**Malaria surveillance: requirements for elimination settings**

*Malaria surveillance in control settings*

The goal of surveillance, monitoring and evaluation in higher burden settings, where control, burden reduction, and case management are the primary focus of malaria programs, is to monitor the burden of malaria and inform population-level programs. Surveillance, monitoring and evaluation in high burden settings includes a combination of passive surveillance of malaria cases reported through the health system (often in the form of a health management information system, or HMIS), and periodic representative household surveys to assess population coverage of key interventions. Key metrics for evaluating the quality of the surveillance system in these settings include the proportion of facilities that report regularly, the proportion of suspected cases that are tested, and the proportion of all malaria cases that are parasitologically confirmed.

*Malaria surveillance in elimination settings*

In low-transmission and elimination settings, malaria infections tend to be more clustered in space and time, and the surveillance system needs to be more sensitive to detect these more dispersed transmission foci. This includes transitioning from aggregate, monthly district-level reporting, to more rapid reporting at health facility, community, and eventually individual levels. In elimination settings, all cases and potential foci of transmission need to be investigated in a timely manner in order to determine appropriate responses to prevent onward transmission of the disease. Ideally, the surveillance system must include real-time case reporting, within 24 hours, and rapid response to individual geo-located cases. Data collection, analysis, and case investigation must occur quickly to identify symptomatic and asymptomatic cases, and prevent additional malaria infections. Certification of malaria elimination status requires a detailed documentation of all cases and foci during this final phase, and as a result, relies upon complete, robust participation of the entire health system. Internet and communication technologies can improve surveillance and response, however, malaria programs should use them only in locations where the capacity and infrastructure exist to implement and maintain them.

The key aspects of surveillance in the malaria elimination phase are outlined below.

*Case investigation*

A key component of surveillance for malaria elimination is case investigation, whereby a detailed investigation is conducted for every confirmed case of malaria. Case investigation involves characterizing patient demographics, travel history and other risk factors, and ideally geo-locating the residence of the patient, and/or likely location of infection. A key output of case investigation is classification of the case as either local or imported, which allows for accurate tracking of local transmission and determining appropriate targeted response.

*Active case detection*

Active case detection consists of identifying malaria infections by testing individuals whether they are symptomatic or not, and is most commonly conducted in the community, rather than in health facilities. Active case detection is often conducted in response to a case presenting at a health facility, as part of case investigation. This form of active case detection is referred to as ‘reactive’ case detection, or RACD, and is practiced by a large number of malaria programs globally. Traditionally, reactive case detection is conducted in the household of the index case and a small number of neighboring households, with the goal of identifying and treating any secondary cases. While there is limited evidence of impact on transmission, this form of targeted surveillance provides programs with additional information to classify foci of transmission and target response. Active case detection can also be conducted proactively in potentially high risk areas even in the absence of cases detected through the health system, to identify potential asymptomatic infections, or individuals who may have difficulty accessing the health care system.

*Foci investigation, classification, and response*

In addition to providing surveillance information about individual cases, active case detection is conducted to help programs define foci of transmission. A ‘focus’ is defined as an area that contains the epidemiological and ecological factors necessary for malaria transmission, which may or may not have current active transmission. Foci investigation and classification is a key component of surveillance for malaria elimination programs. Foci investigation involves defining the area of transmission or transmission potential through a field assessment including active case detection, geographical reconnaissance, entomological investigation, and community behavioral surveys. Based upon this investigation, a detailed map of each focus is developed, and the focus is classified as active (ongoing transmission), residual non-active (recent transmission interruption), or cleared (no local transmission for more than 3 years), with potential responses including vector control, active case detection, or in some cases mass drug administration, depending on the type of foci and program priorities. A foci register is maintained and updated regularly.

*Integrating new technologies*

Historically, foci investigation was conducted through the use of hand drawn maps, but current programs have access to a wide variety of technologies to assist with case reporting, investigation, mapping, and response. These include modern geographical information systems (GIS) and spatial decision support systems (SDSS), as well as mobile tools for data capture at the health facility and community level. These technologies can greatly improve the flow, visualization, and rapid analysis of data, but should only be applied where they are locally appropriate and when they can be used effectively.

*The ideal: integrated information systems, analytics, and feedback to decision makers*

Ideal information system for malaria surveillance incorporate existing external data into the system, such as climate and census information, to ensure that decisions are based on all relevant and available information. The ideal surveillance system should include automated data analysis to ensure timely and consistent outputs, and customized output and feedback such as charts, graphs, work task lists, needed resources, and reports. The surveillance system should ensure that all key members of the health system have access to program data and outputs, including those working at the community level, and provide instructions to the malaria program about how best to respond to outputs in a timely, effective and targeted manner.

*Engaging the private sector*

In many settings, the private health sector is a primary source of care. Given its diversity and reach, the private health sector is an essential partner for malaria surveillance and represents an underutilized resource for malaria programmes to deliver effective healthcare to populations with limited access to the public sector. Engaging the private health sector in malaria surveillance is essential for ensuring all cases are rapidly and appropriately diagnosed and confirmed, reported, investigated, and response conducted. Public-private mix (PPM) programs and rapid reporting systems that integrate private sector providers, including informal ones, are critical in settings with large private sectors.

*Targeting high risk populations*

In addition to identifying geographic foci, many eliminating countries have identified distinct subpopulations at elevated risk of infection due to behaviours that increase their exposure to Anopheline mosquitoes. These high-risk populations are thought to contribute disproportionately to sustaining transmission in low transmission areas and present challenges for reintroduction following elimination. They include groups that primarily acquire and transmit infection locally as well as mobile and migrant populations (MMPs), which may import infections acquired elsewhere. Novel, targeted active surveillance and interventions are often required to access these populations; these strategies may include active case detection at remote worksites such as mining sites and forest plantations, border screening, or using social network strategies to access groups of high risk travelers.

Additional recommendations to support effective surveillance systems for malaria elimination include:

* Making malaria a notifiable disease.
* Moving to integrated notifiable disease reporting, including mandating that all health facilities report to the surveillance system regularly, even when zero cases have occurred, to ensure that all health facilities contribute data and to help prevent resurgence.
* Standardizing indicators and methods for malaria surveillance.
* Developing and implementing standard and streamlined operating procedures to improve consistency and decision-making.
* Guaranteeing free communication among members of the malaria program.
* Prioritizing the expansion of programs to subsidize or donate communication materials and air time to ensure sustainability. Ensure political and financial commitment.
* Working with the political leadership including Ministries of Health and Finance to develop political and financial capital to promote malaria elimination.

Addition references of interest:

* WHO *A framework for malaria elimination* 2017
<http://www.who.int/malaria/publications/atoz/9789241511988/en/>
* *Surveillance and response for high‑risk populations: what can malaria elimination programmes learn from the experience of HIV?* Jacobson et al. Malar J (2017) 16:33
DOI 10.1186/s12936-017-1679-1
<https://malariajournal.biomedcentral.com/articles/10.1186/s12936-017-1679-1>
* *Engaging the private sector in malaria surveillance: a review of strategies and recommendations for elimination settings*. Bennett et al. Malar J (2017) 16:252
DOI 10.1186/s12936-017-1901-1
<https://malariajournal.biomedcentral.com/articles/10.1186/s12936-017-1901-1>
* *Information Systems to Support Surveillance for Malaria Elimination*. Am. J. Trop. Med. Hyg., 93(1), 2015, pp. 145–152
doi:10.4269/ajtmh.14-0257
<http://www.ajtmh.org/content/journals/10.4269/ajtmh.14-0257>