

The University of California, San Francisco

Malaria Elimination Initiative (MEI)



Module 3

Select sampling methods and analytical techniques

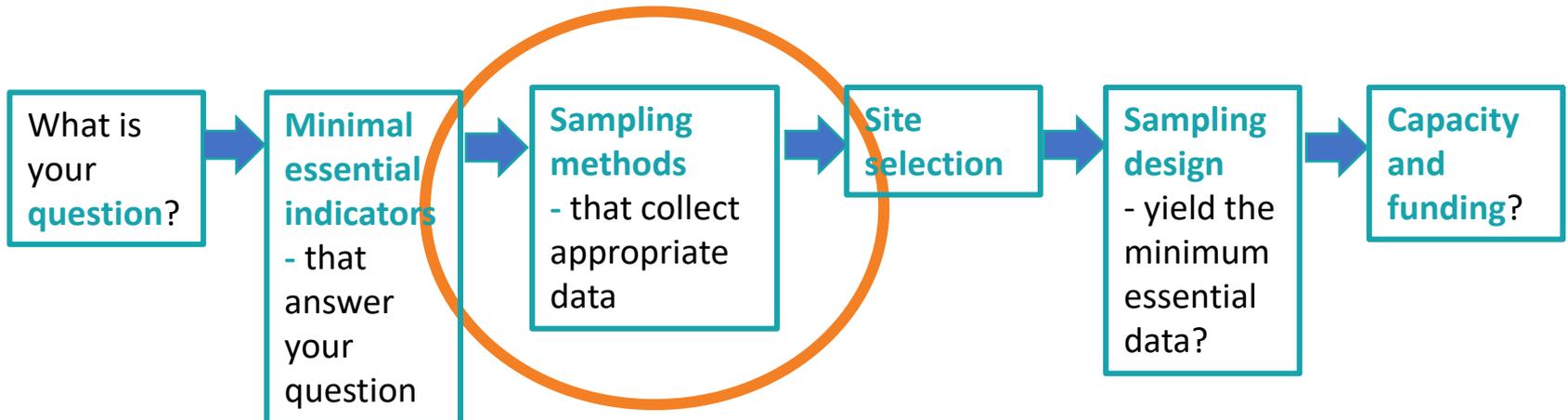
The Entomological Surveillance Planning Tool

Learning objectives: Module 3

1. Understand the basic inherent advantages, limitations, and biases of each entomological sampling method and analysis technique.
 2. Understand how to use the ESPT to guide selection of appropriate and available sampling method(s) to address priority program question(s), accounting for method limitation and biases.
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Where are we in the ESPT?

- **Module 3** describes a variety of common sampling methods and lab analytical techniques.
- Work through Module 3 only after having worked through Modules 1 and 2.
- Module 3 helps you select appropriate methods for your question by packaging key aspects in table format.
- Explanatory text accompanies these tables and directs you to the appropriate tables.



1. Selecting sampling method(s)

Page 18

- Select sampling method(s) **based on your question(s)** and on the **indicators** you have selected.
- Entomological sampling methods take advantage of **specific mosquito behaviors**.
- Each method has its own **biases, advantages, and limitations**.
- **Box 1** of the ESPT outlines commonly used sampling methods for *Anopheles* surveillance.
- See **Annex III** for more information on sampling techniques.

Box 1. Sampling Methods

1. Human landing catches (HLC)
2. Human baited traps (HBT)
3. Indoor resting collections (IRC)
4. CDC light trap (CDC-LT)
5. Human odor baited traps (HOBT)
6. Animal odor baited traps (AOBT)
7. Outdoor resting collections (ORC)
8. CO₂ baited trap
9. Gravid traps
10. Interception traps (window exit traps (WET)/barrier screen (BS))
11. Larval surveys (LS)

Sampling methods – Overview

1. Human landing Catch (HLC)
2. Human Baited Traps (HBT)
3. Indoor Resting Collections
4. CDC Light traps (CDC-LT)
5. Human Odor baited Traps (HOBT)
6. Animal Odor Baited traps (AOBT)
7. Outdoor Resting Collections
8. CO2 Baited trap
9. Gravid Traps
10. Window Exit trap (WET)
11. Larval Surveys

1. Human landing Catch (HLC)

- Gold Standard
- Blood seeking, human feeding mosquitoes

Example of a question?



2. Human Baited Traps (HBT)

- Human Blood seeking feeding mosquitoes
- Example of a question?



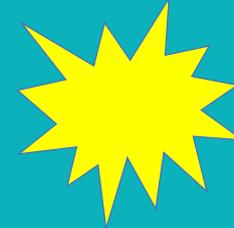
Animal Baited Traps

- Animal blood seeking mosquitoes
- Example of a question?



3. Indoor Resting Collections

- PSC
- Indoor resting mosquitoes
- Informs on IRS



Example of a question?

4. CDC Light traps (CDC-LT)

- Mosquitoes attracted to light
 - Can be associated with
 - human bait
 - CO₂
 - UV light
 - animals, etc

Example of a question?



- 5. Human Odor baited Traps (HOBT)
- 6. Animal Odor baited traps (AOBT)

Mosquitoes attracted to human or animal odors

OBET – Odor Baited Entry trap

Example of a question?



7. Outdoor Resting Collections

Outdoor resting mosquitoes

Pit traps



Pot Traps



Example of a question?

8. CO2 Baited trap

- Mosquitoes attracted to a source of CO2 (host seeking)



Example of a question?

9. Gravid Traps

- Mosquitoes looking to oviposit



MosquiTRAP, double sticky ovitrap and large Gravid Aedes Trap (GAT)

Example of a question?

10. Window Exit trap (WET)

- Mosquitoes that exit houses over the course of the night



Example of a question?



11. Larval Surveys



Example of a question?

Optimal mosquito Collecting methods

- What is your Question?
- What mosquito **behavior** do the available **traps** take advantage of?
- How do the **local mosquitoes/vectors** behave with the trap?

Traps have their pros and cons

Important to pick the trap based on your question!

Important notes:

- If you are using multiple sampling methods, be aware of possible interactions between methods.
 - *Example question: Why should HLCs houses not be combined with PSC houses?*

Well-designed sampling can capture data to answer more than one question.

- *Example: Can you give me an example where a single sampling method can be utilized to collect more than one endpoint?*

	Sampling method	Mosquito behavior that the method targets	Host preference	Is the sampling method appropriate to collect data for these indicators?								Supplemental		Examples of traps (most common are in bold)		
				Minimum essential indicator (to be selected based on the question)											Sporozoite rate ^g	HB
				Vector occurrence ^c	Vector density ^c	Larval habitat occupancy	Biting location	Biting time	Human biting rate	Indoor resting density	Insecticide resistance frequency					
1	Human landing catch (HLC)	Human host seeking	Human												HLC inside, HLC outside	
2	Human baited trap (HBT)	Human host seeking	Human					e	e					h	Tent Trap , Ifakara Tent Trap, Fuvvela Trap, Odor Baited Entry Trap (OBET)	
3	Indoor resting collection (IRC)	Resting behavior (indoor)	Human or animal ^f												g,h	PSC , aspiration (manual/backpack)/Prokopack
4	CDC light trap (LT)	Human or animal host seeking	Human or animal ^f					e	e		e				e	CDC-LT
5	Human odor baited trap (HOBT)	Human host seeking	Human					e	e						h	Suna Trap
6	Animal baited trap (ABT)	Animal host seeking	Animal					e						e		Tent Trap , OBET
7	Outdoor resting collection (ORC)	Resting behavior (outdoor)	N/A												g	Aspiration (manual/backpack), Prokopack, resting pot/box, pit traps
8	CO2 baited traps	Human or animal host seeking	Human or animal ^f					e								CDC-LT with CO2 source, other traps with CO2 sources
9	Gravid traps	Oviposition seeking	N/A													
10	Interception traps	Flying, exiting, sugar or host seeking	Human or animal								(WET)					Window Exit Trap (WET), Barrier Trap
11	Larval surveys	Larvae and pupae development	N/A													Larval dipping

Table 8
(Pg 20):
Sampling methods used to address specific types of questions and entomological indicators

Table 9
(Pg 21):
Detailed
sampling
methods:
the
limitations,
advantages
and
disadvanta
ges

	Sampling method	Trap name (Those in bold are more common; others are more experimental.) (This is not an exhaustive list.)	Requires standardization (at site) ^a (Yes/No)	Condition of samples (1 = poor, 5 = excellent)	Samples alive? (Yes/No)	Level of difficulty (1 = easy, 5 = difficult)	Capacity required ^c (low, medium, high)	Cost of materials (low, medium, high)	Which sampling method(s) can be used to determine if a different intervention may be appropriate?			Which sampling method(s) can be used to evaluate interventions currently in use?		
									LLINs	IRS	Larviciding	LLINs	IRS	Larviciding
1	Human landing catch (HLC)	HLC	Yes	5	Yes	5	High	Low	√			√ ^a	√ ^a	√ ^e
2	Human baited trap (HBT)	Tent Trap	Yes	5	Yes	3	Medium	Low				√ ^a	√ ^a	√ ^e
		ITT	Yes	5	Yes	3	Medium	Medium				√ ^a	√ ^a	√ ^e
		Furvela Trap	Yes	5	Yes	3	Medium	Low				√ ^a	√ ^a	√ ^e
		OBET	Yes	5	Yes	4	Medium	High				√ ^a	√ ^a	√ ^e
3	Indoor resting collection (IRC)	PSC	No	5	No	5	Low	Low		√		√ ^a	√ ^a	√ ^e
		Aspiration (manual/backpack), Prokopack	No	4	Yes	3	Low	Low		√		√ ^a	√ ^a	√ ^e
4	CDC light trap	CDC-LT	Yes	3	No	2	Medium	High	√			√ ^a	√ ^a	√ ^e
5	Human odor baited trap	Suna Trap	Yes	5	Yes	4	Medium	High	√			√ ^a	√ ^a	√ ^e
6	Animal baited trap	OBET	Yes	Varies ^b	Yes	5	Low	High						√ ^e
		Tent Trap	Yes	5	Yes	3	Low	Medium						√ ^e
7	Outdoor resting collection (ORC)	Aspiration (manual/backpack), Prokopack	No	5	Yes	3	Low	Medium						
		Resting pot/box	No	5	Yes	2	Low	Low						
		Barrier Trap	Yes	5	Yes	2	Low	Low						√ ^e
8	CO2 baited trap	Various sampling devices can be used with a source of CO2 (e.g., Tent Trap, CDC-LT, etc.)	Yes	Varies ^b	Varies ^b	Varies ^b	Varies ^b	Varies ^b	√			√ ^a	√ ^a	√ ^e
9	Gravid traps	Gravid traps	Yes	Varies ^b	Varies ^b	Varies ^b	Medium	Varies ^b			√			√ ^e
10	Interception traps	Window Exit Trap (WET)	Yes	5	Varies	4	Low	Low	√	√		√ ^a	√ ^a	√ ^e
		Barrier Screen/Trap	Yes	5	Yes	2	Low	Low				√ ^a	√ ^a	√ ^e
11	Larval sampling	Larval dipping	No	5	Yes	4	High	Low			√			√ ^e



Using Table 8 to select sampling methods:
Are bed nets an appropriate intervention for the village community of Katosha?

	Sampling method	Mosquito behavior that the method targets	Host preference	Is the sampling method appropriate to collect data for these indicators?									Examples of traps (most common are in bold)		
				Minimum essential indicator (to be selected based on the question)										Supplemental	
				Vector occurrence ^c	Vector density ^c	Larval habitat occupancy	Biting location	Biting time	Human biting rate	Indoor resting density	Insecticide resistance frequency ^f	Sporozoite rate ^g		HBI ^f	
1	Human landing catch (HLC)	Human host seeking	Human												HLC inside, HLC outside
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7	Outdoor resting collection (ORC)	Resting behavior (outdoor)	N/A											g	Aspiration (manual/backpack), Prokopack, resting pot/box, pit traps
8	CO2 baited traps	Human or animal host seeking	Human or animal ^a					e							CDC-LT with CO2 source, other traps with CO2 sources
9	Gravid traps	Oviposition seeking	N/A												
10	Interception traps	Flying, exiting, sugar or host seeking	Human or animal								(WET)				Window Exit Trap (WET), Barrier Trap
11	Larval surveys	Larvae and pupae development	N/A												Larval dipping

2. Selecting lab analytical techniques

- **Box 2 (Page 22)** along with brief explanatory text highlights most common methods used for analyzing mosquitoes in the lab.
 - **Annex III** provides further details on these techniques.
- As for sampling methods, each lab method has its biases.

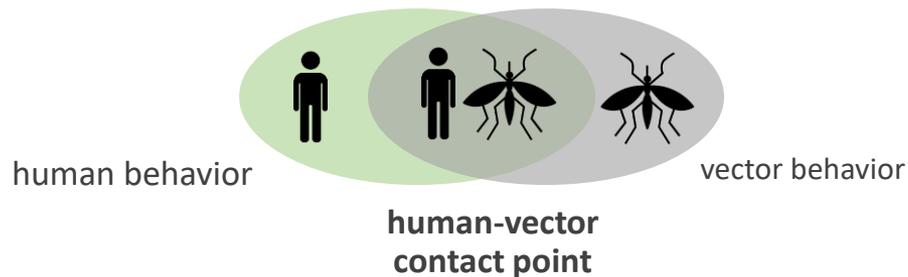
Box 2. Entomological Techniques³

1. *Anopheles* identification keys
2. Molecular identification – PCR
3. Salivary gland dissections
4. Ovary dissections
5. CS ELISA – sporozoite detection
6. BM ELISA – host blood detection
7. PCR – parasite detection
8. WHO tube assay
9. CDC bottle assay
10. Kdr PCR or biochemical assay
11. Cone bioassay



3. Assessing human behavior and high-risk populations

- HLCs are not always reflective of actual exposure to mosquito bites.
 - **Human-vector contact points (exposure) and high-risk populations (HRP)** can be more accurately determined by overlapping **vector data** with **human behavior observations data**.



- **Box 3 (Page 23)** outlines survey methods for 1) assessing human behavior and 2) investigating HRPs, depending on your question objective.

Are bed nets an appropriate intervention for the village community of Katosha?

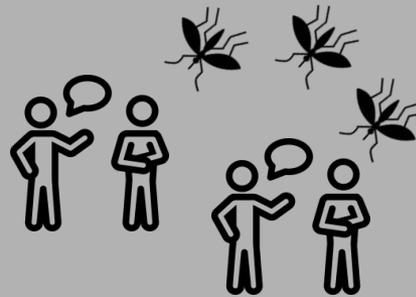
We want to understand Katosha's community members' behavior around **bed net use** and **sleeping patterns**:

- We will overlap this behavior data with Katosha's vector data collected by HLCs.
- **Box 3** advises we conduct **Human Behavior Observations (HBO)**.

10 pm



Mosquitoes are found **indoors** by HLC. But there is **no exposure** because people are sleeping under a bed net



Mosquitoes are found **outdoors** by HLC. There is **exposure** because people socializing outdoors are outside protection of bed net.

Participant exercise 1



Which field sampling method is most appropriate for your program question (identified in Module 2)?

1. Use Table 8 to select all the appropriate sampling methods for your question.
2. Then, use Table 9 to narrow down your selection to 1 or 2 sampling methods.
 - Remember to consider resource availability (e.g., cost, labor).

Participant exercise 2



How could you integrate human behavior and/or HRP survey methods to address your question?

1. First, determine if human behavior is relevant to your question.
 - For example, if your question is “*Is there insecticide resistance in my region?*”, then human behavior is not relevant.
2. If relevant, use Box 3 to decide which human behavior and/or HRP survey method is most appropriate.
3. Briefly outline (in 3 points) how you would conduct both vector and human behavior/HRP surveys.