTER
STRATEGIC ANALYSIS,
RESEARCH & TRAINING CENTER

# PROJECT TEAM

**Fatima Al-Shimari**

MPH Student, Global Health

Project Manager

**Ramya Kumar, MPH**

PhD Student, Epidemiology

Research Assistant

**Mohamed Albirair, MBBS, MPH**

PhD Student, Implementation Science

Research Assistant

**Jairam Lingappa, MD, PhD**

Professor, Global Health

Faculty Lead

# START CENTER OVERVIEW

- Leverages leading content expertise from across the University of Washington
- Provides high quality research and analytic support to the Bill & Melinda Gates Foundation and global and public health decision-makers
- Provides structured mentorship and training to University of Washington graduate research assistants

# OUTLINE

- Project Overview
- Project Timeline
- Problems with HLC
- Challenges to Implementing Alternatives
- Framework for Change Model
- Conclusions

# PROJECT REQUEST

1. Build a framework for change to introduce alternatives to the HLC
2. Conduct a synthesis of two recent literature reviews about alternatives to HLC
3. Conduct key informant interviews (KII) on their perspectives on whether there is a need for alternatives to HLC

**Deliverables:**

- Summary report with a framework for change model
- Slide deck with recorded presentation

# RATIONALE

BMGF Malaria and NTD teams have resources and are requesting a fresh evaluation of this data

What is the BMGF concern with HLC?

- Operational complexities
- Associated risks and costs
- More research is needed to show why an alternative is necessary

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# PROJECT TIMELINE

## Literature Review

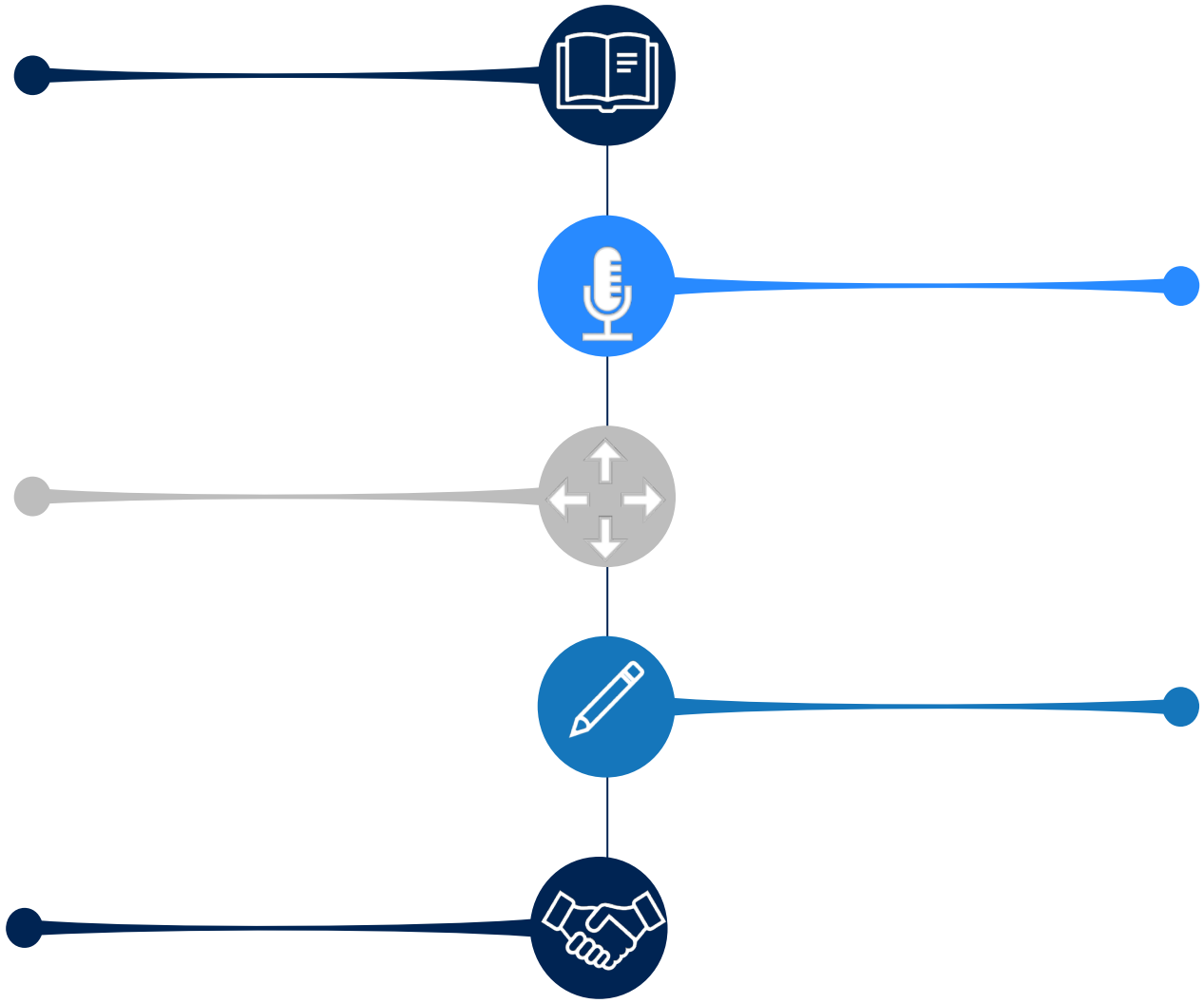
of literature shared by BMGF and PubMed searches

## Theory of Change Model

developed to demonstrate the need for alternatives and the barriers to their implementation

## Review and Feedback

by experts on the summary report draft and theory of change model



## Key Informant Interviews (KII)

of six experts recommended by BMGF

## Summary Report

synthesizes findings from literature review and interviews

# KEY INFORMANTS

| NAME | ROLE | LOCATION | DATE INTERVIEWED |
|---|---|---|---|
| **Dr. Neil Lobo** | Research Professor,<br>Eck Institute for Global Health, University of Notre Dame | Notre Dame, USA | July 7, 2021 |
| **Dr. Tanya Russell** | Medical entomologist working as a senior research fellow co-leading the Mosquito-Borne Diseases Group at James Cook University | Cairns, Australia | July 14, 2021 |
| **Dr. Robert Farlow** | Owner at R. Farlow Consulting LLC | Burkeville, USA | July 14, 2021 |
| **Dr. Thomas Burkot** | Vector biologist at James Cook University and Research leader at the Australian Institute of Tropical Health and Medicine (AITHM). Previously a research entomologist with the United States Centers for Disease Control for 20 years | Townsville, Australia | July 14, 2021 |
| **Dr. Jennifer Stevenson** | WHO Technical Officer, former research scientist overseeing the entomological activities of the International Center of Excellence for Malaria Research (ICEMR) of southern Africa, in two sites in Zambia and one in Zimbabwe | Geneva, Switzerland | July 15, 2021 |
| **Dr. Frances Hawkes** | Senior Research Fellow at the Natural Resources Institute of the University of Greenwich | London, UK | July 16, 2021 |

# POSITIONALITY STATEMENT

- START Center recognizes existing power asymmetries global health
- There is a need to address the limitations that come with these imbalances
- KIIs conducted were limited to the perspectives of researchers from the Global North
- We did not conduct any interviews with researchers from the Global South
- START recommends **engagement with local and regional experts, community stakeholders, and Ministries of Health** in the countries where HLCs take place

# HUMAN LANDING CATCH: THE GOLD STANDARD?

- Human is the bait and catches mosquitoes overnight
- Measures human seeking and landing vs biting rate
- Use to estimate malaria transmission rates
- Not standardized; human attractiveness is complex, variations in mosquito and catchers' behaviors

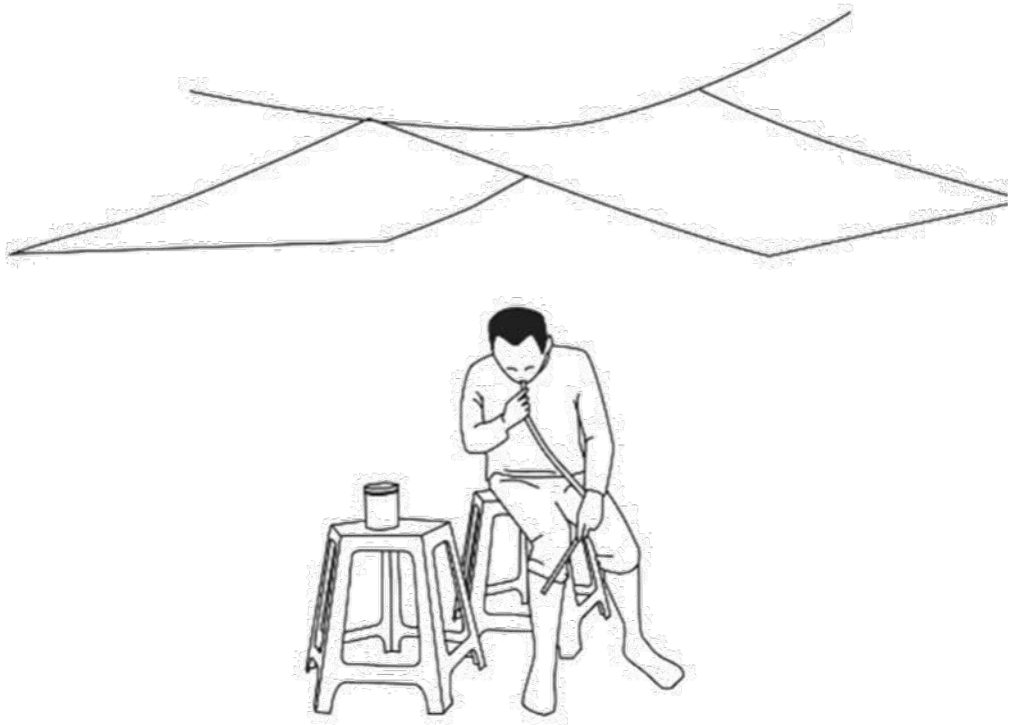
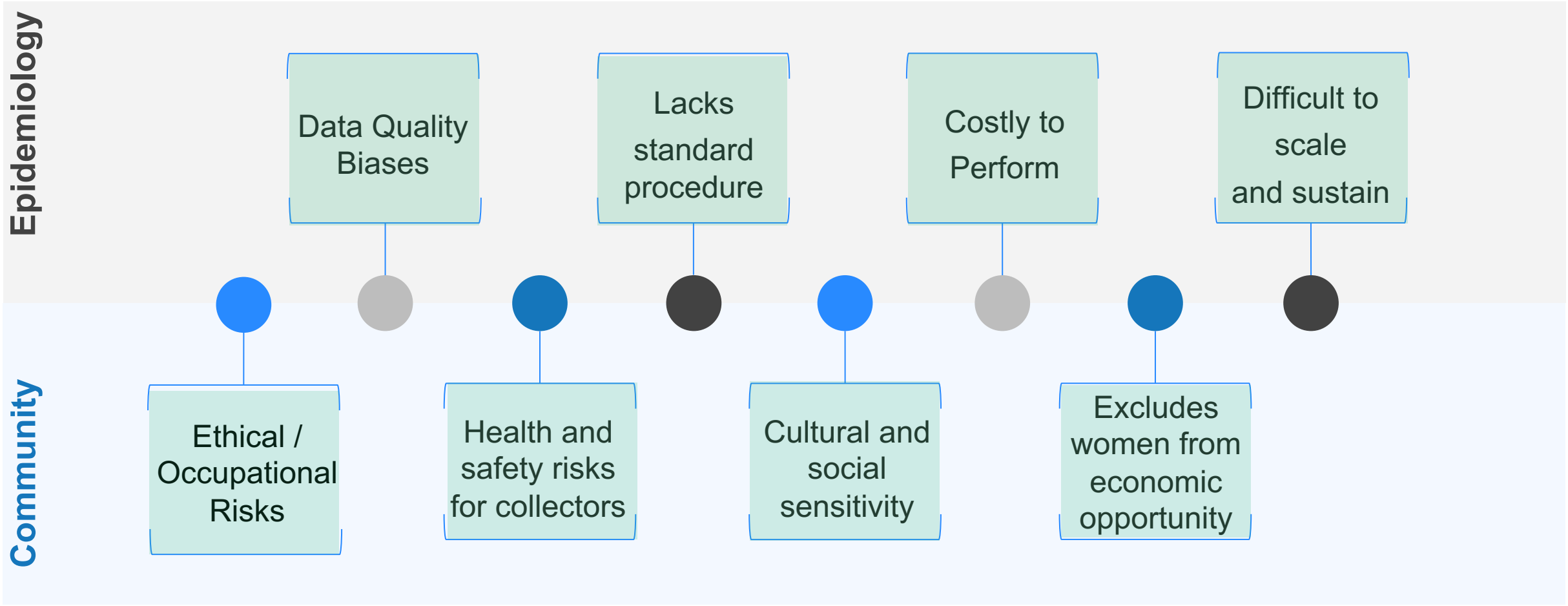


*Image citation:* Tangena JA, Thammavong P, Hiscox A, Lindsay SW, Brey PT. The Human-Baited Double Net Trap: An Alternative to Human Landing Catches for Collecting Outdoor Biting Mosquitoes in Lao PDR. PLoS One. 2015 Sep 18;10(9):e0138735. doi: 10.1371/journal.pone.0138735. PMID: 26381896; PMCID: PMC4575072.

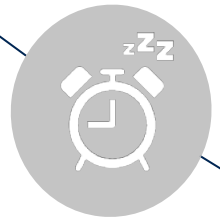
# CHALLENGES WITH THE HUMAN LANDING CATCH



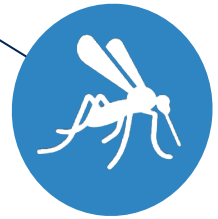
# REASONS FOR DATA QUALITY BIASES IN HLC

Human attractiveness to mosquitoes differs
(i.e., unique human odor, type of soap used, when the collector bathed, etc.)

Surveillance methods differ making it challenging to compare trap effectiveness



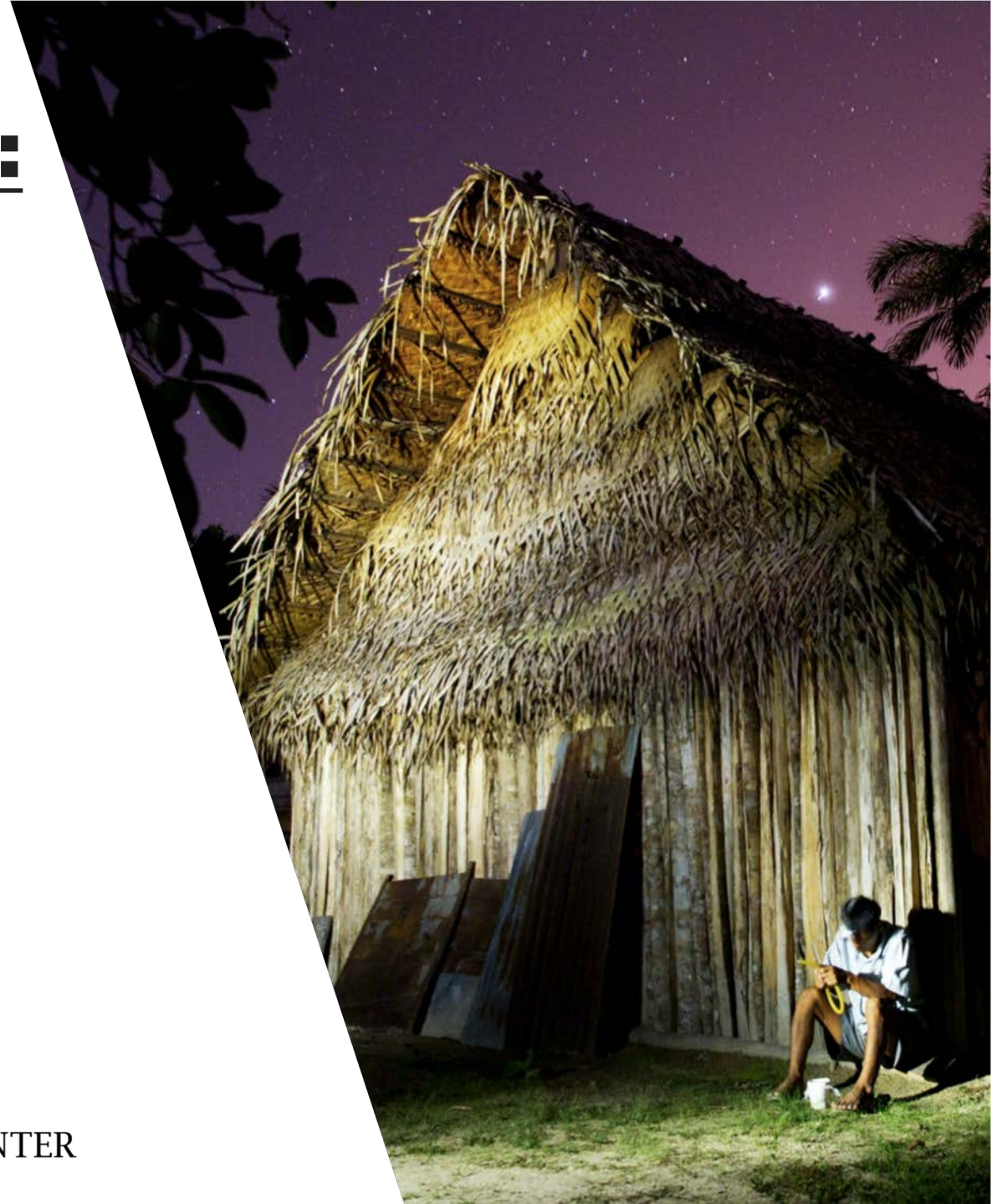
Variations in collectors' catching skills, dexterity, levels of experience, and degrees of alertness



Mosquito behavior (even within same mosquito species) differs

# ALTERNATIVE METHODS: WHAT'S NEEDED?

- Safe
- Consistent across time
- Reduces human error
- Affordable
- Logistically feasible and scalable
- Operates despite preventive measures
- Incorporates an attractant



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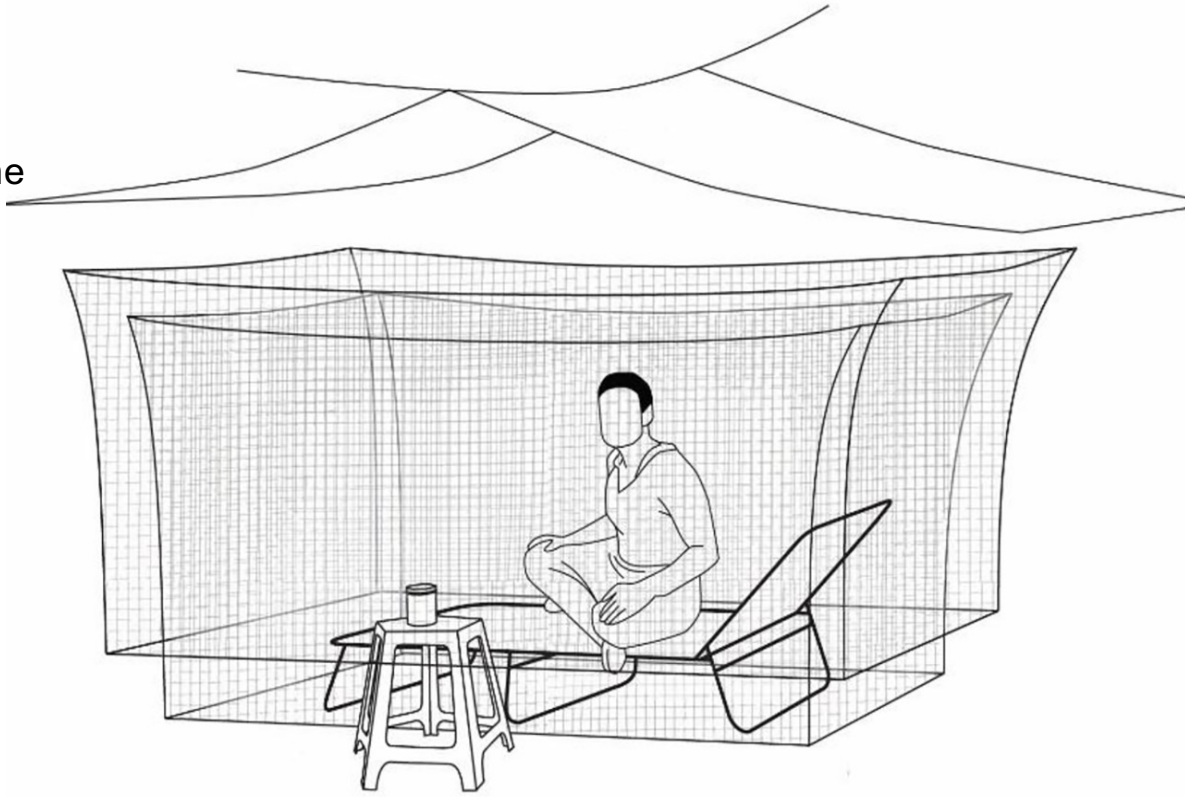
# TYPES OF MOSQUITO TRAPS

| Trap Name | Requires standardization? (yes/no) | Condition of samples (1=poor; 5=excellent) | Samples alive? (yes/no) | Level of difficulty (1=easy; 5=difficult) | Capacity required (low, medium, high) | Cost of materials (low, medium, high) |
|---|---|---|---|---|---|---|
| **HLC** | Yes | 5 | Yes | 5 | High | Low |
| **Double-net trap** | Yes | 5 | Yes | 3 | Medium | Low |
| **Ifakara tent trap** | Yes | 5 | Yes | 3 | Medium | Medium |
| **Furvela trap** | Yes | 5 | Yes | 3 | Medium | Low |
| **Odor-baited entry trap** | Yes | 5 | Yes | 4 | Medium | High |
| **Pyrethrum spray catches** | No | 5 | No | 5 | Low | Low |
| **Prokopack** | No | 4 | Yes | 3 | Low | Low |
| **CDC light trap** | Yes | 4 | Varies | 2 | Medium | Medium |
| **Suna trap** | Yes | 5 | Yes | 4 | Medium | High |
| **Resting box** | No | 5 | Yes | 2 | Low | Low |
| **Barrier trap** | Yes | 5 | Yes | 2 | Low | Low |
| **Gravid Trap** | Yes | Varies | Varies | Varies | Medium | Varies |
| **Window Exit Trap** | Yes | 5 | Varies | 4 | Low | Low |
| **Animal-baited tent trap** | Yes | 5 | Yes | 3 | Low | Medium |
| **Larval Dipping** | No | 5 | Yes | 4 | High | Medium |

# HUMAN BAITED / DOUBLE-NET TRAP (HDN)

- Consists of two box nets; one protecting the collector and a second larger net which is placed directly over the inner net
- The outer net is raised off the ground so that mosquitoes attracted to the human-bait are collected between the two nets
- During catches, one adult occupies one trap for 6-8 hours
- Mosquitoes are caught in the gap between the two nets
- Both nets were under plastic-sheeting roofs
- Collectors raise the bottom of the inner net and aspirate mosquitoes caught between the nets into paper-cup every 10 minutes
- Mosquito catches of each hour are aspirated into different paper cups



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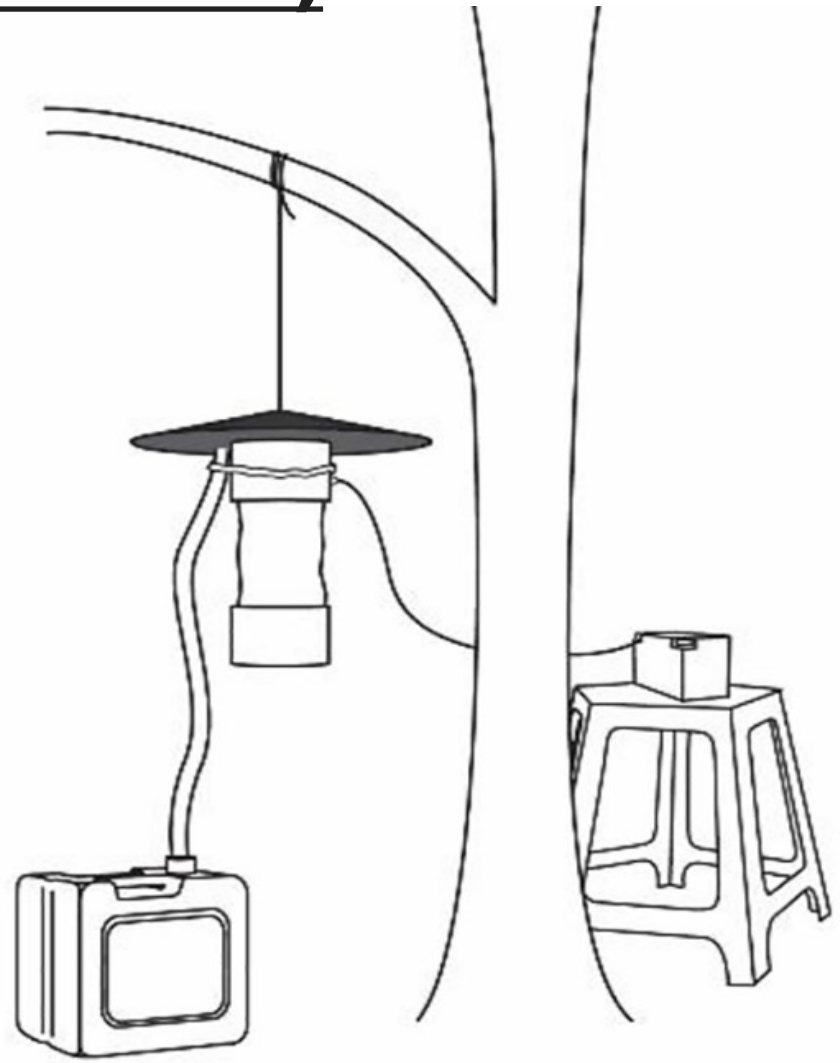
# CDC LIGHT TRAP (CDC-LT)

- CDC-LTs used with the supplied incandescent bulb are suspended from trees with the lightbulb 1.5 m above the ground
- Mosquitoes attracted to the trap are sucked into the collection container by a 6V (6Ah) battery-powered fan
- Carbon dioxide ($CO_2$) produced by fermentation of sugar with yeast is supplied to the trap
- $CO_2$ is produced by mixing sugar, yeast, and water in a plastic jerry-can one hour before trapping; The $CO_2$ produced, passes along tubing and is released at the trap entrance



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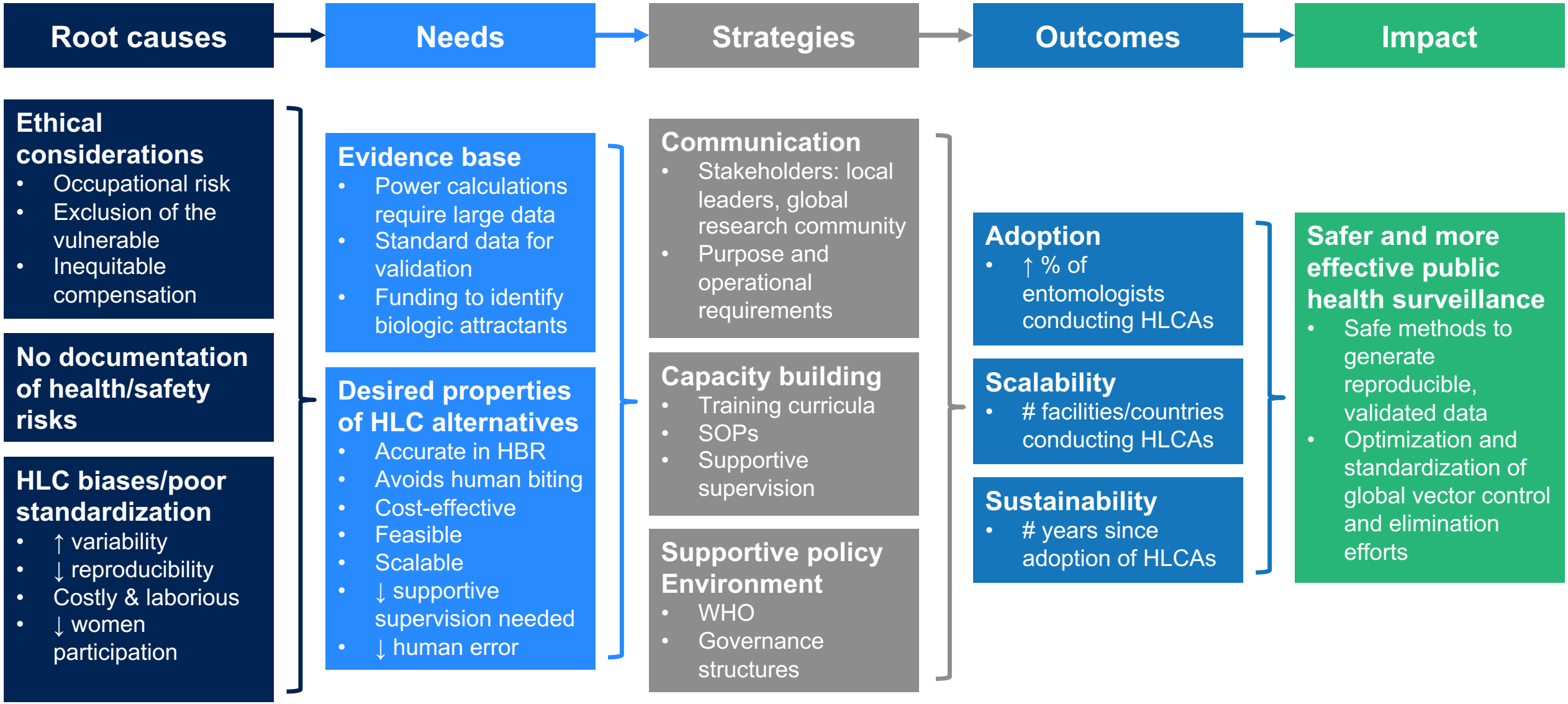
# COMPARISON OF THE DIFFERENT METHODS

| | Human-landing catch | CDC light trap | Human baited / Double-net Trap |
|---|---|---|---|
| **Advantages** | • Monitors more indicators<br>• Estimates human-biting rates (HBR) and entomological inoculation rates (EIR)<br>• Requires limited training and is thus compatible with community recruitment | • Eliminates the need for a human to be used as bait (eliminating challenges of high costs, ethics, data quality bias, etc.)<br>• Community householders are easily trained to operate.<br>• Minimal supervision needed | • Human-baited traps are considered effective<br>• Humans do not get bitten by mosquitos |
| **Limitations** | • Ethics/occupational risks<br>• Requires supervision<br>• Limited reproducibility<br>• High costs of human resources | • Catches a lot of non-target insects<br>• Logistical challenges (e.g., higher costs than HLCs, transportation)<br>• Not all samples obtained are alive<br>• Data from CDC-LT are not directly epidemiologically relevant | • Laborious and costly<br>• Lack of standardization, making EIR calculations problematic<br>• Poor reproducibility |

# CHALLENGES TO IMPLEMENTING ALTERNATIVE METHODS

- HLC is still required to collect the ***minimum entomological information*** needed
- ***Logistical problems*** with using carbon dioxide as an attractant
- Challenging to mimic the ***variability*** of human attractiveness
- Existing alternatives are not easily ***accepted by community*** stakeholders
- More research is still needed to identify a practical alternative…

# FRAMEWORK FOR CHANGE

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# SUMMARY

- **Significant logistical challenges associated with the HLC** *(implementation, generalizability, gender equity, ethics, and safety risks)*

- Need to optimize existing alternative methods in a standardized way so that **surveillance methods can be compared** to find the most effective alternative

# CONCLUSION

- Three imperfect methods (HLC, HDN, CDC-LT) with varying indicators
- Removal of human aspect as bait (major driver)

  CDC light traps require fewer human resources than HLC

  They are also:

  accurate (at catching the same species as HLC);

  are efficient even without the presence of $CO_{2;}$

  can be scaled, are affordable, and portable;

**Areas for improvement:**

- Add a $CO_2$ component that is consistent and can be scaled
- Increase production of CDC-LTs to make them more affordable

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# THANK YOU

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