Revised Guidelines for malaria entomological surveillance in PoR phase

Anti Malaria Campaign

2017

Background:

Sri Lanka has successfully eliminated malaria from the country and has embarked on Prevention of malaria Reintroduction (PoR) phase. Entomological surveillance has been a major component of the malaria elimination strategy of the country and it has to be continued with reorientation even during the Prevention of Reintroduction (PoR) phase to measure the levels of receptivity. Anti Malaria Campaign (AMC) over the past decades, implemented a comprehensive package of entomological surveillance activities among 22 regions throughout the country. These surveillance activities have changed very little from the control through elimination and prevention of reintroduction phases even after the country has been certified a malaria free country by WHO. Therefore, an optimal, rather than exhaustive set of entomological surveillance operations, a reviewed new system has been introduced together with the local and international expert views.

Objective:

The main objective of entomological monitoring for PoR phase is the determination of malaria receptivity in an area through the analysis of entomological data in conjunction with assessments of human activities (development projects, mining, irrigation activities, pilgrimage, etc) and climate changes (e.g. drought or flooding, disasters, etc.).

This will involve extensive short-term spot checks, seasonal trend observations and receptivity monitoring in high vector density seasons as part of epidemiological vigilance.

Hence, entomological surveillance needs to be carried out focusing on following aspects

- identify the geographical distribution and relative density of vector species
- and, particularly, identify newly introduced vector species;

- Determine whether potential vectors have regained high vectorial efficiency in receptive areas.
- Determine the reaction of vectors to vector control, and recommend measures to be taken to prevent reintroduction.

Operational criteria for site selection for each type of surveys

In site selection for each type of survey, the Regional Malaria Officer/Entomologist should carry out a situational analysis on the key parameters, vulnerability and receptivity as per Annex 1 and 2. Then the risk to prevention of re-introduction of malaria should be categorized as low, moderate and high according to Table 1. The lowest unit to be applied is the Medical Officer of Health area and it has to be updated on yearly basis.

Table 1. Risk categorization

Receptivity / **Vulnerability**	**Low**	**Moderate**	**High**
Low	Low risk	Low risk	Moderate risk
Moderate	Low risk	Moderate risk	Moderate risk
High	Moderate risk	Moderate risk	High risk

Types of Entomological surveys

1. Extended sentinel site monitoring
2. Routine sentinel site monitoring
3. Proactive spot checks
4. Reactive spot checks

Summarizing guide to entomological activities in PoR

Table 1 shows at a glance the risk stratification and how each type of survey should be applied in different risk scenarios.

Table 1. Guide to entomological activities in PoR

GUIDE TO ENTOMOLOGICAL ACTIVITIES IN POR				
		Receptivity		
		Low	Mod	High
Vulnerability	Low	No routine surveillance Proactive (LS 1- 3 days) Reactive (all – 3-7 days)	No routine surveillance Proactive (LS 1-3 days) Reactive (all – 3-7 days)	Routine surveillance (Quarterly – 5 days) Proactive (LS 1 - 3 days) Reactive (all – 3-7 days)
	Mod	No routine surveillance Proactive LS 1- 3 days) Reactive (all – 3-7 days)	Routine surveillance (Quarterly – 5 days) Proactive (LS 1-3 days) Reactive (all – 3-7 days)	Routine surveillance (Quarterly – 5 days) Proactive (LS, CBHC – 1 - 3 days) Reactive (all – 3-7 days))
	High	Routine surveillance (Quarterly – 5 days) Proactive (LS 1 - 3 days) Reactive (all – 3-7 days)	Routine surveillance (Quarterly – 5 days) Proactive (LS, HLC, CBHC – 3-5 days) Reactive (all – 3-7 days)	Extended Routine surveillance (Monthly 7-10 days) Full night landing collections Proactive (LS, HLC, CBHC 3-5 days) Reactive (all – 3-7 days)

Sentinel site monitoring

Sentinel site surveillance provides continuous collection of entomological data to observe trends of local vector densities and changes of vector behavior and helps to generate evidence for proper vector management strategy.

Extended routine sentinel site monitoring

With the risk assessment it is advised to carry out continuous monthly monitoring of trends of vector densities only in high risk areas as extended routine sentinel site monitoring.

Hence, an extended routine sentinel site can be defined as a site where periodical entomological surveys are conducted to monitor vector bionomics and seasonal changes in vector densities. The area should include the main vector breeding site/s and a vulnerable population residing around it covering an area of approximately 2 km radius from the centre of sentinel site. The focus could be the main breeding site and the residence of risk population.

e.g. resettlement areas, port of entries, military camps

An extended routine sentinel site monitoring to be carried out in an area where there is high malaria transmission risk (high Vulnerability and Receptivity) over a period.

Criteria for selection

I. Areas with vulnerable populations (resettlement, migratory populations, foreign workers)
II. Areas with high receptivity (vector breeding sites present, suitable environmental conditions)

Frequency of monitoring

The extended sentinel surveys need to be carried out at monthly intervals.

Entomological techniques to be conducted

1. Larval Survey

2. Cattle-baited Huts (CBH)

3. Indoor hand collections/Spray sheet collections

4. Cattle baited net trap collections

5. Outdoor resting collection and collections/spray sheet collections

6. Human landing collection (HLC) partial and full

7. Ovary dissections for parity

8. Insecticide susceptibility testing (annual basis for each class of insecticides)

9. Bio-efficacy testing for vector control interventions

Work plan

A sentinel survey will be carried out for 7 – 10 days in each site decided by relevant authorities in the region.

Points to be noted

- It is recommended that the RMO should inform AMC HQ after analyzing the risk factors of a particular site to be monitored as an extended routine sentinel site.
- If primary vector or secondary vectors are not found consecutively for one year in a particular extended sentinel site because of the vector control measures taken the location needs to be changed after adequate discussion and recommendations by a panel comprising of Director, RMO, Community Consultant Physicians, Entomologists and relevant officers.

Routine sentinel site monitoring

With the risk assessment it is advised to carry out monitoring of vector species composition, abundance and insecticide resistance out during peak season of mosquito population in moderate risks areas.

Hence, a routine sentinel site can be defined as a site where quarterly entomological surveys are conducted to monitor vector abundance and species composition of vector species. The area may include either main vector breeding site/s and/or vulnerable population residing around it covering an area of approximately 2 km radius from the center of sentinel site. The focus could be either the main breeding site or the residence of risk population.

Criteria for selection

I. Areas highly receptive with low to moderate vulnerabilities

II Areas highly vulnerable with low to moderate receptivity

Frequency of monitoring

The routine sentinel surveys need to be carried out at quarterly intervals. If primary vector or secondary vectors are not found consecutively for one year in a particular sentinel site the location needs to be changed after adequate discussion and recommendations.

Entomological techniques to be conducted

1. Larval Survey

2. Cattle-baited Huts (CBH)

3. Indoor hand collections/Spray sheet collections

4. Cattle baited net trap collections

5. Outdoor resting collection and collections/spray sheet collections

6. Human landing collection (HLC) partial and full

7. Ovary dissections for parity

8. Insecticide susceptibility testing (annual basis for each class of insecticides)

Work plan

A sentinel survey will be carried out for 5 days in each site decided by relevant authorities in the region.

Points to be noted

- It is recommended that the RMO should inform AMC HQ after analyzing the risk factors of a particular site to be monitored as a routine sentinel site.
- When *Anopheles stephensi* is detected in a routine sentinel site, it should be converted to an extended routine sentinel site.

Spot checks

- Spot checks are carried out in areas which are not covered by sentinel surveillance in the region to collect entomological information in order to determine the receptivity of a particular area in order to take appropriate action if and when necessary.
- An area with 2 km radius with extent of five square kilometers including breeding sites of malaria vectors should be selected as a spot.
- Spot checks (proactive) should be initiated in areas with significant risk of reintroduction (e.g. influx of potential malaria carriers) and no recent entomological data available.

Proactive spot checks

- At least two spot checks should be carried out per month in different locations within the region depending on the vulnerability and receptivity. All the MOH areas in the region should be covered at least once a year by spot checks. More vulnerable areas should be covered more frequently if not selected as a sentinel site.
- To be conducted in all above scenarios when a significant risk of re-introduction (e.g. due to the influx of potential source of infection) is there or to include mapping and improve knowledge of key larval habitats in the particular area.

- Special attention should be given to the surveys done in urban areas and should refer to the guide provided for detection of Anopheles stephensi and pre and post intervention surveys.

Duration and techniques

- in areas with low/moderate vulnerability and/or receptivity
- in areas with high receptivity and low vulnerability
- in areas high vulnerability and low receptivity

  should be completed within 1-3 days with only larval surveys

- In areas with moderate vulnerability and receptivity
- in areas with high receptivity and moderate vulnerability

  Larval surveys, cattle baited hut collections and human landing catches should be carried out for 3-5 days.

Point to be noted

- When *Anopheles stephensi* is detected in a proactive spot survey, it should be converted to an extended routine sentinel site.

Reactive spot surveys

Reactive spot surveys have to be carried out in all areas with reported cases as per the scope of work to be performed when a malaria patient is reported: imported, relapsing, induced, introduced and secondary cases. In the PoR phase all the reported malaria cases should be covered with entomological survey to evaluate the receptivity status in the areas where the patient has stayed at least one night within the previous two weeks since onset of fever/ clinical features and until diagnosed. It has to be initiated within 48 hours from diagnosis of case and should cover an area approximately with 1 km radius. (Annexure 3 of scope of work). If vectors or vector breeding places are not detected within the area of 1 km radius in previously malaria endemic areas the survey could be extended more than 1 km.

Techniques to be conducted

I. Comprehensive larval survey (All possible mosquito breeding places should be surveyed)
II. Indoor hand collections
III. Spray sheet collections
IV. Human landing night collections (preferably full night collection)
V. Cattle baited net trap collections
VI. Ovary dissection and determination of parous rate
VII. Detection of infectivity by salivary gland dissections of human biting Anophelines found in HLC
VIII. Detection of infectivity by PCR
IX. Susceptibility to Insecticides
X. LLIN and IRS bioassays, if the area is covered with IRS/ LLIN

The duration of the survey should be 3-7 day. If vectors are detected during the initial survey and/or vector control measures are carried out a follow up entomological survey should be carried out. Even if the vectors are not found it is recommended to carry out a follow up entomological survey in receptive areas. It is recommended that the follow up entomological survey is done within 7 days of completing vector control activities.

Insecticide Resistance Monitoring

Insecticide susceptibility tests should be performed on major malaria vector species at least once per year using insecticides of all available insecticide classes. WHO standard test kits to be used for the Diagnostic concentrations following the latest WHO guidelines published in 2016. Priority should be given for insecticides that were shown to be resistant in the 2013 to 2017 surveys. At the minimum, the implementation framework should cover the following activities:

- Monitor IR annually in areas where there is confirmed resistance to DDT, Malathion, Cyfluthrin, Permethrin, Deltamethrin, Lambdacyhalothrin, Etofenprox, Bifenthrin Propoxur (adults of *An culicifacies* and *An subpictus*.
- Establish baseline or monitor susceptibility of *An culicifacies, An subpictus* and *An stephensi* larvae to Temephos and Pyriproxyfen, and annual monitoring. Target areas to be tested for above are areas where LSM can be applied to reduce receptivity.

Table 2. Summarizes the agreements and the entomological surveys to be conducted according to transmission risk as per the outcome of the local and international expert views.

Table 2. Summary of different entomological surveys

Type of Surveys	**Operational Definition / Objective**	**Key Entomological Techniques/ Sampling Methods**	**Parameters/ Indicators**	**Where to Apply**	**When to Apply/ Frequency**	**Duration**
Extended Routine surveillance	Monitor trends over time, and carried out in an area where there is high malaria transmission risk (high V and R) over a period or where *An. stephensi* is reported.	Larval Survey Cattle-baited Huts (CBHC); Indoor and Outdoor resting collection, Human landing collection (HLC)	Larval and adult density; feeding (full night HLC) and resting behavior	Areas highly receptive and highly vulnerable	Monthly	7-10 days
Routine Surveillance	Monitor vector species composition and abundance and insecticide resistance carried out during peak season of mosquito population in risks areas.	Larval Survey Cattle-baited Huts (CBH); Indoor and Outdoor resting collection	Larval and adult density; feeding (half night HLC) and resting behavior	Areas highly receptive with low to moderate vulnerabilities; Areas highly vulnerable with low to moderate receptivity	Quarterly	5 days

Spot Checks (Proactive)	Conducted in targeted areas with significant risk of re-introduction (e.g. due to the influx of potential source of infection). To include mapping and knowledge of key larval habitats as LSM is one of the response strategies that may be effective in certain situations.	Larval Survey in all areas; +CBH in areas with Moderate to High Receptivity and Vulnerability; +HLC in areas with Moderate to High Vulnerability and High Receptivity	Larval Density; Adult Density Feeding behavior (partial night collection);	Areas with past history of malaria transmission but no entomological data in the past 3 years; varying levels of vulnerability	As vulnerability changes	1-3 days
Spot Checks (reactive)	For each imported malaria case or cluster (of secondary cases) reported in an area, entomological investigations should be undertaken.	Larval Survey Cattle-baited Huts (CBH); Indoor and Outdoor resting collection	Larval and adult density; feeding (full night HLC) and resting behavior; parity rate determination	Areas with reported cases: imported, relapsing, induced	Case-based	3 – 7 days

Entomological Staffing Pattern

Entomological data gathered in surveys can be regarded as reliable and acceptable only when they have been collected by qualified entomological staff under the direct and competent supervision.

Entomological surveys are carried out by the trained entomological teams attached to the Regional Malaria Offices and Anti Malaria Campaign Headquarters.

Composition of malaria entomological team

The number of members in an entomological team is eight for the regional teams and it is usually comprised of 02 or 01 Health Entomology Officers (HEO), 01 or 02 Public Health Field Officer (PHFO), five junior category staff including spray machine operators (SMO)/Health Assistants (HA)and a driver. 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.

Mapping of vector breeding sites

The data on vector breeding sites generated from sentinel sites and from the spot checks in MOH areas of the region should be used to map the vector breeding sites. The region should have an inventory of potential and active vector breeding sites.

Mapping of vector breeding sites is useful to assess the malaria risk in terms of receptivity and also to facilitate vector control measures if indicated. vector density is mostly dependent upon temporal and spatial variation in rainfall, and on variety of physical factors. Larval densities and presence of different species in different kinds of larval habitats are affected with increasing size of habitats, increasing of vegetation cover and shading the habitat, water quality and depth of water bodies. Each habitats position should be recorded with hand held GPS. The extensive mapping of breeding sites provides information on targeted sites that generate adult vectors and also served as an indicator of risk of malaria transmission.

Annex 1

Receptivity Measuring Guide: Apply this for MOH level and use previous one year data for measurement

Serial Number	**Factor**	**Possible Scenario**	**Weightage**
1	Presence of potential breeding places – Primary vector, secondary vector or potential vectors	Permanent breeding sites: Semi permanent Temporary Unavailable	3 2 1 0
2	Discovery of the primary vector- *An. culicifaices* (Larva) during the period of previous year	Yes No	3 0
3	Discovery of the secondary vector- *An. subpictus* (Larva) during the period of previous year	Yes No	2 0
4	Discovery of the potential vector- *An. varuna, An. annularis*, (Larva) during the period of previous year	Yes No	1 0
5	Discovery of the secondary vector- *An. subpictus* (Adults) during the period of previous year	Yes No	2 0
6	Discovery of the potential vector- *An. varuna, An. annularis*, (Adults) during the period of previous year	Yes No	2 0

7	Human biting behavior of primary vector- *An. culicifaices*	Positive Negative	4 0
8	Human biting behavior of secondary vector - *An. subpictus*	Positive Negative	3 0
9	Human biting behavior of potential vector- *An. varuna, An. annularis*	Positive Negative	2 0
10	Resting behavior of primary vector- *An. culicifaices*	Endophillic Exophillic	3 2
11	Discovery of parous vectors	Yes No	2 0
12	Conducive environment conditions/Presence of developmental projects creating more breeding sites	Yes No	2 0

Special Points to be considered

- If infective *Anopheles* are detected receptivity categorization should be 'High' regardless of other factors.
- If life stages (larva or adult) of *Anopheles stephensi* are detected receptivity categorization should be 'High' regardless of other factors

Score	**Level of Receptivity**
< 3	Low
3-12	Moderate
> 12	High

Annex 2. Vulnerability Guide. Apply this for MOH level and use previous one year data for measurement

Serial Number	FACTORS	WEIGHTAGE	Possible scenario
1	No of Imported Malaria case s in the previous 3years	0.5 per case (maximum 3)	
2	Locality with high risk of importing malaria	(maximum 4)	• Ports of entries (2) • Illegal Entry routes (2) • Tourist areas (1) • Asylum camps (1), • Detention Camp (1), • Re- settlement areas (1) • Camps for security forces (1)
4	Presence of immigrants population from malaria endemic countries.	5	• Illegal (3)-fishermen, agricultural workers from India etc • Legal (2) - Foreign workers
5	Local people working in high risk sector in malaria endemic countries	4 (maximum)	• Gem traders/miners (2) • Businessmen (1) • UN peace keeping missions (1)

			• Other workers (1)
6	Local people returning from malaria endemic countries within one year	2	• Pilgrims (1) • Returnees from Safari (1)
7	Localities at close proximity to India- Risk of importing infected mosquitoes	2	Costal borders with anchorage facilities

Score	**Level of vulnerability**
< 1	Low
1-2.5	Moderate
> 2.5	High