Guidelines for Entomological Surveillance of Malaria in the Prevention of Re-establishment (PoR) Phase

2023

Anti-Malaria Campaign
Ministry of Health
Sri Lanka

ANTI-MALARIA CAMPAIGN

Guidelines for Entomological Surveillance of Malaria in PoR Phase – 2023 (3rd Edition)

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Abbreviations

AMC – Anti Malaria Campaign

AMCHQ – Anti Malaria Campaign Headquarters

BAT – Bioassay Test

CBHC – Cattle Baited Hut Collection

CBTC – Cattle Baited Trap Collection

HA – Health Assistant

HEO – Health Entomology Officer

HLNC – Human Landing Night Collection

HLNC/F - Human Landing Night Collection – Full Night

HLNC/P - Human Landing Night Collection – Partial Night

IRC – Indoor Resting Collection

IRS - Indoor residual Spraying

ITN - Insecticide Treated Nets

LS – Larval surveys

MOH – Medical Officer of Health

ORC – Outdoor Resting Collection

PCR - Polymerase Chain Reaction

PHFO – Public Health Field Officer

PoR – Prevention of Re-establishment

RMO – Regional Malaria Officer

SMO – Spray Machine Operator

SSC – Spray Sheet Collection

ST – Susceptibility Test

WHO – World Health Organization

WTC – Window Trap Collection

Foreword

As the Director of the Anti-Malaria Campaign, I am pleased to present the updated malaria entomology guidelines. These guidelines are an essential tool for making informed and strategic decisions about vector control, reflecting the current malaria situation in the country. Their development underscores our commitment to sustaining Sri Lanka's malaria-free status and addressing the challenges of the Prevention of Re-establishment (PoR) phase.

I take great pride in acknowledging the outstanding efforts of the entomology unit, which worked collaboratively with the Anti-Malaria Campaign staff, Regional Malaria Officers, and their teams. Together, they have demonstrated unparalleled dedication, attention to detail, and tireless perseverance in fulfilling the critical task of revising and enhancing these guidelines.

It is my privilege to extend heartfelt appreciation to all contributors for their significant roles in this accomplishment. Their collective efforts provide a solid foundation for strengthening our malaria control strategies and ensuring that interventions are timely, targeted, and impactful.

This updated guideline is a testament to our shared determination and will greatly assist all stakeholders as we continue the vital mission of preventing malaria re-establishment in Sri Lanka. I am confident that it will serve as an invaluable resource in guiding our efforts toward a sustainable and resilient future in malaria control.

I wish all those engaged in this important work continued success and express my deepest gratitude for your commitment to this cause.

Dr. Champa J. Aluthweera
Director
Anti Malaria Campaign

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1.0 Background

Sri Lanka has sustained World Health Organization (WHO) certified malaria-free status since 2016. One of the key components of Sri Lanka's strategy to prevent the re-establishment of malaria is entomological surveillance. During the past decade, Anti Malaria Campaign (AMC) has implemented a package of rational entomological activities in 27 regions throughout the country. These surveillance activities have undergone significant refinement on receptivity measurements during the prevention of re-establishment phase.

Sri Lanka is a tropical country. Malaria was endemic in the dry and intermediate zones while it was epidemic in the wet zone. The climate of the country is conducive for the proliferation of the primary malaria vector (*Anopheles culicifacies*) which contributes to the high receptivity of the country (Konradson *et al* 2000, Premaratna *et al* 2014). In addition, *An. subpictus, An. annularis, An. varuna, An. vagus* and *An. tessellatus* are considered secondary vectors. (AMC 2019)

An introduced malaria case reported in 2018 in Sri Lanka (Karunasena *et al* 2019), further confirmed the ability of the primary vector to transmit malaria disease. Globally well-known invasive urban malaria vector *An. stephensi* reported since 2016 has increased the receptivity in the country (Dharmasiri *et al* 2017). Local and foreign populations returning from neighbouring malaria-endemic countries for various reasons pose a constant threat of increasing the importation risk from imported cases of malaria into Sri Lanka. The malaria vector mosquitoes are widely prevalent in the country and when coupled with importation risk the probability of resurgence will be a threat in sustaining malaria eliminated status. Therefore, well organized entomological surveillance needs to be utilized for strategic decision-making including appropriate malaria vector control.

AMC has trained entomological staff where their expertise in entomological activities could be used for other vector-borne disease surveillance (i.e. Leishmaniasis and Dengue) with suitable task shifting wherever appropriate without compromising necessary malaria activities. Therefore, an optimal set of entomological surveillance operations has been reviewed and developed to be used in AMC incorporating the views of experts in malaria in the country.

2.0 Objectives of the Entomological Surveillance in PoR of Malaria

a. General Objective:

To determine the malaria receptivity in the country to generate entomological evidences to implement vector control interventions based on the susceptibility to insecticides and bio efficacy of vector control tools.

b. Specific objectives

1. To assess the receptivity of the locations where importation risk is high through focused entomological investigations

2. To stratify the receptivity in different geo-climatic areas.
3. To assess the receptivity when a malaria case is reported to prevent onward transmission by taking appropriate vector control measures promptly.
4. To assess the spatiotemporal distribution of *An. stephensi*; the invasive urban potential malaria vector.
5. To provide essential information and monitor changes in vector bionomics relevant to vector control.
6. To assess the insecticide susceptibility status of the vector/s, and residual bio efficacy of vector control tools.
7. To provide evidence through operational research to improve the efficacy and the quality of vector control.

3.0 Methodological Concepts/ Guiding Principles

Guiding principles for entomological surveillance are based on receptivity and importation risk.

Receptivity - Receptivity of an ecosystem to the transmission of malaria. A receptive ecosystem should have the presence of competent vectors in abundance, a suitable climate and a susceptible population (WHO, 2021).

Importation risk - Probability of influx of infected individuals and/or infective anopheline mosquitoes (WHO, 2021)

Sri Lanka is a tropical country and it has been traditionally divided into three climatic zones viz. 'dry', 'intermediate' and the 'wet zone' based on seasonal rainfall. Climatic and environmental factors of the dry zone, which cover 2/3 of the country, favorable for vector breeding and survival throughout the year and considered receptive. Therefore, the country's high malariogenic potential may lead the country to a high risk of the re-establishment of malaria.

Geographical areas of the country are categorized into Low, Moderate and High based on receptivity and importation risk (Table 1). The risk categorization is to be applied to the Medical Officer of Health (MOH) areas and it has to be updated monthly.

Table 1. Risk categorization for malariogenic potential

Receptivity / Importation risk	Low	Moderate	High
Low	Low risk	Low risk	Moderate risk
Moderate	Low risk	Moderate risk	Moderate risk
High	Moderate risk	Moderate risk	High risk

The receptivity scoring system is annexed (Annexure 1)

3.1 Types of Entomological Surveys

1) Reactive spot surveys -Reactive surveys are carried out when a malaria patient is reported to assess the areas, where the patient has stayed at least a night within the previous 2 weeks since the onset of clinical symptoms till diagnosed.

2) Proactive spot surveys - To assess the receptivity and vector occurrence in different locations (specially where populations with high importation risk reside) to take appropriate preventive/ control measures.
   2.1 Larval and adult surveys
   2.2. Larval surveys
   2.3 Larval surveys targeting *An. stephensi* - in urban, peri urban and areas identified as risk of introduction.

3) Sentinel surveys - Carried out in fixed locations on monthly basis to monitor the trends of vital entomological parameters (vector abundance, bionomics and level of susceptibility).

3.2 Site selection for entomological surveillance

3.2.1 Reactive spot surveys

Regardless the previous data on importation risk and receptivity, reactive spot surveys should be carried out in the places where malaria patient has stayed during night, evening or early morning within the previous two weeks before the onset of fever/ clinical features until treatment started.

3.2.2 Proactive spot surveys

Site selection for proactive spot surveys is based on importation risk measuring guide (Vulnerability Guide 2019 or updated version) and receptivity measuring guide

(Annexure 1). Given the time and resource constrains, it is advisable to give high priority to areas with high importation risk to resource mobilization. In the absence of importation risk, the survey can be carried out in an area with potential moderate/high receptivity to collect mosquitoes for testing purposes. However, to get a representative idea on country's receptivity, AMCHQ will discuss with the relevant regions to select the proactive spot site during monthly review at the national level.

3.2.3 Sentinel site surveys

Site selection for sentinel surveys is based on previous data on importation risk measuring guide (Vulnerability Guide 2019 or updated version) and receptivity measuring guide (Annexure 1) and on specific requirements such as bionomic studies including resistance monitoring. The list of sentinel sites will be reviewed annually by Entomologists AMCHQ and revised with the inputs of technical staff of AMCHQ and RMO.

3.3 Summarizing guide to entomological activities in PoR

Table 2 shows the risk stratification at a glance and how each type of survey should be applied in different risk scenarios. (Note : The colours are applied based on the package of entomological surveys)

Table 2. Guide to entomological activities based on risk stratification in PoR

Importation risk \ Receptivity	Low	Mod	High
Low	Reactive (1-3 days).	Reactive (3-7 days) Proactive(L) (1 - 3 days)	Reactive (3-7 days) Proactive (AL) (3-5 days) Sentinel (5-7 days) *
Mod	Reactive (1-3 days). Can be extended 5 days if justified Proactive (L) (1 - 3 days)	Reactive (3-7 days) Proactive (L) (1 - 3 days) Proactive (AL) (3-5 days)	Reactive (3-7 days) Proactive (AL) (3-5 days) Sentinel (5-7 days) *
High	Reactive (1-3 days). Can be extended 5 days if justified Proactive (L) (1 - 3 days)	Reactive (3-7 days) Proactive (L) (1 - 3 days) Proactive (AL) (3-5 days)	Reactive (3-7 days) Proactive (AL) (3-5 days) Sentinel (5-7 days) *

(Proactive (AL) - Proactive adult and larval survey; Proactive (L) - Proactive larval survey)

*Sentinel survey can be exempted if the Reactive spot survey was done in the same locality within the same month. The sentinel surveys need to be carried out at monthly intervals for 5 days. The duration of these surveys is extended with additional techniques quarterly up to 7 days.

Proactive survey can be done if any survey has not been done within the past three months in the same locality

3.4 Description of different types of surveys

3.4.1 Reactive spot surveys

Reactive spot surveys are carried out for all confirmed malaria cases as per the scope of work to be performed when a malaria patient is reported: Reported malaria cases should be covered with reactive entomological surveys to evaluate the receptivity status in the areas where the patient has stayed during night, evening or early morning within the previous two weeks before the onset of fever/ clinical features until treatment started. It should be initiated within 48 hours from diagnosis of case and should cover an area approximately within a 1 km radius the above selected

sites. (Refer scope of work when a malaria patient is reported). If vector breeding places are not detected within the area of 1 km radius the survey area may be extended as appropriate in previously receptive areas.

Techniques to be conducted

- Larval survey
- Indoor hand collection
- Spray sheet collection
- Human landing night collection (Full night collection and/or Partial night collection)
- Ovary dissection and determination of parous rate,
- Detection of infectivity by salivary gland dissections of human biting anophelines,
- Detection of infectivity by Polymerase Chain Reaction (PCR)
- Cattle baited net trap collection
- Cattle baited hut collection (mobile hut)
- Window trap (preferably in follow up surveys)

If an adequate number of mosquitoes are available, the following techniques will be conducted as appropriate.

- Insecticide susceptibility test
- Bio-efficacy testing for vector control interventions (Insecticide treated nets (ITN)/ Indoor residual spraying (IRS))

The duration of the survey may be varied from 1 to 7 days based on the need as expressed in Table 2 for confirmed malaria cases. If vector control measures are carried out, a follow up entomological survey should be conducted within 7 days after the completion of vector control activities. In the follow up survey, larval and adult sampling techniques need to be carried out with the relevant bioassays.

In situations of outbreaks, the duration of the malaria entomology survey can be extended based on the technical advice of the Entomologist AMCHQ.

3.4.2 Proactive spot surveys

At least two proactive spot surveys should be carried out per month in different locations within each RMO region depending on the high importation risk. However proactive spot surveys targeting insecticide susceptibility testing should be carried out in high receptive areas annually during the season of high mosquito densities. The proactive site should include the population with high importation risk residing around and/or main vector breeding site/s covering an area of approximately 1 km radius from the center of the site. The areas with high importation risk should be covered more frequently. Proactive spot surveys can be conducted to map the existing and possible larval habitats in the region.

Techniques to be conducted,

3.4.2.1 Proactive Spot survey (Adult and Larval surveys)

- Larval survey
- Cattle baited hut collection (mobile hut)
- Indoor hand collections/Spray sheet collections
- Cattle baited net trap collections
- Human landing night collection (partial night)
- Window trap collections when necessary
- Ovary dissections for parity
- Insecticide susceptibility testing (in high receptive sites)
- Bio-efficacy testing for vector control interventions (Insecticide treated nets (ITN)/ Indoor residual spraying (IRS)

3.4.2.2 Proactive Spot survey (Larval surveys)

- Larval survey

3.4.2.3 Proactive Spot survey (Larval survey searching for An. stephensi)

Larval surveys (mainly focusing on *An. stephensi* preferred breeding sites (eg- wells, water storages items etc.). Special attention should be given to the surveys done in urban and peri urban areas.

- An entomological surveillance plan should be developed and implemented for *An. stephensi* by the relevant RMO coordinating with the Entomologist and in consultation with AMCHQ.

- Larval surveys of all potential mosquito breeding sites to be carried out covering the following areas;
  - Urban, peri urban and areas identified as risk of introduction for *An. stephensi*. areas with abundance of wells, overhead tanks/ ground tanks and other water storage containers.
  - Transportation hubs eg- main bus/railway stations (especially stations where buses/trains come from *An. stephensi* positive regions).
  - Areas with sea and coastal entries, fishing harbours, and airports.

- When *An. stephensi* is detected in a proactive spot survey for the first time in the region, findings should be convey to AMCHQ. The site should be converted to a sentinel site after consultation with the AMCHQ

3.4.3 Sentinel site surveys

Sentinel site monitoring provides continuous collection of entomological data to observe vector bionomics, vector density trends and susceptibility to insecticides to generate evidence for proper vector management strategy. Site selection should be done based on high receptivity regardless of the importation risk according to Table No 2 (Guide to entomological activities based on risk stratification in PoR). Low importation risk areas are preferred for vector bionomic studies. Moderate and high importation risk areas could be selected for vector bionomic studies and for inform vector control decision.

The sentinel site should include the main vector breeding site/s and/or area identified with high importation risk approximately 2 km radius from the center of sentinel site. Furthermore, regions with *An. stephensi* reported for the first time also can be selected as a sentinel site.

Entomological techniques to be conducted (monthly)

- Larval Surveys
- Indoor hand collections/Spray sheet collections
- Cattle Baited Huts Collection
- Cattle baited net trap collections
- Outdoor resting collection and collections/spray sheet collections
- Human landing night collection – (partial night)
- Ovary dissections for parity
- Window trap collections when necessary
- Insecticide susceptibility testing (annual basis for each class of insecticides)
- Bio-efficacy testing for vector control interventions

Entomological techniques to be conducted in extended surveys (quarterly)

- Human landing night collection (HLNC) full night survey

Points to be noted

- If a new site needs to be identified as a sentinel site, RMO should seek the concurrence from AMCHQ based on importation risk and receptivity of that particular site.
- If primary vector or secondary vectors are not found consecutively for one year in a particular sentinel site, the location needs to be changed following discussion with AMCHQ.

3.5 Insecticide Resistance Monitoring

Determining the presence, level and type of resistance in local vector populations to insecticides (or class) currently in use or being considered for future use for vector control, is crucial for selecting effective vector control interventions.

For monitoring insecticide resistance, sentinel sites will be selected representing the country and the sites will be decided from the national level based on the following aspects;

- vector species composition & density
- selection pressure from insecticide use
- previously reported resistance/ history of insecticide resistance

In addition to carrying out insecticide susceptibility tests in the selected sentinel sites, if adequate number of *Anopheles* mosquitoes for a standard test is found during the proactive surveys, recommended to conduct susceptibility tests in those localities. In any of above surveys, the duration of the survey may be extended to collect adequate number of malaria vectors to complete standard susceptibility test/s.

3.5.1. Factors to be considered in conducting insecticide resistance monitoring in selected sites,

- Vector species - *An. culicifacies*, *An. subpictus* and *An. stephensi*
- Timing of testing - annually for above species for insecticide/s in selected insecticide class/s.
- Changing the site - based on the availability of mosquitoes (once site has selected, it should be operated at least for one year).
- Techniques to be conducted to collect vector species - larval survey, cattle baited hut collection and cattle baited trap collection.
- Further studies on confirmed resistance will be carried out by the AMCHQ.
- WHO standard tube testing / WHO bottle bioassay may be conducted (WHO, 2022 a & b)

Standard Insecticide susceptibility tests should be performed on major malaria vector *An. culicifacies* at least once a year for the selected insecticide classes in selected sentinel sites. In addition, the testing shall perform for invasive potential vector *An. stephensi* and secondary vector *An. subpictus*.

Susceptibility tests may be performed for other secondary vectors when adequate numbers of vectors are found. The following points should be noted in,

- Mosquitoes should be tested for discriminating concentration of insecticides.
- If resistance is observed for discriminating concentration of an insecticide, intensity of the resistance can be tested for higher concentrations.
- If possible-resistance is observed for discriminating concentration of an insecticide, the test should be repeated in the following month.
- If confirmed pyrethroid resistance is observed, WHO synergist insecticide bioassay test should be performed.

Larval susceptibility tests could be performed to establish baseline or monitor larval susceptibility against discriminating concentration of Temephos for *Anopheles culicifacies, Anopheles subpictus* and *Anopheles stephensi* larvae. Monitoring should be carried out annually in areas where chemical larval control is implemented or planned to be implemented. This bioassay may be performed for other secondary vectors if enough number of larvae are found.

The insecticide resistance data should be mapped, entered systematically and analyzed semi-annually to determine the resistance profile of local vectors. This data will be used by the AMCHQ as a basis for choosing insecticides in line with insecticide resistance management plans.

When insecticide resistance is detected in a locality, RMO/HEO should inform Entomologists of AMCHQ to plan further testing.

3.5.2 Monitoring Residual bio-efficacy of vector control interventions/products (IRS and ITNs)

Determination of the efficacy of insecticides used in ITNs or IRS operations is an essential component in the vector control operations. Cone bioassays are recommended by WHO to assess the residual bio efficacy of ITNs or insecticides formulations used in IRS.

Bio efficacy test is performed to assess the following aspects

- Residual efficacy of ITNs
- Residual efficacy of IRS
- To assess the quality of the IRS operation

Site selection

Localities where core vector control interventions have been conducted

When to perform testing

Residual efficacy of IRS

- Testing should be conducted after 1 week, 3 months and in 6 months period after the application of IRS.

Residual efficacy of ITNs

- Reactive vector control operations – Bioassays should be conducted after 1 week, 3 months and in 6 months period after the deployment of ITN. This may be continued based on malaria importation risk.
- Proactive vector control operations – Bioassays should be conducted to monitor the residual efficacy of the ITN in a few selected sites representing the country at 3-month intervals.

3.6 Summary of different types of surveys

Table 3 Summarizes the objectives, entomological techniques, indicators to be monitored, site selection, frequency and duration of the different types of entomology surveys to be conducted according to the risk of transmission described in the previous sections.

Table 3. Summary of different entomological surveys

Types of survey	Operational Definition & Objective	Entomological techniques	Indicators	Where to Apply	When to Apply/Frequency	Duration
Reactive surveys	Entomological investigations undertaken for each imported malaria case or cluster or any secondary cases reported in an area/s to find out receptivity.	LS, CBTC, CBHC (Mobile Hut), HLNC (with ovary and salivary gland dissections), IRC, ORC, WTC, Susceptibility tests Bioassays	Primary/ secondary vector occurrence, larval densities, adult densities, human biting rate, peak biting time, resting densities & surfaces, parous rates, level of susceptibility, mortality rates after 24 hours,	Areas with reported cases	When a confirmed malaria case is reported	3 – 7 days
Reactive follow-up surveys	Entomological investigations undertaken for each area/s where core vector control was conducted for malaria case to find out receptivity.	LS, CBTC, CBHC (Mobile Hut), HLNC (with ovary and salivary gland dissections), IRC, ORC, WTC, Susceptibility tests Bioassays	Primary/ secondary vector occurrence, larval densities, adult densities, human biting rate, peak biting time, resting densities & surfaces, parous rates, level of susceptibility, mortality rates after 24 hours,	Area/s where core vector control is conducted for reported malaria case/cases	One week after completion of core vector control activity.	3 -5 days
Sentinel surveillance	Entomological investigations	CBTC, CBHC, IRC, ORC, LS,	Larval densities Adult densities	Areas with high	Monthly	5 days monthl

	undertaken routinely to monitor trends over time and carried out in an area where there is a high malariogenic potential and/or high receptivity risk or where *An. stephensi* is reported over a period of time. Monitor insecticide resistance	WTC, HLNC (partial night in monthly and full night in quarterly basis), Susceptibility tests	Seasonal abundance Human biting rates peak biting time, exophagy, endophagy resting densities & surfaces, parous rates, level of susceptibility,	importation risk and highly receptivity		y and can be extended upto 7 days quarterly with additional techniques.
Proactive Spot survey (Adult and Larvae)	Entomological investigations undertaken in targeted areas with significant risk of re-introduction (e.g. due to the influx of potential sources of infection). Including mapping and knowledge of key larval habitat	CBTC, CBHC, IRC, ORC, LS, HLNC (partial night) Susceptibility test Bio assays	Larval densities, adult densities, resting behaviours, feeding behaviour (partial night collection); Level of susceptibility	Areas with high/moderate importation risk and no entomological data within the past 3 years	As importation risk changes	3-5 days
Proactive Spot survey (Larval only)	Entomological investigations undertaken in targeted areas with a significant risk of importation where the receptivity risk is unknown or minimum.	LS only	Larval densities Habitat availability/occupancy	Areas with high, moderate or low importation risk with no data available for receptivity	As importation risk changes	1-3 days
Proactive Spot survey (Larval surveys targeting *An. stephensi)*	Entomological investigations undertaken in areas with the presence of *An. stephensi* infestation and, in urban, peri urban and areas identified with risk of introduction for *An. stephensi,* to containment of the spread of *An. stephensi.*	LS covering wells, water storage items and small size containers, roof gutters and discarded receptacles …etc.	Larval densities	In urban, peri urban and areas identified as risk of introduction and transportation hubs	Monthly (if there are few such places can be done on a rotation basis)	1-3 days

4.0 Mapping

Entomological surveys need to be mapped using software such as ArcGIS/ QGIS/ Google earth/ Google my maps for better understanding and response.

Reactive, proactive and sentinel surveys should be mapped to show the spatial distribution of vectors, vector breeding sites and locations where various techniques were performed in the sampling area.

5.0 Entomological staff

It is important that entomological surveys are conducted by skilled and trained entomological teams to ensure the accuracy, quality and reliability of data collected.

In that aspect it is vital that the surveys are conducted by qualified entomological staff under direct competent supervision. Entomological surveys are carried out by the trained entomological teams attached to the Regional Malaria Offices and Anti Malaria Campaign Headquarters.

5.1 Malaria entomology team composition

The number of members in an entomology team for an adult and larval survey is eight and it is usually comprised of two Health Entomology Officers (HEO), one Public Health Field Officer (PHFO), five spray machine operators (SMO)/Health Assistants (HA) and a driver. However, if only one HEO is available two PHFOs can be included to the team.The Health Entomology Officer is the team leader and he/she is responsible for performing the techniques according to the SOPs and the guidelines and reporting. However, the number of team members may be reduced based on the type of survey and the techniques to be performed.

6.0 Data Reporting

The entomological data collected through the different types of surveys are to be used for decision making and the data are to be stored at regional and Headquarters levels as hard copies and soft copies. Data is also entered into the Google database using Google Forms to be visualized in the Receptivity Google dashboard. The data should be presented in monthly reviews, semi-annual reviews and annual reports.

Data formats and reporting

- Record the entomological findings in entomology forms.

6.1 Reporting deadlines

Reactive surveys

Findings of the survey should be communicated to RMO by the respective Health Entomology Officer in charge of the team on daily basis and RMO should communicate AMCHQ regarding important findings immediately over the phone with Entomologists and the technical staff of AMCHQ. The final report should be submitted to the RMO by the respective Health Entomology Officer in charge of the team immediately after the completion of the survey. RMO should send the final report via fax or email to Entomologists of AMCHQ immediately. A hard copy of each data set is to be forwarded to the Anti Malaria campaign Headquarters via post within 3 days after completion of

the survey. HEO conducted the survey should enter data into the receptivity dashboard within 3 days after completion of the survey.

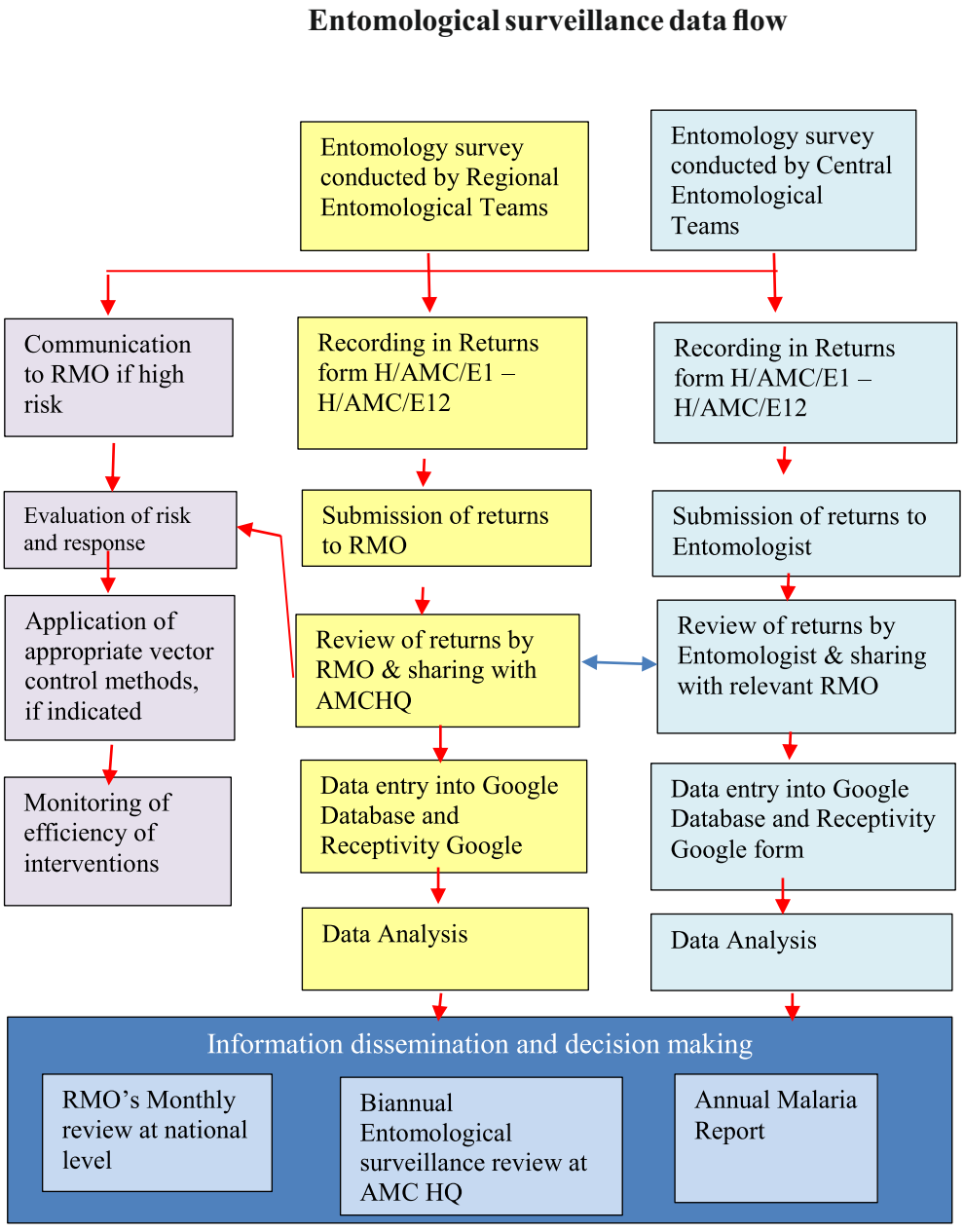
Proactive surveys

To be submitted to RMO within 3 days after completion of survey; To be entered into the receptivity dashboard and submitted to AMCHQ within 3 days after completion of the survey.

Sentinel entomological surveillance

To be submitted to RMO within 3 days after completion of survey; To be entered into the receptivity dashboard and submitted to AMCHQ within 3 days after completion of the survey.

Figure 1. Entomological surveillance data flow in Anti Malaria Campaign.



Annexures

Annexure 1. Receptivity Measuring Guide

Receptivity measuring guide: Apply this for the level of Medical Officer of Health (MOH) area for a particular survey except for Larval only surveys.

Type of the parameter	Indicator	Density/Availability	Receptivity score
Presence and Density of Vectors	Presence of Primary Vector Larvae	>20 per 100 dips >10-20 per 100 dips 0-10 per 100 dips 0	4 3 2 0
	Presence of primary vector adults (From Cattle Baited Hut Collection)	>20 per hut >10-20 per hut 0-10 per hut 0	8 6 4 0
	Presence of Secondary vectors larvae	Yes No	1 0
	Presence of Secondary vectors adults	Yes No	1 0
	Presence of *An. stephensi* larvae	Yes No	2 0
	Presence of *An. stephensi* adult	Yes No	2 0
Biting Behaviour and its density	Presence of Human Biting Behaviour of *An. culicifacies* (Indoor)	>1 per man hour 0<1 per man hour 0 per man hour	6 5 0
	Presence of Human Biting Behaviour of An. culicifacies (Outdoor)	>1 per man hour 0<1 per man hour 0 per man hour	6 5 0
	Presence of Human Biting Behaviour of Secondary malaria vectors (Outdoor)	Yes No	2 0
	Presence of Human Biting Behaviour of Secondary malaria vectors (Indoor)	Yes No	2 0
	Presence of parous *An. culicifacies*	Yes No	4 0
	Presence of parous secondary malaria vectors	Yes No	2 0
Geographical and Topographical Factors	Presence of key breeding places for primary vector	Yes No	1 0
	Presence of developmental projects creating more breeding grounds	Yes No	1 0

	Altitude (<1750m)	Yes No	0.5 0
Climatic Factors	Temperature (within the range of 17-34°C)	Yes No	0.5 0
	Relative humidity >60%	Yes No	0.5 0
	Rainfall	Heavy Moderate No	0 0.5 0.5
Malaria endemicity	Previous malaria endemicity	Yes No	1 0

** *Primary vector – Anopheles culicifacies*

*** *Secondary vectors-Anopheles subpictus, Anopheles annularis, Anopheles varuna, Anopheles vagus and Anopheles tessellatus*

- *The data is updated on monthly basis. However, the data could be applied on annual basis to assess the receptivity of the region /country.*

Score	Level of Receptivity
1-7	Low
8-17	Moderate
> 17	High

Special Instructions:

- If infective *Anopheles* are detected receptivity categorization should be 'High' regardless of the other factors.
- If life stages (larva or adult) of *Anopheles stephensi* are newly detected in an MOH area receptivity categorization should be “High” regardless of other factors based on the elimination strategy of the *An. stephensi*. If more than one possible scenario is present take all of them for weightage.

Annexure 2. Entomology activity schedule

Table 4: Entomological Activity Schedule (5 day) for Reactive surveys; Larval and adult survey.

Techniques	LS	CBTC	CBHC	WTC	LTC	IRC	SSC	HLNC/P	HLNC/F	ST	BAT
No/day	500 dips	1 trap	1 hut	2 trap	2 traps	0.5 Mhrs	10 rooms	1	1	*	*
Time	8:00	5:00	5:00	6:00	6:00	7:30	7:30	18:00-21:00	18:00–06:00		
Day 1	✓	Site selection for techniques, logistic arrangements, setting up traps and hut									
Day 2	✓	✓	✓	✓	✓	✓		✓		*	*
Day 3	✓	✓	✓	✓	✓		✓		✓	*	*
Day 4								✓		*	*
Day 5	✓	✓	✓	✓	✓					*	*
Total Work output	2000 Dips	3 Traps	3 Huts	3 Traps	6 Traps	5.0 Mhrs	10 Rooms	36 Mhrs	48 Mhrs	*	*

***** Number of tests depends on *Anopheles* vector mosquito density;

Note

1. If SSC is not performed it can be replaced with IRC
2. In low receptive areas, only Larval survey, IRC and Partial HLNC (1-3 day) can be conducted.
3. Number of dips in LS can vary with the availability of water resources

Table 5: Entomological Activity Schedule (5 day) for Proactive/Sentinel site surveys; Larval and adult survey.

Techniques	LS	CBTC	CBHC	WTC	LTC	IRC	SSC	HLNC/P	ST	BAT
No/day	500 dips	1 trap	1 hut	2 trap	2 traps	0.5 X 10 Mhrs	10 rooms	1	*	*
Time	8:00	5:00	5:00	6:00	6:00	7:30	7:30	18:00-21:00		
Day 1	✓									
Day 2	✓	✓	✓	✓	✓	✓		✓	*	*
Day 3	✓	✓	✓	✓	✓		✓	✓	*	*
Day 4	✓	✓	✓	✓	✓	✓		✓	*	*
Day 5		✓	✓	✓	✓				*	*
Total Work output	2000 Dips	4 Traps	4 Huts	8 Traps	8 Traps	10 Mhrs	10 Rooms	54 Mhrs	*	*

***** Number of tests depends on *Anopheles* vector mosquito density

Note -

1. If SSC is not performed it can be replaced with IHC
2. Only a Larval survey (1-3 day) can be conducted in proactive surveys in low receptivity areas
3. Number of dips in LS can be vary with the availability of water resources
4. Number of days for AMCHQ Entomology teams can be extended based on the objectives and the distance to localities

CBTC- cattle baited trap collection, **CBHC**- cattle baited hut collection, **WTC**- window trap collection, **LTC** – light trap collection, **IRC**- indoor resting collection, **SSC**- spray sheet collection. **LS**- larval survey, **HLNC**- human landing night collection, **ST**- susceptibility test, **BAT**- bioassay test
(✓- This technique should be performed; performing other techniques are optional)

Table 6: Entomological Activity Schedule for Sentinel site surveys (quarterly extended to 7 days); Larval and adult survey.

Techniques	LS	CBTC	CBHC	WTC	LTC	IRC	SSC	ORC	HLNC/P	HLNC/F	ST	BAT
No./day	500 dips	1 Trap	1 hut	1 trap	2 traps	0.5 Mhrs	10 rooms	4 Mhrs	1	1	*	*
Starting Time	8:00	5:00	5:00	6:00	6:00	7:30	7:30	8:00	18:00-21:00	18:00-6:00		
Day 1		Site selection for techniques, logistic arrangements, setting up traps and hut										
Day 2	✓	✓	✓	✓	✓	✓			✓		*	*
Day 3	✓	✓	✓	✓	✓		✓		✓		*	*
Day 4	✓	✓	✓	✓	✓			✓			*	*
Day 5											*	*
Day 6	✓	✓	✓	✓	✓	✓			✓		*	*
Day 7	✓	✓	✓	✓	✓		✓				*	*
Total Work output	3000 Dips	5 Traps	5 Huts	5 Traps	10 Traps	10.0 Mhrs	20 Rooms	8 Mhrs	542 Mhrs	48 Mhrs	*	*

***** Number depends on *Anopheles* vector mosquito density

Note

2. The Number of dips in LS can vary with the availability of water resources

Table 7: Entomological Activity Schedule (3 day) for Proactive site surveys; Larval adult survey.

Techniques	LS	CBTC	CBHC	WTC	LTC	IRC	SSC	HLC/P	HLC/F	ST	BAT
No./day	500 dips	1 trap	1 hut	2 trap	2 traps	0.5 X 10 Mhrs	10 rooms	1	1	*	*
Time	8:00	5:00	5:00	6:00	6:00	7:30	7:30	18:00-21:00	18:00-06.00		
Day 1	✓									*	*
Day 2	✓	✓	✓	✓	✓	✓		✓		*	*
Day 3	✓	✓	✓	✓	✓		✓			*	*
Total Work output	1500 Dips	2 Traps	2 Huts	4 Traps	4 Traps	5 Mhrs	10 Rooms	18 Mhrs		*	*

***** The number of tests depends on *Anopheles* vector mosquito density

NB 1. If SSC is not performed it can be replaced with IHC

2. The Number of dips in LS can vary with the availability of water resources

CBTC- cattle baited trap collection, **CBHC**- cattle baited hut collection, **WTC**- window trap collection, **LTC** – light trap collection, **IRC**- indoor hand collection, **SSC**- spray sheet collection. **LS**- larval survey, **HLNC**- human landing night collection, **ST**- susceptibility test, **BAT**- bioassay test
(✓- This technique should be performed; performing other techniques are optional)

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