MINISTRY OF HEALTH AND CHILD CARE

Malaria Epidemic Preparedness and Response Guidelines

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National Malaria Control Programme
Zimbabwe

Malaria
Epidemic Preparedness and Response Guidelines

Foreword

Malaria is one of the leading causes of morbidity and mortality in Zimbabwe. It is estimated that malaria accounts for 20 to 30 percent of outpatient clinic visits and approximately 10 percent of hospital admissions.

Almost 98 percent of all malaria cases in Zimbabwe are caused by *Plasmodium falciparum*, a parasite which causes the most deadly form of malaria and is a major cause of morbidity and mortality. Malaria transmission is affected by climatic changes (e.g., high seasonal rainfall and variation in temperature and humidity), socio-economic activities, and population movement, among other factors. These conditions may favour mosquito breeding, which in turn can result in increased malaria transmission and subsequent malaria outbreaks in affected areas. While the southern part of Zimbabwe is characterized by low malaria transmission, the northern region is typically characterized by more sustained and recurrent transmission. Given the fact that all pre-cursors for malaria outbreaks prevail in many parts of the country, the National Malaria Control Programme (NMCP), supported by partners, found it of paramount importance to review and update the Malaria Epidemic Preparedness and Response (MEPR) Guidelines.

The updated MEPR Guidelines provide a detailed picture of the many technical, logistical, partnership, and funding aspects required for effective Epidemic Preparedness and Response (EPR). They describe who will do what, when (before, during, and after a malaria epidemic), and how. The MEPR Guidelines explore the potential for forecasting malaria epidemics, and clarify the planning, preparedness, and response actions, using best judgment and offering recommendations on how to deal with the entire malaria epidemic cycle. The document contains guiding principles and strategies that will help all levels (national, provincial, district, and community) of the Ministry of Health and Child Care (MOHCC) and its partners to effectively manage and successfully control malaria epidemics.

The MOHCC recommends that all levels of health care use these guidelines in tandem with other key documents, including the National EPR Guidelines, Integrated Disease Surveillance and Response Guidelines, National Malaria Strategic Plan 2016-2020, and the Communication Strategy 2016-2020.

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Glossary

Action threshold – The critical level at which the number of reported malaria cases is considered to be above what is normally expected. When this threshold is crossed, an investigation should be implemented to confirm the emergence of an epidemic so that appropriate control measures can be implemented. This threshold is calculated as the mean plus 1.5 standard deviations of weekly case counts over three to five prior, consecutive, non-epidemic years.

Alert threshold – The level at which the number of reported cases is considered to be concerning, prompting close follow-up to future levels of malaria cases. This is calculated as the mean weekly case counts over three to five prior, consecutive, non-epidemic years.

Annual parasite incidence (API) – Total number of confirmed cases for parasite during one year multiplied by 1,000 and divided by the total population under surveillance.

Confirmed malaria case – Malaria case (or infection) in which the parasite has been detected in a diagnostic test (i.e. microscopy), a rapid diagnostic test, or a molecular diagnostic test.

Early warning systems – A means of predicting the likelihood of malaria epidemics. Early warning systems rely mainly on the patterns of rainfall, humidity, and temperature measured monthly or every 10 days. The warning is usually available three months before the transmission season. Other indicators that are useful in predicting the probable severity of an epidemic include mosquito and larval densities, nutritional status, drug and insecticide resistance, loss of immunity because of a recent reduction in population exposure, and human population movements in and out of endemic areas.

Early detection – Early detection requires recognition of the beginning of an epidemic by the observation of changes in local disease incidence or number of cases, mainly from surveillance data. The purpose is to detect the likelihood or the occurrence of an epidemic.

Endemic – Applied to malaria when there is a constant measurable incidence of cases and mosquito-borne transmission in an area over a succession of years.

Entomological inoculation rate (EIR) – Number of infectious bites by adult female vectors per person per unit time, usually per year. *Note: this rate is the product of the "human biting rate" (the number of bites per person per day by vector mosquitoes) and the sporozoite rate (proportion of vector mosquitoes that are infective). At low levels of transmission, the estimated EIR may not be reliable, and alternative methods should be considered for evaluating transmission risk.*

Epidemiological investigation – Study of the environmental, human, and entomological factors that determine the incidence or prevalence of infection or disease. *Note: in malaria elimination, epidemiological investigation is a part of surveillance operations and involves ascertaining the origin and means of transmission of any malaria case discovered. It involves epidemiological surveys, localized mass blood examinations, and entomological surveys to ascertain the existence and nature of any malaria foci in surrounding areas, to establish whether transmission is taking place and, if it is, its source and potential to spread.*

Foci – Well-defined areas situated in a current or former malarious area, and where there exist continuous or intermittent epidemiological factors necessary for malaria transmission.

Intermittent preventive treatment in pregnancy (IPTp) – A full therapeutic course of antimalarial medicine given to pregnant women at routine prenatal visits, regardless of whether the woman is infected with malaria.

Insecticide resistance – Property of mosquitoes to survive exposure to a standard dose of insecticide; may be the result of physiological or behavioural adaptation.

Larval source management – Management of aquatic habitats (water bodies) that are potential habitats for mosquito larvae, in order to prevent completion of development of the immature stages. *Note: the four types of larval source management are 1) habitat modification, which is a permanent alteration of the environment (e.g., land reclamation); 2) habitat manipulation, which is a recurrent activity (e.g., flushing of streams); 3) larviciding, which is regular application of biological or chemical insecticides to water bodies; and 4) biological control, which consists of the introduction of natural predators into water bodies.*

Larvicide – Substance used to kill mosquito larvae. *Note: larvicides are applied in the form of oils (to asphyxiate larvae and pupae), emulsions, or small pellets or granules of inert carrier impregnated with insecticide, which is released gradually when placed in water.*

Malaria elimination – A reduction to zero of the local transmission of infection caused by human malaria parasites in a defined geographical area as a result of deliberate efforts. Continued measures to prevent re-establishment of transmission are required.

Malaria epidemic (outbreak) – The occurrence of more cases of malaria than expected in a given area or among a specific group of people over a specific period of time. Sharp increase in the incidence of malaria in populations where the disease is rare, or a seasonal increase in areas of low-to-moderate transmission over and above the normal pattern may constitute epidemics. *Note: although there is often an attempt to differentiate between outbreak and epidemic for the purposes of this guidance, both are used here to mean the same.*

Malaria incidence – The number of newly-diagnosed malaria cases identified during a specified time period in a specified population. Normally presented as the number of new cases per 1,000 individuals.

Malaria parasite prevalence – The proportion of individuals with malaria infection detected by microscopy or rapid diagnostic at a specific point in time or over a given period of time.

Malaria surveillance – The continuous and systematic collection, analysis, and interpretation of malaria-specific data and the use of that data in the planning, implementation, and evaluation of public health practice.

Post-epidemic assessment – An assessment designed to identify successes and failures of epidemic investigation and control measures, and to indicate whether the early warning, detection, and response systems have had the expected impact on the burden of malaria.

Population at risk – Population living in a geographical area where locally-acquired malaria cases have occurred in the past three years.

Seasonal transmission – Transmission that occurs only during some months of the year and is markedly reduced during other months.

Suspected malaria case – A case in which an individual has an illness suspected by a health worker of being due to malaria, generally on the basis of the presence of fever with or without other symptoms.

Threshold limit values (TLVs) – Critical number of cases used to sound an early warning or trigger the initiation of an epidemic investigation.

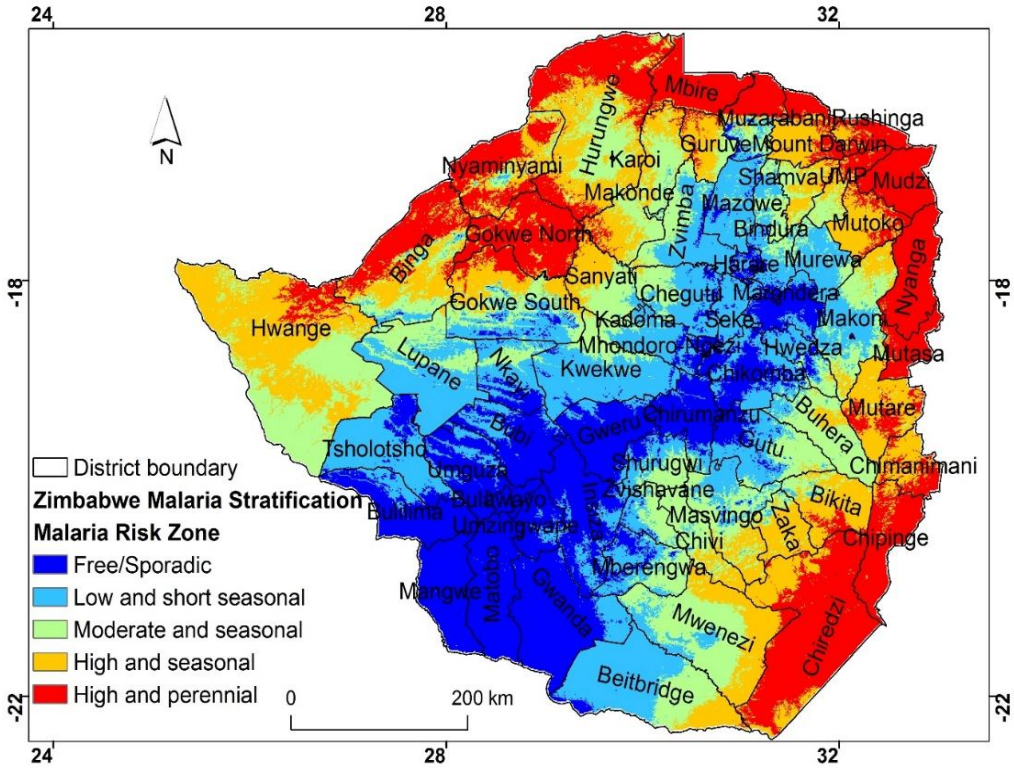
Acronyms

ACT	Artemisinin-based combination treatment
API	Annual parasite incidence
DMO	District Medical Officer
EIR	Entomological inoculation rate
EPR	Epidemic preparedness and response
EPRT	Epidemic preparedness response team
IPTp	Intermittent preventive treatment in pregnancy
IRS	Indoor residual spraying
LLIN	Long-lasting insecticidal net
LSM	Larval source management
MOHCC	Ministry of Health and Child Care
MEPR	Malaria epidemic preparedness and response
NMCP	National Malaria Control Programme
PMD	Provincial Medical Director
RDT	Rapid diagnostic test
RRT	Rapid Response Team
SADC	Southern African Development Community
SBCC	Social and behaviour change communication
SOP	Standard operating procedure
TET	Therapeutic efficacy trial
TLV	Threshold limit value
VHW	Village Health Worker
WHO	World Health Organization

1. Introduction

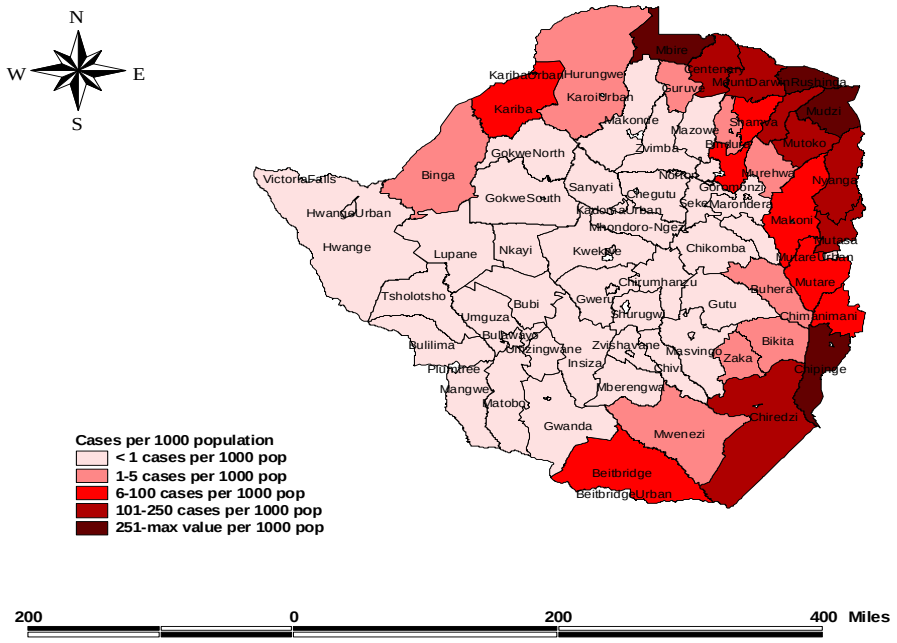
According to the WHO 2018 definition, a malaria epidemic is a sharp increase in the incidence of malaria in populations where the disease is rare, or a seasonal increase in areas of low-to-moderate transmission over and above the normal pattern. A number of human-made and natural factors can make populations susceptible to malaria epidemics. These include long- and short-term climatic variation, development activities, natural disasters, migration of non-immune populations, and scaling down or loss of effectiveness of malaria prevention and control activities (e.g., due to budget limitations, insecticide resistance, or decreased efficacy of treatment). Areas with lower-level, highly-seasonal transmission, and areas in which transmission has been reduced by interventions but where receptivity remains high, are particularly prone to malaria epidemics. Given its current epidemiological situation, most areas of Zimbabwe fit one of these two scenarios and are pre-disposed to experience malaria epidemics (*WHO Surveillance, Monitoring & Evaluation Reference Manual, 2018*).

FIGURE 1: ZIMBABWE MALARIA RISK MAP, 2015



Zimbabwe experiences the full spectrum of malaria transmission, ranging from limited transmission in the central and south-western portions of the country, to a comparatively high malaria burden in the northern and eastern provinces (see Figures 1 and 2). Although transmission can occur year-round in most areas, the majority of malaria transmission occurs during the December to April rainy season.

FIGURE 2: MALARIA INCIDENCE MAP BY DISTRICT, 2017



The geography and ecology of central and south-western parts of Zimbabwe support low levels of highly seasonal transmission. In these areas, the population has limited immunity. As a result, transmission is unstable and small variations in climatic or other contributing factors can result in increased transmission and localized epidemics. The goal of the NMCP is to eliminate malaria in these areas, making the identification and control of these epidemics critical to the success of the programme.

In addition to efforts deployed in lower burden areas, the NMCP with support from partners, has worked diligently to reduce the malaria burden in higher-burden areas, i.e., in the north and east of the country. As a result, the malaria burden in these areas has decreased substantially compared to levels reported a decade ago. However, malaria vectors persist and transmission receptivity appears to be high, making these areas prone to epidemics. Although reduced in magnitude, seasonal malaria epidemics continue to occur on an annual basis and, depending on the mix of contributing factors for malaria epidemics outlined above, can vary substantially in magnitude. In addition, shorter-term, localized epidemics are frequently reported. This situation is complicated by the proximity of these areas to the Mozambican border and the frequent and habitual migration of individuals across the border into Zimbabwe. As Zimbabwe continues to transition from burden reduction to elimination, malaria transmission in these areas may become even less stable and epidemic prone.

Given this situation, Zimbabwe has prioritized revising the national Malaria Epidemic Preparedness and Response (MEPR) Guidelines to align with current international recommendations and to provide a framework for implementing EPR activities nationwide. The contents of these guidelines and accompanying materials are intended to provide clear guidance to health workers at all levels of the system, as well as partners who support the malaria programme. These guidelines incorporate lessons learned since the introduction of the first edition of EPR Guidelines in 2011, and build upon the experiences and expertise of the wide body of stakeholders involved in the revision process.

1.1 Objectives of the Malaria Epidemic Preparedness and Response Guidelines

1.1.1 Broad Objective

To standardise public health measures for malaria EPR, and to contribute towards reduction of morbidity and mortality as articulated in the *National Malaria Strategic Plan (2016-2020)*.

1.1.2 Specific Objectives

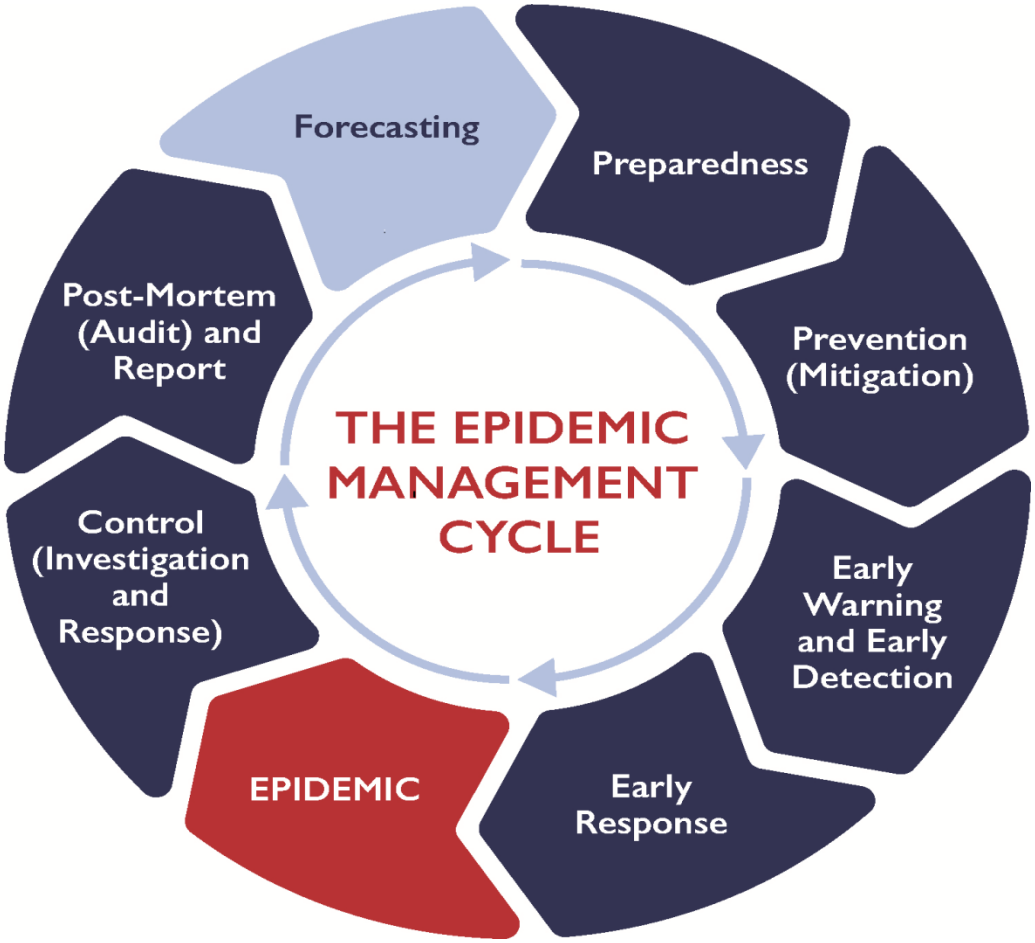
1. Provide a comprehensive framework for malaria EPR.
2. Provide specific guidance for effective implementation of malaria EPR at all levels of the health system.
3. Outline a systematic approach to monitoring and evaluating malaria epidemics.

2. Epidemic Preparedness and Response Framework

The conceptual framework for Zimbabwe's MEPR Guidelines is presented in Figure 3 below. Prompt and effective implementation of each inter-related component of this cycle is necessary to: 1) minimize the likelihood of malaria epidemics; 2) mitigate the impact of epidemics when they do occur; and 3) ensure rational and efficient use of limited malaria prevention, control, and elimination resources.

The subsequent sections of this chapter describe the rationale and implementation methodologies for each of these components.

FIGURE 3: CONCEPTUAL FRAMEWORK FOR THE ZIMBABWE MEPR GUIDELINES



2.1 Forecasting

Forecasting is the process of making predictions of a future disease burden based on analysis of trends of past, present, and future events. Forecasting is undertaken prior to the malaria season to provide a strategic overview of the expected malaria burden and to anticipate activities to be undertaken. The ability to estimate well in advance the likelihood of increased seasonal malaria transmission is critical to the success of EPR efforts. Forecasting is based on historical, entomological, and epidemiological factors, as well as ecological data and meteorological forecasts. Together, these are used to predict the timing of an increase in malaria transmission two to four months before an epidemic occurs. Forecasting happens at different levels, i.e., regional, national, provincial, district, and rural health centre. The process can also be used to estimate the number of people that are likely to be affected by malaria.

Malaria vectors breed in water and the amount of rainfall, which can be forecasted, greatly influences the ability of mosquitos to reproduce. Temperature also plays an important role in determining the rate of development of malaria vector mosquitoes and to some extent plasmodium parasites.

In forecasting, the following areas should be considered:

2.1.1 Population Movement

Population movement can be internal or cross-border, either intentional or unintentional (e.g., displacement for social or economic reasons), and temporary or permanent. In general, population movement can affect malaria forecasting and subsequent programmatic planning as it changes the population-at-risk in a given geographic location. Population movements of particular interest for forecasting include:

- From high to low malaria transmission areas, as this has the potential to introduce parasites in low transmission areas leading to increased malaria burden; and
- From low to high malaria transmission, as people moving from low transmission areas are at increased risk of developing malaria due to their relatively lower immunity.

2.1.2 Socio-economic Factors

The following socio-economic factors drive population movement and can impact forecasting:

- **Artisanal mining** is associated with population movement into mining areas, and can include setting up temporary shelters not suitable for indoor residual spraying (IRS), as well as creation of breeding sites due to mining activities. All these factors potentially increase the risk for transmission in malaria receptive and/or endemic areas.
- **Development projects and changes in land use** that promote malaria transmission (e.g., dam and/or road construction) are associated with movement of labourers, as well as displacement of people from construction or other activity sites. The consequences also have the potential to increase mosquito breeding sites.
- **Agricultural irrigation schemes** can create mosquito breeding sites. In addition, nocturnal work in the schemes exposes people to mosquito bites.
- **Religious gatherings** are associated with population movement, as well as the use of temporary structures and lack of protection from mosquito bites. This is particularly the case for religious communities who prefer to practice outdoors at night or over a series of days/nights.
- **Riverbank cultivation** in some areas, populations routinely move to temporary structures by river banks during cultivation season, leaving their permanent homes that can be protected with IRS

or long-lasting insecticidal nets (LLINs). Dwellings on river banks using temporary structures increase exposure to the malaria vector. River banks also provide breeding sites for mosquitoes.

- **Fisheries**—habitual fishing, especially during the early morning or at night, exposes fishermen to mosquito bites during the hours of peak vector activity.
- **Seasonal livestock pasturing** involves minding livestock as they graze in pastures, resulting in population movement and the use of temporary structures that are not sprayable during IRS campaigns.

2.1.3 Climatic and Seasonal Changes

Long-term climatic forecasting can help predict the severity of malaria transmission 6-12 months or longer before the malaria season. Rainfall amounts, relative humidity, and temperature all influence transmission by determining the availability of vector breeding sites, the duration of the life cycle of parasites and of the female *Anopheles* mosquito, and the biting behaviour of mosquitoes.

The relationship between climate and malaria transmission is complex. In warmer ambient temperatures (compared to lower temperatures):

- Female anopheles mosquitoes live longer;
- Parasite development and growth in the mosquito is faster; and
- Mosquitoes feed more frequently and rest indoors more.

In temperatures below 16^0 Celsius, female *Anopheles* mosquitoes stop developing, and die at temperatures below 14^0 Celsius. In cold temperatures, larvae develop slowly or die.

In dry climates, heavy rainfall can provide good breeding conditions for mosquitoes. Droughts may turn rivers into strings of pools, producing breeding sites for mosquitoes. Alternatively, heavy rainfall in some areas can wash out breeding sites and initially reduce the incidence of malaria.

Climatic events, such as the El Nino southern oscillation and La Nina events, impact significantly on weather patterns in Southern Africa. These events can now be predicted with reasonable accuracy. Information regarding such events can be used to broadly predict the months of epidemic risk over large geographic regions or areas. By modelling all the stages of the malaria transmission process based on weather conditions, and linking the model to seasonal climatic forecast, it is possible to predict the risk and severity of malaria epidemics.

2.1.4 Implementation of Forecasting Activities

Forecasting should be implemented regionally and at all levels of the health system in Zimbabwe, including at the national, provincial, district, and rural health centre levels. Zimbabwe should coordinate regionally and nationally with neighbouring countries through bodies and mechanisms such as Elimination 8 and cross-border initiatives. Such coordination helps to monitor longer-term predictions, and enables dissemination of information to lower levels of the health system.

The Southern African Development Community (SADC) region has a Climate Services Centre, which generates medium range (10-14 days) and long range (3-6 months) climatic outlook forecasts. These are disseminated to local communities by the Meteorological and Hydrological Services Centres in member states. Zimbabwe benefits from these regional forecasts. The SADC Regional Climate Outlook Forum produces regular bulletins that help nations to plan in various sectors, including agriculture, health care, and disaster management. The NMCP should use the seasonal climatic forecast to model and predict the risk, timing, and scale of malaria epidemics in Zimbabwe.

Provinces, districts, and health centres should attempt to forecast the burden of illness for the upcoming malaria transmission season. The forecast should take into consideration: long- and intermediate-term rainfall and temperature forecasts from the Government of Zimbabwe Meteorological Services Department; likely population movements into and out of catchment areas; entomological data on vector densities and EIR; and other critical information. Forecasting should include mapping of high risk areas and the expected spatial and temporal trends of transmission throughout the forthcoming season.

Table 1 below highlights some of the major sources of data to be used during the forecasting process.

TABLE 1: DATA SOURCES AND USE FOR FORECASTING

Data Elements	Data Source	Data Usage In Forecasting
Epidemiological: Historical case data on suspected cases, tested cases, positive cases, and treated cases.	• T5 cases for health facilities and village health workers (VHWs) • Case-based surveillance system for elimination areas (DHIS2 Tracker) • Risk mapping	Baseline for determining the expected burden of transmission for the forthcoming season
Climatic: Rainfall, temperature, and humidity	• Zimbabwe Meteorological Services Department http://www.msd.org.zw/ • Famine Early Warning Systems Network http://fews.net/ • SADC Climate Services Centre https://www.sadc.int/sadc-secretariat/services-centres/climate-services-centre/ • SADC Regional Climate Outlook Bulletins http://www.inam.gov.mz/images/pdfs/SADC-CSC-Regional-Early-Warning-Bulletin_-2018-19-Rainfall--Season.pdf • World Metrological Organization https://www.wmo.int/ • Intergovernmental Panel on Climate Change http://www.ipcc.ch/	Estimating the abundance of vector habitats and the likelihood of conditions that can sustain malaria transmission for the forthcoming season
Entomological: Insecticide resistance, EIR, vector species, vector density, vector resting, and biting behaviour	• Sentinel sites' routine reports • Foci investigation reports • Bioassay reports	Estimating the availability of malaria vectors and their capabilities in sustaining malaria transmission for the forthcoming season
Demographic, development, and economic: population movement and displacements, agricultural activities, and infrastructure development	• ZimStat census reports • Health facilities • Local authorities • Humanitarian agencies • Ministries of agriculture, mines, information, and media • Household enumeration data	Forecasting the expected population residing in areas at risk for malaria transmission

2.2 Epidemic Preparedness

Measures for epidemic prevention and control can be implemented effectively only if supported by well-trained personnel, adequate supplies (materials, equipment, and transportation), effective supervision and evaluation, and sufficient funding for implementation. Effective malaria epidemic preparedness is critical to ensure that the required resources are available for each component of the EPR framework: forecasting, preparedness, prevention, early warning and detection, response, and post-mortem. Preparedness activities should consider the forecasting information described above, and must include planning to ensure that adequate staffing, transportation, supplies, laboratory facilities, educational messages, training/refresher training, surveillance, and funding are in place when and where they are needed most. Table 2 summarizes the key activities for epidemic preparedness.

TABLE 2: KEY ACTIVITIES FOR EPIDEMIC PREPAREDNESS

Maintain quality surveillance:	**Keep databases up-to-date:**	**Think ahead – be prepared:**
• Rapid disease notification system registers • Case data (VHWs and facilities) • Updated threshold limit values (TLVs) • Updated risk factors for malaria (see section 2.1)	• Risk mapping • Seasonal malaria trends • Previous outbreak reports • Case data (VHWs and facilities)	• Update local EPR plan • Mobilise adequate resources • Pre-position resources • Conduct awareness raising at all levels

2.2.1 Costed Malaria Epidemic Preparedness Plans

Costed MEPR plans are essential for all levels of the health system (national, provincial, district, health facility), as well as for partners and stakeholders. The costed MEPR plans should be updated annually, prior to malaria season. The plan should include the costs of specific EPR activities for all relevant stakeholders for the year. The annual MEPR plan should also describe priority anticipated EPR activities for each component of the epidemic cycle for one year, clearly defined responsibilities for implementation, costs for each activity, identified funding, and a clear timeline for delivery of outputs.

The plan should:

- Be based on the assessment of forecasting information, the epidemiological situation, and the needs and resources available for EPR;
- Provide estimates of the populations at-risk;
- Provide risk mapping of the communities in each district;
- Provide estimates of human resources, quantities of medicines, diagnostics and supplies, and information, education, and communication materials for each epidemic-prone area in the district;
- Detail strategies for reaching hard-to-reach, at-risk populations;
- Provide communication materials on prevention and treatment; and
- Be updated annually at each level of the system by the end of September.

The annual MEPR costed plan operationalizes the malaria response mechanism at each level of the health system. Good planning will provide a framework to ensure that each level is prepared to take all the necessary steps for successful management of an epidemic. In planning, consideration of the previous years' events is critical and should include a review of the following:

- What happened during the last three malaria peak seasons?
- Were there outbreaks or epidemics?
- Where and when did they occur?
- What were the strengths and weaknesses of the response?
- What helped address the response?
- What should be done differently this season?

2.2.2 Human Resources

Health workers and implementing partners should be trained and their capacity built in EPR. The roles of different cadres should be clearly defined during trainings and be outlined in the EPR plans. There should be a contingency plan for additional staffing, should it be required. Each cadre at every level of the health system should understand their role in the event of an epidemic. There may be other partners (non-governmental organizations or private sector entities) that can play a role in helping to manage a malaria epidemic in their area. The roles of these partners should be clearly laid out in the written plan. For those partners who move into an area during outbreaks only to support the response, the response team leader should outline the duties of any new partner.

2.2.3 Commodities

Preparation for a malaria epidemic includes ensuring that sufficient malaria commodities are on hand, and that additional commodities can be mobilised quickly if necessary. All levels of the health system should monitor the stock status of malaria commodities for appropriate prevention, diagnosis, and treatment throughout the year, but with particular emphasis on ensuring availability prior to the onset of increased seasonal transmission. Past issues with stock availability (e.g., adequate stocks at the beginning of the season but a tendency to run low during malaria season or epidemics) should be reviewed to ensure corrective action and stock availability moving forward.

Districts should preposition commodities before an epidemic occurs. Hard-to-reach areas, areas that become inaccessible during heavy rains, or areas prone to flooding should have sufficient supplies delivered before the onset of the malaria season. Care should be taken to avoid stocks expiring before the end of the season by ensuring the viable shelf-life of commodities.

Early and prompt diagnosis and treatment of malaria cases within communities is a key component of epidemic prevention and response. Adequate supply of commodities at the community level should be ensured before the onset of the malaria season. Districts should establish a contingency stock of medicines, diagnostics, and other supplies, and regularly monitor the contingency stock to avoid shortages and expiries. A risk assessment can be conducted to develop a list of materials that should be stockpiled at the district and community levels.

2.2.4 Social and Behaviour Change Communication

District and health facilities should ensure the availability of social and behaviour change communication (SBCC) materials. This includes brochures or posters on malaria prevention and treatment. Community radio and press releases should also be considered to raise community awareness. Prevention and treatment messages should be circulated to raise awareness prior to and during peak malaria transmission season to ensure communities are prepared to do their part.

2.2.5 Surveillance Thresholds

Preparedness for malaria epidemics includes understanding how to monitor malaria cases at all levels, especially at the health facility level, and how to use malaria threshold levels. Health facility staff should understand how to actively document and analyse malaria cases. Before the malaria season, health facility staff should be trained to understand monitoring principles and how to use threshold levels so they know when to be 'on alert' and when to declare an epidemic and 'take action'.

District and provincial levels can assist in threshold setting as necessary. District teams should ensure that all health facilities have their threshold levels plotted on graphs before the malaria season. All health facilities should have graphs plotted with the alert and action thresholds clearly marked by the second week of the year. All cases should be plotted on the health facility graph on a weekly basis to ensure early alerts and detection of epidemics. VHWs should be trained to report any increases in fever cases and confirmed malaria in the community immediately. VHWs should also be encouraged to report their malaria data weekly so that it is factored into the week's caseload on the facility graph. For control areas, the thresholds based on the mean cases for the past three to five years will be used.

In pre-elimination areas, constant case counts are used for outbreak detection and notification. In addition, every malaria case identified in a pre-elimination area should be investigated as guided by the *National Malaria Elimination: Foci Investigation and Response Guidelines*. See **Annex 3** for guidance on setting thresholds specific to each location situation.

2.3 Prevention (Mitigation)

Prevention is a critical component of the EPR cycle. Without effective and timely implementation of measures to prevent/mitigate malaria transmission, the number and severity of seasonal and localized epidemics will increase. This will stretch the human and financial resources available for epidemic response, resulting in preventable morbidity and mortality.

These prevention measures are in addition to efforts to ensure the prompt diagnosis and treatment of malaria cases at the community and facility level. All levels of the health system should work together to ensure timely implementation and high coverage of prevention and control measures. In areas experiencing population shifts (including refugee situations) or natural disasters, efforts should be made to provide adequate protection to displaced or newly arrived individuals to prevent the introduction and/or further spread of disease.

2.3.1 Vector Control Options for Prevention and Control of Malaria Epidemics

Vector control interventions primarily target adult mosquitoes to limit malaria transmission, and where applicable, larval source management can be employed to mitigate malaria transmission. Below is a summary of the prevention measures used in Zimbabwe. For more information, please refer to the *National Malaria Strategic Plan (2016-20)*.

2.3.2 Indoor Residual Spraying

IRS primarily targets indoor feeding and resting vectors. The timing of IRS implementation is critical. Therefore, IRS should be implemented a few months preceding the onset of peak seasonal malaria transmission. In Zimbabwe, IRS is normally implemented from October to December targeting moderate to high burden areas, specifically those with an annual parasite incidence (API) of >5/1000

population. Operationally, IRS coverage of above 85 percent should be achieved for good impact. Residual efficacy varies depending upon the insecticide used and the wall surface. Hard-to-reach areas and those that become impassable when heavy rains fall should be sprayed first before the rain accumulates and becomes a barrier to transportation.

2.3.3 Long-Lasting Insecticidal Nets

LLINs should be distributed in malarial areas where IRS is not implemented, targeting every sleeping space in districts or wards with API between 1-4/1,000 population. MOHCC distributes LLINs free of charge through mass and continuous distribution strategies to help ensure universal coverage of targeted populations. Net coverage should be maintained at above 85 percent. Net distribution campaigns should be followed by net hang-up campaigns to encourage consistent net usage in all sleeping spaces, including outdoors.

2.3.4 Larval Source Management

Larval control can reduce the vector population in some ecological settings. Interventions against larvae should be undertaken in situations where breeding habitats are few, fixed, and findable. Larval control measures include larvicides or source reduction measures. Selection of either option depends on the availability of resources and the nature of larval breeding habitats. According to the National Malaria Strategic Plan (2016-20), larval source management (LSM) may be implemented in districts or areas with API of <1/1,000 population, in areas with large-scale irrigation schemes (i.e., flood irrigation), to address pre-elimination foci identified, and in urban areas that accumulate water. LSM should be implemented through community participation.

2.3.5 Personal Protection

This strategy can be used before or during a malaria epidemic. Personal protection can be in the form of using repellents or wearing treated clothing. Repellents may be used to protect special populations (e.g., overnight farmers, artisanal miners, fishermen, or communities with unsprayable structures) that cannot be covered by other preventive interventions.

2.3.6 Screened Housing

Improving housing to protect inhabitants from mosquito exposure should be encouraged. More enclosed housing that limits mosquito exposure can be done to existing structures, or incorporated in plans for future construction in malaria prone areas.

2.3.7 Provision of Intermittent Preventive Therapy in Pregnancy

Intermittent preventive treatment in pregnancy (IPTp) should target all pregnant women in high burden districts to reduce the risk of contracting malaria and to improve maternal and foetal outcomes. Targeted districts should provide sulfadoxine-pyrimethamine doses for pregnant women as per the national policy.

2.3.8 Social and Behaviour Change Communication

SBCC activities should be conducted before, during, and after the malaria transmission period. Communities should be mobilised to use prevention interventions appropriately, and to seek care immediately when disease occurs.

2.4 Early Warning and Early Detection of Malaria Epidemics

Seasonal increases in malaria transmission are an annual occurrence in Zimbabwe. In addition, shifts in the geographical distribution of malaria transmission (e.g., emergence of disease in previously unaffected areas) also takes place. As described above, the NMCP endeavours to: 1) forecast the likely severity of these increases and shifts; 2) ensure adequate planning and preparation for epidemic response; and 3) implement prevention measures to limit the extent of transmission. Despite these efforts, seasonal increases in malaria transmission continue to occur. Malaria transmission sometimes exceeds what is expected based on trends from previous years. This can be due to factors such as rainfall and temperature patterns, development of insecticide resistance to vector control measures, changes in infrastructure, population movement, and sub-optimal access to and utilization of prevention and control measures. In addition, localized increases in transmission can occur, even in relatively low transmission years.

Early warning and early detection of malaria epidemics are therefore critical as they enable prompt implementation of additional control measures to limit morbidity and mortality. To ensure rapid response and the effective use of limited resources, the NMCP relies upon a specific set of epidemic early warning and detection methodologies. These approaches depend on meteorological and disease surveillance data to detect the occurrence of malaria transmission beyond what is expected in geographic areas prone to malaria transmission, and to detect the emergence or re-emergence of disease in less transmission-prone areas.

2.4.1 Early Warning

The following early warning methods are recommended (see forecasting section above for more details):

1. Monitoring of meteorological and regional early warning system data (e.g., rainfall and temperature data in coordination with the Zimbabwe Ministry of Environment, Water, and Climate using Southern Africa Famine Early System data) to provide advance warning of the potential for increased or shifting malaria transmission. At a minimum, this should be conducted at the national level with information disseminated to all levels of the health system.
2. Identifying and reporting on potential triggers of increased or shifting malaria transmission infrastructure changes (e.g., damming of water bodies or road building) and population movement or refugee resettlement that could result in increased malaria transmission. This should be conducted at all levels of the health system.
3. Identification of vector breeding sites, rumours of increased malaria transmission or deaths, and increases in febrile illness at the community level. These activities should be conducted by VHWs, Health Centre Committees, and community members. The information should be passed to the health facility level where appropriate follow-up and investigations should be conducted. Reporting to higher levels should be initiated by the health facility, as appropriate.

2.4.2 Early Detection

The recommended methods for epidemic detection include:

1. National, provincial, and district level monitoring of weekly malaria case data to identify, as early as possible, the onset of increased seasonal transmission and to track larger trends in malaria epidemiology. This information should be shared with staff responsible for malaria EPR at all levels. Data quality assurance checks should be implemented at least weekly, monthly, and quarterly during disease surveillance meetings and monthly clinic meetings to ensure inclusiveness (e.g., to ensure that community-level data is included), as well as to ensure the accuracy and validity of data.
2. Calculation of health facility-level alert and action threshold limit values (TLVs) for malaria cases. In control areas, TLVs should be created at the district level using the previous year's weekly baseline data that includes all cases seen at the health facility and community level. The resulting TLV graph should be shared with health facility staff. Health facility staff should then plot current -year weekly cases against the TLV. See Table 3 for a summary of the overall approach to calculating TLVs.
3. Constant case counts should be used in elimination areas (i.e., areas with an API less than one). Constant case count is recommended as this method can be sensitive and is capable of picking even minor epidemics. Constant case counts can be set for each health facility, district, and province. Three-year data is compared by week; the highest recorded number of cases becomes the expected number of cases not to be surpassed. If the cases surpass that cut-off value, then an outbreak is declared. This constant case count does not replace the requirement that all malaria positive cases identified are responded to within a three-day period as outlined in the *National Malaria Elimination: Foci Investigation and Response Guidelines.* See **Annex 3** for an example of constant case count.

TABLE 3: BASELINE DATA AND THRESHOLD LIMIT VALUES FOR CONTROL AREAS

	Control Areas
Baseline data	Weekly malaria case data for the last five years
Alert threshold	Mean weekly malaria cases using a three-week rolling average
Action threshold	Mean weekly malaria cases plus 1.5 standard deviation using a three-week rolling average

To optimize the ability of facility staff to appropriately detect increased malaria transmission using the TLV approach, it is acceptable (and often necessary) to adapt the baseline data used in control areas to better reflect the locality's recent historical trends. Appropriate adaptations include:

- Removing outlier baseline years (i.e., those with dramatically increased or decreased case numbers compared to other baseline years) from the TLV calculation.
- New facilities will continue to use data for previously existing facility in the catchment area. This should be continued until three years of baseline data are available for the new facility's catchment area. The district should obtain assistance from their provincial office to make these adjustments.

More details regarding the methods for calculating and interpreting TLVs and constant case count are available in **Annex 3.**

2.5 Epidemic Investigation and Response

An effective epidemic response is the product of a well-co-ordinated effort from the community level up to the national level. In responding to epidemics, health care workers should be able to differentiate between expected predictable seasonal increases and true epidemics.

The following are key steps in responding to a suspected malaria epidemic:

- Data verification;
- Confirmation of the existence of an epidemic;
- Investigations to determine the precipitating or contributing factors; and
- Action or response to control the epidemic.

After confirmation, the aim of the malaria epidemic response is to control the epidemic as quickly as possible. According to the *National Malaria Strategic Plan (2016-20*), all epidemics should be controlled within two weeks of onset.

VHWs do not have alert and action thresholds for outbreak detection. However, any numbers of malaria cases above their usual level should be reported immediately to the health facility level. All suspected malaria cases in the community should be tested for malaria. Rumours and reports of increased malaria transmission (or increased febrile illness) from the community level should be investigated to determine if actual increases in malaria transmission are occurring and why.

Data from VHWs should be shared with the health facility every week. The health facility should ensure that they agree with the VHWs on the best mode of communication. Community level responses should be coordinated by health facilities after data verification and notification to the district. Details of expected response activities for the various levels of the health system, including the community, are provided in **Chapter 4,** Table 4.

2.5.1 Alert Threshold Surpassed

As described in **section 2.4**, epidemic detection is guided by the use of threshold graphs at health facility level that show alert and action limits. Once the alert line is surpassed, this tells health staff that further investigation is needed. These investigations include:

- Data verification/validation covering totals, ensuring malaria cases are entered on the appropriate weekly intervals on the graph, proper plotting on the graph, data validation using all data sources, and including community data sources.
- Description of who is getting malaria, where, and the potential risks identified for their acquisition of the disease.
- Verification of the adequacy of stocks of required commodities at health facility and community levels, and staffing levels, by end of day on Monday of the same week.

During data verification and confirmation, the health facility alerts the District Medical Officer (DMO) by phone or any method as agreed within the district. After confirmation, the health facility alerts all community health workers (VHWs and school health coordinators) about the increase in malaria cases, and ensures that they have adequate rapid diagnostic test (RDT) kits and medicines. The facility ensures community awareness to increase case detection and early health seeking behaviour (e.g., through the community health workers' meeting and community/leadership education).

2.5.2 Action Threshold Surpassed

Surpassing an action threshold triggers a definitive response, which includes the following:

- Health facility continues to record cases daily and monitors cases against the thresholds weekly;
- Health facility verifies the accuracy of the data and ascertains that indeed the threshold has been reached or surpassed;
- Health facility confirms the presence of an epidemic;
- Health facility notifies the District Medical Officer (DMO) (before verification exercise), who in turn notifies the Provincial Medical Director by phone; and
- District rapid response team (RRT) is activated to respond to the epidemic. Please see **Chapter 5** for more details on the roles and responsibilities of the RRT.

2.5.3 Verification

An increase in the number of weekly malaria cases in excess of the action threshold should be investigated to determine if an actual increase in malaria transmission is occurring and why. This verification exercise should be conducted prior to the initiation of response measures to ensure the rationale use of limited malaria resources. Verification steps may include but are not limited to:

- Ensuring that there are no errors in the malaria case data, the correct number of cases were entered on the graph according to the source documents, and cases are entered and recorded accurately on a weekly basis and properly plotted on the graph.
- Assessing for recent changes in data quality or reporting practices (e.g., report batching from VHWs or improved data quality following a recent training or supervision exercise) that may have resulted in an increase in the number of malaria cases reported.
- Assessing for recent changes in case management practices (i.e., supervision of health facility staff) that may have resulted in increased diagnosis.
- Assessing for recent changes in availability of diagnostic commodities (e.g., increased availability of RDTs compared to previous years leading to increased diagnosis or decreased availability of artemisinin combination treatments [ACTs] leading to presumptive treatment).
- Determining if recent population movement or increases in community or facility-level access are contributing to the increased case burden. In other words, is the increased number of cases simply a reflection of an increase in the size of the population under surveillance?

2.5.4 Investigation of Contributing or Precipitating Factors

Once data verification confirms the occurrence of an actual increase in malaria cases beyond what is expected, the possible contributing and precipitating factors for the increase will need to be investigated. The decision to implement additional response measures beyond the prevention and control measures already implemented is not strictly tied to verifying the existence of an epidemic. Other factors should also be considered, such as the duration and magnitude of the increase in transmission, availability of resources and suitable control measures (e.g., LLINs, effective insecticides for IRS, and larviciding), the rapidity with which those control measures can be implemented, and the likelihood that those measures will reduce malaria transmission.

Important factors for deciding on the most appropriate response are: knowing who is contracting malaria, where they are contracting it, and potential risks for acquiring the disease. This can be

understood by describing the demographic data of malaria cases. Line-listing and spot-mapping of cases should be deployed where possible. The RRT should conduct investigations, which include:

- **Entomological surveys** for:
    - Breeding sites;
    - Adult vector mosquito collection;
    - Vector density;
    - Vector biting and resting behaviour; and
    - Vector chemical susceptibility.
- **Assessment of human factors and high risk socio-economic activities** including:
    - Population movements into the area from known high-transmission areas;
    - Population movements into high-transmission areas from low or no-transmission areas;
    - Religious gatherings that have taken place in the area;
    - Artisanal mining that has attracted an influx of people into the area; and
    - Unique settlement patterns or occupational trends associated with malaria outbreaks (e.g., river bank cultivations, seasonal livestock pasturing, or fishing).
- **Assessment of natural phenomena c**ontributing to malaria outbreaks, as described under forecasting above.
- **Assessment of prevention interventions coverage** in the affected area:
    - If IRS was conducted in the area, the following should be undertaken:
        - Audit of the IRS coverage; and
        - Entomological efficacy of the sprayed surfaces.
    - If LLINs were distributed, the following assessments should be undertaken:
        - LLIN coverage; and
        - LLIN access and usage in the affected areas where feasible.

2.5.5 Epidemic Response

An effective epidemic response involves taking swift action to address the identified precipitating factors. The following responses should be considered: case management, proper documentation of cases, vector control measures (IRS, LLIN distribution, or LSM), personal protection measures, SBCC, and malaria surveillance. Each response is discussed separately in the sections that follow.

2.5.5.1 Case Management

Prompt and effective treatment of all cases is a cost-effective epidemic response that should be deployed early in all epidemics. To enable this, the RRT should ensure the following:

- Adequate RDTs and medicines are available in the community and at the facility;
- All cases are treated according to treatment guidelines;
- Provisions are made for access to services in hard-to-reach areas through VHWs, School Health Coordinators, or by establishing mobile or temporary outreach clinics;

- Active case-finding is employed, particularly in pre-elimination districts;
- Staffing levels are adequate to cope with the increased number of cases. This can be done by mobilising staff from other sites;
- Detailed history taking is conducted for all cases, including assessment of risk factors for acquiring the disease; and
- Clear mechanisms exist for prompt, effective treatment and appropriate referral of severe malaria cases at the community and facility levels.

2.5.5.2 Proper Documentation of Malaria Cases

Proper documentation of suspected, confirmed, and treated cases as well as documentation of treatments prescribed should be ensured. This includes:

- Documentation of severe malaria cases and related deaths;
- Daily tracking of malaria cases at health facilities and weekly at community levels; and
- Preparation of an epidemiological profile of identified cases to describe the affected population.

Note that line-listing of the cases may not be practical in high burden districts that may have up to 500 cases per week.

2.5.5.3 Vector Control Measures

Entomological assessments should help to determine whether vector control intervention is necessary, what vector control measures are appropriate, and what chemicals to use for IRS if indicated. Factors to be considered when deciding to deploy vector control measures include:

- Cost-effectiveness of the intervention;
- Ability to implement the intervention quickly at the onset of the epidemic;
- Chemical susceptibility of the vector;
- Vector density;
- Vector's resting and biting behaviour (indoor versus outdoor);
- Presence of active breeding sites;
- Settlement patterns; and
- Housing type (i.e., are structures sprayable).

2.5.5.3A Indoor Residual Spraying

Prior arrangements and preparedness, including emergency stocks of effective insecticide, equipment, and supplies, should be prepositioned readily in areas known to be epidemic prone. This will allow for the required swift deployment. Adequate, trained, and experienced IRS response teams (pre-trained spray operators and exceptionally good supervisors) should be identified prior to an outbreak. IRS should be considered in situations where:

- Malaria vectors in the area are known to prefer resting indoors (endophilic species);
- Houses and dwelling rooms have solid, contiguous walls and roof cover (sprayable);
- Most malaria infections are suspected to be acquired by indoor biting (endophagic species);
- Houses/rooms are clustered and densely populated (scattered settlements are contra-indicated for IRS);

- There are permanent homesteads;
- Community is likely to accept spraying to achieve impact coverage of at least 85 percent; and
- Implementers can organize the delivery of at least 85 percent population coverage of spraying within a week.

2.5.5.3B Long Lasting Insecticidal Nets

When distributed and used properly, LLINs are another effective intervention that may help contain malaria outbreaks. LLINs are effective in epidemic control if coverage and use is maintained above 80 percent. Where net coverage is low, nets can be deployed in response to epidemics. Net hang-up and follow-up campaigns can be used to increase use during epidemics, especially where consistent net usage is low. There should be a stock of LLINs kept at the district level that can be quickly deployment to needy health facilities and communities during an epidemic, when needed. In areas where continuous distribution is carried out, existing stocks can be used to respond to outbreaks/epidemics and replenished later.

LLINs should be used to control epidemics in situations where:

- Mosquitoes prefers biting at times when and where people are in bed;
- Targeted populations are able to consistently and correctly use the nets; and
- LLIN ownership, coverage, access, and use will be high at population level, as this has a cumulative effect of reducing vector density in a community.

2.5.5.3C Larval Source Management

LSM is a key intervention, particularly in elimination districts. There is need to select an appropriate anti-larval strategy and method. Environmental manipulation and modification, with full participation of the community, can drastically reduce or eliminate mosquito breeding sites. Follow-up assessment to monitor larval reduction and re-treatment of positive breeding sites should be conducted.

LSM may be deployed to manage breeding sites in areas reported to have outbreaks/epidemics. This intervention controls the vector mosquitoes before they are highly mobile and mature enough to carry malaria parasites. LSM is applicable in the following areas:

- There are few, fixed, possible to locate and manageable breeding sites;
- Vector mosquitoes are known to breed in semi-permanent sites;
- It is feasible to map out a large proportion of the breeding sites within mosquito flight range of the community in which there is an outbreak; and
- An appropriate anti-larval measure exists (biological or chemical larvicides, biological control, habitat modification or manipulation).

2.5.5.3D Personal Protection Measures

Use of repellent creams, repellent coils, and protective clothing to prevent mosquito bites should be encouraged as a control measure for prevention and response to epidemics. This set of interventions is commonly left to communities and individuals to source for themselves, while the MOHCC plays an advocacy and promotional role. It is an effective strategy, particularly where transmission is suspected to take place outdoors.

2.5.5.4 Social and Behaviour Change Communication

SBCC is a pivotal intervention that supports all of the above strategies for outbreak response. It is conducted in outbreak areas to promote and encourage the following actions:

- Early treatment seeking behaviour;
- Uptake of LLINs and consistent use;
- Increased acceptance of IRS;
- Adoption of personal protection measures;
- Protection of most vulnerable groups: pregnant women, children under five years of age and non-immune individuals should be emphasised in SBCC communications and campaigns; and
- Community participation in the identification, environmental manipulation, and control of mosquito breeding sites.

2.5.5.5 Malaria Surveillance

Malaria surveillance should be viewed as a core intervention in areas experiencing outbreaks/epidemics. Data collection through routine investments enables the detection of outbreaks. Continued vigilance and use of data is critical for monitoring the effectiveness of epidemic response. Surveillance data will inform the response teams of their successes or failures in containing outbreaks, and provides information critical for understanding disease trends and overall response performance.

Once the district has been notified by the health facility that cases have surpassed the action threshold, the district RRT should:

- Verify and confirm the outbreak and assess its magnitude;
- Notify the province verbally or in writing and indicate whether additional resources are needed; and
- Provide technical assistance and resources to assist the health facility and community with the investigation and response.

When the provincial office receives notification of an outbreak from the office of the DMO, the provincial RRT should carry out the following activities:

- Determine the outbreak magnitude and requirements;
- Assess the district's capacity to effectively respond to the epidemic;
- Support further field investigations as indicated; and
- Mobilise and supply required resources.

Once the province has gathered adequate information, they will notify the national level. Once the province notifies the NMCP of a confirmed existence of an outbreak, the NMCP should respond to the request within 48 hours by mobilising resources to cover gaps identified by the province and by conducting supportive visits to the province. The NMCP should notify the multi-sectoral epidemic response team (MOHCC departments, NMCP, and malaria partners) of the existence of the epidemic and their identified requirements.

3. Epidemic Reports and Post-epidemic Assessment

Post-epidemic reporting and assessment will help staff at all levels identify successes and areas for improvement. This will also indicate whether early warning, detection, and response activities were well-implemented and contributed to a reduction in malaria burden.

3.1 Epidemic Reports

The health facility reports suspected epidemics to the DMO. The DMO deploys an RRT to investigate the epidemic. For each investigated epidemic, the RRT and the health facility staff should complete a preliminary report for submission to the DMO. Based on the findings of this preliminary report, the DMO, in consultation with the provincial RRT, should determine the best response measures for the outbreak. During the epidemic response, an interim report should be submitted two weeks after the onset of the epidemic if it is not controlled by that time. When the epidemic is declared over, the RRT or health facility staff should write a final report within two weeks of the end of the epidemic. All reports should use the format presented in **Annex 5** for submission to the appropriate higher level(s).

3.2 Post-epidemic Assessment

The results of a post-epidemic assessment can help to improve the preparedness plan and response, and to advocate for necessary support from different levels of the response system. Following each epidemic, a post-epidemic review team, comprised of individuals from all levels of the health system, should be constituted and a post-epidemic assessment carried out. The review team should include members of the RRT at different levels, members of the EPR committee, and other important stakeholders in the district.

This review team should assess the impact, response, verification, early detection, and early warning, and forecasting conducted during the epidemic response, using the questionnaire provided in **Annex 6.** These post-epidemic assessments form the basis for learning, and the findings should be used to improve future EPR activities. Each year, when districts and health facilities review and update their EPR plans, they should make use of the assessment results from the previous year.

4. Roles and Responsibilities within the EPR Framework

Effective EPR is a coordinated effort by stakeholders from the national level to the community level. It is also a collaborative effort between the government, its partners, and the private sector. All levels and partners work together to ensure quality, effective, and timely actions at all stages of the EPR framework. Partners work with the NMCP at all levels to provide the needed technical guidance and financial support. The NMCP, through government structures, coordinates efforts from different stakeholders and provides the common implementation pathway and platform.

Table 4 below provides guidance on the roles and responsibilities within the EPR framework for the different MOHCC levels.

TABLE 4: EPR ROLES AND RESPONSIBILITIES OF MOHCC STAFF

MOHCC Level	Roles and Responsibilities
National	**Forecasting** • Liaise with meteorological departments from the national and regional climate forecasting centres to obtain the latest rainfall, temperature, and humidity data • Facilitate access to meteorological data for district and provincial levels • Collect, analyse, and interpret national malaria epidemiological data, and share findings with partners, stakeholders, and regional and provincial levels • Forecast the consumption of malaria commodities based on anticipated burden of malaria (RDTs and ACTs) • Sensitise partners and stakeholders (including community) on the predicted levels of cases • Routinely monitor vector susceptibility to insecticides and disseminate the information to other levels • Support vector mapping exercises • Conduct stratification of malaria through prevalence studies or other cross-sectional studies • Determine EIR and disseminate information to provinces (EIR provides information on the number of infective mosquito bites per person per unit time)
	Epidemic preparedness • Ensure availability of updated EPR guidelines to guide the other levels • Ensure availability of adequate commodities for EPR • Organize trainings on EPR • Ensure all levels have up-to-date EPR plans and threshold levels • Ensure timely quality surveillance and reporting of malaria data
	Prevention (mitigation) • Establish policy formulation and planning • Mobilise resources and provide logistics management • Administer and produce weekly bulletins

MOHCC Level	Roles and Responsibilities
National	• Provide technical guidance and develop standard operating procedures (SOPs) • Ensure capacity building and development • Coordinate partnerships • Conduct operational research • Provide feedback to provinces • Monitor and evaluate programme performance
	Early warning system and early detection • Mobilise resources for sentinel sites for active malaria surveillance • Strengthen routine disease surveillance systems • Analyse surveillance data and provide feedback to other levels • Conduct therapeutic efficacy trial (TET) for early detection of parasite resistance • Conduct insecticide resistance
	Response • Support provincial field investigations • Mobilise additional resource for epidemic control • Convene multi-sectoral epidemic preparedness and response team meetings • Request for external assistance if the situation has attained disaster proportions • Provide technical and financial assistance • Alert national-level partners and the civil protection committee • Document and collate information on epidemic events
Provincial	**Forecasting** • Extract forecast data from national profile and distribute to district levels • Compile/update the provincial epidemic database • Help the district access meteorological data • Initiate a provincial inter-sectoral meeting to discuss forecast data • Sensitise partners and stakeholders (including community) on the predicted severity of malaria transmission • Forecast the consumption of malaria commodities based on anticipated burden of malaria (RDTs and ACTs) • Conduct basic analysis of the resistance pattern and share the results with the districts • Conduct basic analysis of EIR results and forward to districts • Identify high-risk groups by person, place, and time
	Epidemic preparedness • Ensure EPR trainings for health facility staff • Ensure each district has up-to-date EPR plan • Ensure contingency stock of IRS chemicals, LLINs, and other commodities for use in epidemic response • Ensure adequate stocks of malaria medicines and RDTs • Ensure adequate staffing levels in health facilities
	Prevention (mitigation) • Interpret and implement strategic direction and policy • Support the district to implement preventive programmes • Mobilise resources and manage logistics • Rationalize malaria resources and commodities

MOHCC Level	Roles and Responsibilities
Provincial	• Coordinate partner support • Facilitate planning and review meetings • Conduct malaria data verification and validation • Report data to national focal person • Ensure capacity building and development • Conduct stakeholder sensitisation meetings • Identify and conduct operational research activities • Provide feedback to districts • Monitor and evaluate programme performance
	Early warning system and early detection • Analyse surveillance data and feedback to district level • Support disease prevalence surveys • Assess medicine sensitivity (TET) • Carry out insecticide susceptibility tests (bioassays) • Undertake vector mapping exercises
	Response • Notify the national level of epidemics and resource requirements, as appropriate • Make provincial RRT visits to the district to verify the existence of the outbreak, to determine magnitude and resource requirements, and to assess the district's capacity to effectively respond to the epidemic • Identify where there are information gaps, and/or support further field investigations • Mobilise and supply required resources • Provincial Epidemiological Disease Control Officer gathers adequate information and updates the national focal person • Activate contingency plans • Mobilise resources (e.g., funds, staff, transport, medicines, and SBCC materials) • Ensure enhanced surveillance during the outbreak • Monitor the effectiveness of the outbreak or the response activity • Guide the appropriate methods that are implemented in the district (e.g., meetings, health personnel, and communities)
District	**Forecasting** • Interpret forecast data and initiate appropriate action • Identify high-risk groups by location, community/population, and time period • Sensitise partners and stakeholders on the predicted severity of malaria transmission • Gather meteorological data from local meteorological offices (where applicable) • Forecast the consumption of malaria commodities based on anticipated burden of malaria (RDTs and ACTs) • Make use of EIR results to conduct health education sessions and prepare for an outbreak • Assess and anticipate health impacts from any development projects within the district
	Epidemic preparedness • Advocate for regular meetings with the district EPR committee • Review surveillance data for trends that cause concern for public health • Ensure that the Nurses in-Charge and Environmental Health Technicians at all health facilities in the district know and use protocols for recommended case management of priority notification diseases, conditions, and events

MOHCC Level	Roles and Responsibilities

District	• Review and update supplies and resources for epidemic response, including:
	  ○ Presence of trained staff
	  ○ Diagnosis and treatment equipment and supplies
	  ○ Transportation and communication
	  ○ Supplies for collecting and transporting specimens for confirmation
	• Create a budget line for EPR
	• Check emergency stocks of medicines and supplies monthly, check medicine expiry dates, and ensure all supplies are in good storage conditions (i.e., dry, clean, undamaged, and ready for use)
	• Ensure steps for obtaining laboratory confirmation are known by the appropriate staff
	• Ensure health education and social mobilisation is conducted in high-risk areas just before the epidemic season

	Prevention (mitigation) • Conduct stakeholder sensitisation meetings for malaria at district level • Coordinate partner support • Provide technical support and supervision to lower levels • Mobilise resources • Develop TLVs and disseminate to health facilities • Conduct weekly surveillance meetings • Conduct quarterly malaria data verification and validation • Report data to province • Preposition malaria commodities • Provide feedback to health facilities • Monitor and evaluate implementation at facility and community levels

	Early warning system and early detection
	• Analyse outpatient department data on a daily basis
	• Strengthen routine disease surveillance at clinic level by:
	  ○ Submitting weekly disease surveillance reports on time
	  ○ Reporting on increase in number of cases above threshold
	  ○ Holding weekly disease surveillance meetings
	  ○ Analysing surveillance data and providing feedback to health facility submitting to province on a weekly basis
	  ○ Monitoring malaria slide positivity rates
	• Support disease prevalence studies

	Response • Verify the existence and magnitude of the epidemic • Alert the Provincial Medical Director (PMD) and the District EPR committee of the malaria epidemic • Strengthen diagnosis and treatment of malaria • Verify adequacy of antimalarial commodities and staff, and replenish or augment staff where needed • Establish temporary community treatment centres to improve access in hard-to-reach areas • Establish a mechanism for management of severe malaria (e.g., deploy doctor to health facility, establish temporary admission facilities, or position an ambulance or local transportation systems strategically, whichever is feasible within available resources)

MOHCC Level	Roles and Responsibilities
District	• Provide refresher training for response teams • Conduct training of health care workers at both community and facility level • Provide the necessary resources required as determined by RRT findings • Continue to identify and map areas where cases are identified • Intensify or maintain preventive measures for pregnant women and children under five years (IPTp and LLINs) • Reinforce health information systems for reporting and monitoring the epidemic (line-listing, completeness of data, and timeliness of reporting) • Conduct specific health education campaigns • Deploy appropriate vector control measures (i.e., IRS, LLINs, or LSM) • Mobilise vector control standby teams for IRS where needed
Health Facility	**Forecasting** • Request and act on information provided by provincial level via the district (e.g., increase public awareness in high-risk areas) • Monitor population movement within catchment areas and adjacent catchment areas • Monitor mosquito densities • Monitor vector behaviour in relation to human outdoor and nocturnal activities • Monitor land usage, especially in agriculture and mining-related activities for possible breeding sites • Sensitise partners and stakeholders (including community) on the predicted severity of malaria transmission • Forecast the consumption of malaria commodities based on anticipated burden of malaria (RDTs and ACTs) • Identify high-risk groups by location, community/population, and times • Sensitise partners and stakeholders (including community) on the predicted levels of cases • Use EIR results to conduct health education sessions and prepare for an outbreak
	Epidemic preparedness • Understand the disease trends in the area • Identify at-risk populations • Map out the geographical area to identify predisposing factors • Conduct entomological studies to understand vector species and behaviour
	Prevention (mitigation) • Conduct community sensitisation meetings • Coordinate with other stakeholders • Mobilise communities for IRS and LLIN distribution • Coordinate continuous distribution of LLINs through antenatal care, Expended Programme on Immunization, and community channels • Conduct mapping of breeding sites and larviciding • Diagnose, treat, and track malaria cases • Investigate malaria cases and foci in elimination areas • Conduct data collection and reporting • Plot TLVs • Conduct weekly disease surveillance meetings • Coordinate management and monitoring of medicines stocks
	Early warning system and early detection

MOHCC Level	Roles and Responsibilities
Health Facility	• Request the required EPR reports from the community (VHWs, Health Centre Committees, Ward Health Teams, and any other relevant member of the community) and investigate reports • Analyse out-patient data on a daily basis • Collect malaria blood slides in pre-elimination areas • Carry out domiciliary visits to identify community health problems, and raise awareness about malaria and its prevention • Plot current year case data and monitor in relation to TLVs
	Response • Inform DMO as soon as alert and action threshold levels are surpassed • Verify/validate data for TLV monitoring covering totals, correct weeks, accurate plotting on the graph, and data validation using all data sources, including community data sources • Describe the data in terms of persons, places, and times (line-listing) • Conduct spot-mapping of cases • Verify adequacy of stocks for required response commodities (health facility and community levels), including staffing levels, by end of day on Monday same week • Enhance community awareness to increase case detection (community health workers' meeting and community/leadership education) • Conduct targeted vector control measures • Carry out environmental assessment and institute control measures • Alert community-based health workers and supply them with adequate malaria commodities, if trained to implement case management • Update the district on the evolution of the epidemic (concurrent reports)
Community	**Forecasting** • Take heed of and act upon warnings and forecasting from higher levels
	Epidemic preparedness • Ensure use of LLINs, where available, and promote uptake of IRS • Conduct health education and community sensitisation on malaria, early treatment seeking behaviour, and ways of preventing malaria • VHWs and Health Centre Committee members should be trained in EPR
	Prevention (mitigation) • Sensitise communities on the use of LLINs and IRS uptake • Conduct peer education • Assist with environmental management and manipulation, as appropriate • Test, treat, and track malaria cases, if trained to do so • Refer complicated malaria cases to health facilities • Ensure quality data collection and timely reporting to health facilities • Participate in intervention programmes (IRS, surveillance, foci investigation, and biolarviciding)
	Early warning system and early detection • Report identified breeding sites to health facilities • Log rumours received from the community (see **Annex 2: Rumour Log**) • Report any increase in febrile illnesses to health facilities • Report any community deaths to health facilities
Community	**Response**

MOHCC Level	Roles and Responsibilities
	• Notify health facility immediately of suspected epidemics • Ensure community leadership and Health Centre Committee awareness meetings are conducted—health facility gathers community intelligence by meeting with village health workers (confirmation) • Enhance community awareness to increase case detection • Conduct community case management, as appropriate • Resupply/replenish community antimalarial commodities • Assist with local responses like environmental control, larval source control, and LLIN hang up campaigns.

5. Rapid Response Team and Emergency Preparedness and Response Committee Roles and Responsibilities

5.1 Emergency Preparedness and Response Committees

These are coordinating committees composed of technical and non-technical members from health and other sectors, and should exist at all levels of the health system. Their role is to develop and oversee the implementation of emergency preparedness strategies, action plans, and procedures. District-level committees should work closely with their counterparts at the provincial and national levels to plan and monitor the implementation of emergency plans.

5.2 District Emergency Preparedness and Response Committee

The composition of the District Emergency Preparedness and Response Committee should be multi-sectoral and include the following:

- District Administrator;
- District police officer;
- Community leadership;
- District Health Executive;
- Local authority;
- Wildlife and veterinary services;
- Laboratory scientist/technician from the district laboratory;
- Representatives from other government departments; and
- Representatives from non-governmental organizations and the private sector.

The District Administrator is the chair of the committee and the District Health Executive is the secretariat of the committee.

The general functions of the District Emergency Preparedness and Response Committee are as follows:

- Develop a district emergency preparedness and response plan that accounts for all potential emergencies, including disease outbreaks and detection of other emergent public health events or hazards.
- Establish a community communications plan for sharing information with communities before, during, and after the malaria epidemic.

    - Include a plan for disseminating information to the public and media about activities conducted for preparedness and during a response; and
    - Coordinate activities with relevant partners in multiple sectors, including points of entry (especially in elimination provinces) and other required reporting sites.
- Mobilise resources for emergency prevention and control, including procurement of response and communication supplies:
    - Plan to monitor the use of the resources before, during and after the emergency event.
- Support the procurement of emergency material stockpiles within the district.
- Enhance linkages with community surveillance informants to ensure flow of data for early detection of public health events.
- Coordinate community risk mapping activities within the district and ensure all reporting sites are aware of the use of thresholds for reporting acute outbreaks or events.
- Coordinate training of community, health facility, and district personnel in emergency preparedness and response.
- Plan to periodically conduct emergency response simulation activities at the district and community levels.
- Coordinate post-emergency evaluation, and plan to disseminate findings with affected communities.
- Hold quarterly meetings to assess the trends of epidemic prone diseases and monitor implementation of EPR activities.
- Organize special preparatory meeting at the beginning of each outbreak season to review their level of preparedness:
    - Share conclusion and recommendations of these meetings with the higher level.

5.3 Roles and Responsibilities of the Emergency Preparedness and Response Committee during an Epidemic

These are as follows:

- Meet as soon as an outbreak is confirmed;
- Hold daily meetings at the beginning of an outbreak/epidemic and weekly depending on the evolution of the epidemic;
- Assess and request support if the situation is beyond the district's capacity to respond;
- Review and improve the epidemic response measures to ensure the success of control actions; and
- Prepare minutes after each meeting and forward to higher level.

5.4 Roles of the District Health Executive in the Emergency Preparedness and Response Committee

The District Health Executive team/staff should routinely implement the following:

- Advocate for regular meetings with the District Emergency Preparedness and Response Committee;
- Review surveillance data for trends that cause a concern for public health.
- Ensure that the nurses in-charge and Environmental Health Technicians at all health facilities in the

district know and use the appropriate protocols for recommended case management of priority diseases, conditions, and events.

- Review and update supplies and resources for epidemic response of priority diseases, including:
    - Presence of trained staff;
    - Treatment equipment and supplies;
    - Transport and communication; and
    - Supplies for collecting and transporting specimens for confirmation.
- Create a budget line for EPR.
- Check emergency stock of medicines and supplies monthly, to verify expiry dates and ensure that all supplies are in good storage conditions (i.e., they are dry, clean, and ready for use).
- Ensure steps for obtaining laboratory confirmation are known by the appropriate staff.
- Ensure community awareness activities and social mobilisation are conducted in risk areas just before the epidemic season.

5.5 Rapid Response Teams

RRTs are a group of experts who provide technical support to all levels of the health system for the investigation and control of epidemics. The members of the team should be oriented on emergency preparedness and response, and they should be provided with adequate resources. Establishment of a district RRT is critical for a prompt response to a malaria epidemic. The District Health Executive should update regularly the RRT membership list. During the non-outbreak season, the RRT may have orientation/refresher trainings to strengthen their capacities. They should also support MEPR training for health workers at all health facilities.

The composition of the district RRT is as follows:

- Team leader;
- Clinician Medical Officer/Clinical Officer/Nursing Officer;
- Epidemiologist;
- Laboratory Scientist/Technician;
- Environmental Health Officer;
- Pharmacist/Pharmacy Technician;
- Health Promotion Officer; and
- Co-opted members: Entomologist, Health Information Officer, and Partners (depending on their areas of expertise).

Please see **Annex 10** for further information on the roles and responsibilities of these team members.

The RRTs should be trained in October, after the EPR plan is submitted to the Emergency Preparedness and Response Committee, and before the onset of increased malaria transmission.

5.6 Roles and Responsibilities of the Rapid Response Team

The RRT is responsible for undertaking the preliminary control/containment measures needed to prevent further spread of malaria.

The following are the roles and responsibilities of the RRT:

- Conduct a preliminary epidemiological investigation aimed at identifying the origin/source, extension, and potential for spread of the malaria outbreak;
- Immediately notify the relevant authorities about the findings/results of the investigation and to recommend possible interventions;
- Carry out preliminary containment and control measures, as appropriate, according to findings from the field, including risk communication activities;
- Prepare a detailed report of the investigation mission;
- Support and coordinate follow-up containment and control measures with partners/stakeholders, according to finding/results and national intervention policies; and
- Contribute to the final evaluation of the outbreak response.

The RRT will also be expected to reinforce the following activities for an effective EPR programme:

- Strengthen the disease surveillance system;
- Pre-position the health workers;
- Establish minimum medical supplies stock levels and adequate buffer stocks at all levels;
- Intensify public awareness campaigns;
- Provide logistics, equipment, and fuel supplies;
- Source human and other resources for epidemic control;
- Train key players in EPR; and
- Strengthen coordination mechanisms with partners.

Annex 1: Format for Epidemic Preparedness and Response Plan

The epidemic preparedness plans must include the following sections:

Introduction:

- Relevant background information regarding the health facility/district/province/country;
- Malaria burden (malaria epidemiology, vectors, and phase in the malaria control continuum);
- Population at-risk with disaggregation to include special populations;
- Risk factors for malaria; and
- Malaria prevention and control interventions already implemented or planned to mitigate malaria transmission throughout the year.

Objectives of the Plan

Description of EPR Strategies and Activities:

- Surveillance:
    - Calculation and updation of TLVs for health facilities;
    - Monitoring of malaria cases and deaths per week will be performed, including strengthening of weekly surveillance meetings at all levels;
    - Epidemic investigation will be performed and by whom, in alignment with the EPR guideline;
    - Training and supportive supervision plan for new health workers and refreshers for already trained health workers on surveillance for elimination areas;
    - Deployment of transport systems/logistics to support malaria surveillance activities; and
    - Deployment of human resources for effective the surveillance.
- Case diagnosis and treatment:
    - RDT availability, quantification, and pre-positioning;
    - Malaria medicines availability, quantification, and pre-positioning;
    - Community health worker training in case management;
    - Human resources for case management at health facilities;
    - Health worker training and supportive supervision plan for case management;
    - Human resources for outreach and establishment of temporary treatment centres; and
    - Deployment of transportation systems/logistics.
- Vector control:

    - Insecticide availability, quantification, and pre-positioning;
    - Equipment (e.g., camping, sprayers, entomology);
    - LLIN availability, quantification, and pre-positioning;
    - Human resource for IRS and LLIN distribution; and
    - Deployment of transport systems/logistics.
- SBCC:
    - Development of appropriate prevention and treatment messages before and after the epidemic and define the medium of communication;
    - Development of appropriate messages in response to the drivers of the outbreak; and
    - Definition of messages for special groups and seletion of medium of communication.
- Programme management:
    - Supportive supervision;
    - Transport management;
    - Coordination;
    - Partnership formation;
    - Capacity building; and
    - Human resource for the above management activities.

Implementation of the EPR Plan:

- Who will be responsible for implementation, monitoring and review of the plan;
- Committees required, their composition, and roles; and
- Timing of intervention deployment for rapid containment of the outbreak.

Budget and Resources (Human, Financial, and Material):

- Total cost of the plan;
- Sources of funding; and
- Funding gaps.

Monitoring, Evaluation (Indicators), and Report Writing

- Indicators to be monitored;
- Support and supervision;
- Submission of an epidemic needs assessment/epidemic investigation report, response report and end of epidemic report; and
- Conduct an epidemic post mortem (guideline to be provided) and document findings.

Annex 2: Epidemic and Rumour Log

District Log of Suspected Outbreaks and Rumours

Record verbal or written information from health facilities or communities about suspected outbreaks, rumours, or reports of unexplained events. Record the steps taken and any response activities carried out

Condition or disease (1)	Number of cases initially reported (2)	Case location: health centre, village (3)	Date district was notified (4)	Date suspected outbreak was investigated by the district (5)	Result of district investigation (confirmed, ruled out, or unknown) (6)	Date outbreak began: date onset index case/date crossed threshold or first cluster (7)	Date a case was first seen at a health facility (8)	Date concrete interven tion began (9)	Type of concrete intervention begun (10)	Date district notified provincial level of the outbreak (11)	Date district received provincial level response (12)	Comments (13)

Annex 3: Calculating and Interpreting Epidemic Threshold Limit Values

Introduction

As defined by WHO, an epidemic threshold is the level at which the reported malaria case count in a given locality and time are higher than would be considered "normal". This epidemic threshold is used to confirm the presence of an epidemic so that appropriate control measures can be implemented in a timely manner.

The overall goal of epidemic detection is to identify increases in malaria cases that may warrant a response.

There are multiple approaches[1] that can be used to calculate epidemic TLVs, including but not limited to:

1. Constant case count;
2. Median plus upper third quartile;
3. Mean plus a given number of standard deviations; and
4. Cumulative sum method (this is essentially number three using a rolling average).

The most appropriate approach depends on the epidemiology of malaria transmission and other factors in the area under surveillance. The approach that is chosen should be the one that provides the optimal mix of sensitivity, specificity, and positive predictive value.

Each of the methods listed requires certain data to be available. This includes weekly data on confirmed malaria cases for the current year, as well as multiple past years of weekly malaria data to define the expected "long-term" weekly caseload. It is common practice to calculate two thresholds: an alert threshold for early warning (more sensitive), and an epidemic threshold for early detection (more specific).

To further optimize the sensitivity and specificity of the outbreak detection system, the TLV calculation approach may be modified. For example, outlier years can be removed from baseline data or fewer years of baseline data can be used if the epidemiology of malaria transmission is rapidly and consistently growing or decreasing. In areas where there are a small numbers of cases, or the number of cases varies dramatically from week to week, the baseline data can be "smoothed" to minimize the number of "on and off" alerts that may not warrant investigation.

[1] For more details on these various approaches, please review pages 117-119 of the WHO's Malaria Surveillance, Monitoring & Evaluation: A Reference Manual, available online at http://www.who.int/malaria/publications/atoz/9789241565578/en/.

Calculating Malaria TLV: Zimbabwe Approach

Baseline data and threshold limit values for control areas.

	Control Areas
Baseline data	Weekly malaria case data for the last five years
Alert threshold	Mean of weekly malaria cases using a three week rolling average
Action threshold	Mean weekly malaria cases plus 1.5 SD, using a three week rolling average

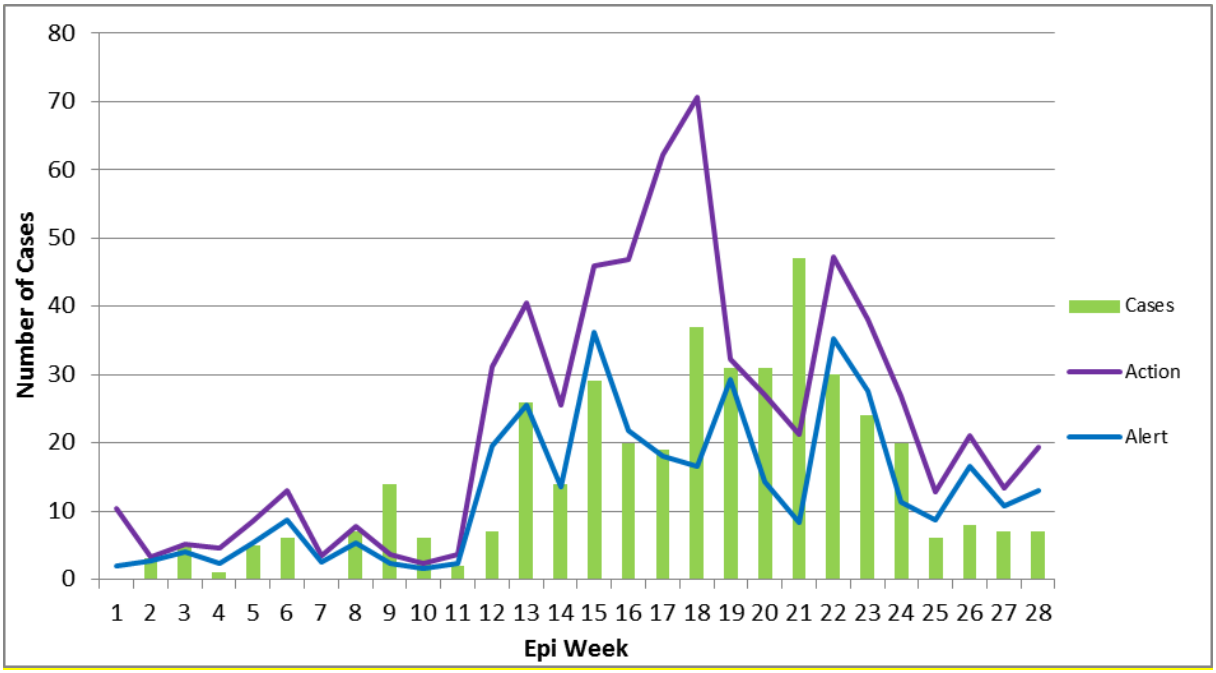
Note: the alert threshold is more sensitive and provides an early indication that there might be an increase in cases. The action threshold is a higher value: this is the level at which an investigation may need to be initiated to determine the cause for the increase in cases beyond what is expected based on previous years' data.

The approach used in control and pre-elimination areas (i.e., those not yet implementing malaria elimination activities), is based on the mean plus 1.5 SDs. The basic methodology for calculating the action threshold includes the following steps and can be accomplished fairly easily in an excel spreadsheet:

1. Calculate a three-week rolling mean for each week from the previous five years of health facility data;
2. Calculate the SD for each week and multiply by 1.5;
3. Add the product of step two (1.5 SD) to the weekly mean; and
4. Plot the weekly data.

Calculating the alert threshold is simpler: calculate the weekly mean for the previous five years of data and plot.

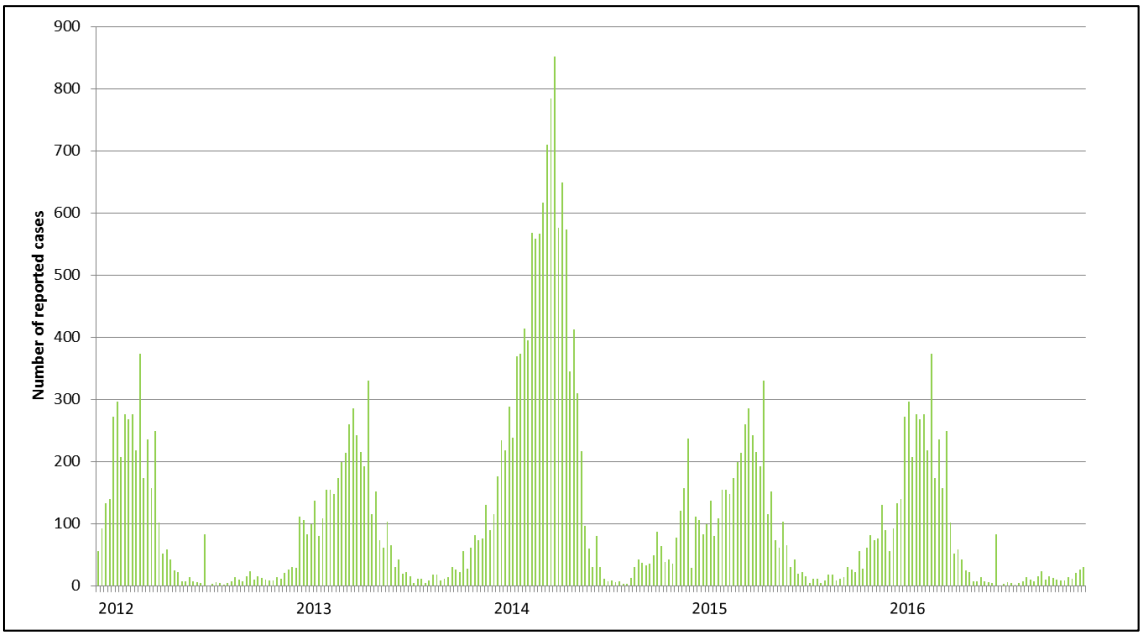
Below is an example graph showing how the TLV looks when everything is plotted. In this example, data is presented only up to week 28 of 2016 to make it easier to fit the graph in this document. Normally, the entire year would be plotted. The graph shows the weekly data plotted. The jagged curves could result in more "on and off" signals, such as in week 21 and 22. The curves for the alert and action thresholds can become smoother by using a three-week rolling average.



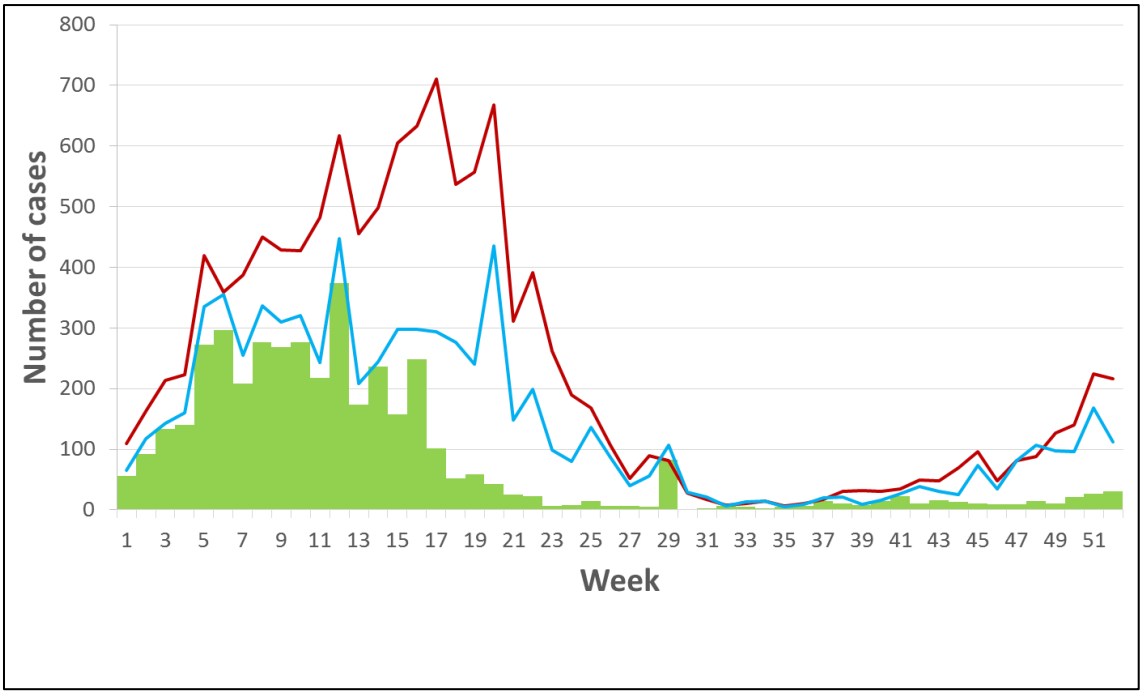
As mentioned in the introduction, it is sometimes appropriate to modify the approach to TLVs to make them more sensitive or to minimize the number of false positive alerts. The main ways that this can be done are listed below—the approach used depends on the epidemiology of the area under surveillance.

1. Removing outlier baseline years from the TLV calculation (i.e., those years with dramatically increased or decreased case numbers compared to other baseline years).

The graph below shows an example of an area with a significant outlier in the baseline five-year data (year 2014).

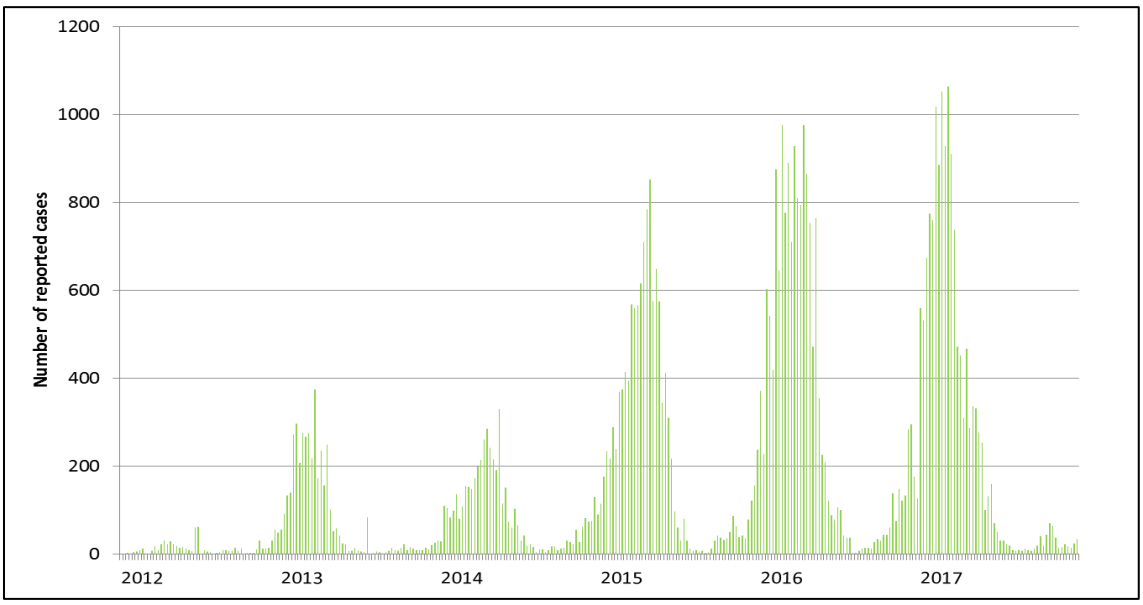


If the 2014 data was included, the TLV curve would appear as the red line in the graph below. Excluding the 2014 data results in the blue TLV curve, which is more representative of the overall historical trend. This makes it more likely that current year data (the green bars in the graph) will produce a deviation above the threshold. As a result, the system is better optimized by eliminating the outlier year.

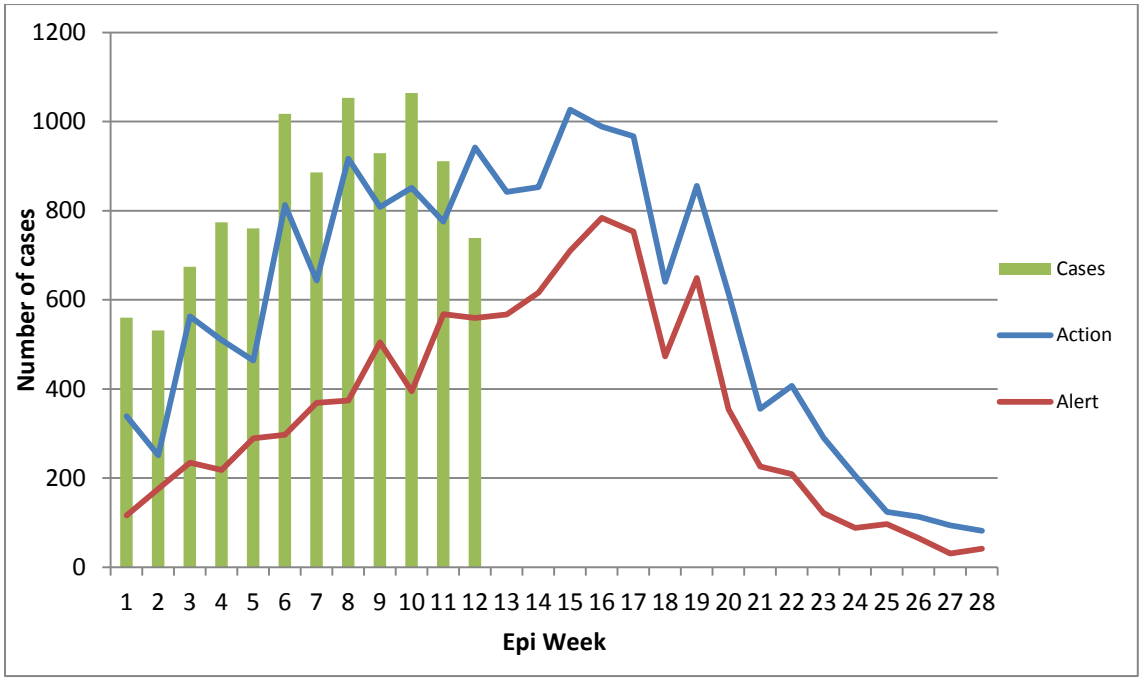


2. Reducing of the number of baseline years (to between two and four years) in areas with evidence of relatively consistent, step-wise increases or decreases in case burden during the past five years.

The graph below shows an example of an area with consistently increasing transmission over the years.

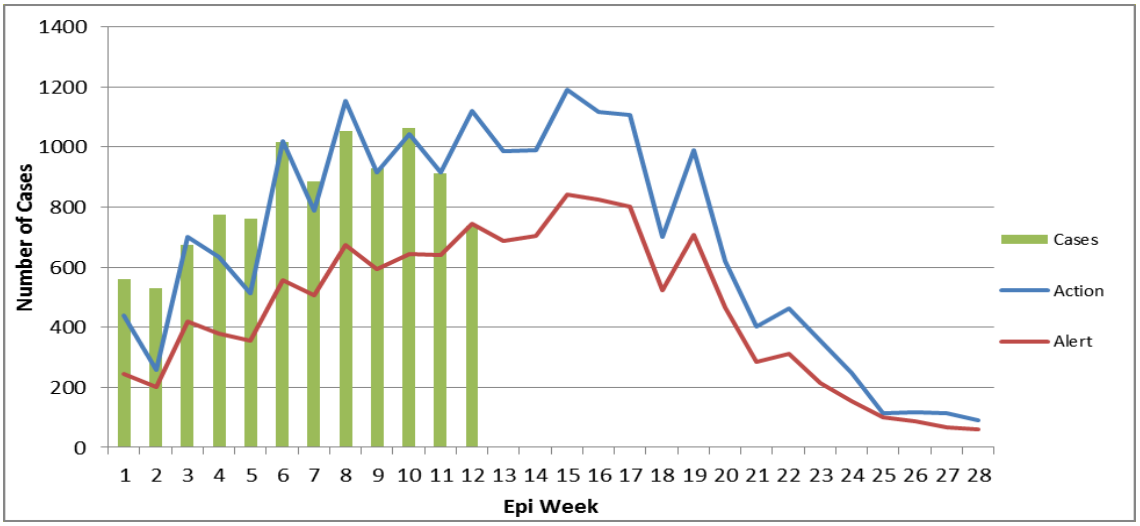


As the graph below shows, if the normal mean plus 1.5 SD approach is applied in this situation, a large number of action signals (deviations above the action threshold) will be seen. This is because the current year is higher than any of the previous baseline years.

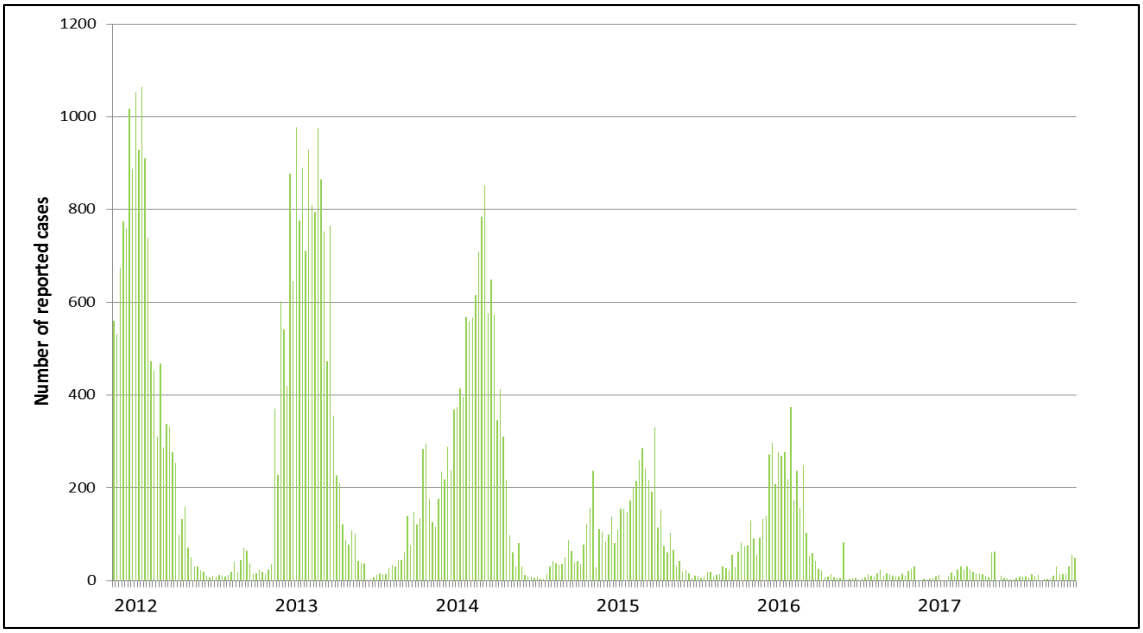


If the number of baseline years is reduced to reflect the more recent past, fewer alerts are seen. This is important because each alert needs to be investigated, which requires resources. Since the alerts seen in the first graph (where all five years of data were used) are an artefact of the increasing trend in the baseline data, they may not reflect actual changes in the number of cases compared to what has happened in more recent years. As a result, these signals may not be a cause for concern or warrant investigation.

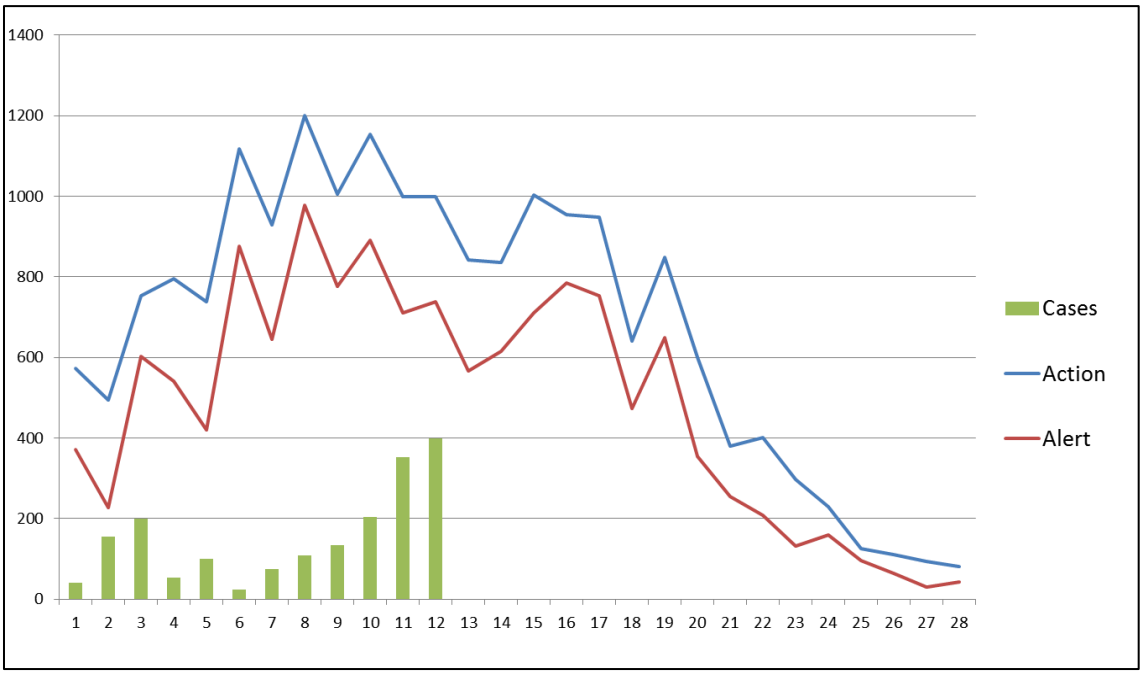
To address this problem, the number of baseline years can be reduced. The graph below shows what happens when only the three most recent years are used to calculate the TLVs. This results in fewer alerts that are more likely to represent situations of concern (in other words, the specificity of the system is increased).



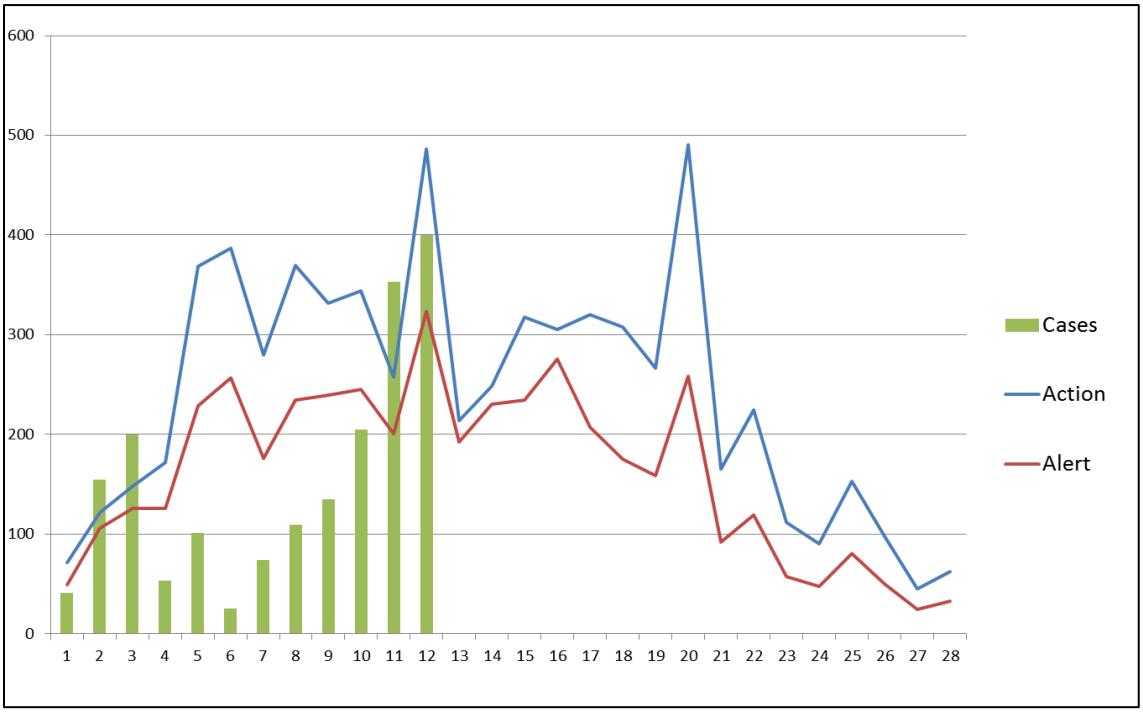
As the graph below depicts, the same situation can be seen in reverse for an area with steadily decreasing transmission.



In this situation, using the normal mean plus 1.5 SD approach makes it very unlikely that any weekly data in the current year will exceed the threshold, which was calculated using data from past years when transmission was very high (see graph below). This means that the sensitivity of the system is too low to detect any potential increases.



This can be corrected by using a reduced number of baseline years. The graph below shows what happens when only the two most recent years of baseline data is used. This adjustment makes it more likely that an increase in weekly caseload in the current year will create a signal, thus optimizing the sensitivity and specificity of the system.



3. For new facilities, continuing to use combined data for the catchment area of the new and previously existing facility. This should be continued until three years of baseline data are available for the new facility's catchment area, allowing for the use of more robust baseline data.

Interpreting Increases in Cases above the TLV

Any weekly deviation in the current number of cases above the alert threshold should serve as a warning signal. If the action threshold is crossed, then an investigation should be initiated. A deviation above the TLV means that the situation should be investigated—it does not necessarily mean there is an outbreak. The increase in cases could be due to an actual increase in local transmission, but the investigation could also reveal that the cause is due to importation of cases, changes in record keeping practices or quality, increased diagnosis, or a host of other factors.

Determining Constant Case Counts for Elimination Areas

In malaria elimination settings, a constant case count is recommended for identifying epidemics. In this regard, the three-year data is compared by week. The highest recorded number of cases in the three years for any particular week becomes the expected number of cases not to be surpassed. If the cases surpass that value, then an outbreak is declared. The constant case count approach does not replace the requirement that all malaria positive cases recorded are responded to within a three-day period. This will apply to health facilities with low levels of malaria cases; however some areas with higher burden of cases should continue to use weekly averages. The districts in consultation with the provinces should determine the most appropriate approach for facilities in their areas.

Interpreting Increases in Cases above the Constant Case Count

If the table below shows malaria cases data from a health facility, then it shows that there is a problem with week three in 2018, as the cases have surpassed the constant value recorded in 2015 of five cases in week three. This requires action to understand what could be the cause of the increase of cases.

Year	Week 1	Week2	Week 3
2015	7	3	5
2016	4	4	4
2017	5	2	2
2018	2	1	6

Annex 4: Epidemic Report Format

Title/Description (include disease/condition investigated)

Period; place (Village(s), City, Town, District, Province)

Executive Summary:

Introduction:

Background:

- Geographical location
- Demographical data
- Disease pattern

Epidemic Preparedness

- Were adequate drugs and medical supplies available at the onset of the outbreak? (date 1, 2 & interval)
- Were treatment protocols available to health workers? (date 1, 2 & interval)
- Did the District Epidemic Response Committee regularly meet as part of epidemic preparedness (date 1, 2 & interval)?
- Was an epidemic preparedness plan available?

Investigation

- Reasons for investigation (public health significance, threshold exceeded, etc.)
- Investigation report

  Methods:

  - Date(s) of investigation
  - Site(s) of investigation (health care facilities, villages, other)
  - Case finding (indicate what was done regarding case finding (e.g., register review, contact investigation, alerting other health facilities, other)
  - Describe response and intervention (include dates)
  - Interviews with key informants (health facilities/MOHCW, community & partners)
  - Group discussions with EPR committee & other coordination bodies

  Findings:

  - With text, describe key features of results of time, place, and person analysis. (Please attach relevant source documents; time (epi curve), place (map), and person characteristics (table) and line lists)
  - Results of response and evidence of impact (comment on following levels: community, health facility, district, partners, provincial, and national)
  - Recommended public health actions at community, health facility, district, partners, provincial, and national levels

- Self-evaluation of the timeliness and quality of preparedness, epidemic detection, investigation, and response
- Challenges and lessons learnt
- Discussion and conclusion

Epidemic investigation:

- Case forms/line listed completed
- Interval between notification of district and district field investigation conducted (Target: within 48 hours, indicate; date 1, 2 & interval)

Epidemic response:

- Interval between notification of outbreak to district and concrete response by the district (Target: within 48 hours of notification; indicate date 1, 2 & interval)
- Adequacy & rational use of drugs and other supplies
- Adequacy of human resources
- Response staff incentives
- Transport and communication

Evaluation and Feedback:

- Interval between end of the outbreak and finalization of outbreak report with case forms/line list sent to national level (Target: 2 weeks)
- Outbreak management committee met?
- Feedback given to health facilities, partners and community?
- Method of feedback used

Other aspects, evaluation:

District Epidemic Committee Chairperson:

Name Signature

District Medical Officer:

Name Signature

Date report completed:

N.B.: Include annexes of the following:

1. Epi curve
2. Self-evaluation report
3. Spot map
4. Person characteristics (table and line listing)

Annex 5: Questionnaire for Assessment before and after a Malaria Epidemic

The following questionnaire should provide an analytical framework to assess the level of preparedness or success in responding to the epidemic.

1. Epidemic-prone areas:
    a. Demarcated? If yes, is/was the epidemic in a high-risk area?
    b. Is/was the epidemic in refugee camps?
    c. Is/was the epidemic related to population movement?
2. Forecasting and warning systems: with El Niño, real-time and satellite weather data:
    a. Are/were forecasting data made available, used, and shared by national teams?
    b. Do/did the data predict a possible epidemic in the region?
    c. Is/was the regional malaria control station aware of the risk?
    d. Is/was this information disseminated to all levels of malaria control?
    e. Are/were early warning indicators validated over space and time?
    f. Is/was there adequate planning for source reduction measures if the predictions were confirmed?
3. Early detection system:
    a. Is/was a well-functioning surveillance system in place for early detection in epidemic-prone districts?
    b. Are/were these data recorded and analysed with set-up thresholds at district level with regular feedback/update to peripheral health care facilities?
    c. Are/were records of previous years available for comparison?
    d. What method is/was used to analyse anomalies and define/validate thresholds (i.e. mean + two standard deviations, third quartile, cumulative sum)?
    e. Are/were these data regularly reported to a central facility? If yes, describe communication channels used.
4. Recognition of anomalies and preliminary action taken at the periphery:
    a. Are/were anomalies detected at the periphery and action immediately taken?
    b. If yes, what action was taken at the periphery first and then at district level?
    c. How was the verification process? Fast enough (in days)?
    d. How is/was notification to district made? Lag time (days)? If more than two days, what caused the delay?
5. Preparedness plan of action:
    a. Is/was there a plan of action
    b. If yes, is/was it technically and operationally appropriate?

c. Are/were partners involved in preparing the plan of action? If yes, list.
d. Is/was a budget allotted for malaria epidemic response?
e. Is/was the budget translated into actual disbursements for response?
f. Are/were adequate drugs and medical supplies pre-positioned at district level for rapid distribution? Specify the missing commodities.
g. Are/were there sufficient trained personnel to handle the epidemic?

6. Response:

   a. Is/was there effective communication between the local and district level and above?
   b. What is/was the lag time between confirmation of the epidemic and local response?
   c. Were there sufficient trained personnel to handle the epidemic?
   d. Which vector control measures are/were applied?
   e. Is/was mass drug administration considered for transmission reduction? If yes, specify the type of medicine, coverage in the affected population.
   f. Are/were community mobilisation and engagement activities adequate?

7. Disease and economic burden:

   a. Length of the epidemic in weeks?
   b. Population size affected?
   c. Lives lost (excess number of deaths) over the threshold?
   d. Morbidity (excess number of cases) over the threshold?

8. If the situation required mobilising national emergency support:

   a. What was the time lag for communication between district and national levels?
   b. Who alerted the national level to stimulate a national response (district office, newspaper or other media, other source)?
   c. Was national support necessary? Was partners' support necessary?
   d. If so, was it effective in curbing the epidemic? Provide some rationale.

9. Action items:

Annex 6: Self-evaluation of the Timeliness and Quality of Epidemic Detection, Investigation, and Response

Outbreak Detection:

1. Interval between onset of index case (or occurrence of an unusual cluster at the community level) [date 1] to arrival of first epidemic case at the health facility [date 2] (Target: <3 days):

   _____ _____ _____
   Date 1 Date 2 Interval

2. Interval between initial epidemic case seen at the health facility (or date of epidemic threshold crossing at the health facility [date 1] and reporting to the district health team [date 2] (Target: within 24 hours):

   _____ _____ _____
   Date 1 Date 2 Interval

3. Cumulative interval between onset of index case (or occurrence of an unusual cluster at the community or health facility) [date 1] to notification to the district [date 2] (Target: <7 days):

   _____ _____ _____
   Date 1 Date 2 Interval

Epidemic Investigation:

4. Case forms/line listed completed? Yes ☐ No ☐
5. Laboratory specimens taken (if required)? Yes ☐ No ☐
6. Interval between notification of district [date 1] and district field investigation conducted [date 2] (Target: within 48 hours)

   _____ _____ _____
   Date 1 Date 2 Interval

7. Interval between sending specimens to the lab [date 1] and receipt of results by the district [date 2] (Target: 3-7 days, depending on type of test)

   _____ _____ _____
   Date 1 Date 2 Interval

Epidemic Response:

8. Interval between notification of epidemic to district [date 1] and concrete response by the district [date 2] (Target: within 48 hours of notification)

_____	_____	_____
Date 1	Date 2	Interval

Evaluation and Feedback:

9. Interval between end of the epidemic [date 1] and finalization of epidemic report with case forms/line list sent to national level [date 2] (Target: 2 weeks)

_____	_____	_____
Date 1	Date 2	Interval

10. Epidemic management committee met? Yes ☐ No ☐
11. Feedback given to health facilities and community? Yes ☐ No ☐
12. Method of feedback used: _____

Other Aspects, Evaluation:

Interpretations, discussion, and conclusions:

_____

_____

_____

Recommended public health actions:

Comment on following levels: community, health facility, district, partners, provincial, and national.

_____

_____

District Epidemic Committee

Chairperson: _____

Name Signature

District Medical Officer:_____

Name Signature

Date reported completed: _____

Annex 7: Malaria Epidemic Investigation Field Guide

- Relevant background information of the health facility; name/district/province.
  - Malaria burden (malaria epidemiology, vectors, and phase in the malaria control continuum)
  - Population at-risk; disaggregation to include special populations
  - Risk factors for malaria
  - Routine malaria prevention interventions used in the catchment area
- Data verification
  - Verify the data to confirm an actual increase in malaria transmission.
  - Brief description of the data verification process
- Confirmation of the epidemic
  - Identify who is getting malaria and where? Summary demographic data (line-listing)
  - Map the population at-risk
  - Spot-mapping of cases
  - Describe potential contributing factors
- Investigations for potential or contributing factors
  - Describe contributing natural climatic factors
  - Have there been population movements in the area? Describe the nature and magnitude.
  - Investigate and describe socio-economic and land use factors
  - Evaluate routine vector control measures used in the affected area
    - Methods
    - Coverage
    - What is the estimated usage rate among those with LLINs?
    - If IRS, do bio-assays on sprayed surfaces. What are the results of bio-assays?
    - Are routine vector control measures adequate to protect the population at-risk?
    - SBCC to promote malaria prevention and treatment
    - Summarize—what are the postulated contributing factors?
  - Conduct an entomological survey. Describe results.
    - Breeding sites
    - Adult vector mosquito collection
    - Vector density
    - Vector biting and resting behaviour
    - Vector chemical susceptibility

- Action or response to control the epidemic
  - Propose action to control the epidemic and give justifications based on the investigation findings

Annex 8: RRT Members and Roles and Responsibilities

Team Leader

This is usually the Epidemiology and Disease Control Officer or other representative as appointed by the PMD or DMO.

Roles and responsibilities include:

- Present available information
- Outline investigation plans
- Assign roles and responsibilities
- Oversee team member roles
- Communicate with media
- Communicate with other officials

Epidemiologist

- Verify the existence of outbreak
- Coordinate the activities of the RRT related to the investigation and containment of suspected or confirmed epidemics
- Identify and coordinate control measures
- Institute case management measures
- Supervise data collection and data analysis in order to give information on the evolution of the epidemic
- Liaise with all stakeholders involved in the investigation and response of the epidemic
- Collect all available information from the provincial (sub-national) focal points prior to the field mission and prepare the logistics of the mission in collaboration with the Team Leader
- Alert all relevant national health authorities
- Notify the next level about the outbreak
- Coordinate all follow-up measures in collaboration with the Team Leader

Environmental Health Officer

- Conduct epidemiological field investigations
- Provide community education about the outbreak
- Liaise with stakeholders involved in field investigation
- Organise and implement vector control activities (IRS, larviciding, and environmental management)

Clinician

- Educate on case definitions and identification of cases
- Advise and gives leadership in management of patients
- Educate, implement, and supervise infection control measures
- Advise on area hospital bed capacity and medical capability
- Advise on collection of clinical specimens from cases/patients
- Conduct malaria death investigations

Laboratory Scientist

- Perform laboratory diagnosis to help refine/confirm a case definition and confirm the epidemic
- Advise and assure proper specimen collection, transportation, and storage
- Assess area laboratory capability
- Liaise with National Institute of Health Research and National Medical Reference Laboratory on drug resistance and/or drug efficacy

Pharmacy Staff

- Should ensure health facility has adequate minimum stock of medical supplies at all times
- Should ensure adequate supply of medicines and commodities to VHWs
- Should keep stock cards up to date

Health Promotion Officer

- Conduct community sensitisation activities
- Develop the main messages for public education including media alerts
- Liaise with community and other important stakeholders

Annex 9: List of Participants at the Consultative Meeting

No.	Name	Designation	Organization
	PARTNERS		
1	Anthony Chisada Dr	Senior Case Management Specialist	ZAPIM
2	Elizabeth Juma Dr	Medical Officer	WHO
3	Anderson Chimusoro Dr	Malaria-National Professional Officer	WHO
4	Jasper Pasipamire	Malaria-National Professional Officer	WHO
5	Khoti Gausi Dr	Global Malaria Expert	WHO IST
6	Anderson Chinorumba	Technical Officer	WHO IST ECSA
7	Shadreck Sande	Operations Manager	Abt-AIRS
8	Wonder Sithole	Data Quality Officer	ZAPIM
9	Patrick Chinyamuchiko	M&E/OR Manager	ZAPIM
10	Rameck Makokove	Nationa Malaria Coordinator	Plan International
11	Joseph Chipinduro	Acting Chief Laboratory Scientist	National Institute of Health Research
12	Lukwa Nzira	Entomologist	NIHR
13	Hieronymo Masendu Dr	Entomologist	Abt-AIRS
14	Tendayi Muchenje	Enviromental Compliance Officer	Abt-AIRS
15	Noe Rakotondrajaona Dr	Chief of Party	ZAPIM
16	Gilson Mandigo Dr	Case Management Specialist	ZAPIM
17	JB Rwakimari Dr	Technical Director	ZAPIM
18	John Githure	Principal Environmental Health Officer	Local Funding Agent
19	Albert Makone	M&E Officer	Local Funding Agent
20	Brighton Gambinga	Associate Malaria Specialist	CHAI
21	Peter Troell Dr	Malaria Advisor	PMI/CDC
22	Christe Billingsley	Malaria Advisor	PMI
23	Regis Magauzi	Malaria Specialist	PMI
	MOHCC PROVINCIAL STAFF		
24	Christopher Muchira	Provincial Health Information Officer	MOHCC PMD Mashonaland East
25	Munekayi Padingani Dr	Provincial Epiology and Disease Control Officer	MOHCC PMD Matabeleland North
26	Notho Dube	Provincial Environmental Health Officer	MOHCC PMD Matabeleland South
27	Fortunate Manjoro	SBCC Officer	MOHCC- NMCP
28	Clever Matiringe	Provincial Environmental Health Officer	MOHCC PMD Mashonaland East
29	Harusekwi Andrew Hukuimwe	Provincial Health Information Officer	MOHCC PMD Mashonaland West
30	Chikono Gibson	Provincial Health Information Officer	MOHCC PMD Manicaland
31	Tapera Saravoye Dr	Provincial Epidimiology and Disease Control Officer	MOHCC PMD Masvingo
32	Stanely Tapesana Dr	Provincial Epidemiology and Disease Control Officer	MOHCC PMD Mashonaland Central

No.	Name	Designation	Organization
33	Mary Muchekeza Dr	Provincial Epiology and Disease Control Officer	MOHCC PMD Midlands
34	Munyaradzi Mukuzunga Dr	Provincial Epiology and Disease Control Officer	MOHCC PMD Manicaland
35	Cansio Makombe	Health Information Officer	MOHCC PMD Midlands
36	Calson Mazembe	Provincial Health Information Officer	MOHCC PMD Masvingo
37	Henry Dube	Provincial Health Information Officer	MOHCC PMD Matabeleland North
38	Abigail Chirema	Provincial Pharmacist	MOHCC PMD Masvingo
39	Brian Guveya	Provincial M&E Officer	MOHCC PMD Matabeleland North
40	Gift Masoja Dr	Provincial Epidimiology and Disease Control Officer	MOHCC PMD Mashonaland West
41	George Kambondo	Provincial Health Promotion Officer	MOHCC-PMD Mash West
42	Mark P. Jira	Provincial Health Information Officer	MOHCC PMD Matabeleland South
43	Paul Matsvimbo Dr	Provincial Epidemiology and Disease Control Officer	MOHCC PMD Mashonaland East
	MOHCC NATIONAL OFFICE STAFF		
44	Patience Dhliwayo Dr	Deputy Director	MOHCC- NMCP
45	Wilson Chauke	Vector Control Officer	MOHCC- NMCP
46	Andrew Tangwena	M&E Officer	MOHCC- NMCP
47	Joseph Mberikunashe Dr	NMCP Director	MOHCC- NMCP
48	Busisani Dube	Assitant M&E Officer	MOHCC- NMCP
49	Vimbayi Machiwana	Country Focal Person	NMCP/E8
50	Joel Mouatcho	Entomologist	NMCP/Abt
51	Sarah Mwai	Health Information Officer	MOHCC
52	Dumisani Ncube	Provincial Environmental Officer	MOHCC