

Prevention and control of malaria epidemics

Learner's Guide



World Health Organization
HIV/AIDS, Tuberculosis and Malaria
Roll Back Malaria

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Foreword

This module uses a training method based on learning by problem-solving to facilitate the understanding of the antimalarial combination therapies and formulation of treatment policies in different epidemiological situations. The underlying principle is that learners who are actively involved through a series of group exercises and discussions learn more and better than those who simply sit and listen to a single person talking for long periods of time. The reasoning and deduction required in the module makes this subject extremely suitable for this training method, but the success of the module will depend on your active participation in the training activities proposed. The module is addressed to health personnel responsible for malaria control at national and sub-national levels of the health care system who often face the challenges of increasing resistance to antimalarial drugs and policy changes. It requires some basic knowledge of malaria case management (uncomplicated and severe malaria); parasitology, and general epidemiology. However, the contents of the module are flexible enough to allow the emphasis to be placed according to the specific training needs. The main objective of this module is to inform professionals of new elements in combination therapies and methods of drug policy formulations. Combination therapies for malaria are increasingly being taken as best alternatives in countries where there is extensive resistance to antimalarial drugs to a level where the drugs have no more effect in reducing mortality and morbidity. It should therefore facilitate a better understanding of the current antimalarial treatments, their selection in different epidemiological and socio-economic circumstances; and accordingly of changing or revising drug policies.

The module is divided into two parts - Part I the Learner's Guide and Part II the Tutor's Guide. The Learner's Guide covers basic concepts and information together with a series of problems and hints or partial solutions to them. The Tutor's Guide outlines the main points to be learnt, but does not provide definitive and inflexible responses. In this way it is designed to stimulate active learning.

The basic factors influencing the mono-therapies, combination therapies and parasite dynamics are first reviewed and then the module introduces the learner to the principles of antimalarial treatments, selection of drugs, decision making, implementation of antimalarial treatment policies based on relevant epidemiological information and health system and socio-economic situations.

The module has been conceived for group work. The exercises in the Learner's Guide should be carried out in small groups to stimulate discussions and exchange of experience between the participants (who would come from different countries/areas with different experiences), the facilitators and the tutor. The guide can be used for workshops of varying duration depending upon the time available and the rate at which the exercises proceed. The module can be independently given in a separate course or be customized into a course with other subjects depending on the need of audiences. Certain exercises may be completed at a later date by the participants individually provided they have both the Learner's and Tutor's Guides. The complete module is optimally designed to be accomplished in 24 hours (3 days).

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The module is still a trial edition which needs further editing effort and scientific review. It will be field tested in various international training courses before reaching its final stage of development. Authors highly appreciate inputs and useful suggestions from readers (tutors, facilitators and participants) to be incorporated into further editions.

Introduction

The planning and implementation of a malaria control programme must be based upon epidemiological analysis and application of interventions suitable to specific localities or countries. Health workers and all involved need to be equipped with a sound and updated knowledge on malaria epidemics, its prevention and control methods at national level, district and peripheral levels. The aims of this training is to improve your capacity on critical syntheses of malaria epidemics and prevention and control options upon which decision and actions should depend on epidemiological circumstances through application of efficient planning, management and evaluation activities. This module can be used for in-service training or as part of a basic course on malaria control. The operational relevance of the understanding of how this knowledge should be utilized for the latter case, is that it is recommended to deliver it after parasitology, vector control and epidemiological approach to malaria control have been covered. A prior knowledge on malaria case management including antimalarial drug policies and vector control option would be more beneficial.

For whom is this training module intended?

The module is designed for health professionals involved in malaria control, and in epidemics in particular, at national, sub-national and district levels who have responsibility for planning, executing malaria control, and monitoring activities in their respective working levels. These include medical officers, medical assistants, public health officers, environmental health officers, parasitologists, and biologists involved in malaria control either with government or NGOs. Most of these people will already have a working knowledge of the basic principles of malaria epidemiology and communicable diseases control.

Objectives

At the end of the training programme based on this Learner's Guide you should have acquired the skills that will enable you to:

- Define a malaria epidemic, identify contributing / triggering factors.
- Describe how to use early warning and detection systems, notify and verify malaria epidemics
- Identify the most cost-effective malaria epidemic preventive and control options
- Undertake a quick assessment of the epidemic detection and control response
- Develop a preparedness plan of action

How is the course run?

Tutor

The tutor has overall responsibility for the planning and management of the course and will also introduce each of the learning units, but the tutor will not give formal presentations of this module.

Facilitators

The tutor is assisted by a number of facilitators who will work with you continuously through small group sessions and provide additional information whenever required. They will also assist the moderators in guiding group discussion. Together with the tutor, they are your constant source of information and experience. If you study in small groups but without a facilitator, the tutors must to some extent play the role of the facilitator.

Presentations

Lectures are kept to a minimum and will be replaced by limited introductory remarks by the tutor at the beginning of each subject and short examples to overcome points of common difficulty.

Small Group work

The module is designed for 3 *days* of training, working mainly in *small groups*, say 2 or 3 groups of 6 to 9 learners each. It is desirable for each group to have its own room, with at least one of the following: overhead projector, whiteboard, blackboard, flipcharts. For each unit the group selects, among its members, a *moderator* and a *rapporteur* by rotation, so that, as far as possible, each learner performs each of those two functions at least once.

The sessions provide good opportunities for you and the other learners to give your opinions, develop your ideas and learn from one another. The learners will usually have different backgrounds, in terms of training and experience, so that they should have much to *learn from each other*. The exchange of experiences among participants contributes to most of the training material, the Learner's Guide providing a lead for discussions and work. A moderator chosen by the members of each group will lead discussions on the particular subjects proposed in the learning units. At the end of the group work devoted either by the moderator responsible and discussed by all participants and commented on by the tutor. These presentations and discussions are important but are not meant to be formal as working notes. The overall success of this training module will depend on the active participation of all learners in the group exercises and discussions.

This training module

Use of the Learner's Guide

This Learner's Guide consists of instructional materials and problems designed to enable you and your colleagues to achieve the objectives stated earlier. The Guide is divided into Learning Units. Before each session you should read each Unit carefully and make sure you understand it, as the tutor will not be giving a detailed presentation of the material to be learnt. If you are unclear about any part of the Learning Unit you should discuss it with

your colleagues in the discussion group, your facilitator and with the tutor, if necessary. Each Learning Unit consists of a series of questions (and hints and partial solutions to some of them) to be worked through as individual or a group. The discussions during small group work and during plenary sessions with the participation of facilitators and tutors will facilitate this process. You must acquire the skills and knowledge contained in one unit before progressing to the next, otherwise you may have difficulty in achieving the objectives of subsequent learning units.

Individually, make maximum effort to read some of the important references and guidelines sited in the document as details are left for further reading. Annexes are given as additional sources for in-depth knowledge.

Use of the Tutor's Guide

During the course, the tutor's guide would be available only to the tutor and facilitators and upon completion of the course/module, all learners would get a copy of the tutor's guide so that they can use the materials for further training and reference.

The module consists, in its present state, of two major learning units addressing. Each unit consists of a Learner's Guide and a Tutor's Guide. The Learner's Guide proposes a series of exercises and offers hints for some of the problems. The Tutor's Guide gives guidance to the tutor for answers to the exercises.

The module aims at developing an *approach*, namely the *critical analysis of precipitating factors of malaria epidemics, preparedness and responses under different epidemiological situations* rather than to convey a body of facts (even though many facts may be conveyed in the process). Most facts and details are referred to relevant guidelines and other resource materials.

No document can, and this module does not, exhaust such a wide and dynamic subject. Malaria epidemics is dynamic issues and the prevention and control methods also evolve over time and so this module does. The module will be successful if it helps the learners understand the mechanics of malaria epidemics in the context of new developments to incorporate better prevention and control approaches. This will help participants *continue to update their knowledge as an integral part of their professional activities*.

The Learner's Guide can also be used in conjunction with the Tutor's Guide, for individual active self-learning.

Evaluation

Evaluation of the learner

The evaluation of individual progress and achievement will be carried out by the tutor, the facilitators and yourself. It will include :

- *Spot tests*
At regular intervals, a series of "spot tests" will be set out for you to comment on. They are designed to help you and the tutor assess how well you have mastered the skills and developed the competence to carry out your work.

Correct answers will be supplied after the spot tests and a discussion will take place. This is intended to improve the process of learning and help you to identify those activities in which you need further practice.

- *Multiple-choice quizzes*
In multiple-choice quizzes, each question is provided with a list of possible answers from which you must select the one you think is correct. At the end of these sessions you will not necessarily be given the correct answer to each question, but the tutor will analyse the results to identify topics that were not clearly understood. The tutor may also tell you where you made mistakes and point out areas where mistakes were made and point out areas where you need to improve.

This part of the evaluation is designed to help you and the tutor to assess how well you understand the course. Multiple-choice tests will take place at the end of the module to assess the achievement of technical competencies by the participants.

Evaluation by the learner of the training

At the end of the course you will be asked to complete a questionnaire to tell the tutor how you think the training has helped you and how it might be improved. This evaluation will take place at the end of the training period in order to provide as much feedback from the learners as possible. During the course you should also feel completely free to make suggestions for improvements on the part of the tutor and facilitators as well as in the content of the course and the training facilities. This will help your colleagues in a next training course!

Learning unit 1**Introduction to malaria epidemics****Learning objectives**

By the end of this unit you will be able to:

- define a malaria epidemic
- identify contributing / triggering factors.

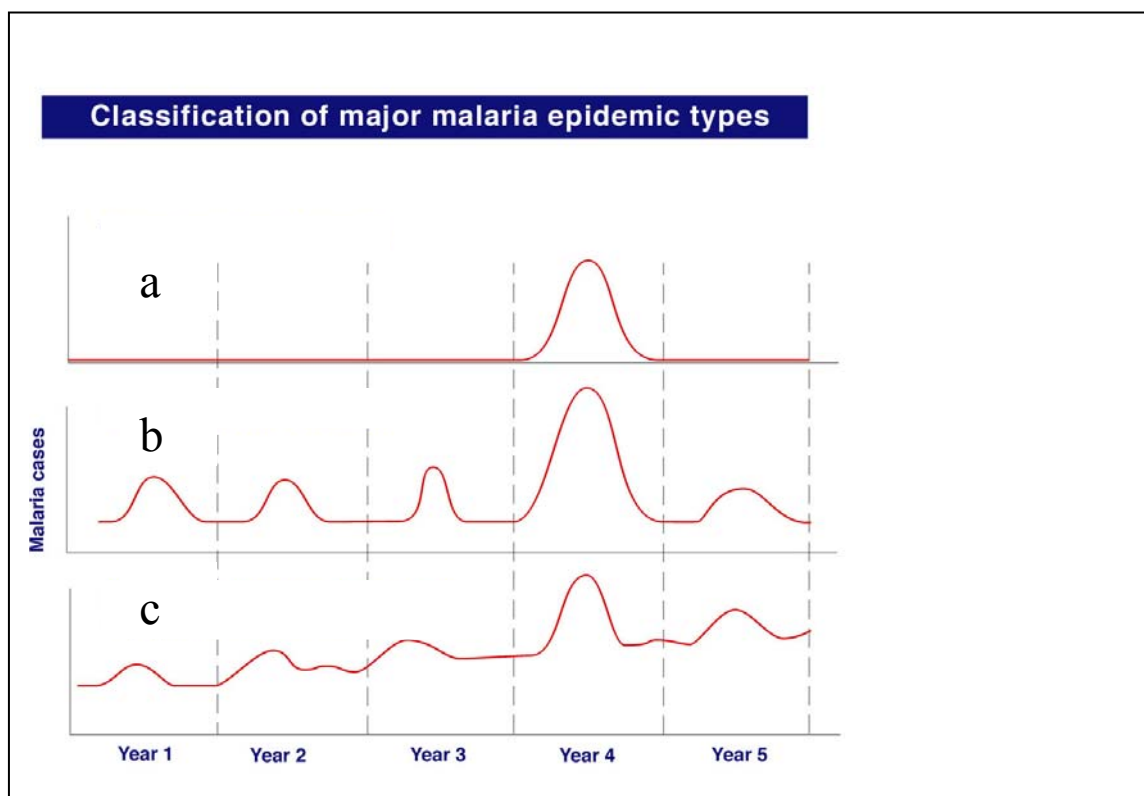
In the following pages of this Learning Unit you will find a series of questions which you should answer the best you can. This is **not** an examination but is designed to make you think about the relationship between malaria epidemics and its epidemiology as it relates to your own country or place of work. You should answer the questions in the sequence in which they are written because depending on your answer to some of them you may not need to answer some of the questions that follow. Your answers should be in respect to your own country (or the country in which you are, or will be working). If you cannot answer the question relative to the whole country, but can for a part of it, then please do so stating clearly to what part of the country your answer applies.

Answer clearly and briefly those questions on which you have a definite opinion. Where "yes", "no", "do not know" answers are provided then please tick the box for which one of them is appropriate.

Definition of malaria epidemics

1. Have you ever been directly involved in prevention and control of a malaria epidemic ?
Yes, no
2. What is your **definition** of a malaria epidemic, or a malaria outbreak ?
3. What different types of malaria epidemics do you know? and could you assign the these types to the situations (a), (b) and (c) indicated in the diagram given below?

Fig 1. Classification of major malaria epidemic types



Zone and population at risk to malaria epidemics

4. Do you know where malaria epidemics most frequently occur ? and why ?
Yes, no
If yes, briefly describe the main epidemiological settings.
5. In epidemic prone regions, only children below 5 and pregnant women are at risk.
Yes, no, don't know. Explain why.
6. In your country, are there malaria-free areas, or malaria epidemics prone areas ?
Yes, no don't know.
If yes, is population at risk of epidemics well identified, regions at risk mapped out?

7. Do you know why quick assessment to measure the risk of malaria epidemics is important?
Yes, no, I don't know.
If yes, provide briefly reasons of its usefulness.
8. Identify, at least three conditions that make human populations vulnerable to malaria epidemics. (Hint: think of immunity, parasite and environment).
9. What are the characteristics of epidemic prone areas? Provide some examples of environmental settings.

Indicators of malaria transmission and methodologies to map out zones at risk

10. For a successful malaria transmission to occur, mention at least two epidemiological requirements? (Hint: think of the parasite, vector and host interaction)
11. Why do diseases caused by vector-borne pathogens have a much higher rate of transmission than directly transmitted pathogens.

The equation on '*Basic Reproductive Number (R_0)*' expressed below:

$$R_0 = \frac{m a^2 p^n}{-r \log_e p}$$

R_0 = the total number of secondary cases arising from a single primary case in a susceptible population

m = the number of female mosquitoes in relation to people

a = proportion of vectors feeding on man averaged over the length of the gonotrophic cycle

p = the probability of a vector surviving through one day

n = the number of days needed to complete the sporogonic cycle

r = the total number of days a malaria patient remains infectious

12. What does the above equation express? (express your understanding in words)

A key concept in malaria transmission is *Entomological Inoculation Rate (EIR)*, the number of infective bites per person per time. Based on the EIR, the direct and indirect factors responsible for malaria transmission. "Direct" factors appear in the equation, but these parameters are frequently difficult or impossible to measure.

13. In the table given below mention the factors that have influence in positively or negatively affecting the determinants given in the first column.

Table 1. Direct and indirect factors that contribute to occurrence of malaria epidemic

Determinants (Direct)	Influencing factors (Direct)
Vector density	
Man biting	
Rate of gametocyte carriers	
Length of sporogony	
Daily survival rate of vectors	

Of the two columns which one can be used to measure as indicators for predicting of monitoring level of transmission?

Mapping areas of epidemic risk

In the 1950s malaria endemicity was mapped in a number of African countries using both epidemiological and environmental data, for example Tanzania and Kenya (Anon, 1956; Anon, 1959). In the last few years, attention has, once more, been drawn to the desirability of creating detailed maps of malaria transmission intensity in Africa (Snow *et al.*, 1996; Thomson *et al.*, 1997). The availability of geographical information system technology and continent-wide data sets of climate 'normals' (long term mean monthly rainfall and temperature surfaces) in digital format have prompted the mapping of malaria endemicity throughout the entire African continent using age-related prevalence rates. The MARA/ARMA (Mapping Malaria Risk in Africa/Atlas du Risk de Malaria) initiative is using both epidemiological and entomological data from a wide variety of sources in an attempt to determine the differing epidemiological situations occurring throughout Africa, and their respective malaria risk (Le Sueur *et al.*, 1997). Since this information is absent for much of the continent, the project has developed a model of stable malaria risk based on the effect of environmental parameters, (rainfall and temperature) on the biology of malaria transmission parameters (Craig *et al.*, 1999). Snow and colleagues extended the early mapping work to quantify malaria morbidity and mortality burdens across Sub-Saharan Africa (Snow *et al.*, 1999a).

Whilst such models provide a crude overview of malaria endemicity, it is precisely in the areas where they are weakest (marginal areas) that information is required to alert health services to changes in malaria risk (Connor *et al.*, 1999). Two limitations of this approach have been observed. Firstly, the climate models take no account of hydrological processes which may provide active vector breeding sites even when rainfall is low (Hay *et al.*, 1998b). Secondly, levels of disease endemicity can change over extensive regions in relatively short periods of time. For instance a profound change in endemicity occurred in Senegal between the early 1960's and the early 1990's as a consequence of declining rainfall levels and intermittent periods of severe drought (Mouchet, 1998) and areas of Niger, once mesoendemic for malaria are now hypoendemic with a consequent increased risk of malaria epidemics (Julvez *et al.*, 1997). Thus the climate 'normals' used in creating

the MARA risk map (using data from 1920-1980) are likely to overestimate rainfall levels in the Sahel region experienced over the last two decades.

Another approach for routine malaria stratification has been proposed using the seasonality of vegetation growth, as observed with satellite data, in combination with information on the temperature constraints of malaria transmission. For example stratification of malaria endemicity in Namibia for 1995/1996 has been undertaken using principle component analysis followed by non-hierarchical clustering of satellite derived vegetation indices (the Normalized Difference Vegetation Index: NDVI) using software developed by USAID/FAO (Connor, 1999). In this analysis temperature constraints on transmission were estimated from altitude. Support for the use of seasonal vegetation 'greenness' comes from a geo-spatial analysis of NDVI and under-fives prevalence rates in The Gambia (Thomson *et al.*, 1999a). Such maps can be routinely updated from data made available through environmental monitoring organisations. They may be particularly useful in marginal areas where inter-annual variation in climate/hydrological processes may result in epidemic situations developing.

In order to identify when and where epidemics are likely to occur in highland areas of Africa (often characterised by high population densities) the HIMAL project has developed an extensive database on malaria occurrence in highland areas in Cameroon, Kenya, Uganda, Ethiopia and Tanzania, Rwanda, Burundi Zimbabwe and Madagascar (Cox *et al.*, 1999). An analysis of age related prevalence rates and altitude show that while in some areas strong correlations exist this is not true for everywhere and information on altitude alone cannot therefore be used as a reliable guide to endemicity. Further observations from this study include:

- While temperature and rainfall are important determinants of areas at risk of epidemics at the national/regional scale they can be confounded significantly by local non-climatic factors – especially those impacting on environment (e.g. man-made) that determine the local presence/absence of vectors
- The effect of these localised risk factors mean that general models of malaria risk based on climate are unlikely to predict rates of transmission reliably at the level of the individual locality
- Where epidemics do occur the report suggests that the most significant and widespread epidemics have occurred during and/or after abnormal weather events
- There is little evidence that recent epidemics have been associated with longer term shifts in climate conditions

A number of recent reviews concerning the use of geographical information systems and remote sensing in mapping vector-borne diseases – including malaria in Africa, have been published (Hay, 2000; Thomson and Connor, 2000). Environmental stratification has played an important role in delineating areas which may be prone to malaria epidemics. However, predicting the occurrence of an epidemic in the near future is dependant on monitoring changes in identified risk indicators.

The use of health statistics to differentiate endemic and epidemic prone areas

14. Are health statistics (national/local epidemiological characteristics) useful to differentiate endemic to epidemic prone areas?

Yes, no, don't know.

If yes, why ?

If not, why not ?

Could you highlight some of the limitation while using health data?

Precipitating factors to malaria epidemics

15. Can you list obvious precipitating factors of malaria epidemics in your country / other places?

a) *Working in small groups, could you roughly fill in the table given below and link/correlate the these factors to the main epidemiological and environmental consequences.*

Table 2. Precipitating factors for malaria epidemics and their consequences

Cause	potentially leading to:
1. Economic development activities (legal or not)	
• Overpopulation	
• War/civil disturbances	
• Road construction/ improvement in transport facilities	
• Urbanisation	
2. Natural disasters	
• Expected or unexpected meteorological events (heavy rainfall, unusual heavy flooding, cyclones, climatic changes...)	
• Global and local climate changes	
3. Degradation of preventive and curative health services	
• Deficient surveillance within the control services	
• Malaria prevention activities are deteriorating (such as lack/shortage of insecticide and/or inadequate or poor spray coverage)	
- Reluctance of villagers concerning some Malaria Control Activities (especially spraying operations)	
• Increasing resistance of vectors to insecticide and/or parasites to antimalarials.	

b) *Why is it necessary to identify precipitating / contributing factors ?*

Yes, no.

If yes, why ?

Essential past and current information required to explore potential contributing factors to any malaria epidemics

- In case of past epidemics in an area?
Ask whether it is well documented and go back to reports if available.
- Epidemiological data from the health information system: Look at the malaria transmission pattern in the region and classify it as a highly, short- seasonal or cyclical epidemics or others.
- Meteorological data: Look at unusual rainfall, temperature, humidity pattern correlated to epidemics in the past or correlated to the current epidemics.
- Population movements: Observe whether there had been a large group of people coming (or passing through a) from high transmission areas recently [Refer to camps and refugee situation].
- Increase in population vulnerability/susceptibility:
 - Population affected by hunger and malnutrition as result of unusual drought
 - population affected by (forced) migration (for example due to civil war)
 - determine HIV/AIDS prevalence in the pop etc.

Control measures.

- Check if control measures are in place, if yes, what are they?
- And examine if these control measures are efficient. For example case management affected by high parasite resistance to national recommended drugs or affected by vectors resistance to insecticides in use etc.

16. Indicate where to obtain each of these information from?

Please read carefully the next Unit of this module before commencing the session to which it relates.

Learning unit 2

Early warning, early detection, notification and verification of a malaria epidemic

Learning objectives

By the end of this unit, you will be able to:

- Describe the usual channels of notification.
- Describe the concept and rationale of early warning and detection system.
- Describe how to identify / detect a malaria epidemic on a timely basis,
- Describe how to quickly verify a malaria epidemic ?
- Describe urgent measures to be taken on the ground.

Early malaria epidemic detection systems

1. Working in groups discuss and sketch a diagram how currently any unusual events/epidemics including malaria epidemics are usually reported / notified.
2. Working in small groups, indicate the rationale for setting-up an early detection system?

Methods for determining epidemic thresholds

3. What system/s would you propose for a routine early detection of malaria epidemic and what kind of data would be important to use?

Many epidemics occur in situations where previous data is either not available, or irrelevant due to significant contextual changes. In these circumstances, precise thresholds will be difficult to set up. What sort of indicators would you use to monitor malaria epidemic in situations like this?

Median and 3rd quartiles

4. **Table 3** given below provides data on malaria cases reported throughout 5 years from El Obeid district in Sudan. You need to work in small groups and present your findings to the class.

Table 3. Malaria cases reported from El Obeid (Sudan)

Malaria cases reported from El Obeid (Sudan)												
Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1994	1609	2235	2035	1597	4927	2442	2857	5159	9245	1490	1299	2267
1995	1214	1322	1784	1880	1863	1958	398	2815	4761	5845	2588	
1996	1198	1099	2010	1411	1449	2018	1737	1902	1939	1842	2332	2321
1997	2597	2219	2988	2977	5276	3534	2822	4028	3188	3395	2269	2223
1998	2941	2449	2619	2462	2973	2200	2612	2424	8658	10158	4274	2944

- Calculate the median and the quartiles of the cases for each month and show on a table. Compare your results with the **table 3a** provided by the tutor.
- Plot the figures in Excel or spread sheet. In case you have no access to computer or Microsoft Excel programme, use graph paper or simple squared paper to construct a graph of the median and the 3rd quartile.
- What does the 3rd quartile indicate on the graph?
- Now, suppose you want to monitor malaria situation for the year 1999 with the given figured below, what would you do given the median and quartiles obtained for the year 1994-1998 above in (a), (b) and (c). Which month of the 1999 year does show epidemic situation? Why?

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1999	1364	2560	2817	1656	1958	2021	2255	3169	4897	9158		

- Similar to Sudan data, determine the methods and the columns that contain median, lower (1st) and upper (third) quartiles (by bolding or shading the columns) from the malaria morbidity data given below in **table 4**. You are then asked to compare the data with a particular year 1992 given in the last column of the table.

Table 4. Malaria morbidity data of Zwai, Ethiopia (1988-1998)

Month	Week										1992 Epidemic
January	1	48	20	121	76	44	47	24	9	40	63
	2	50	8	83	65	39	45	29	6	37	41
	3	105	13	112	108	43	48	31	8	32	56
	4	88	15	130	96	49	52	35	1	46	69
February	1	72	9	88	84	44	46	38	7	41	41
	2	58	14	100	76	41	48	23	4	31	45
	3	52	11	74	70	35	38	27	3	28	50
	4	70	14	98	97	49	68	41	8	43	39
March	1	42	11	69	50	33	39	30	4	32	50
	2	66	10	80	77	39	45	24	3	25	52
	3	45	18	67	59	39	44	32	5	35	46
	4	49	9	83	63	34	45	9	8	33	38
April	1	44	18	62	47	40	44	25	5	35	42
	2	45	14	76	48	36	44	23	6	25	30
	3	35	22	61	53	34	35	31	8	33	23
	4	57	19	60	60	42	54	27	18	42	36
May	1	53	15	106	77	43	44	24	9	35	36
	2	54	23	72	55	38	42	25	9	31	45
	3	69	23	95	80	34	37	27	5	33	44
	4	94	37	113	95	71	76	40	24	57	76
June	1	81	25	113	93	54	74	31	21	52	44
	2	69	39	123	72	55	60	48	17	50	61
	3	69	23	157	116	58	67	40	15	51	64
	4	100	41	200	113	59	94	46	18	57	79
July	1	94	29	184	110	60	62	29	19	55	93
	2	69	25	200	129	56	60	44	11	51	62
	3	92	24	129	123	53	63	31	15	40	68
	4	92	23	216	96	64	74	31	16	64	89
August	1	86	23	112	89	41	77	29	9	39	81
	2	95	23	202	109	73	81	26	5	29	112
	3	99	28	156	154	60	90	41	13	55	132
	4	159	29	271	200	104	118	41	9	62	188
September	1	93	19	136	128	80	84	75	13	79	162
	2	159	30	221	193	126	141	95	9	116	188
	3	149	26	259	181	127	137	108	11	109	258
	4	272	62	540	279	139	183	101	31	105	346
October	1	165	27	302	190	100	161	28	23	85	350
	2	185	36	272	220	131	174	69	28	88	322
	3	159	33	181	170	100	123	68	23	83	343
	4	182	46	276	221	169	179	71	25	109	413
November	1	122	30	230	139	103	104	42	19	85	487
	2	96	13	192	128	73	86	41	11	71	378
	3	79	23	153	100	58	74	32	18	51	383
	4	116	18	248	147	95	114	53	12	66	265
December	1	93	17	143	108	62	69	45	11	50	106
	2	76	25	115	99	53	65	41	12	46	113
	3	55	12	114	67	50	53	33	7	41	163
	4	50	19	102	69	36	37	21	15	26	223

- a) Plots the Median, Upper and Lower Quartiles derived from the weekly data on a graph.
- b) What do you conclude from the graph?

Cumulative-Sum Methods

6. Use table 3 again for exercising *the Cumulative-SUM (C-Sum) method* as follows:

To calculate the C-SUM for January add the sum for December, January and February, and divide the total by 15. Similarly the C-SUM for February is calculated by adding the sum of January, February and March and dividing by 15.

Then complete the empty cells of C-SUMS for each month in the table given below.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
C-SUM												

- Show your results on plotting. This line represents the threshold above which you should be alert for an epidemic.
- If you then add the figures for 1999, how would the graph look like? Show both lines on the same graph and interpret.
- As you have noticed, these methods all use monthly figures. What could be the disadvantages of using monthly data?
- Ideally, data should be collected and analysed at the peripheral level on a weekly basis, and the methods described can be adapted to weekly figures. The following method is suggested to use the thresholds developed from 5 years of monthly data and apply them to current weekly data. Using graph paper with the C-SUM or quartile threshold clearly marked as above in the previous exercises (b and c). As the weekly data are collected, mark the number as a column under the month in question. The next week, add the number to that of the first week, and extend the column to the new figure. Using a different colour for each week will make it clearer. Do the same for the 3rd and 4th weeks. If the column is already at the threshold by the 2nd or 3rd week, it will be possible to raise the alert of an epidemic much sooner than waiting for the whole month's figures.

Present your findings to the class and compare it with the one provided by the tutor.

Early detection and overall management systems

- Working in small groups, list down the measures you would set-up in a country to detect a malaria epidemic at early stage, either as part of the routine information system or/and as part of the epidemic surveillance system? Classify your measures at peripheral, district and national level.

Verification of malaria epidemics

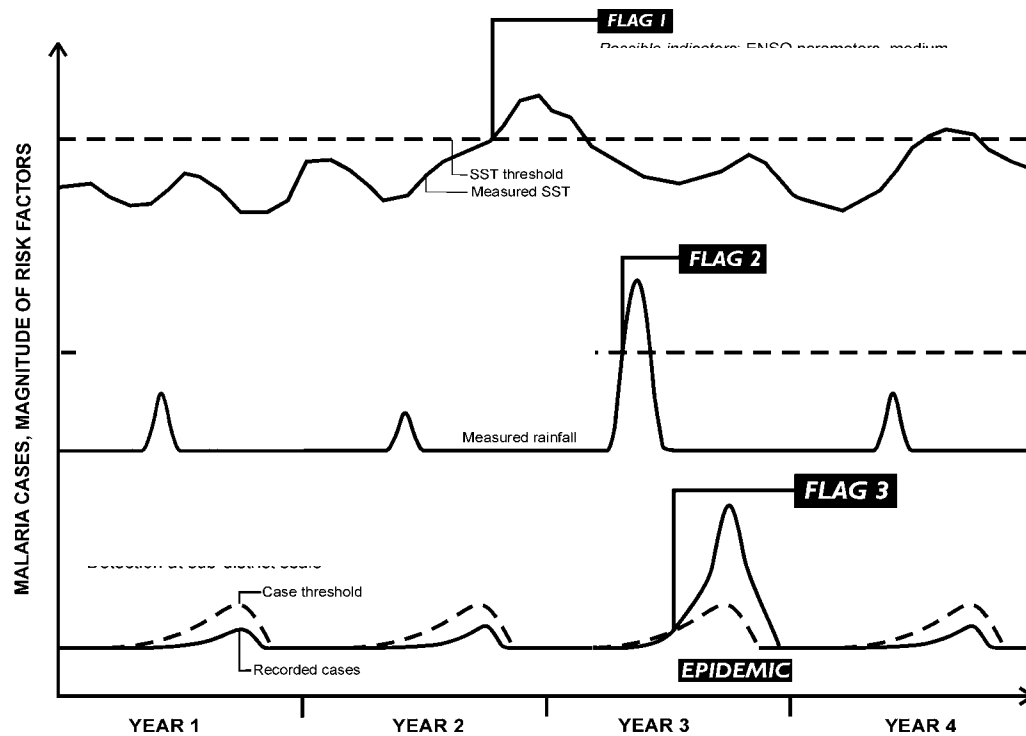
8. Working in small groups discuss and outline the steps that you would follow to verify malaria epidemics at peripheral level.
9. Working in small groups prepare a flow chart that covers early detection, verification and notification of malaria epidemics. The flow chart should indicate a logical flow from the peripheral to the district level. This exercise will enable you to summarise all the elements discussed in exercise 6 and 7. Present your findings to the class for discussion. Compare your results with the one provided by the tutor.
10. It is necessary to monitor the percentage of clinical diagnoses that are proven malaria cases by regularly sampling a given number of clinical cases for parasitaemia in different epidemiological settings. Working in small groups, discuss Slide Positive Rate or positive RDT rate at normal and epidemic times in arid/semi-arid areas; and highland regions with short seasonal transmission. Where would positively be higher during epidemics? Why?

Where would be laboratory diagnosis then more required?

Monitoring areas of epidemic risk

- In 1980, a two stage malaria epidemic forecasting system, based on the monitoring of meteorological variables and changes in the entomological inoculation rate (EIR), was proposed (Onori and Grab, 1980). The system is suited to the forecasting of resurgent outbreaks where comprehensive surveillance systems have already been developed and operated for some time, as part of the routine malaria control services. However, the capacity to monitor EIR as a routine component in an epidemic forecasting system is at present beyond the scope of most African countries.
 - Experiences from inter-sectorial (example food security) which use environmental information systems (EIS) could also be suited to the development of Monitoring and early warning systems (MEWS).
 - Tanzania, Uganda and Kenya, in conjunction with HIMAL have proposed the development of a three-tiered approach for malaria epidemic forecasting, early warning and early detection in the highlands of East Africa (Anon, 1999) with each tier being associated with specific indicators and responses.
11. Working in small groups analyse the model in figure 2 and answer the questions below. It shows forecasting, early warning and early detection model resulting from the Salt Rock Meeting, South Africa (Anon, 1999).

Fig 2. Forecasting, early warning and early detection model resulting from the Salt Rock Meeting, South Africa, Anon, 1999



- At which level would you assume (i) long range weather forecasting, (ii) early warning based on meteorological indicators (iii) early detection?
- What would be the possible indicators and responses for flag 1, flag 2 and flag 3.

Please read carefully the next Unit of this module before commencing the session to which it relates.

Learning unit 3

Prevention and early response to confirmed malaria epidemics

Learning objectives

By the end of this unit you will be able to:

- Identify the most cost-effective malaria epidemic control options
- Identify the most cost-effective malaria epidemic preventive options

Cost-effective interventions to control of *P. falciparum* malaria epidemics

1. Working in small groups, propose a list of the most important cost-effective control interventions in case of malaria epidemics?

Among this list, rank them according to their cost-effectiveness.

- a) Of the ones listed in your interventions which one would you think be necessary to set-up at early stages of any notified malaria epidemics?
 - b) What should be the guiding principle/s for a drug to have a significant effect on transmission during epidemics?
 - c) Do you think good case management procedures have significant effect on transmission if drugs such as Chloroquine and Sulfadoxine-pyrimethamine are used? Yes or NO, what about using artemisinin-based combinations (ACTs) or primaquine? In such emergency context, do you recommend use of effective drugs free of charge?
 - d) In case of emergencies or epidemics what do you think is a usual problem in terms of providing care to those sick at home in affected remote communities? What operational solutions would you propose to reach for those affected communities?
2. For operational and biological reasons vector control options may or may not be applicable in cases of epidemics. Discuss with your colleagues under which circumstances should these options be considered in epidemic prone districts.
 - a) What stage of the vector should vector control measures target to have significant impact on malaria transmission and hence on the burden?
 - b) Under what circumstances is indoor residual spraying (IRS) a viable option?
 - c) Under what circumstances are the use of insecticide treated nets (ITNs) or impregnated surfaces taken as viable options?
 - d) What specific vector control options/methods would you recommend in situations of complex emergencies for example in a set-up of refugee camps?
 - e) Where and when do you consider other vector control options?

3. Working in small groups use the following data (**Table 5**) to exercise different scenarios of early detection and interventions of epidemics and implications of not doing so. Figures in the table (column2-5) show the number of malaria cases or deaths corresponding to time (column 1) in months. In the absence of access to computers plot them on graph paper.

Table 5. Number of cases recorded in different stages of detection of malaria epidemics

Column 1	Column 2	Column 3	Column 4	Column 5
Time (month)	Non-intervened epidemic	Lately detected & intervened epidemic	Some delay in detection & intervention	Early detected & intervened epidemic
1	12	12	12	12
2	13	13	13	13
3	14	14	14	14
4	13	13	13	13
5	11	11	11	11
6	24	24	24	24
7	49	49	49	35
8	199	169	129	39
9	190	160	120	38
10	185	155	115	15
11	150	120	90	14
12	70	40	12	13
13	60	35	14	12
14	50	25	13	13
15	26	11	12	12
16	14	14	13	13
17	13	13	12	12

- From the data given in table 5, show each column (number of cases) against time on a graph. Produce one graph for each column by comparing them with **column 2** and level them. Shade them differently to show the different areas of under curve in each graph.
- What are the differences between these episodes or what does the difference of area-under-curve show in each graph?
- Which column or (from the figure you produced) does show existence of proper preparedness and response (better malaria control programme) when compared to **column 2** where no intervention is done?
- If forecasting, early warning and detection would work well for your programme for a complete prevention of the epidemics, how would you indicate them on the graph of **column 2** with a time sequence? What would this system lead to?

Case management and drug policy during epidemics.

Managing uncomplicated malaria cases during epidemics

Early access by everybody to efficient drugs during a malaria epidemic is key intervention to minimise the malaria burden. People at risk are non-immune and existing cheap monotherapies especially in Africa are not longer fully effective. There is a need to shift to other policy options such as combination therapies in endemic countries but also in prone countries to perhaps set up specific approaches.

Managing severe malaria cases during epidemics.

4. Suppose you are working in country that has epidemic-prone regions. While planning for managing uncomplicated malaria cases during epidemics, is it possible to use drugs different from the first-line drug treatment used (uncomplicated malaria) for endemic areas in the country? Explain your answer.
5. In terms of antimalarial drugs to be used for severe malaria cases during epidemics, what kind of drugs should be recommended ? Explain your answers in situations of higher and peripheral health facilities.

Failure rate threshold to shift from one drug to another during epidemics

6. In endemic regions, to develop a new drug policy and shifting from one failure drug to a more efficient one, WHO recommends to use a threshold of 25% as therapeutic efficacy failure rate (early *plus* late failure rate). Do you think this threshold would be applicable in epidemic situations ?
 Yes, no, don't know.
 If yes or no, give rationale

Mass drug administration

Pertaining to the use of antimalarials before or during epidemics, in addition to the use of first line drug treatment through fixed or mobile clinics, there are other complementary strategy of using antimalarials. Mass drug administration could be recommended in certain circumstances.

7. Define Mass Drug Administration
 - a) What is the principle behind MDA?
 - b) Can MDA be applied to entire populations considered to be at risk? Discuss with your colleagues on its potential limitations and suggest under which situations it would be best applicable. Give Examples of drugs used for MDA and their limitations.

Vector control options for prevention and control of malaria epidemics

Epidemics can be either prevented or controlled by using vector control interventions like IRS which have a direct impact on transmission in the affected areas. If not well set up, epidemics will continue their progress over time and space and spontaneously resolve by themselves. If well planned and carried out in advance at the appropriate time as a result of accurate warnings, vector control interventions will either contribute to cut the transmission season and/or mitigate further development of the epidemic by slowing down the development of adult mosquitoes and killing them before they become able to transmit the disease. The list below summarises the type of vector control options that may or may not be relevant to prevention and control of malaria epidemics:

- Indoor residual spray of insecticides
- Insecticide-treated materials
- Aerial spray of insecticides
- Larval control (environmental, chemical)

Insecticides for prevention and control of epidemics:

For indoor residual spraying:

- DDT 75% WDP
- Malathion 50% WDP
- Pyrethroids (Permethrin, Deltamethrin, Lambda-cyhalothrine, etc.)
- Other insecticides depending on resistance, cost and specific needs of countries and epidemic situations
- Formulations (Example DDT): 75% WDP, 100% Technical grade
- Dosage: DDT 2 g active ingredient / m² surface area
- Mode of application: Apply to inside surface of houses using Hudson X-pert spray pumps

For larval control:

- Temephos 50% EC, *Bacillus thurungiensis isrealiensis* (Bti)

For impregnation of bed nets, curtains, blankets and clothes:

- Pyrethroids (Permethrin, Delatamethrin, Lambda-cyhalothrine, etc.)

Note: Consult specific instruction for dosage, application, side effects and safety precautions of each insecticide.

Indoor residual spray of insecticides

It is not rare to see that during epidemics, when political pressure is high without appropriate preparedness, vector control measures like IRS are employed after the transmission peak or long after transmission has almost ceased (see exercise and graphs of scenarios of epidemic detection and response).

Many epidemic prone regions in Africa practice some form of routine vector control, mainly residual spraying of houses. However, in many countries, due to accumulated

problems of evaluation and financing, the practice has probably lost the required operational quality, acceptability and effectiveness. Several aspects of vector intervention, in practice, could often go wrong when employed to reverse epidemic situations. It is not rare to see that they are employed long after transmission has almost ceased. Shortage of skilled vector control staff and lack of adequate planning and supervision often compromise the effectiveness of insecticide-based control operations. Despite these problems, indoor residual spraying (IRS) is the most effective measure to prevent malaria epidemics when there is a reliable early warning system, and where the basic requirements of logistics and personnel exist.

8. Taking the biological factors (life-cycle of the parasite and the vector) into account, what would be the minimum (in weeks) time needed for application of IRS to effectively prevent a predicted malaria epidemics?
 - a) Is it possible to apply IRS once an epidemic has onset? If yes within what time?
 - b) Why is coverage so important for effectiveness of IRS?
 - c) Would IRS be more effective in areas where there is high vector density or in areas with low vector density?
9. Working in small groups discuss with your colleagues and identify the important issues (criteria) that need to be considered when indoor residual spraying operations are planned.

Mention an insecticide that qualifies such criteria.

Impregnated treated materials (ITMs)

Another vector control strategy relates to the use of Impregnated Treated Materials (ITMs) such as impregnated treated bed nets (ITNs).

10. For ITNs to be fully effective what coverage and re-impregnation rate must be attained? Why is coverage important criteria?
 - a) Coverage and acceptance by community in epidemic areas/regions is far less than in most endemic areas. Why?
 - b) Under which circumstances would ITN be effective in terms of preventing epidemics?

Space spray application

Aerial spraying of insecticides could also be useful in emergency situations when a large number of displaced non-immune populations are forced to live in malaria-endemic areas under poor housing conditions.

11. What stage of the mosquito does aerial sprays mainly target? Do you think this is a viable option? If possible in only limited circumstances, mention some.

Larval control (chemical, environmental)

Larval control could be an important tool for reducing the vector population in some ecological settings. Interventions against larvae should be undertaken in situations where breeding habitats are limited or clearly identifiable. Larval control can be made using larviciding chemicals or source reduction measures. Selection of either option depends on the availability of resources and the nature of larval breeding habitats.

12. Given such limitations, where could larval control be applied in relation to prevention and control of malaria epidemics?

What biological and operational factors should be taken into account when considering larval control?

Larval control can be made using larviciding chemicals or source reduction measures. Selection of either option depends on the availability of resources and the nature of larval breeding habitats.

It should be noted that larval control measures are more effective when undertaken prior to the occurrence of epidemics or at the very early indications of increased transmission than when employed late to mitigate ongoing epidemics. Such measures should be based on sound meteorological warnings and actual data on the abundance and persistence of mosquito breeding habitats. Entomological information such as the abundance of larvae could often be misleading as larval abundance climaxes after the peak in adult population and thus action could be too late to have an impact in epidemic control.

Abuja's targets pertaining to malaria epidemic control

On the 25th of April 2000, African Heads of State and Ministries of Health met in Abuja, Nigeria, and agreed to set up Roll Back Malaria targets and indicators in the African region to half malaria mortality by 2010. One of the targets relates to detection and control of malaria epidemics and is stated as follows: "Proportion of epidemic prone countries which have detected and controlled epidemics within 2 weeks of onset". Target expected for 2005 is 60% of them will have set up a system for early detection and develop a preparedness plan of action which makes selected control measures ready to be implemented within 2 weeks of onset in well known affected areas.

13. Do you think the targets mentioned above are realistic and achievable? Discuss with your colleagues and reason out why?

Malaria in relation to epidemic diseases

Standard case definitions need to be agreed upon and peripheral staff trained need to use such definitions and quickly report any cases to district authorities. What is really important from an epidemiological point of view is the consistency of recording suspected malaria cases over time rather than ensuring a valid malaria diagnosis even if any effort, clinically or laboratory-based, should be made to improve the diagnosis. In recognised prone districts, suspected malaria cases can be reported on a weekly basis alongside with other epidemic diseases.

14. In areas where there are no appropriate laboratory facilities, how would be malaria defined? And should all those patients who received antimalarial drug treatment be considered as malaria cases?
15. Should planned epidemic interventions be set-up as isolated / vertical interventions or linked to other epidemic interventions
If it has to be linked to others, to which ones ?
16. Of preventive and control interventions of malaria epidemics, which one do you think is more effective?

Measuring the impact of preventive / control measures

From historical records there is scarce documented information on the impact of epidemic. Most of the time, epidemics surprised population and health authorities who have to set up preparedness plan of action. The magnitude of the malaria burden during epidemics is rather linked to the stock out or absence of efficient drugs, absence or long delay of measures impacting on transmission and limited knowledge of the population and media pertaining to the "how" the disease is transmitted, cured and to be avoided.

17. When preventive measures are undertaken in advance or control options implemented at early stage, deaths and severe cases averted in a targeted population can be calculated based on the some conservative assumptions. Working in a small groups discuss with your colleagues and identify the underlining assumptions for measuring impact of either prevention or control.

Other managerial issues for preparedness and response during epidemics

NMCP staff at national level with interested partners are those in charge of advising the Government/MOH / disaster department on strategic technical measures to be taken in case of malaria epidemics. Operational research is an important component driven by NMCP with research institutions. It includes defined areas and population at risk and pre-defined cost-effective control options, drugs and insecticides to be used, etc. Epidemic prone district management teams are those in charge of establishing an implementation plan of action which has to include early warning and detection systems backed up by NMCP and articulated with field partners including NGOs. The process to elaborate a preparedness POA is described in the learning unit 4.

Malaria epidemics can also occur in emergency complexes and there are some strategies that respond to such situations.

18. Working in small groups discuss with your colleagues on best control options for malaria control that would be employed in a complex emergency situation or during early stage of setting refugee camps or in any acute emergency situations where there is limited knowledge of the local malaria situations.

19. Working in small groups look at the following three figures of different stages of epidemic detection and use the checklist given below in the table to mark right (\checkmark) or (X) if right or applicable if not applicable for the particular stage of epidemics. In case some applications have some peculiarities for certain level put your comments just under the corresponding box.

Fig 3. Detection of malaria epidemics at different stages

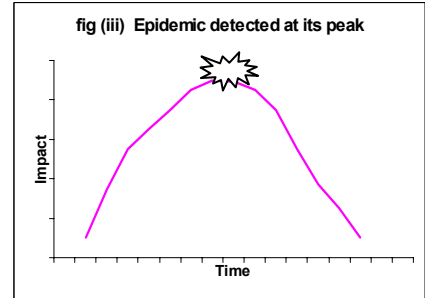
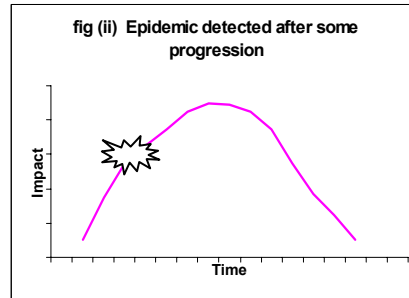
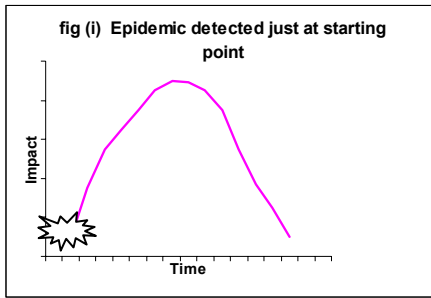


Table 6. Operational responses to different stages of malaria epidemics

No	Interventions or operational measures	Starting Epidemic	Accelerated Epidemic	Epidemic peak
1	Ensure all clinics and health facilities are operational and have sufficient drugs, equipment and trained staff			
2	Establish treatment centres (temporary clinics or mobile clinics) where access is a problem or health facility coverage is low			
3	Ensure that the correct diagnosis and treatment is provided at all health facilities and at community level			
4	Promote pro-active clinical case detection and management/referral			
5	Reinforce the referral system and consider the introduction of artesunate suppositories and artemether IM as a temporary measure where these are not already used			
6	Intensify/maintain effective preventive measures for pregnant women			
7	Reinforce health information systems for reporting and epidemic monitoring, preferably on a weekly basis			
8	Conduct specific epidemic health education campaigns			
9	Organize regular press releases/conferences/articles for public information			
10	IRS if area is previously sprayed:			
11	IRS in areas previously not sprayed.			
12	Fogging			
13	Insecticide Treated Materials (ITMs)			

Please read carefully the next Unit of this module before commencing the session to which it relates.

Learning unit 4

Post-epidemic assessment and preparedness plan of action

Learning Objectives

By the end of this unit you will be able to:

- Undertake a quick assessment of the epidemic detection and control response
- Develop a preparedness plan of action

Rationale for post-epidemic assessment exercise

The post-epidemic assessment exercise is one vital step within the epidemic circle to identify success and failure of all interventions planned or unplanned and ultimately consider if detecting systems and control options have had an impact on the malaria burden. This important exercise is frequently neglected by implementing partners and MOH. It means that good or bad lessons are not seriously taken on board and may can be used to modify or strengthen existing interventions. Building on past lessons will improve to update preparedness plan of action, articulate and support provided by national and district partners. The report should be widely distributed for partners' information and inputs.

1. Working in small groups discuss with your colleagues on a logical flow and steps of an epidemic cycle and produce a diagram of the cycle and present it for class discussion. Consider what have been so far covered in previous learning units (1-3) and include the post-epidemic assessment exercise. All elements which are part of the classical epidemic described earlier must be carefully analysed.
2. During the post-epidemic assessment exercise, what factors do you think you should be able to carefully analyze?

Building on exercise 2 above the essential elements to be assessed during this analysis exercise are highlighted using a questionnaire and an example of such is given in **Annex 1**.

Participants of post-epidemic assessment exercise

NMCP staff from the MOH should lead the field exercise with clear expected outcomes since they are in charge of developing and monitoring strategic operations related to malaria epidemic prevention and control. They should be accompanied in the field by the following experts:

- a national epidemiologist working in national health information system is expected to manage the overall epidemic surveillance system,
- a national meteorologist and or an expert dealing with meteorological, other relevant issues and warning indicators,
- a representative from the national disaster department,
- representative from the partnership at national and/or district level,

The team should preferably be from multiple sectors to get a comprehensive overview of problems encountered at national and district level. Occasionally, external technical assistance can be requested by the GVT to WHO or to other technical / funding agencies.

Preparedness plan of action

NMCP from MOH with partners in prone epidemic countries are supposed to develop a national document which highlights strategic approaches to cope with malaria epidemics with the ultimate aim of minimizing malaria burden in such emergency circumstances as much as possible. This strategic document should be part of a comprehensive emergency health document expected to cover other health emergencies. The preparedness plan of action (PPOA) should be complete, accurate and agreed among partners based on understanding of the epidemiology, best choice of preventive and control options of malaria in prone areas. The PPOA is expected to detail and budget all planned interventions at all levels with all partners. Malaria epidemic budget should be part of the overall disaster department budget covered both by GVT and country partners.

Strategic elements of a preparedness plan of action

Strategic elements of a preparedness plan of action should include all practical aspects which relate to the above boxes as part of the epidemic circle. The "how" and "where" should be explained in details with attached additional budget if requested. Ideally NMCP at central level should provide prone districts with technical guidance and should facilitate partnership building in particular with implementing agencies at district level like INGOs, local authorities, media, civil society and private companies. All stake holders should be part at planning stage and be and involved in specific actions based on comparative advantages and mandates. Capacity building as a key component of success has to be part of the planning activities and should target all actors.

3. Working in small groups discuss with your colleagues what strategic elements need to be included in a preparedness plan of action for prevention and control of malaria epidemic on a logical flow and produce a diagram of the steps and present it for class discussion. (Hint: consider the discussion on indicators for epidemics, assessment/investigation, reporting and response)
4. Should the preparedness POA for malaria epidemic be developed in isolation or linked to other epidemics, disasters components and places? Should it be developed at inter-country, national or regional / district level?
5. Working in small groups discuss the reasons why most of countries are not prepared enough to cope with epidemics. List some key reasons and rank them according to their importance and potential for solution.

Annex 1

Example of questionnaire for malaria post-epidemics assessment

The following questionnaire should provide the basic guidelines for post-epidemic assessment and help identify potential defects in the key components described above. It would furthermore provide an analytical framework to assess the level of success in responding to the epidemic.

1. Have epidemic prone areas for the country been demarcated?
If so, did the epidemic occur in a high-risk area?
2. Are early warning systems using, for example, real-time weather data made available and shared and discussed by district management teams ?
 - a. Did this data predict a possible epidemic in the region?
 - b. Was the regional malaria control station aware of the risk?
 - c. Was this information disseminated to all levels of malaria control?
 - d. Are early warning indicators validated over space and time ?
 - e. Was there adequate planning for source reduction measures if the predictions were confirmed?
3. Early detection system.
 - a. Is a well equipped active surveillance system for early detection of any epidemics including malaria working at prone district level?
 - b. Was this data recorded, analyzed with set up thresholds at district level with regular feed back / update to peripheral health care facilities ?
 - c. Were records of previous years available for comparison?
 - d. What method was used to analyze anomalies and define / validate thresholds (i.e. mean + 2 standard deviations, 3rd quartile, etc)?
 - e. Was this data regularly reported to a central facility?
If yes, communication channels in use '
4. Recognition of anomalies and preliminary action taken at the periphery.
 - a. Are 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 (days ?) ?
 - d. How notification to district was made ? and lag time (days) ? If more than 2 days, what cause the delay ?
5. Was the response timely?
 - a. Was there effective communication between the local and district level?
 - b. What was the lag time between confirmation of the epidemic and local / field response?
 - c. Were there adequate drugs and medical supplies at district level for rapid distribution?
Insecticides and related supplies available if relevant ?
 - d. Were there sufficient stocks of anti-malaria drugs?
 - e. Were there sufficient trained personnel to handle the epidemic?
 - f. Were there sufficient diagnostic facilities?

6. Disease and economic burden.
 - a. How long did the epidemic last (weeks)?
 - b. population affected ?
 - c. Lives lost?
 - d. Morbidity?
 - e. If private companies affected, was some attempt made by the company to measure the economic impact ?
7. If the situation required mobilizing 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 (i.e., 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? [give some rationale]
8. Preparedness plan of action.
 - a. Was there a budget allotted for malaria epidemic response?
 - b. Were partners involved and articulated in the development of the POA ?
 - c. Were source reduction measures employed?
If yes, Were they technically appropriate? Were they effective?

The above questionnaire is just an example. It should make clear what problems were faced during the pre-epidemic and early epidemic periods when control options are expected to be the most efficient. This knowledge would enable NMCP and partners to understand how to strengthen or amend the existing epidemic preparedness plan.

Annex 2

References

A. Public Health action in Emergencies caused by Epidemics

A Practical Guide

P Bres. WHO 1986 ISBN 92 4 154207 1

It emphasizes on organization issues at national level and the same principles can be applied at district level or within camps for displaced population. Detailed description of planning outbreak investigation includes safety of personnel and organisation of teams.

Specifically for vector control, there is a section on the logistics of insecticide spraying operations.

There are formats for reporting and for a final report.

The annexes contain useful explanations of epidemiological terms and examples of statistical analyses.

WHO Expert Committee on Malaria. Twentieth report

WHO. 2000 ISBN 92 4 120892 9

This publication concentrates on current concerns including early detection and containment or prevention of malaria epidemics. It also discusses epidemic risk, prediction of epidemics, development of early warning systems, the effect of drug resistance on epidemics, the role of epidemics in the spread of resistant and the place of mass chemotherapy.

The increased risk of epidemics, the spread into urban areas and the re-emergence of malaria in areas where it was previously eradicated are described.

Epidemic preparedness, including post-epidemic evaluation and review of planning are emphasized.

Manual for Indoor Residual Spraying. Application of Residual Sprays for Vector Control

WHO 2000

This is a very practical manual which fully describes the available insecticides and their safe and effective application.

B. Malaria Vector Control

Insecticides for Indoor Residual Spraying

WHO 2001

by Najera and Zaim

This manual gives advice on the choice of insecticide in different situations, and how to purchase, store, use and dispose insecticides safely. It gives a detailed description of the various insecticides, their use and adverse effects.

C. Malaria Control among Refugees and Displaced populations

WHO 1996

Since refugees and displaced populations are at particular risk of malaria epidemics, this provides very useful information on how to assess the level of risk, preventative measures in camp situations, and the need for effective treatment taking into account the relative immunity of displaced population and the resistance of the parasite to antimalarials. It discusses the “epidemiological exchange” between the displaced and host populations.

It describes preventative measures during an emergency phase and when the camp is more settled. Consideration is given to the benefits and dangers of mass treatment and chemoprophylaxis.

The importance of information systems and their adaptation to different stages of the emergency is also emphasized.

D. Malaria Diagnosis New Perspectives

WHO 2000

This is a useful book in describing various rapid tests now being used for malaria diagnosis. It compares the sensitivity, specificity and performance of tests.

Comparison is made between the advantages and disadvantages of using rapid tests as compared to microscopy and there is discussion on further research needs.

E. Malaria Epidemics Detection and Control Forecasting and Prevention

WHO 1998

This is a very informative book that starts with a historical overview and gives many examples of epidemics of malaria in more recent years, with good graphical illustrations of their evolution. The major determinants of epidemics are discussed in detail.

The chapter on early detection and control of epidemics describes the early outbreak investigation and identification of resource capacity. Various aspects of disease management and control of transmission are described, with the possibilities and constraints of early transmission control by mass drug administration and space spraying with insecticides.

The third part of the book covers surveillance and forecasting.

The African Summit on Roll Back malaria

This report summarizes the Plan of Action agreed to by the head of African States that participated in the summit. It includes the development of early warning systems and emergency preparation and response for malaria epidemics.

It also includes the indicators to achieve control of malaria epidemics through detecting and properly controlling within 2 weeks of onset.

Prevention and Control of Malaria Epidemics; 3rd meeting of the RBM Technical Support Network

WHO 2002

A report on the progress to date and definition of further needs. There is emphasis on surveillance and communication, and the need for decision-making guidelines.

There is a clear definition of an epidemic. The importance of Epidemic preparedness and response plans is also emphasized.

Monitoring Antimalarial Drug resistance

WHO 2002

This is a report of an informal consultation which was conducted in December 2001 to review and update the WHO protocols for assessing therapeutic efficacy. It should be read in conjunction with the existing protocols of 1996 and 1998.

There are significant changes on the classification of therapeutic response and recommendations about analytical and statistical procedures. The place of in vitro tests and molecular markers is also discussed.

***In vitro* micro-test (markIII) for the assessment of the response of Plasmodium Falciparum to chloroquine, mefloquine,quinine,amodiaquine, sulphadoxine/ pyrimethamine and artemisinin.**

1997

**Malaria Early Warning Systems Concepts, Indicators and Partners
A framework for Field research in Africa.**

WHO 2001

This book mainly discusses the development of Malaria Early Warning Systems, with the possibility of epidemic prevention. Much of this is concerned with climatic data, but also with the importance of the regular collection and interpretation of clinical data. Ways of identifying epidemic thresholds are also discussed.

The Use of Artemisinin and its Derivatives as Anti-Malarial Drugs

WHO 1998

Report of a joint CTD/DMP/TDR Informal Consultation June 1998

The meeting reviewed the research and use of artemisinin derivatives and the recommendations and availability at that time

The clinical use, especially combination therapy, and the need for ongoing research is described.

The Use of Antimalarial Drugs

WHO 2001

Report of a WHO Informal Consultation Nov 2000

A useful overview of the individual antimalarials currently in use, and programmatic considerations.

Antimalarial Drug Combination Therapy

WHO 2001

Report of a WHO Technical Consultation April 2001

An update and overview of available and potential combinations, with clear recommendations for their use to replace monotherapy. Their use needs to be accompanied by careful monitoring.

Management of Severe Malaria

A practical handbook

WHO 2000 ISBN 92 4 154523 2

All you need to know about the clinical presentation and management of severe malaria is clearly discussed in this handbook.

Assessment of the safety of Artemisinin Compounds in Pregnancy

WHO 2003

Report of two informal consultations convened by WHO (RBM & the UNDP/WB/special programme for research and training in tropical diseases) in 2002.

This report gives the position of WHO and recommendations on the current use of artemisinin derivatives in pregnancy based on the current evidence. WHO/CDS/MAL/2003.1094

Essential Malariology 4th edition

Warrell and Gilles 2002 ISBN 0 340 74064 7

A comprehensive textbook brought up to date. It includes the history and epidemiology of malaria. There are chapters on parasites, vectors and malaria control, and on clinical presentations and treatment.

Framework for Monitoring Progress and Evaluating Outcomes and Impact

Roll Back Malaria 2000

It gives the framework of malaria programmes in country, and the indicators to monitor the progress, outcomes and impact of programmes

Scaling-up insecticide-treated netting programmes in Africa

RBM 2002

A framework for national ITN programmes

Specifications for Netting Materials

WHO 2000

Report of an informal consultation June 2000.

It describes technical details with clear explanations of the need for particular materials and requirements for nets.

Entomological field techniques for malaria control

WHO 1992

It is A manual, divided into learning units, taking a student through the practical entomological techniques related to malaria vector

The Malaria Control programme of Namibia

Report of a WHO mission 1990

The report analyses the epidemics of malaria in 1989 and 1990 including the background for these epidemics and makes recommendations on malaria control and epidemic preparedness.

Clinical epidemiology of malaria in the Highlands of Western Kenya and Defining and Detecting malaria Epidemics in the Highlands of Western Kenya.

Hay et al. Emerging Infectious Diseases. Vol 8 no 6 June 2002

A retrospective analysis of the incidence of malaria in this region over 2 decades, with discussion about the application of different methods of defining epidemics.

Intersectoral response to the 2002 malaria outbreak in the highlands of western Kenya

Hay for UNICEF 2002

A retrospective analysis of the epidemic of the same year is given, applying the different methodologies for defining an epidemic. Recommendations are given for tightening up surveillance and using available information for early warning systems. The triggers for the epidemic are discussed, and many practical recommendations are made to address those issues and improve the detection and management of future outbreaks.

Malaria Epidemics: Preparedness: Early Warning Systems

WHO 2002

By JA Najera

This book is largely concerned with early warning systems and risk factors. Early detection based on epidemiological surveillance systems is also addressed, and illustrated with many tables and graphs.

The Health Management Information System Manual

WHO

The surveillance system used in many countries, is clearly set out in this manual.

Test procedures for Insecticide Resistance Monitoring in Malaria Vectors, Bio-efficacy and Persistence of insecticides on treated surfaces

WHO 1998

Report of the WHO Informal consultation. WHO 1998

The report has results from a number of studies and updated recommendations.

Space spray application of insecticides for vector and public health pest control. A practitioner's guide.

WHO 2003

This guide provides information and recommendations on how to control flying insect pests and vectors of diseases by applying space insecticides sprays. WHO/CDS/WHOPES/GCDPP/2003.5

Communicable Disease Control in Emergencies

WHO 2002

It includes general principles of data collection for communicable diseases, and sources of data. The chapter on malaria deals with diagnosis and treatment, and information required to investigate a suspected malaria outbreak. There are useful annexes with case definitions, indicators and standards for use in emergency cases and sampling forms.

A clinical-symptoms-based early warning system for the timely detection of malaria epidemics

Delacollette C. unpublished document, 1998

Using the 1990 malaria epidemic in Burundi, this paper discusses the use of routinely collected clinical data for the early detection of malaria epidemics. The system is based on monthly data collection.

A Guideline for malaria epidemic prediction, prevention, detection and control in Africa.

WHO 2003 (in preparation)

Interagency Handbook for Malaria Control in Complex Emergencies

It covers initial Assessment Planning and survey methods.

(in preparation)

Malaria Control Achievements problems and Strategies

WHO 1999

By JA Najera

It gives an overview of the history of the efforts to control and even eradicate malaria and the current global strategy. There is a section on control and prevention of malaria epidemics indices for early warning and practical use of clinical data.

Vector control

By Jan Roozendaal