Malaria Epidemic Forecasting and Preparedness Manual

Ministry of Health, Asmara, Eritrea

FOR PREDICTION, PREVENTION, DETECTION AND CONTROL OF MALARIA EPIDEMICS IN ERITREA

National Malaria Control Program

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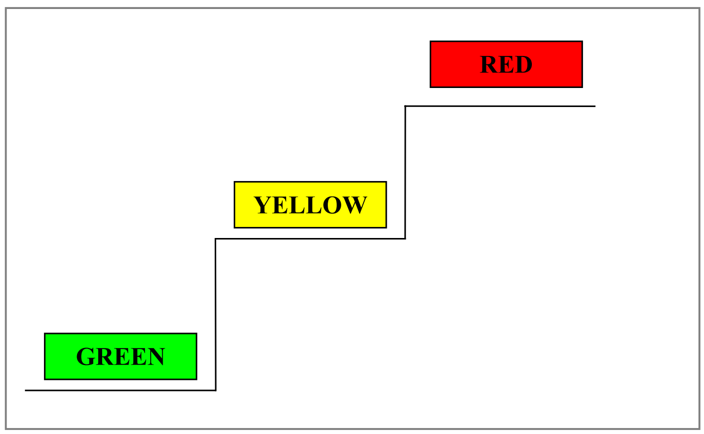
Contents

Introduction

This manual is written for zoba malaria coordinators (and future sub-zoba malaria coordinators) to help predict, prevent, detect and control malaria epidemics in Eritrea.

Epidemic preparedness and prevention is mostly a matter of being on **alert**. From year to year, the probability of an epidemic varies depending on biological factors, social factors, and particularly the weather. The level of alert varies from year to year depending on these factors. In this manual, we will use three levels of alert in a colour-coded system:



We can think of these levels as a series of steps, raising alert from the baseline (Green) to higher levels (Yellow and Red). In the manual, we define which factors should cause the alert level to rise up a step. These are noted in "boxes" in the text, and summarised on Page 22.

There are also criteria for deciding when to move down a step in the alert level. This is an important part of the system because otherwise you would be permanently on high alert.

The alert level should ideally be decided by the sub-zoba. This is because the likelihood of epidemics varies too much over a zoba or over the country as a whole. Since the alert level depends greatly on the amount of recent local rainfall, it cannot be decided unless there is a source of rainfall data for the sub-zoba.

The manual is organized as follows:

In Sections 1 and 2, we provide a general definition of an epidemic and describe key characteristics of malaria epidemics in Eritrea.

In Eritrea there is large variation in malaria incidence across the country due to altitude, terrain, amount of rainfall and proximity to water. In Section 3, we describe this variation in terms of "geographical stratification." This does not vary much from year to year. We can then add information on factors which do change from year to year as discussed under "Assessing Vulnerability" in Section 4. We use such information to decide on the likelihood of an epidemic in any particular year. This likelihood is characterized by the alert level.

Action to prevent or control an epidemic should not wait until after an epidemic is in progress. Certain actions can be taken after forecasting and warning indicate that the level of alert is high. The appropriate actions to be taken are discussed under Section 5: "Epidemic Forecasting and Warning."

Once an epidemic has been detected, we should move from "ALERT" to "RESPONSE." How to detect an epidemic is discussed in Section 6 "Epidemic Detection." How to prepare for epidemics is discussed in Section 7 "Epidemic

Preparedness," and what actions to take during response are described in Section 8 "Epidemic Response."

When an epidemic is over, we move back from "response mode" to "alert mode." The criteria for deciding when an epidemic is over are discussed in "Definition of an epidemic" in Section 6.

1. General Definition of an Epidemic

The usual definition of an epidemic is the following:

"The occurrence in a community or region of cases of an illness, clearly in excess of normal expectancy."

This definition shows that we have to define an epidemic with reference to a particular **geographic area** (community or region)**.** Also, to know how many cases are expected, we have to know what **time period** we are talking about.

Thus, for example, we could say that in the **whole country** (geographic area) in the **year 1998** (time period), we had a malaria epidemic. However, this is on a very large scale of area and time, and is not very informative. If we want to be more specific, we could also say that in **Massawa subzone** (geographic area) in the month of **January 2001** (time period) we had an epidemic. This is a more medium area and time-scale. On an even smaller scale, we could say that in a certain **village** (geographic area) in the first week of **October 2002** (time period) we had an epidemic. For all of these situations, we need to know what number of cases would normally be expected for that place and time period.

Often, an increase in cases is called an **outbreak**. This word is sometimes used for an increase in case numbers in a small geographic area (e.g., in a village), or for cases that occur in a place that usually does not have malaria. However, there is no real difference between the definition of outbreak and of epidemic.

2. Characteristics of Malaria Epidemics in Eritrea

In Eritrea, there is also a lot of variation in transmission from place to place in the country. In some parts, for example the southwest, there is transmission year-round, but the number of cases is usually much higher in some months than other. In these places, the seasonal rise in transmission is expected every year. In other places, such as on the Red Sea coast, there is a rise in malaria cases in some years, but not every year.

Therefore there are two distinct types of malaria epidemics which occur:

- The seasonal increase in malaria transmission is much greater than expected.

- Increased malaria transmission occurs in a place that usually has very low numbers of cases.

An example of the first type of epidemic is given in Fig. 1.

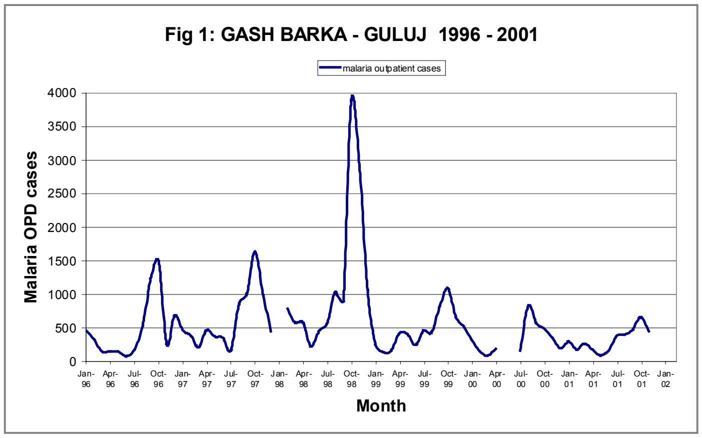
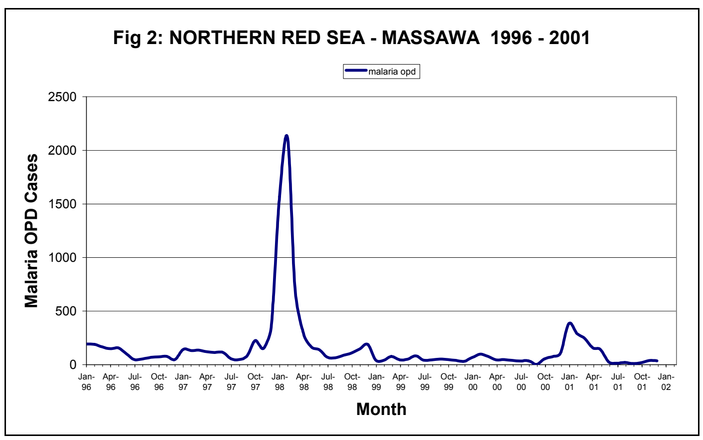


Fig. 1 shows the number of cases by month from Guluj health centre from January 1996 to December 2001. There is a peak of transmission every year, around September or October. However in 1998, the peak was much higher than usual and was clearly higher than expected. Thus we can say that in this health centre, during October 1998, there was a malaria epidemic.

An example of the second type of epidemic is shown in Fig. 2.



As you see in Fig. 2, in Massawa subzoba, there is not a regular seasonal peak of transmission. Instead, there is low level transmission most of the time, with occasional peaks. In this case it seems that there were epidemics in January 1998 and January 2001.

To understand the likelihood of epidemics in a particular area at a particular time, we need to have knowledge of the past history of cases in that particular area so that we know how many cases are expected. Much of that information is known by the experienced staff, but it is important to document it to make it clear and to pass on the knowledge to others.

We also need to give a figure of the number of epidemics that occurred in particular areas over particular time periods (for example, by year or quarter). This is because one of the targets of the NMCP is to reduce the number of malaria epidemics and the number of cases during epidemics. This cannot be evaluated unless we know how many epidemics were occurring in the past and present, and how many may occur in the future.

3. Geographic Stratification

Stratification is used to define the underlying probability of malaria infection in a particular place. It can be thought of as the level of endemicity. This depends on altitude, proximity to rivers and water bodies, and usual rainfall, and is fairly constant from year to year.

The tremendously varied distribution of malaria in the country is well known, and most zoba coordinators are using stratification maps, which they have prepared, to plan where to focus their activities. However, we need to use a standard method of malaria stratification throughout the country. Also, we need to be able to update the maps regularly and link them to rainfall and other data. Therefore a computerized Geographic Information Systems (GIS) model of malaria stratification is being developed.

4. Assessing Vulnerability

Social factors

Social factors include population movements within the same country, or between neighbouring countries. This includes internally displaced persons, returnees or refugees moving due to war or natural disaster.

People may be moving from areas of no malaria transmission to areas that have transmission, in which case they do not have much immunity to malaria and are vulnerable to infection in the new place. Movement of people may also bring malaria from areas of high transmission to a new place that does not usually have malaria, but has mosquitoes as potential vectors. Therefore transmission to the local population will occur when infected people move in.

Population movements are hard to define in a scientific way. The important thing is for zoba/subzoba coordinators and health facilities to be aware of social disruption and movement, and to communicate this to other malaria control workers at national, zonal, and subzonal offices.

If there has been unusually large movement of people during the last year, raise the alert level by one step.

If there have not been large population movements for a year or more, go back down a step.

Biological factors

We also need to be aware of biological vulnerability factors. An example of this is when an area has not had malaria transmission for some time, so that people have lost their immunity, or when there is food shortage so people are at higher risk of any illness. If a drought period continues for several years, people are very susceptible to malaria, especially children born since the last high transmission years. Drought does not tell you that an epidemic is likely to happen, just that if it does, things are likely to be bad.

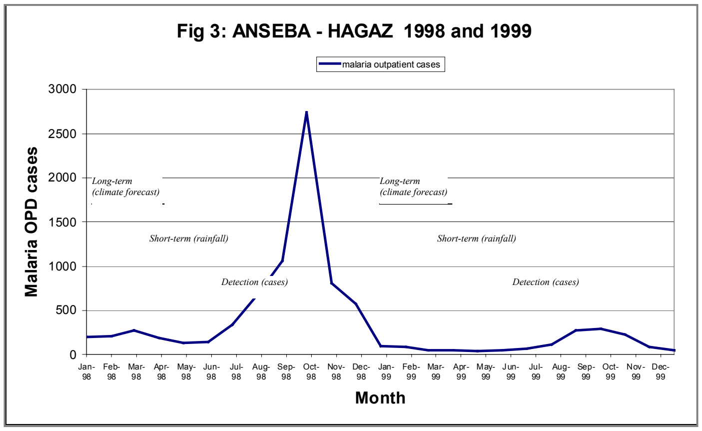
The same thing can happen even without drought, if control measures are effective and the incidence of malaria becomes very low. This is what happened in India and Sri Lanka in the 1970s. After many years of DDT spraying, there were few malaria cases in these countries, and few people were immune. When spraying was cut back and transmission started again, there were large epidemics because the population was so vulnerable to infection.

If there have been low numbers of malaria cases for 3 years or more, due to drought or very effective control measures in an area which previously had high incidence, raise the alert level by one step.

After a high incidence year, go back down a step.

5. Epidemic Forecasting and Warning

There are distinct stages defined in the process of epidemic warning and forecasting. We can divide them into "long-term forecasting" and "short-term warning." The time scales involved are shown in Fig. 3.



Long-term forecasting (several months in advance)

Long-term forecasting is based on meteorological data, usually fairly general predictions of rainfall amounts. These are not very accurate and only give a probability of whether the rainfall will be higher or lower than usual, or will be normal.

Seasonal rainfall predictions are made regularly by international organisations. An example is the seasonal climate forecast for the Greater Horn of Africa produced by the Climate Outlook Forum in Nairobi. These forecasts are sent to the Meteorology section at the Asmara airport and are also available on the internet. The forecasts are based mainly on sea surface temperatures in the tropical Atlantic and Indian oceans as well as El Niño conditions in the Pacific Ocean.

At the moment, these seasonal forecasts are not very accurate for Eritrea. Therefore we do not recommend changing the alert level depending on the forecast. In the future, this advice may change. In the meantime, if there is a seasonal forecast giving high probability of above normal rainfall, this should trigger stronger monitoring of local rainfall data.

Short-term warning (up to 2 months in advance)

This type of warning is based on actual rainfall amounts occurring (or other meteorological information), or on entomological data. There are several possible sources of data:

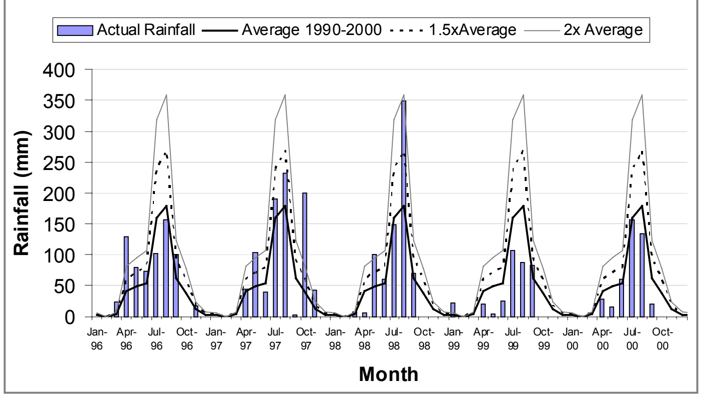
- Monthly or decad (10 day) meteorological data (rainfall amounts, temperature, relative humidity) reported by the Dept. of Agriculture stations throughout Eritrea
- Meteorological data (rainfall, temperature, relative humidity) recorded on a daily basis at sentinel sites

- Rainfall amounts estimated from satellite photographs and made available on the internet by the Africa Data Dissemination Service. Recently, maps especially for malaria early warning have been provided. A new map is shown every 10 days showing the differences above and below expected levels of rainfall

- Entomological data on numbers of adult or larval mosquitoes caught in routine standardized catches at sentinel sites. We do not yet know what suitable threshold numbers of mosquitoes would be. Therefore we do not know yet whether this entomological data will be useful, but it may be in the future.

To use meteorological data for warning, we need to have detailed knowledge of past rainfall levels and define what is an **abnormal** (unusual) amount for a particular location. Thus, we have to have an estimate of “normal” rainfall. Fig. 4 shows the average rainfall by month (thick solid line) over the period 1990–2000 at one rainfall station (Elabered). It also shows 1.5 and 2 times the average monthly rainfall (dotted line and thin sold line respectively), as well as the actual rainfall in the years 1996 to 2000 (bars).

Fig 4: Rainfall, Elabered 1996 - 2000



You can see from Fig. 4 that there was abnormally high rainfall early in the season in 1996: more than twice the average for the month of April 1996. The monthly totals for the rest of the year 1996 were fairly normal.

In 1997 we had unusually high early rainfall in May, and the rain also continued unusually late that year. The amounts in May, October and November 1997 were more than twice the averages for those months.

Note that 1997 was an El Niño year. Long-term seasonal forecasts are most likely to be accurate in such years.

In 1998, there was again abnormal early rainfall (in May 98), and much more rain than usual in August 1998. Rainfall was at least twice the average in each of these months.

To use monthly rainfall data for early warning, each month's average rain needs to be summarized as quickly as possible after the end of the month, and compared with the 10-year average.

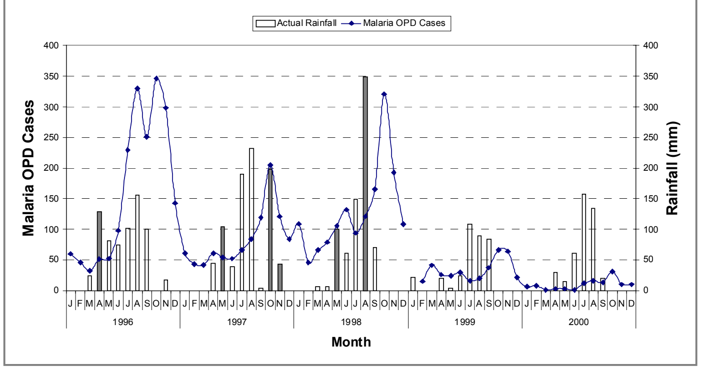


Fig.5: Elabered
Rainfall and Malaria OPD Cases 1996-2000

If we get unusually high rainfall in any month (more than 2x the average), raise the alert level by one step.

The alert level should stay high until there have been at least two months without unusually high rainfall. Then it should go back down a step.

In Figure 5 we see the actual monthly rainfall plotted as bars, and the months that had more than 2 times the average rain are shaded grey. The monthly OPD cases are shown as a line. Whenever there was a month with above average rain, it was followed two to three months later by a rise in the number of cases. See for example, rain in April 1996, which was followed by a sharp rise in cases in June and July 1996. Abnormal rain in

August 1998 was followed by a peak of cases in October 1998.

Action to be taken after a short term warning

This is the most critical stage for preventive action. There is about a two month lag between rain falling and a rise in malaria cases. In the areas where unusually high rainfall has been detected:

1. Start spraying or increase number of houses/villages sprayed

2. Increase amount of larviciding and source reduction

3. Finish annual net impregnation if not already done

4. Check stocks for adequate anti-malarial drug supply

5. Inform health facilities and villages of the increased risk

6. Inform Epidemic Preparedness and Response Committees at Zoba, Subzoba and village levels of the increased risk.

6. Epidemic Detection

Once an epidemic starts, the alert system is no longer useful. We have to move from "**Alert mode**" to "**Response Mode**." The epidemic is actually happening, and we have to start responding.

Response is discussed in the next section. The question is, how do we know when to start the response? This section is about how we detect that an epidemic is in progress, so that we can take action to decrease the number of cases.

Detection of an epidemic should be based mainly on a single indicator—the **total number of malaria cases**. For this purpose, it is not useful to break the number down by age. However, it is useful to find out whether the cases are from the local area or came from other areas, so that response can be targeted.

An unusual number of severe malaria cases (inpatient admissions) or deaths may also be a useful additional indicator. Because of the relatively low number of deaths occurring, it is not easy to estimate a threshold number for deaths. Keep in mind that an unusual number of severe malaria cases may also indicate a problem of drug resistance. If there is an increase in cases despite extensive spraying or bednet impregnation, this may indicate a problem of insecticide resistance.

To detect an epidemic, we need an estimate of the normal (expected) number of cases for that place and time period. Of course there is some variation from year to year, so we define an upper limit of normal—the **epidemic threshold** value. If the number of cases is above the threshold, then we say it is abnormal (unexpected). Thus we can say that an epidemic is occurring and action should be taken.

The threshold can be calculated by month, by week, or any other time unit. There are several ways to estimate the threshold. Four methods which have been used are as follows:

a. *Constant case count:* This is used where there is little or no malaria, or not much variation by season. It sets a threshold that is constant all year—for example 10 new cases a week. An epidemic occurs if the number is above the threshold.

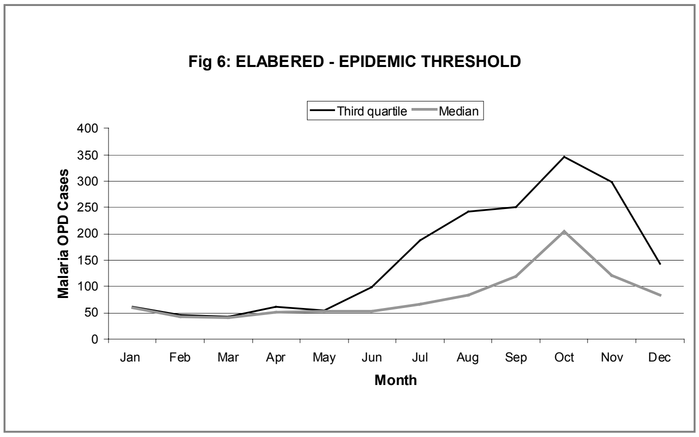
b. *Third Quartile method*: Calculates the threshold as the third quartile value of the number of cases per month or week for at least the last five years. This means that three-quarters of the time, we expect the number of cases to be below the threshold.

c. *Cullen method*: sets a threshold from the mean + 2 standard deviations of the five or more previous years' numbers of cases for that month or week. This means that roughly 97.5% of the time, the number of cases will be below the threshold.

d. *CSUM (cumulative sum) method*: this uses a running total of cases for each year rather than the monthly average. The threshold for each month is based on a moving average of that month plus the preceding and following months, to account for yearly variation in onset of the malaria "season." This method can give a good picture of whether the number of cases is rising faster than usual in a certain year.

WHO recommends the **third quartile method** (3Q) method. It is fairly simple to calculate, and we will use that method here. After further evaluation of past data, we may decide that another method, such as the CSUM method, would be better.

An example of a graph showing the third quartile threshold is given in Fig. 6.



Calculation of epidemic threshold

To calculate the third quartile threshold, we need to have data from at least the last five years on number of cases by month, or by week, or both. Ten years would be even better. Any epidemic year (e.g., 1998) should be included in this calculation.

The epidemic threshold should be calculated for each health facility by month and by week. To detect epidemics quickly, it is best to use the weekly threshold. However, the weekly data may not be available for the last five years, so monthly can be used first.

The threshold can be calculated with or without a computer. If you do not have a computer, you can still calculate the thresholds and make the graphs by hand. In this case, it is best to use five years' data. If you have more than five, it is easier to use the computer.

To calculate and draw monthly threshold by hand

1. Write down the data on malaria OPD cases by month for each health facility (or subzoba) from the last five years as shown in Table 1 below.

2. For each month, sort the numbers from lowest to highest, and write them in order as shown in Table 2 below. For example, take the number of cases from each January of the last five years from the first line of Table 1, and write them in ascending order in the first line of Table 2. Repeat with all the other months.

3. The middle number in each series (third column in Table 2) is the median. Take the median for each month and plot the points on a graph of cases by month, then join the points with a line. This is the average number of cases expected per month.

4. The 4th highest number in each series (4th column in Table 2) is the third quartile. Take the third quartile numbers for each month and plot them on a graph of cases by month, then join the points with a line. This is the epidemic threshold line.

Table 1:

Month	OPD malaria cases by Health Facility or Subzone				
	Year 1	Year 2	Year 3	Year 4	Year 5
Jan	48	28	47	28	44
Feb	18	21	28	32	29
Mar	34	24	17	2	38
Apr	44	31	15	15	32
May	24	19	28	34	39
Jun	39	24	33	9	12
July	61	32	32	39	33
Aug	78	107	39	44	56
Sep	59	132	94	75	59
Oct	153	289	131	93	70
Nov	69	188	171	58	27
Dec	50	122	53	6	22

Table 2:

Month	**Re-ordered** OPD malaria cases by Health Facility or Subzone				
	Lowest	1st Quartile	**Median**	**3rd Quartile**	Highest
Jan	*28*	*28*	***44***	***47***	*48*
Feb	*18*	*21*	***28***	***29***	*32*
Mar	*2*	*17*	***24***	***34***	*38*
Apr	*15*	*15*	***31***	***32***	*44*
May	*19*	*24*	***28***	***34***	*39*
Jun	*9*	*12*	***24***	***33***	*39*
July	*32*	*32*	***33***	***39***	*61*
Aug	*39*	*44*	***56***	***78***	*107*
Sep	*59*	*59*	***75***	***94***	*132*
Oct	*70*	*93*	***131***	***153***	*289*
Nov	*27*	*58*	***69***	***171***	*188*
Dec	*6*	*22*	***50***	***53***	*122*

5. If you have a computer, you can use an Excel spreadsheet which automatically calculates the median and third quartile, and draws graphs. The file is called "Threshold 3Q.xls." A print-out is shown at the end of this manual. There are separate sheets for monthly and weekly thresholds.

To calculate and draw monthly threshold by computer

1. Open the file "Threshold 3Q.xls" in Excel

2. Save a copy of the file under a new name (e.g., name of the health facility).

3. Click on the sheet marked "Month data."

4. Add the name of the health facility in cell D3.

5. Delete the data in the shaded area by highlighting it and pressing "Delete."

6. Enter the data on monthly malaria OPD cases for the health facility in recent years in the columns labeled "year1" to "year10." You can change the names to the actual years if you want. If you do not have ten years data, leave some of the columns blank (do not enter zeros).

7. The median and third quartile will be calculated and the graph will be automatically redrawn on the sheet marked "month graph."

8. Print the sheet called "month graph."

9. Save the file again and close it.

To calculate and draw weekly threshold by computer

Follow the instructions for monthly thresholds above, but enter the weekly data in the sheet called “Week data” by week number (1 to 52). The weekly data may be available from the IDSR weekly reports.

To remove the median line on the graph

If you want only the third quartile line and not the median line, here is how to get rid of it:

Click on the median line with the right mouse button. A menu will pop-up. Click on “Clear” and the line will disappear. If you want it back again, choose “Edit –Undo” from the menu at top of screen, or the back arrow on the toolbar.

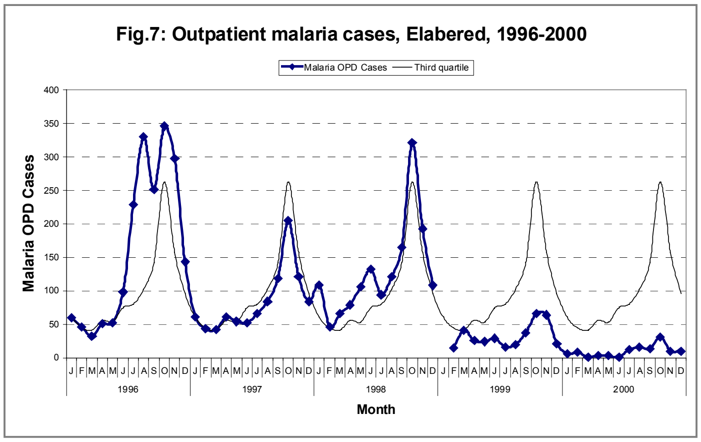
When to recalculate the thresholds

At the beginning of each year, you can recalculate the thresholds by adding the most recent year’s figures to the table. If you have more than ten year’s data, replace the oldest year’s with the most recent year’s.

You can calculate the thresholds for both unconfirmed cases and for confirmed cases, if you have the data. It may be more accurate to use confirmed cases if the data is available.

To determine if current cases are above the threshold

Most of the time, we expect the number of cases per month (or week) to be below the third quartile line. If you plot the current weekly or monthly cases on the graph, you will see whenever the number is over the threshold (third quartile) line. This suggests that an epidemic (higher than expected number of cases) is happening.



For example, we again use Elabered Health Centre (see Fig. 7).

In Fig. 7, we can see that the actual number of cases reported (thick line with points marked) moved higher than the third quartile line (the thin line) at the following times:

1. July 1996. It stayed above the line until November 1996, with two peaks during that time.

2. January 1998. It stayed above the line until December 1998, with three separate peaks during that time, including a significantly higher peak in October 1998.

You can see from Fig. 7 that epidemics have a natural rhythm and momentum, like a series of waves in the sea. They rise to a peak, and then fall away. Sometimes, there are successive waves, which may build up higher and higher, as in 1998.

Definition of an epidemic

At the beginning of this manual, we had a general definition of an epidemic. Now we will give a more specific working definition of an epidemic:

An EPIDEMIC STARTS when the reported number of outpatient malaria cases per month in a certain health facility FIRST rises higher than the third quartile number of cases estimated for that month in that health facility.

An EPIDEMIC CONTINUES while the reported number of cases per month stays above the third quartile line.

An EPIDEMIC may have more than one WAVE. A wave is each peak seen in the number of reported cases during the epidemic.

An EPIDEMIC ENDS when the reported number of cases falls down below the third quartile line again.

Therefore in 1996 in Elabered (Fig. 7), we had one epidemic with two waves. In 1998, we had one epidemic with three waves. In 1997, 1999 and 2000, we did not have any epidemics.

When the number of cases first goes above the third quartile line, every effort must be made to bring it down by seeking out places with large number of cases, treating them, and increasing vector control activities. Otherwise the waves may build higher and higher, as they did in 1998.

> Remember that suspected epidemics may be reported by rumours, press reports, school teachers, etc. Always pay attention to these, and investigate them.
>
> Do not wait in order to confirm that cases are above the health facility threshold because people may not be reaching the health facility for treatment.

7. Epidemic Preparedness

Epidemic preparedness should be done in collaboration with the Epidemic Preparedness and Response Committees at the zoba, subzoba and village. Preparedness involves the following steps:

1. Deciding on the alert level (at national, zoba, subzoba levels).

2. Monitoring weather information closely (e.g., monthly rainfall) and communicating the information between levels (e.g., between national office, zoba and subzoba).

3. Strengthening the surveillance system and analysing data quickly after the end of the month (or week) so you can detect an increase above the third quartile.

4. Predicting the worst-case scenarios and stockpiling the amounts of supplies, equipment and transport needed.

5. Improving and testing the channels of communication

Supplies and equipment

A commonly used rule is that 10–25% of the usual amount of supplies used in a regular season should be easily available for emergencies. Given the potential for large epidemics, it is suggested that 20–25% should be stockpiled. This should be calculated from the amount used in the zoba in the last epidemic year (1998).

The categories required are:

1. Diagnostic tests (Optimal or slides)

2. Drugs

3. Insecticides for IRS and spray equipment

4. Insecticides and pumps/dispensers for larviciding

5. Insecticide for net impregnation

6. Nets

Because of the short shelf-life of some of these items (especially Optimal), there must be a system for rotating the supplies. For example, if the stockpiled Optimal are not used after 6 months, they should be sent out to clinics for use, and replaced with new stocks. The same applies to insecticides that are nearing the end of their shelf-life. For items that are not usually held by the malaria program (e.g., drugs), check with the pharmacy department that they have such supplies available if needed.

Human resources and transport

Preparedness must include a plan for quickly locating human resources (e.g., people to do blood surveys, mass drug administration and vector control) and transport.

Epidemic forecasting and preparedness depends very much on **communication**. There is no point in the national office monitoring rainfall and deciding on an alert level, unless they tell the zobas. Similarly, there is no point in the zoba staff knowing about a large increase in local rainfall or big population movements, unless they tell other staff at the zoba and national levels. The communication channels and lines of authority (who can give permission to release emergency supplies) must be well defined and tested.

8. Epidemic Response

If an unusual increase in cases or deaths is detected, this should be reported to the Zoba Epidemic Response Team. They are responsible for coordinating the response, according to the protocols developed by IDSR, with full participation of the malaria coordinators.

The main additional action taken after an epidemic has been detected is that mass treatment is added to the other control measures.

Action taken after epidemic detection consists of:

a. rapid confirmation of the epidemic

b. response.

Information may come from a village or health facility without diagnostic facilities, so it will be necessary to make sure that the problem is really malaria and not some other cause of fever. This can be done by blood survey using Optimal or slides, testing either a whole village, or fever cases only if the village is too big.

The main priority in response should be mass treatment of fever cases using normal first- line treatment, followed by vector control. The type of protocol has been described in the past as “MASS RADICAL TREATMENT.” This means house to house visits and treatment with three day course of chloroquine plus SP. If there is some reason to suspect that drug resistance is a factor (for example increase in number of severe malaria cases), then second-line treatment (quinine) could be used.

While no control method should be ruled out, “reactive” indoor residual spraying may be too late to help once an epidemic has been detected. Spraying would be better used to prevent epidemics before they occur by targeting villages known to be at high risk of malaria, or known to have had high numbers in the previous year. Extra spraying could be done in areas that have had unusual monthly rainfall recently.

Larval control is too slow to have an immediate effect on reducing the severity of an epidemic. However, it would cut the chances of a second epidemic wave, and is easier to organize quickly than indoor residual spraying. Bednet distribution and reimpregnation could be increased, but is not likely to have a rapid effect.

After-epidemic review

After each epidemic, there should be a meeting to discuss and document what happened, to help guide and improve response for the future. A short report should be written, answering the following questions:

What happened leading up to and during this epidemic?

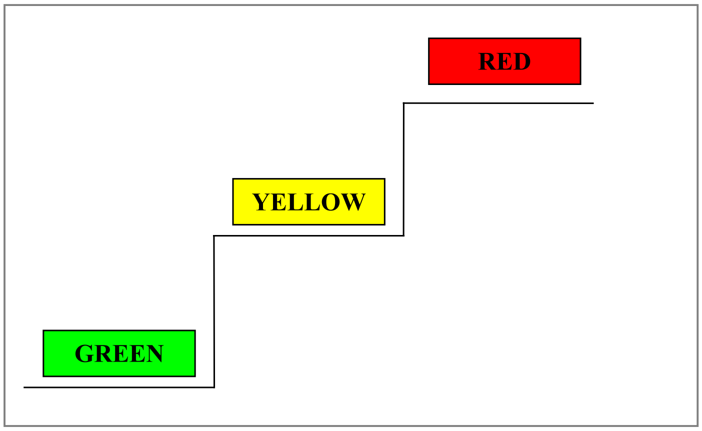
Did we miss possible early warning signs?

In the response: What went right? What went wrong?

What could have been done better?

How can we use the experience to better predict future epidemics?

Alert Levels



Each year, start at level Green (low risk).

When to move to the next higher step:

- 3 years or more since last high incidence year
- large population movements in the last year
- unusually high monthly rainfall in any month

Stay at the level until there are specific reasons to move down.

When to move back down a level:

- After two months without unusually high rainfall
- After an epidemic year
- One year after large population movements cease.

Response

When to change from “ALERT mode” to “RESPONSE mode”:

- When the reported number of OPD cases rises above the third quartile line

- When other sources of information indicate an unusual number of cases, admissions or deaths, and rapid investigation shows the cause to be malaria

When to move back from “RESPONSE mode” to “ALERT mode”:

- When the reported number of cases falls back below the third quartile line

Table 1: WORKSHEET FOR CALCULATING THE THIRD QUARTILE THRESHOLD BY HAND (photocopy as needed)

Month	OPD malaria cases by Health Facility or Subzone				
	Year 1	Year 2	Year 3	Year 4	Year 5
Jan					
Feb					
Mar					
Apr					
May					
Jun					
July					
Aug					
Sep					
Oct					
Nov					
Dec					

Table 2:

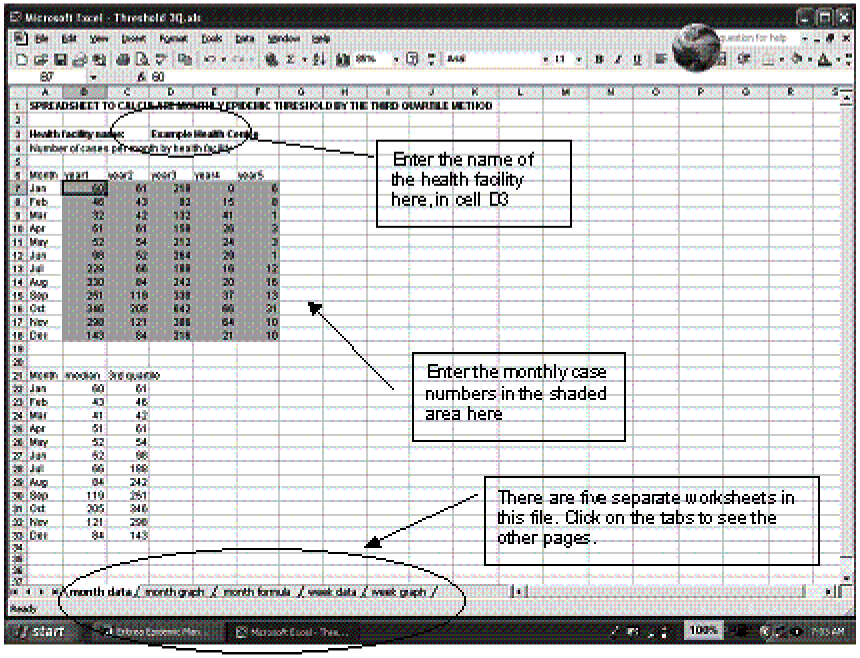
Month	**Re-ordered** OPD malaria cases by Health Facility or Subzone				
	Lowest	1st Quartile	**Median**	**3rd Quartile**	Highest
Jan					
Feb					
Mar					
Apr					
May					
Jun					
July					
Aug					
Sep					
Oct					
Nov					
Dec					

PRINT-OUT OF “THRESHOLD 3Q.XLS”

EXCEL SPREADSHEET FPOR CALCULATING THIRD QUARTILE THRESHOLD BY COMPUTER

When you first open the file “Threshold 3Q.xls” in Excel, you will see a screen looking like this (the exact appearance may be different depending on your version of Excel):

Data is entered in the sheets called “Month data” and “Week data.”



Graphs are shown in the sheets called “Month graph’ and “Week graph.”

The sheet called “Month formula” just shows the formulas that are behind the automatic calculations, for information.

Month Data

SPREADSHEET TO CALCULATE MONTHLY EPIDEMIC THRESHOLD BY THE THIRD QUARTILE METHOD

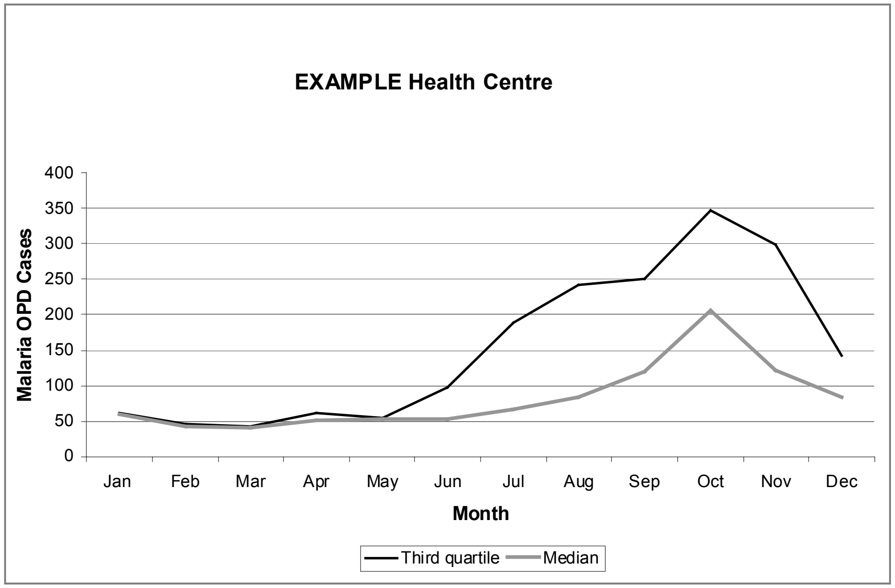
Health facility name: Example Health Centre

Number of cases per month by health facility

Month	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10
Jan	60	61	218	0	6					
Feb	46	43	92	15	8					
Mar	32	42	132	41	1					
Apr	51	61	158	26	3					
May	52	54	212	24	3					
Jun	98	52	264	29	1					
Jul	229	66	188	16	12					
Aug	330	84	242	20	16					
Sep	251	119	330	37	13					
Oct	346	205	642	66	31					
Nov	298	121	386	64	10					
Dec	143	84	216	21	10					

Month	median	3rd quartile
Jan	60	61
Feb	43	46
Mar	41	42
Apr	51	61
May	52	54
Jun	52	98
Jul	66	188
Aug	84	242
Sep	119	251
Oct	205	346
Nov	121	298
Dec	84	143

Month Graph


EXAMPLE Health Centre
Malaria OPD Cases
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Third quartile
Median

Week Data

SPREADSHEET TO CALCULATE WEEKLY EPIDEMIC THRESHOLD BY THE THIRD QUARTILE METHOD

Health facility name: **EXAMPLE Health Centre**

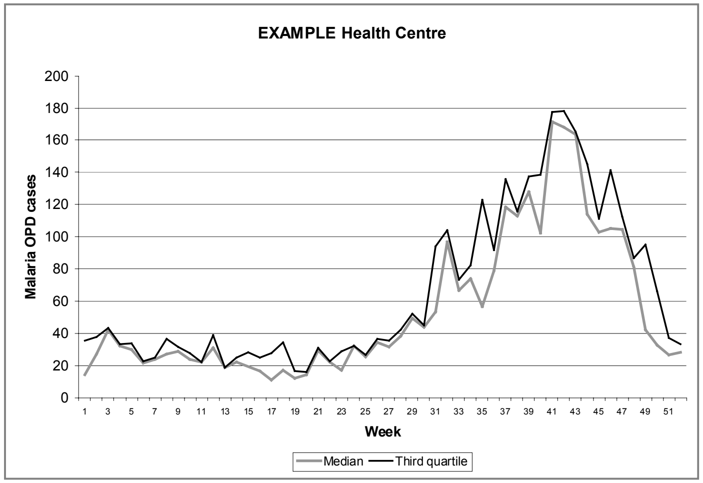
Number of cases per week by health facility

week	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10
1	8	42	6	36	14					
2	12	42	27	38	17					
3	10	42	43	49	21					
4	20	17	34	59	32					
5	34	17	46	20	30					
6	18	10	34	22	23					
7	12	19	33	24	25					
8	37	10	27	61	23					
9	32	18	37	29	26					
10	31	24	28	17	13					
11	22	19	22	12	23					
12	17	39	31	22	43					
13	5	19	19	16	21					
14	22	19	28	25	21					
15	29	16	28	19	13					
16	17	32	25	6	11					
17	28	11	32	8	8					
18	17	34	40	13	8					
19	12	17	27	9	10					
20	16	18	14	1	9					
21	31	34	29	2	8					
22	38	22	23	1	8					
23	29	33	14	1	17					
24	19	32	35	1	32					
25	27	10	25	1	34					
26	36	20	34	1	47					
27	15	32	36	4	62					
28	19	42	44	8	38					
29	52	49	47	10	62					
30	31	44	45	12	73					
31	31	51	53	94	142					
32	97	67	56	114	104					
33	42	73	67	94	67					
34	74	61	71	82	125					
35	53	123	46	57	130					
36	41	58	92	79	131					
37	76	136	118	70	177					
38	116	113	134	37	87					
39	94	145	128	73	138					
40	93	102	194	103	139					
41	108	692	171	52	178					
42	34	178	168	59	208					
43	49	165	232	59	164					
44	27	183	145	44	114					
45	16	283	111	34	103					
46	55	141	150	40	105					
47	33	133	112	20	105					
48	40	122	87	25	81					
49	40	95	102	30	42					
50	19	67	71	30	33					
51	26	56	21	38	27					
52	23	55	34	29	6					

Week Data continued

week	median	3rd quartile
1	14	36
2	27	38
3	42	43
4	32	34
5	30	34
6	22	23
7	24	25
8	27	37
9	29	32
10	24	28
11	22	22
12	31	39
13	19	19
14	22	25
15	19	28
16	17	25
17	11	28
18	17	34
19	12	17
20	14	16
21	29	31
22	22	23
23	17	29
24	32	32
25	25	27
26	34	36
27	32	36
28	38	42
29	49	52
30	44	45
31	53	94
32	97	104
33	67	73
34	74	82
35	57	123
36	79	92
37	118	136
38	113	116
39	128	138
40	103	139
41	171	178
42	168	178
43	164	165
44	114	145
45	103	111
46	105	141
47	105	112
48	81	87
49	42	95
50	33	67
51	27	38
52	29	34

Week Graph


EXAMPLE Health Centre
Malaria OPD cases
Week
0
20
40
60
80
100
120
140
160
180
200
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51
Median
Third quartile