Federal Democratic Republic of Ethiopia
Ministry of Health

National Malaria Guidelines

FOURTH EDITION

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Abbreviations

ACT	Artemisinin-based combination therapy
AIDS	Acquired immunodeficiency syndrome
AL	Artemether-lumefantrine
ARDS	Adult respiratory distress syndrome
CBO	Community-based organization
iCCM	Integrated community-based case management
CHW	Community health worker
DIC	Disseminated intravascular coagulation
DDT	Dichloro-diphenyl-trichloroethane
DHS	Demographic and Health Survey
EC	Emulsifable concentrate
EDS	Early detection system
EOS	Enhance outreach strategy
EPHI	Ethiopian Public Health Institute
EPI	Expanded programme on immunizations
FAO	Food and Agriculture Organization
FBO	Faith-based organization
FMOH	Federal Ministry of Health
G6PD	Glucose-6-phospate dehydrogenase
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
Hb	Hemoglobin
HEP	Health extension program
HEW	Health extension worker
HIV	Human immunodeficiency virus
HSDP	Health Sector Development Plan
ICAP	International Center for AIDS Care and Treatment Programs
IM	Intramuscular
IRS	Indoor residual spraying
IV	Intravenous
IMNCI	Integrated management of neonatal and childhood illnesses
ITN	Insecticide-treated net
LLIN	Long-lasting insecticidal net
MACEPA	Malaria Control and Evaluation Partnership in Africa

MCST	Malaria Control Support Team
MDA	Mass drug administration
MDG	Millennium Development Goals
MFTT	Mass fever testing and treatment
MIS	Malaria Indicator Survey
MPFT	Mass presumptive fever treatment
NGO	Non-governmental organization
NMA	
NMCP	National Meteorology Agency
National	Malaria Control Program
ORS	Oral rehydration solution
PATH	Program for Appropriate Technology in Health
PCR	Polymerase chain reaction
PHEM	Public Health Emergency Management
PMI	President's Malaria Initiative
PPE	Personal protective equipment
RBM	Roll Back Malaria
RDT	Rapid diagnostic test
RHB	Regional Health Bureau
SBCC	Social behavior change communication
SP	Sulphadoxine–pyrimethamine
SUFI	Scaling up for impact
SNNPR	Southern Nations, Nationalities and Peoples Regional State
TAC	Technical Advisory Committee
TB	Tuberculosis
TPR	Test positivity rate
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WDP	Water dispersible powder
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme

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Executive Summary

Ethiopia is among the few countries with unstable malaria transmission. Malaria is mainly seasonal in the highland fringe areas and of relatively longer transmission duration in lowland areas, river basins and valleys. Approximately 60% live malaria-endemic areas in Ethiopia, chiefly at altitudes below 2,000 meters. The main malaria parasites are P. falciparum and P. vivax, accounting for 60% and 40% of all cases, respectively. Anopheles arabiensis is the main vector; An. pharoensis is also widely distributed in the country and is considered to play a secondary role in malaria transmission.

Due to the unstable nature of malaria transmission, major malaria epidemics had been one of the serious public health emergencies in the country. Recently, however, because of unprecedented scale-up and sustenance of key anti-malaria interventions throughout the endemic areas of the country, Ethiopia managed to record significant reduction in number of reported malaria cases and deaths. Moreover, there have not been any major malaria epidemics in the country for the last fourteen years.

Considering the achievements made so far and the global momentum in the fight against malaria, the country plans to eliminate the disease by 2030 from the country. Accordingly, the national malaria elimination roadmap developed and launched. As of 2017, two hundred thirty nine (239) districts have already started elimination programme. Subsequently, additional districts will be enrolled into elimination programme. With the endeavor of interruption of the local transmission, new tools and strategies are considered; and surveillance will become a core intervention.

Malaria vector control, malaria diagnosis and treatment, and malaria surveillance guidelines are incorporated in the national guidelines. Summary of main issues under each guidelines presented as follows.

Malaria Vector Control Guidelines

The main vector control activities implemented in Ethiopia include indoor residual spraying (IRS), long lasting insecticidal nets (LLINs) and larval source reduction (LSM). The country has managed to scale-up the vector control interventions in all malarious areas since 2005. For example, nearly 90 million LLINs have been distributed to households between 2006 and 2017 and now spraying of more than 85% unit structures targeted for IRS has been achieved. The malaria indicator survey (MIS) 2015 results also show tremendous achievements by Ethiopia's malaria control program. MIS 2015 shows that insecticide-treated net (ITN) coverage increased from 55.2% to 64% between 2011 and 2015, and ITN use by children under five years of age and pregnant women reaching over 70% in households that owned at least one ITN. Overall, 71.7% of households in malaria-endemic areas were protected by at least one ITN and/or IRS.

It is believed that the vector control interventions have greatly contributed to the overall reduction in malaria burden recorded in the country. Moreover, as the National Strategic Plan (NSP) for Malaria Control and Elimination in Ethiopia:2017-2020 aims to consolidate the achievements made and sustain their impacts, implementation of appropriate vector control measures will continue for the realization of the NSP targets. Accordingly, distribution/replacement of nets is done regularly and operation of IRS will be maintained in targeted areas. Environmental management and use of larvicides are also considered. Thus, the three major vector control measures, namely, LSM, IRS, and LLINs are to be implemented. The NSP 2017-2020 has the following targets:

- 100% of households in LLIN targeted areas own at least one LLIN per two persons; and achieve and maintain levels of LLIN use above 80% by all age and gender groups.
- Achieve 100% coverage of IRS in targeted woredas and/or kebeles; and maintain >85% coverage of unit structures sprayed in targeted woredas and/or kebeles.
- 100% of permanent larval habitats are identified and managed in the targeted areas.

The vector control guidelines provides updated information and guidance on the vector control to health workers and programme coordinators in Ethiopia.

Malaria Diagnosis and Treatment Guidelines for Health Workers

As outlined in the NSP that spans from 2017-2020, Ethiopia has a target of 100% access to effective and affordable malaria treatment. This requires improving diagnosis of malaria cases using microscopy or using multi-species RDTs, and providing prompt and effective malaria case management at all health facilities in the country. Thus, malaria diagnosis and treatment are essential components of anti-malaria interventions in the country. This guideline provides updated information and guidance on the diagnosis and management of malaria to health workers of Ethiopia. This fourth edition revises and updates the third edition of the Malaria Diagnosis and Treatment Guidelines developed by the FMOH in 2012.

Malaria diagnosis consists of a patient's clinical assessment, microscopic examination of blood slides and use of multi-species RDT in accordance with the level of the health facility. Microscopic diagnosis remains the standard of diagnosis in health centers and hospitals of different levels, whereas multi-species RDTs are the main diagnostic tool at the health post level. ACTs are the first-line drug for treatment of uncomplicated P. falciparum malaria. Oral quinine is used as the first-line treatment for pregnant women during the first trimester. Chloroquine is used for treatment of P. vivax. Radical cure with primaquine is recommended for patients with P. vivax, residing in elimination targeted areas with possibility of using it to all malarious areas of the country. It is to be noted that per the WHO's recommendation, a single-dose primaquine is already rolled out at country level to treat gametocytes of P. falciparum. AL is used for mixed infections due to both P. falciparium and P. vivax. Patients with malaria should sleep under LLINs at night, especially while completing anti-malarial treatment. This will decrease transmission in addition to protecting the patient from reinfection. At a health post, children less than 6 years of age with severe malaria are given rectal artesunate as pre-referral treatment. At the health centre and hospital levels, intravenous (IV) artesunate infusion or IM injection (or, alternatively, quinine IV infusion when artesunate is not available) is the first-line anti-malarial drug for management of severe malaria and the treatment should be continued

with a full dose of AL once the patient is able to swallow. Optimal nursing care and intensive clinical follow-up are the cornerstones of managing patients of severe malaria. Travellers to malaria-endemic areas are advised to use LLINs and mosquito repellents and to seek medical care promptly after acute febrile illness to rule out malaria. Mefloquine and atovaquone-proguanil are the recommended chemo-prophylactic anti-malaria drugs in Ethiopia.

Malaria Surveillance

Preventing epidemic occurrences within the available lead-time depends on the capacity of the health system to make use of available data at each level to early detect malaria. Therefore, a strong surveillance system helps in data management, informing programme managers in responding in the event of unusual circumstances, including malaria upsurge or outbreaks. It also facilitates monitoring progress of malaria control and avoid wastage of resources. Since 2005, Ethiopia has strengthened the health system with the establishment and subsequent expansion of the Health Extension Program (HEP), allowing closer monitoring of epidemic-precipitating factors at the local level.

Two major types of alert thresholds are suggested in this guideline: 1) the weekly second highest number in a five-year dataset (the third quartile threshold or norm) for health posts with five years data set, or doubling of the previous year weekly cases threshold for health posts with at least single year data. 2) Cluster mapping technique, which is a new method, is based on analyzing for absolute numbers of malaria illnesses every 30 days within communities, documenting approximate map locations of recent cases.

It is expected that with the decreasing trend of the malaria situation and the ongoing optimization of the antimalarial interventions in the country, the role of forecasting and early detection diminish. However, it could still serve to assess resurgence of malaria in any area of the country, reintroduction into malaria-free zones, or colonization of previously malaria free areas. Epidemic preparedness plans should be contextual at different levels of the health system. This guide recommends the preparedness plan at all levels.

Once malaria epidemic or significant case build-up observed, notification by telephone or SMS should occur as soon as possible to all higher levels of the health system. Among the critical information needed is the number of malaria cases in the last week by species and number of ACTs, Primaquine, RDTs and Chloroquine in stock. A mass test and treat strategy will be maintained in most situations and mass presumptive fever treatment (MPFT) with ACTs is appropriate when test positivity rate is ≥50% upon examination of at least 50-suspected cases.

This guideline emphasizes that the causes of epidemics are highly variable and may involve natural and man-made precipitating factors. Epidemic prevention and control necessitates a multi-sectoral approach and requires coordination of roles and responsibilities of the health system at different levels. There is an important role for malaria technical experts and other partners in the academic and developmental sectors to coordinate with the public health sector on malaria epidemic preparedness and epidemic response.

Section 1

MALARIA VECTOR CONTROL

1. Introduction

Approximately 60% of the Ethiopian population live in malaria risk areas. The disease primarily occurs up to the 2000-meter (m) elevation but can also occasionally affect areas up to 2300m elevation in response to the spatial and temporal changes. The country shows marked seasonal, inter-annual and spatial variability due to large differences in climate (temperature, rainfall and relative humidity), topography (altitude, surface hydrology, land vegetation cover and land use) and human settlement and population movement patterns. In general, the peak periods of malaria incidence occur between September and December following the main rainy seasons (June-September) and from March to May during and after the small rainy seasons (February-March). Historically, there have been around 5 million clinical malaria cases annually. Since 2006, however, cases have reduced substantially. Majority of malaria cases have been due to P. falciparum, with the remainder caused by P. vivax. Anopheles arabiensis is the main malaria vector; An. pharoensis, An. funestus and An. nili play a role as secondary vectors.

Since 2005, Ethiopia has scaled-up one of the largest and most ambitious malaria control programs in Africa, designed to support the country's Health Sector Development Plan (HSDP), the NSP and the national child survival strategy, in order to reduce under-five mortality rates by two thirds by 2015. This SUFI phase has been possible because of substantial increases in resources from various funding sources and the commitment of the Government of Ethiopia (GoE). These resources have enabled an unprecedented scale-up of malaria control interventions: prompt and effective treatment, case management through rolling-out of the highly efficacious anti-malaria drugs (i.e. ACTs), and selective vector control, with a special emphasis on increasing coverage and use of ITNs, and targeted and timely application of IRS of households with insecticide.

Ethiopia's malaria control program is currently shifting from the SUFI phase to consolidate the achievements made to date and sustain its impacts. This will involve gradually moving from scaling-up for impact to sustainable long-term impact and ending malaria for good. The challenge now is increasing quality, utilization and targeting of interventions based on epidemiological and entomological data.

2. Malaria Vectors and Their Bionomics

Life cycle of Anopheles mosquitoes: The mosquito life cycle has four distinct developmental stages: egg, larva, pupa and adult (Figure 1). Eggs are about 0.5 mm in length, boat-shaped and nearly all species are provided with tiny air-filled floats that allow them to remain on the water surface. Eggs are laid singly by the female Anopheles on the pools of water preferred by a particular species (Table 1; Figure 2). An. arabiensis usually prefers clean rainwater and open sunlit habitats without vegetation for oviposition (Gimnig et al. 2000; Shililu et al. 2003; Muturi et al. 2008).

Larvae hatch from eggs as small 'wrigglers' and have a distinct head and thorax, and an abdomen composed of nine segments. The globular thorax is broader than the head or abdomen and somewhat flattened. Larva has several groups of hairs on the thorax and abdomen that are useful for identifying species of Anopheles. The body of an anopheline larva lies parallel to the water surface (Table 1; Figure 2). Like all mosquito larvae, those of Anopheles undergo three successive molts, separating the life of the larva into four stages or instars, i.e. first instar, second instar, third instar and fourth instar, which mainly differ from each other size. At the end of the fourth stage, the larva changes into a pupa. The pupa is comma-shaped and differs greatly from the larva in appearance. Pupae do not feed during their aquatic existence, but come to the water surface to breathe. Finally, the pupa emerges as an adult male or female. The length of each stage is dependent on a range of environmental conditions, including water temperature. In favorable conditions, it takes an average of seven to ten days from egg to emerging adult.

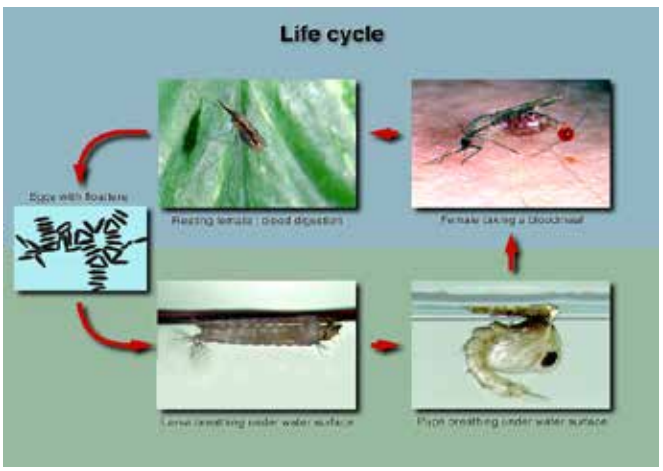


Figure 1 Mosquito life cycle

Distinguishing anophelines from culicines (Culex and Aedes)

Mosquitoes are classified mainly in two groups as anophelines and culicines and vary in their developmental stages. The main criteria for differentiating the two are the way eggs are oviposited, shapes and the structure they contain, laraval resting and feeding position, presence/absence of a siphon, pupal breathing trumpet shape and size and adult resting position, size of palps and other morphological differences. Figure 2 and Table 1 below depict the differences at the egg, larva, pupa and adult stages.

Eggs: Culicine eggs clump together in a "raft" (Culex) or float separately (Aedes); anopheline eggs float separately and each of them has "floats".

Larvae: Culicine larva has a breathing tube (siphon) which it also uses to hang down from the water surface, whereas the anopheline larva has no siphon and rests parallel to and immediately below the water surface. The siphon of Culex larvae is longer than Aedes larvae.

Pupae: Pupae of both anophelines and culicines are comma-shaped, hang just below the water surface and swim when disturbed. The breathing trumpet of the anopheline pupa is short and has a wide opening, whereas that of the culicine pupa is long and slender with a narrow opening. However, as it is difficult to distinguish anopheline from culicine pupae in the fi–eld, it is preferable to rear them in an insectary so that the emerging adult mosquitoes can be identified.

Adults: With live mosquitoes, adult anopheline and culicine mosquitoes can be distinguished by observing their resting postures. Anophelines rest at an angle between 50° and 90° to the surface whereas culicines rest parallel to the surface (Fig. 2).

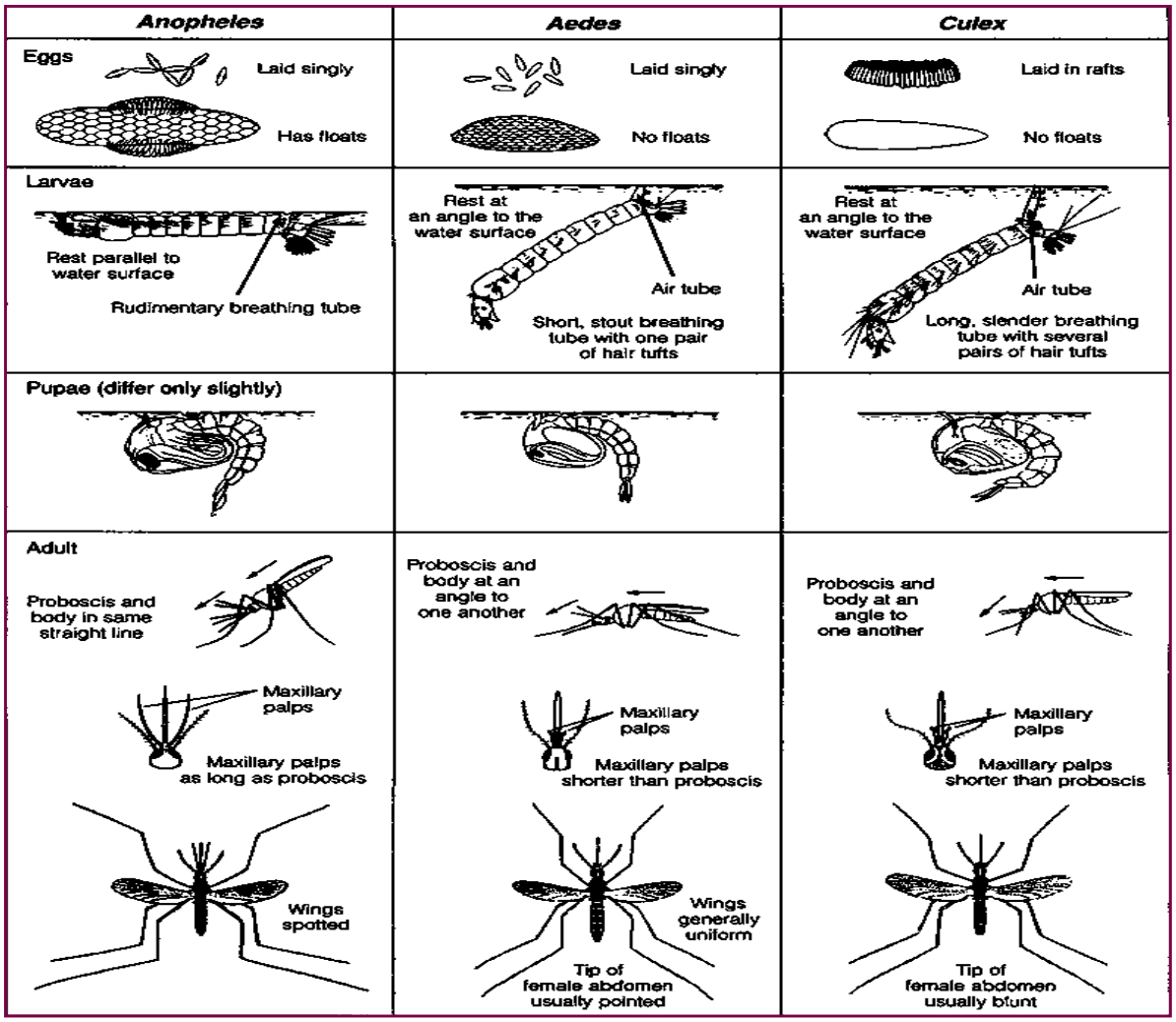


Figure 2 Differentiation of Anopheles, Aedes and Culex mosquitoes at various stages of development

Table 1 Distinguishing Anopheline and Culicine mosquitoes

Developmental Stage	Anophelines	Culicines
Eggs	Float separately and have "floaters"	Clump together in a raft (*Culex*) or float separately *(Aedes)*
Larvae	No siphon	Has siphon
	Rests parallel to water surface	Hangs down from the water surface
Pupae	Trumpet is short and has wide opening	Trumpet is long and slender with a narrow opening
Female Adults	Palps as long as proboscis,	Palps very much shorter than proboscis

Vector distribution: An. arabiensis is the only species from the An. gambaie complex known to be prevalent across malaria-endemic areas in Ethiopia (Abose et al., 1998; Lulu et al. 1991). An. pharoensis is a widely distributed anopheline mosquito in the country and is considered to play a secondary role in malaria transmission, along with An. funestus and An. nili.

Breeding habitats: An. arabiensis prefers breeding in small, temporary, and sunlit water collections such as rain pools; however, it can also breed in a wide variety of other types of water bodies. The breeding habitats of An. pharoensis are usually large, permanent water bodies with emergent vegetation, such as swamps and the edges of lakes. An. funestus shares the breeding habitat of An. pharoensis. An. nili breeds in brackish water and is much more localized in its distribution.

Sporozoite infection: The sporozoite infection rate of An. arabiensis in Ethiopia ranges from a reported 0% to 5.4%. An. nili was shown to have a sporozoite infection rate of 1.6%. The Human Blood Index (HBI) of An. arabiensis collected from different habitats ranges from 7.7% to 100%. The HBI of An. funestus and An. nili populations collected from indoor biotypes was 100% (FMOH, 2007).

Resting and biting behavior: An. arabiensis is partially endophilic and endophagic in most localities. Biting occurs throughout the night but in some areas, the peak time of feeding is in the early hours in outdoor locations.

Nighttime flight: The normal flight range of An. arabiensis is usually less than 1 km. Studies show, however, that the distribution of mosquitoes is related to the predominant wind direction at night, suggesting that wind assists the dispersal of mosquitoes from their breeding site. An. gambiae s.l. have been shown to fly up to 7 km with the assistance of wind.

Host Selection: An. arabiensis is known to be facultative in its host selection in general. A study in Konso in southern Ethiopia showed that human-baited traps produced five times as many mosquitoes as animal-baited traps, suggesting an inherent anthropophilic tendency of An. arabiensis population in the area. Furthermore, it was shown that 46% of mosquitoes resting outdoors fed on humans despite the high number of cattle present in the area (Tirados et al., 2006).

Vector resistance to insecticides: According to WHO (2012), resistance is the term used to describe the situation in which the vectors are no longer killed by the standard dose of insecticide or manage to avoid coming into contact with an insecticide treated surface (WHO, 2012). Resistance has been observed in more than 500 insect species worldwide including Anopheles mosquitoes responsible for the transmission of malaria. Insecticide resistance in malaria vectors has been reported from 64 countries including Ethiopia. The operational criteria of resistance has usually been taken as the survival of 20% or more individuals tested at the known diagnostic concentrations of commonly available pesticides using World Health Organization (WHO) test kits in the field.

In Ethiopia, there is widespread resistance to DDT and pyrethroids in the major vector, An. arabiensis. The country has already abandoned the use of these insecticides for IRS until such time evidence based on susceptibility tests suggests otherwise. The presence of very high resistant populations of An. arabiensis in the country is not surprising because of the long history of using DDT for IRS and the widespread use of pyrethroids (deltamethrin, permethrin, alphacypermethrin) for LLINs and IRS in recent years, leading to increased selection pressure. The next action has to be implementing the national insecticide resistance management strategy and routinely monitor the status of insecticide susceptibility/resistance of malaria vectors and the pattern of frequency using standard protocols based on the WHO susceptibility test and the CDC bottle bioassay (WHO 2016).

3. Larval Source Management

Larval source management is an additional strategy for malaria control in Africa. Unlike LLINs and IRS, which target the adult mosquito vector, LSM targets the immature, aquatic stages of the mosquito (larvae and pupae), thereby reducing the abundance of adult vectors. Water is essential for the breeding of malaria mosquitoes. To ensure the prevention and control of malaria, it is important that all temporary or permanent breeding sites with water are identified and eliminated through the active participation of communities. Malaria control strategy is effective only when mosquitoes are interrupted from breeding and/or their population is substantially decreased. This can be achieved in areas where only a limited number of fully identified breeding sites exist. These usually are in relatively drier areas, towns, or development areas. In humid regions, mosquito breeding sites are widely distributed and in abundance during the rainy season. Because it is virtually impossible to identify the exact number of breeding sites and apply control measures during the rainy season, planning environmental management for vector control is futile and would waste human resources, materials and funds. Although malaria mosquitoes mainly prefer collections of rainwater for breeding, mosquitoes can also breed in intermittent rivers and streams, around ponds, swampy and marshy areas, slow-running shallow irrigation waters, and around shallow dams. There are two types of LSM.

3.1 Environmental Management

Environmental management (habitat modification and manipulation) for vector control has been implemented in urban and semi-urban areas, refugee camps, development projects, water harvesting ponds, and irrigation scheme areas. In areas where breeding sites are few, accessible, and manageable, communities are encouraged to participate in environmental management activities under the direction of HEWs, assisted by volunteer community health workers. In addition to efforts through the HEP, community-level social and traditional structures, such as women's associations, youth associations, cooperatives, health committees, schools, idir and religious gatherings, will play a major role in social mobilization, as well as empowerment of the community to implement community-based activities.

Communities can participate in and support malaria prevention and control activities in many ways. Community-level social and traditional structures can mobilize the public and implement environmental management, such as draining or filling of communal mosquito breeding sites and irrigation canal water management in development areas as well as traditionally irrigated agricultural areas.

Habitat Modification

Habitat modification is a permanent alteration to the environment, defined as 'a form of environmental management aimed at preventing, eliminating or reducing the habitats of vectors without causing unduly adverse effects on the quality of the human environment. The method is applied in urban and pre-urban areas, development projects, irrigation systems, etc. where the intervention permanently avoids the breeding sites. Abandoned ditches, ponds and borrow pits can be permanently removed through filling with soil, rubble, stones, ash or rubbish.

Activities to be taken under the habitat modification are:

- Landscaping, surface water drainage, filling and land reclamation.
- Breeding sites in swampy and marshy areas can be dried up by constructing drainage ditches and planting trees that consume large amounts of ground water (e.g. eucalyptus);
- In dry seasons, intermittent rivers and streams that form streambeds, pools and side water pockets can be filled, drained or connected to the main course of water.

Habitat Manipulation

Habitat manipulation is a form of environmental management aimed at producing temporary conditions that are unfavourable breeding to vectors. Unlike habitat modification, habitat manipulation must be repeated to remain efficacious. The methods of habitat manipulation are controlling water levels (including intermittent irrigation), stream flushing, shading, clearing of aquatic vegetation, straightening and steepening of shorelines. These would be applied where applicable by the responsible institutions and communities.

Priority actions that help in the implementation of environmental management vector control:

A. Identifying the number and distribution of mosquito breeding sites;
B. Determining the amount of manpower needed;
C. Identifying working tools by type and number, e.g. spade, pick-axe, sickle, cutting knife, sack and wheelbarrow;
D. Determining the time required to complete the implementation of the environmental vector control measures;
E. Determining the type of vector control activities, e.g. leveling and filling; drainage; cleaning and clearing ditches; and clearing grass or weeds in irrigation ditches;
F. Coordinating and managing the environmental control program on the scheduled day and place; and
G. Keeping a record of the tasks accomplished.

3.2 Larviciding

Larvicides can be used to address collected water that cannot be managed through environmental control measures. Larviciding includes the use of chemicals or biological agents to kill larvae and pupae. Larvicides are used in areas where the breeding sites are few, fixed (water body relatively long-standing duration that persists during or beyond the rainy season) and findable.

Currently, there are five main groups of larvicides including oils and surface agents; synthetic organic chemicals; bacterial larvicides; spinosyns; and insect growth regulators. Of these, synthetic organic chemicals (Temephos/Abate®) and bacterial larvicides will be applied for LSM in Ethiopia.

The application of Temephos must be carried on larvae-positive sites through the guidance of HEWs in areas where breeding sites are easily identifiable. Larval control through use of these larvicidal chemicals is highly useful in areas of development activities such as water harvesting ponds, dams, irrigation canals, road construction and other land development activities. Temephos is safe for humans when used in the recommended dosage and, therefore, can be applied to drinking water. However, considering its high cost, and the need for repeated applications, spray equipment and human resources, Temephos should be applied only for small breeding sites, and only if other control measures are inapplicable (e.g. in towns, lowlands and agriculture-development areas with irrigation systems). It is not advisable to spray Temephos during the rainy season or other rainy periods, because the chemical will be washed away. Preparation for spraying Temephos:

A. Identify in square meters the size of the breeding sites positive for anopheline larvae;
B. Prepare one cc of Temephos in one liter of water for use in 40 square meters area;
C. Prepare the solution in the spray pump;
D. Pump by hand 60 times to produce the necessary level of air pressure in the sprayer;
E. Use experienced spray men; and
F. Keep record of the accomplished activities.

4. Indoor Residual Spraying

IRS is the application of long-lasting residual insecticides to potential malaria vector resting surfaces such as internal walls, eaves, and ceilings of all houses or structures (including domestic animal shelters) where such malaria vectors might come into contact with the insecticide.

IRS is one of the most common vector control interventions for reducing and interrupting malaria transmission, and one of the most effective methods for obtaining rapid large-scale impact on reduction of both vector populations and malaria morbidity/ mortality. The effectiveness of IRS as a malaria control intervention arises from the fact that many important malaria vectors are endophilic. That is, when searching for blood meals they enter human habitations or animal shelters where they rest on the walls, ceilings and other interior surfaces before and/ or after feeding on inhabitants. The objectives of IRS towards curtailing malaria transmission are:

A. Reducing the life span of vector mosquitoes to less than the time it takes for the malaria sporozoites to develop, so that they can no longer transmit malaria parasites from one person to another;
B. Reducing the density of vector mosquitoes by immediate killing; and
C. Reducing human-vector contact through repellent effect, thereby reducing the number of mosquitoes that enter sprayed rooms.

IRS can be effective in most epidemiologic settings:

- In areas with unstable malaria transmission, IRS will prevent seasonal increases in transmission, will prevent and control epidemics, and can eliminate local transmission of malaria; and
- In areas with stable endemic malaria with moderately intense but seasonal transmission, IRS will prevent seasonal increases in transmission and reduce malaria prevalence and seasonal increases in morbidity and mortality.

In areas with stable hyper-endemic malaria, where transmission is intensely seasonal or perennial and without much seasonal changes, IRS will reduce malaria prevalence, incidence, morbidity, and mortality when applied more frequently than in the above instances. Further, the importance of sufficient capacity to deliver the intervention effectively, prevent unauthorized and un-recommended use of public health pesticides, and manage insecticide resistance is unequivocally stressed.

4.1 Status of IRS in Ethiopia

In Ethiopia, IRS was first implemented in the mid-1960s during the era of the global malaria eradication program and it remains a key component of the national malaria prevention and control strategy until to date. The GoE exclusively funded the IRS operations after the eradication program ended. Failure to secure external financial support had affected the IRS operations and resulted in limited the coverage and the quality of spraying. At present due to financial support through the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM), and the U.S. President's Malaria Initiative (PMI), districts target for IRS conduct regular spraying annually with aim of preventing malaria epidemics and reducing transmission of the disease

With the exception of malathion (50% WP), which was used in highly DDT-resistant areas, DDT (75% WP) was in use until 2009, when widespread vector resistance to DDT was documented. DDT was replaced by the pyrethroids (i.e. deltamethrin) which was then discontinued due in 2012 because of resistance. The carbamate insecticides, propoxur and bendiocarb, have been found to be effective against populations of An. Arabiensis and are in use in majority areas of the country. Just recently, actellic (CS) is being used for IRS in some areas. In the future, IRS in Ethiopia will be conducted based on the recently approved national insecticide resistance management strategy, which focuses mainly on rotation of insecticides every two years.

4.2 Selection of areas for IRS

The selection of areas for IRS must take into account the relationship between the vector, humans and the environment, as well as the level of disease transmission in the area under consideration. Applying IRS in a targeted manner is critical, and programme managers will need to make strategic decisions about where IRS should be deployed in relation to transmission ecology, malaria endemicity, cost, and logistics. The possibility of combining the intervention with other vector control measures, especially LLINs, will also have to be considered. In high transmission areas, IRS can be used to rapidly bring down malaria transmission to a level that can subsequently be sustained through a high proportion of the population using LLINs. In low and moderate transmission areas especially areas found adjacent to high transmission areas, IRS has been implemented to reduce the seasonal annual peaks of malaria transmission, prevent epidemics and support malaria elimination endeavor. Strong surveillance, monitoring and stratifying of areas must exist to appropriately prepare and immediately deploy IRS in areas above 2,000 meters when the need arises.

The following determinants should be considered when selecting where to implement IRS:

Entomological determinants: The key entomological determinants are vector species, seasonal density and distribution of the vector(s), resting and feeding behaviour of the vector(s) and insecticide susceptibility status.

Epidemiological determinants: are identifying Parasite prevalence (PP) – gathered through cross-sectional population-based surveys and parasite incidence – through facility-based records and calculated monthly or annually. Traditionally this has been expressed as the annual parasite incidence (API), and calculated as the number of new parastiologically confirmed cases per thousand population per year.

Ecological environmental determinants: this includes topography, altitude, presence of permanent water bodies, temperature, humidity (wet, dry and winter seasons), and rainfall (duration and intensity) have an impact on vector bionomics and transmission dynamics.

Demographic and socio-economic determinants: When selecting which zones are to be sprayed, population number, density and ease of access need to be taken into account. Poor or non-existent roads, widely dispersed housing, or the presence of physical barriers, such as rivers and mountains can be major obstacles for spray teams trying to reach all settlements. In order for IRS programmes to be successful, target structures must have suitable surfaces for treatment and the correct insecticide formulations for those surfaces must be selected.

Health service determinants: assessing the status of the following elements: health policies to support vector control with IRS; health system organization at district, regional and national level to support an IRS programme; health financing for annual insecticides, equipment, transport and operational costs; human resources capacity in vector control and entomology for planning and managing an IRS programme.

In general, the following criteria should be used when selecting kebeles or localities for IRS:

A. Malaria caseload – the lowest available health facility (e.g. health post) malaria case data should be used for prioritizing areas for IRS. Based on kebele level stratification 100% of high-risk areas will be covered by IRS. Districts at boundary of high stratum will be considered from moderate stratum and some from low risk areas with malaria epidemic history and areas that are implementing malaria elimination;
B. Areas with natural or man-made emergencies, where malaria epidemics are feared/forecasted and/or when other vector control interventions are considered less feasible.

4.3 Structures to be sprayed

In IRS-targeted areas, structures to be sprayed should include all human habitations where vector-man contact is likely to occur. For example, in many rural areas people may spend long periods of time in "farm huts" within their fields and these maybe very important in maintaining transmission. They often consist of no more than a roof and one or two partial walls. Similarly, other structures, such as animal shelters, latrines, stores or outhouses, may be important resting places for exophilic blood-fed mosquitoes. Whatever the objective of malaria control (e.g. prevention of epidemics or control of transmission in endemic areas), IRS requires a high

degree of coverage of potential resting places, including all walls, ceilings and furniture. The spraying of window frames and both sides of doors is also necessary. IRS district coordinators should compile this information using the latest census data, local government records and health-sector data,

In order to plan an IRS campaign it is essential to know:

- The number of houses or structures;
- The average number of rooms per household (e.g. sitting room, bedroom, kitchen, dining
- Room, bathroom, toilet);
- The average size of one room (in square meters of sprayable surface area);
- The average number of persons per household;
- The type of materials used for construction of walls and ceilings (e.g. mud, thatch, brick, bamboo, corrugated iron).

Estimating sprayable surface area

Sprayable surface: is defined as the inside surfaces of all structures or houses that should be sprayed. This includes eaves not exposed to rain, ceilings, under-floor areas in raised housing, and the inside walls of latrines. Walls, doors and windows of houses constructed from metal should not be sprayed. Other structures in the village, outside the household compounds and where there are no sleeping areas, such as schools (except boarding school dormitories) and shops, should not be sprayed, as these will attract very few malaria vectors. The surface and type of all the structures (main houses, animal shelters and other buildings) should be measured (inside walls, ceiling, doors and windows – inside and outside).Based on this the average sprayable surface area of the target houses must be obtained before insecticide quantification, procurement, and distribution. This is usually accomplished using a representative sample of 5–10% of the total houses.

Most spray target areas contain two basic types of structures: traditional and modern (or formal). This classification is very useful in estimating the formulation of insecticide to be used in IRS operations and in determining the logistical requirements of the programme.

4.4 Insecticides for IRS use

Insecticide selection: Insecticide(s) for IRS operations must be selected based on evidence, i.e. that they will be effective in killing mosquitoes. Several insecticides have been recommended for use in IRS for malaria control by WHO (Table 2). The most important criterion to be considered is the active ingredient; it is essential to check if the compound meets WHO specifications and if the manufacturer has submitted the product for evaluation with the WHO Pesticide Evaluation Scheme (WHOPES). Different insecticides have Repellent, irritant and killing effects on the particular species of mosquito. In order to maximize the effect on vector survivorship and malaria transmission, insecticides with a high level of killing effect are preferred to those with a high level of repellent and irritant effect. A residual insecticide should be:

- Highly toxic to target insects: Insecticides may lose their effectiveness if the target insects develop resistance. From time to time, samples of the target insect should be collected and checked for the development of resistance. If resistance is observed, another insecticide to which mosquitoes do not have (cross) resistance should be used;
- Long-lasting on a given surface: The toxicity should remain high over a sufficiently long period to prevent the need for frequent reapplication, which is costly and time-consuming;
- Safe to humans and domestic animals: There should be no danger to spray workers, inhabitants or animals accidentally contaminated with the insecticide during or after spraying;
- Acceptable to house owners: Some insecticide formulations are less acceptable because of their smell (e.g. malathion) or because they leave unattractive deposits on walls (e.g. DDT);
- Stable during storage and transportation, mix well with water, harmless to spraying equipment;
- Cost-effective: Calculation of the cost should be based on how the insecticide is applied, at what dosage and how many times a year.

Table 2. WHO recommended insecticides for use in IRS operations for malaria control (2013)

Insecticide compounds and formulations[1]	Class group[2]	Dosage (g a.i./m^2)	Mode of action	Duration of effective action (months)
DDT WP	OC	1-2	Contact	>6
Malathion WP	OP	2	Contact	2-3
Fenitrothion WP	OP	2	Contact & airborne	3-6
Pirimiphos-methyl WP & EC	OP	1-2	Contact & airborne	2-3
Pirimiphos-methyl CS	OP	1	Contact & airborne	4-6
Bendiocarb WP	C	0.1–0.4	Contact & airborne	2–6
Propoxur WP	C	1-2	Contact & airborne	3-6
Alpha-cypermethrin WP & SC	PY	0.02–0.03	Contact	4-6
Bifenthrin WP	PY	0.025–0.05	Contact	3-6
Cyfluthrin WP	PY	0.02–0.05	Contact	3-6
Deltamethrin SC-PE	PY	0.02–0.025	Contact	6
Deltamethrin WP, WG	PY	0.02–0.025	Contact	3-6
Etofenprox WP	PY	0.1–0.3	Contact	3-6
Lambda-cyhalothrin WP, CS		0.02–0.03	Contact	3-6

[1] CS = capsule suspension; EC = emulsifiable concentrate; SC = suspension concentrate; SC-PE = polymer enhanced suspension concentrate; WG = water dispersible granule; WP = wettable powder.
[2]OC = organochlorines; OP = organophosphates; C = carbamates; PY = pyrethroids.

Note: WHO recommendations on the use of pesticides in public health are valid ONLY if linked to WHO specifications for their quality control. WHO specifications for public health pesticides are available on the WHO homepage on the Internet at http://www.who.int/whopes/quality/en/

4.5 Insecticide formulations

Insecticides are rarely applied in their pure form. They are available as special formulations adapted to the requirements of the various application methods. Residual insecticides for IRS operations are generally formulated as water-dispersible powders, emulsifiable concentrates, or suspension concentrates.

Water-dispersible powder: This is a dry powder of insecticide mixed with a surface-active agent that allows the insecticide to dissolve in water. The insecticide remains in suspension in the water with occasional stirring. The products are usually packaged as powders, containing 5–80% active ingredient. Thus, one kilogram of a 50% powder formulation would consist of 500 g of inert material and 500 g of pure insecticide. Such products are ready for mixing with water to form a spray suspension, normally containing 1–5% of active ingredient. For IRS purposes, the water-dispersible powder is the most effective formulation in most countries. This is because it is most suited for porous surfaces such as brick and mud walls. The insecticide particles are comparatively large and absorption is comparatively slight, allowing more active ingredient to remain available on walls to be picked-up by resting mosquitoes and crawling insects as well as creating a longer residual effect. Water-dispersible powders are also lighter and easier to transport than emulsifiable concentrates. They can be prepacked for use in the field and are less toxic to humans.

Emulsifiable concentrate: An emulsifiable concentrate consists of a solvent and an emulsifying agent in which the insecticide is dissolved. When mixed with water it forms a milky, white emulsion composed of finely suspended oil droplets. It remains in suspension with a minimum of agitation. The emulsifiable concentrate is more expensive and used for spraying impervious surfaces and walls with fine coverings, because it does not cause spots and stains. The residual effect of emulsifiable concentrates depends on the absorption capacity of the wall and on the physical properties of the insecticide. Usually, water-dispersible powders and suspension concentrates have a longer residual effect, except on non-absorbent surfaces, where the effectiveness and persistence of the three types of available formulations are equivalent.

Suspension (or flow-able) concentrate: A suspension concentrate consists of particles of the insecticide with a wetting agent and some water, which can be used to make a water-based suspension. A distinct advantage is that the ingredients are not flammable. The insecticide particles are larger and remain available on wall surfaces longer than those of emulsifiable concentrates remain. However, the particles are smaller than those of water dispersible powders and

they are therefore less effective on porous surfaces. The residues left on the wall are aesthetically more acceptable than those of water dispersible powders. The suspension concentrate is also suitable for rough surfaces, but special care is needed during the formulation process in order to avoid caking of solid materials at the bottoms of containers and, as it is a liquid, it requires relatively expensive containers and careful handling to avoid spillage.

Commonly used insecticides

Classification

Insecticides approved for indoor residual spraying fall into four major classes:

1. Organochlorines

DDT

- Commonly available formulations: 75% water-dispersible powder (the most commonly used) and 50% water-dispersible powder; 25% emulsion concentrate;
- Dosage: 1–2 g/m^2 depending on the surface (more on mud-bricks, less on timber) and the length of the transmission period (the higher dosage lasts longer);
- Storage: It is stable and can be stored in tropical countries without deterioration if heat, bright sunlight and high humidity are avoided;
- Residual efficacy: Six months or more.

2. Organophosphorus compounds

Malathion

- Commonly available formulations: 50% water-dispersible powder and 50% emulsifiable concentrate;
- Dosage: 1 or 2 g/m2;
- Residual efficacy: At the higher dose it may last up to six months on thatch or wood, but only 1–3 months on mud and plaster surfaces. Mud surfaces with high alkali content (minerals) tend to break down malathion more rapidly.

Fenitrothion

- Commonly available formulations: 40% and 50% water-dispersible powder; 5% emulsifiable concentrate;
- Dosage: 1 or 2 g/m2;
- Residual efficacy: On wood surfaces, 1 g/m2 may remain effective for up to 2.5 months; on mud surfaces it lasts 1–2 months.

Primiphos Methyl

- Commonly available formulations: 40% and 50% water-dispersible powder; 5% emulsifiable concentrate;
- Dosage: 1 or 2 g/m2;
- Residual efficacy: At the higher dose it may last up to six months on thatch or wood, but only 1–3 months on mud and plaster surfaces.

3. Carbamates

Propoxur

- Commonly available formulations: 50% water-dispersible powder and 20% emulsifiable concentrate;
- Dosage: 1 or 2 g/m2;
- Residual efficacy: At 2 g/m2 it may last 3–6 months.

Bendiocarb

- Commonly available formulation: 80% water-dispersible powder in pre-weighed sachets, one sachet to be used per spray charge;
- Dosage: 0.2–0.4 g/m2;
- Residual efficacy: Remains effective for 2–6 months.

4. Synthetic pyrethroids

Deltamethrin

- Commonly available formulations: 2.5% and 5.0% water-dispersible powder. 2.5% and 5.0% emulsifiable concentrate, and 25% water dispersible granules;
- Dosage:0.05 g/m2;
- Residual efficacy: Remains effective for 2-3 months on mud and thatch surfaces, but 9 months has been reported for other surfaces

Permethrin

- Commonly available formulations: 25% water-dispersible powder;
- Dosage: 0.5 g/m2;
- Residual efficacy: Remains effective for 2–3 months.

Lambdacyhalothrin

- Commonly available formulations: 2.5% emulsifiable concentrate and as 10% wettable powder in preweighed sachets.
- Dosage: 0.025–0.05 g/m2;
- Residual efficacy: Remains effective for 2-3 months.

Alphacypermethrin

- Commonly available formulations: 5% and 25% emulsifiable concentrate;
- Dosage: 0.5 g/m2;
- Residual efficacy: Remains effective for four months or longer.

Application Rates

The application rate is the amount of a.i., expressed in grams, per square meter (g/m2) of the insecticide applied to a unit of surface area. The correct application is one of the most important issues in IRS programmes. Monitoring systems must be established to ensure that the correct application rates are adhered to at all times. Training programmes for spray operators should always focus on proper application techniques.

Number of Spray Rounds

The implementation of spray operations of all sprayable houses in an area over a period of time is called a 'spray round'. The spraying round will depend on the malaria transmission patterns of the area and the residual effect of the insecticide formulation chosen. If the transmission pattern exhibits bimodal peaks, spraying rounds should target the peaks. In areas with one seasonal transmission that lasts for three and more months, one spray round, in yearly cycles before the period of transmission, should be enough to have an impact on malaria transmission. Spray rounds should ideally be completed in less than two months and just before the transmission season.

4.6 Estimating insecticide requirement

To estimate the amount of insecticide required (water dispersible powder and emulsifiable concentrates) for an IRS operations round the following information is needed:
U: the number of houses or structures to be sprayed (expressed as the percentage of modern and traditional structures);
S: the average sprayable surface per house in m2 (modern and traditional structures);
C: the concentration of the active ingredient in the formulation (% a.i.);
D: the target dosage expressed in g/m2 (application rate) of insecticide to be used on each type of structure according to who recommendation (table 2).
Once this information is gathered, **A,** the total quantity of insecticide needed (kg) is calculated as shown below:

Amount of insecticide required in kg (A) = $\frac{u * s * d * 100}{1000 * c}$ (Without safety margin)
u = total number of unit structures,
s = average sprayable surface area in m^2 per unit structure
d = dosage of insecticide's active ingredient in gm/m^2
c = insecticide concentration in percentage
Amount of insecticide required (with safety margin of 10%) = A + 0.1A

If a lesser amount of suspension is required, the amount of insecticide for the required volume of suspension could be calculated for both water dispersible and emulsifiable concentrate formulations as follows:

Amount of insecticide required for 1 liter suspension = $\frac{25a * d * 100}{c}$
a = 25 is the area (m^2) covered by 1 liter suspension; d = recommended application rate (g/m^2)
c = concentration of active ingredient in formulation

4.7 Organization of IRS operations

Districts are primarily responsible for organizing IRS operations in their respective areas, and should be coordinated between and closely supervised by the district health office and the district's primary health care unit (i.e. health centers with satellite health posts). This approach will ensure specific targeting and shorter duration of operations. If decentralized, HEWs should lead IRS operations as squad leaders, using four to five kebele-level spray operators. In an average-sized kebele of 5,000 people, there are around 1,000 households and an estimated 1,500 sprayable structures. These could be sprayed within 20-25 actual spray-days, taking an average of 13-15 structures per spray operator per day, assuming five spray operators per health post are used. This time could be shortened by either increasing the number of spray operators or increasing daily output. The number of spraying team per district depends on the number on structures to be sprayed.

The classic spray team is comprised of a district health head/vice head or malaria focal person, who leads one or more spray teams. A team consists of 4-5 squads, with each squad consisting of 4-5 spray operators (Figure 3). Each squad would have one assistant operator/porter. In this scenario, a team could consist, at a maximum, of 38 people who would be directly involved in spraying. Furthermore, the spray team should wear clean protective equipment throughout the campaign and washers should be assigned (the number depends on the size of the spray team). Supervisor(s), who have the necessary technical and managerial competencies, should be assigned from the spray team. Supervisors should have adequate knowledge and capacity to oversee and support the spray technique, environmental compliance, data collection and reporting and overall management. Supervisors should use an IRS checklist whenever they are at the spray sites.

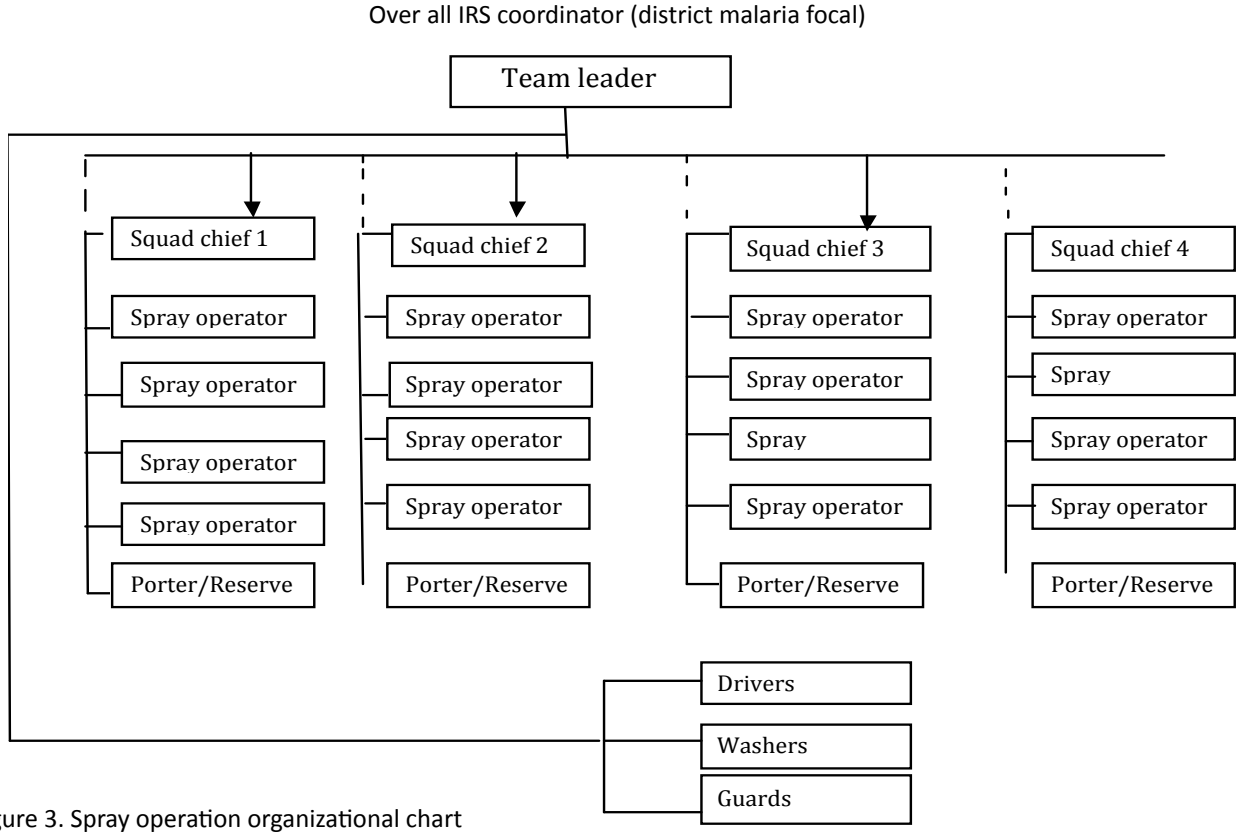


Figure 3. Spray operation organizational chart

4.7.1 Timing of IRS operations

In areas where malaria transmission is seasonal, IRS should be applied just prior to the onset of transmission. This is particularly important when the insecticides used give protection for only a few months.

[**Note:** If the residual effect of the insecticide is insufficient to cover the entire transmission period, the area should potentially receive a second round of IRS. This requirement has operational and financial implications that must be taken into account from the onset in order to ensure the timely arrival of supplies and the training or retraining of spray operators.]

When IRS operations are large enough to pose difficulty in timing, priority should be given to localities known to have the highest cases of malaria. Generally, if only one round of IRS is adopted for the year (e.g. most of Ethiopia, where the main transmission season is from September to late November), IRS should be completed by late August/ early September. For areas having different malaria transmission patterns, the timing of spraying should be adjusted accordingly. It should be noted that all household sprayable surfaces must be covered by an effective dose of insecticide during the entire period when transmission needs to be controlled.

Conducting a house spray

Once the necessary planning and training has been completed in preparation for IRS, actual house spraying can begin. This phase of the IRS operations involves: informing the Community so that they may be ready for the spray teams when they arrive (moving household items, making water for mixing available); preparing insecticides; spraying target

structures; and recording which structures are sprayed and which are not. Adequate supervision is important to ensure each step is preformed efficiently.

Communicating with the villages and households

Prior to spraying, team leaders must contact community leaders to inform them of the planned spray operations and of the fact that IRS team members will be visiting the villages to provide more detailed information and to conduct the spray. The day before the actual spraying (or as near to the planned spraying date as possible), a member of the IRS team known as the 'warner' or 'sensitizer', travels to the target location and informs community leaders and householders of the purpose of spraying, the details of the spraying schedule, and what residents are expected to do in preparation. Spray operators should always maintain a positive approach when communicating with village leaders and householders.

Specifically, spray operators should ensure that householders willingly agree to:

- Allow spray teams to enter their households;
- Collect and make available at least 8-10 liters of clean water for mixing of insecticides in the sprayer and for any other use;
- Notify the spray team if there are sick residents, newborn infants, or any cultural issues that would prevent a room or house from being sprayed;
- Prepare houses for spraying by covering or moving portable items (foodstuffs and other consumables, cooking utensils, light furniture, bedding and clothing) outside;
- Move those items that cannot be taken out of the dwelling to the centre of the room and cover them with a plastic sheet;
- Move themselves and their families outside and remain outside for one hour or more while the insecticide dries;
- Sweep out any household pests (cockroaches, beetles, etc.) That are killed in the house by the spraying and bury, burn, or dispose of these in a pit latrine;
- Prevent chickens and other domestic fowls from eating the dead insects;
- Refrain from re-plastering, re-painting or washing the sprayed surfaces for at least six months.

Preparation of houses before spraying

To prepare houses for spraying, householders must remove as many of their household contents as possible, especially water containers, food, cooking utensils and toys. All pictures, wall hangings, and posters should be removed. Items that cannot be removed should be completely covered with plastic sheeting and placed in the centre of the room to allow easy access to the walls. Caged or leashed pets and domestic animals should be relocated away from the house until sprayed surfaces have dried and dead insects have been swept up and removed from the floor

4.7.2 Training of spray personnel

The outcome of IRS operations is highly dependent on the quality of training given to spray operators. Spray operator training should take place at the district/cluster level. Adequate training of spray operators contributes significantly to the success of IRS operations and the expected impact of IRS on disease transmission. It is vital that all squad chiefs (e.g. HEWs), technicians and other supervisory personnel follow standard guidelines in training spray operators so that the work is carried out in an orderly and well-organized fashion. The duration of the curriculum should be in line with the contents of the training manual. The curriculum should also adequately address environmental and human safety issues as well as communication skills and key IRS messages. Please refer to the IRS training curriculum for detailed information on the contents, methods of IRS training and spray techniques and procedures **(Annex A1)**.

Supplies and equipment: The following is a list of supplies and equipment used for IRS.

- Personal protective equipment (PPE) (Figure 4):
  - coveralls
  - waterproof hats or helmets
  - face shields or goggles
  - respiratory mask
  - gloves
- Rubber boots
- Spray pumps (Figure 5)
- Insecticide(s)
- Spare part kits
- Tool kit
- Camping materials:

- tents
- camp coats or folding mattress
- canvas chair
- kerosene lamps

• Transportation (as required):
- vehicles

Preparing the spray charge

Just as there are a series of steps for the householder to prepare the structures for spraying, there is a standard series of procedures for the spray operator to prepare the insecticide mixture (the "charge") to spray. The following nine steps should be followed to ensure safe and proper application.

Step 1: proper Wearing of protective clothing and gear

Spray operators must be aware that they are at occupational risk when using insecticides.
It is their responsibility to ensure they use the following protective clothing:

1. Broad rim hat or plastic helmet (to protect head, face and neck from spray droplets);
2. Full face shield or goggles (to protect eyes against spray fall-out and splashes);
3. face mask/respirator (to protect nose and mouth from airborne particles of the spray fall-out and to avoid inhalation);
4. Long sleeved overalls; and mutton cloth or light cloaks (to protect the neck)
5. Rubber gloves (to protect the hands);
6. Boots (to protect the feet);

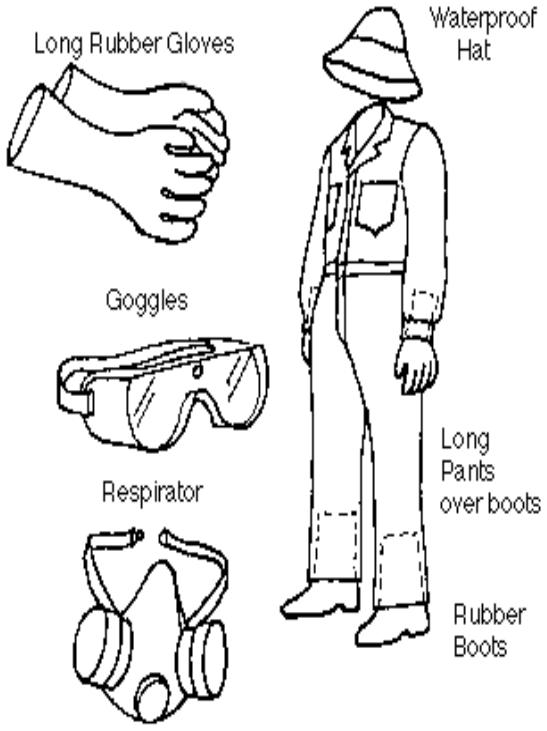


Figure 4 Personal protective equipment

Step 2: Checking the sprayer

Before starting a spray operation, the equipment must be checked. Faulty sprayers may result in poor application, over or under-application, and personal or environmental contamination. Examine the sprayer to ensure that all component parts are present, assembled correctly and are in good condition.

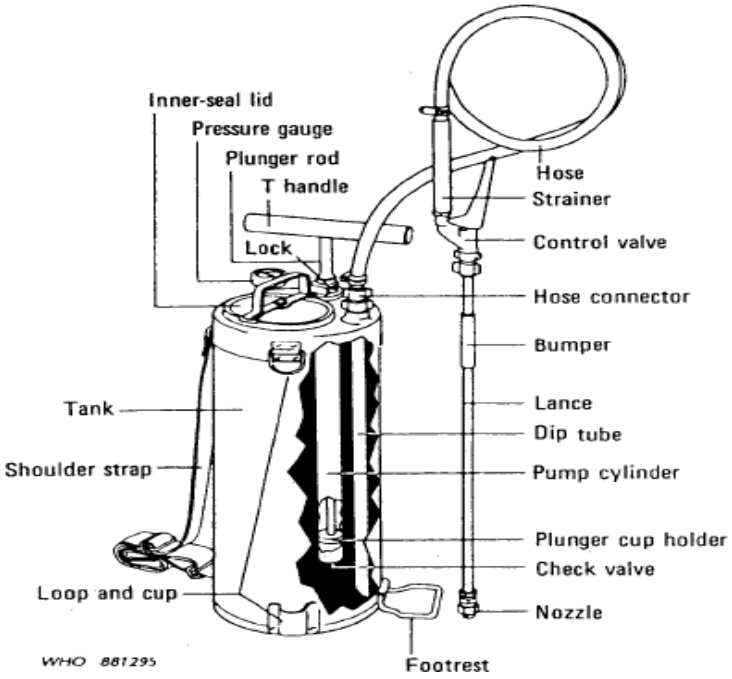
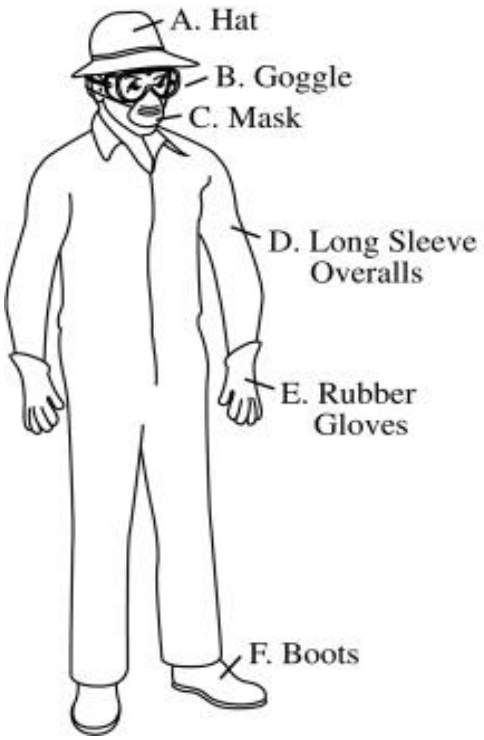


Figure 5 Cutaway diagram of a hand-compression sprayer



4.7.3 Duration of working day and safety

The duration of the working day should ensure that the exposure of spray operators to the insecticide remains within the limits allowed by safety requirements. Whenever more toxic insecticides, such as fenitrothion, are used, it is necessary to monitor worker exposure and contamination. Spray operators cannot avoid a certain degree of contamination when spraying, but it is imperative to monitor their exposure carefully. In addition, with most organophosphate insecticides, blood samples for the determination of cholinesterase activity should be taken at least every week and whenever there has been any accidental exposure.

Because all insecticides are poisonous, care must be taken when they are handled. The following precautions are recommended and should always be practiced: All persons handling insecticides should be informed of the risks involved in their use and should receive instructions for handling them safely. There should be adequate technical supervision of spray operators. All spray operators should wear a hat to prevent the accumulation of insecticide on their heads and use a clean cloth to cover their mouth and nose while spraying. Workers should not smoke or eat without first thoroughly washing their hands with soap and water. Water dispersible powder should be mixed with a paddle or stick, never with bare hands. Spray pumps should be filled carefully using a funnel. Do not let the liquid suspension or solution splash onto arms, legs or other parts of the body. Repair leaky spray equipment; do not allow the insecticide to fall onto the spray operator.

4.8 Standard spray application

The insecticide suspension must be sprayed evenly at the recommended dosage over all sprayable surfaces. The amount of insecticide that is sprayed on a surface is determined by a number of different factors. The following factors determine the amount of insecticide to be sprayed on a surface:

- The concentration of insecticide in the suspension;
- The air pressure in the spray pump; (should be maintained at 245–380kPa (35–55psi) or (2.5–3.8bar).
- The nozzle tip aperture size;
- The distance from the nozzle tip to the surface being sprayed should be kept at 45cm
- The speed of movement of the nozzle over the surface.

In Ethiopia eight-liter working capacity spay pumps have been in use for more than four decades, and standard procedures were designed accordingly. The air pressure in the spray pump should be kept between 25 and 55 psi (an average of 40 psi) within which the fan tip nozzle discharges 760 ml per minute. The spray operator should be trained to cover 19 m^2 at a constant rate within a minute. This will allow applying 40 ml of suspension on one m^2 of sprayable surface (or one liter of suspension covers 25 m^2) when the nozzle tip is effectively kept at a 45 cm distance from the spray surface.

Spray data recording and reporting

The spray operator should ensure that household information is filled in accurately before leaving the site. This information must be presented to the team leader at the end of each working day using the daily reporting form. It is the responsibility of the team leader to summarize this information at the end of each working day. The information is necessary for programme management and supervision and it will be crosschecked with the information provided by district supervisors.

Malaria house spray cards

An IRS household record card is kept accessible in each household. The house spray card acts as a census record of the number of people and rooms or structures per household or dwelling and provides a record of insecticide spraying for each numbered house. Annex B.1 shows an example of the card.

Routine reporting forms

Spray operators, spray team leaders and IRS district coordinators should use standard reporting forms to report, supervise and monitor IRS implementation. A daily reporting form (see Annex B 2) is completed by the spray operator for each house and submitted at the end of the day to the spray team leader who records and checks the performance of the individual spray operators. Districts IRS supervisors and districts IRS coordinators (see Annex B.3) should maintain a weekly reporting form. Each coordinator tracks around four to ten spray teams and measures the weekly progress in relation to the total planned target for the spray round. A monthly reporting form (see Annex B.4) is used by IRS district coordinators to monitor progress on IRS spraying coverage for the spray round in the district in relation to the total planned target.

Post-Spraying Procedures

When spraying has finished for the day, and before removing any protective clothing, the following procedures should be followed:

- All the empty chemical containers/sachets should be returned and counted
- unused chemicals should be returned to the camp guard/supervisor.
- The day's spray report should be submitted to the supervisor.
- Any final surplus spray solution from the final cleaning through the progressive rinse method should not be thrown away but should be kept and re-used the next day.
- Sprayers must be cleaned daily inside and out using the progressive rinse method of saving and recycling water used for cleaning the sprayers and re-using it the next day.
- The spray mixture should not be left in sprayer overnight as suspension will start caking and block the filters and hose.
- The chemicals may also damage the components of the sprayer and reduce their life span (e.g. Seals or valves will stick and disintegrate);
- Sprayers should be checked for any faults that may have developed and these should be reported to the team leader;
- All cleaning and washing of the sprayer should be done away from water sources; cleaned sprayers should be put in an inverted position to drain off any water; sprayers are returned to storage making sure they are kept dry. If possible, they are stored in an inverted position with the cover assembly loose.

After doing all the above, spray operators should:

- Remove protective clothing and gear and wash their whole body thoroughly using soap, and paying particular attention to exposed areas such as hands and face;
- Wash used protective clothing in detergent (separately from household washing);
- Dispose of washing water and rinse water safely, using a toilet or bathroom with a soak-pit or soak-way.

Human safety and environmental protection

Occupational safety; Spray operators must always be provided with personal protection devices and clothing including: gloves; hats; goggles or clear plastic visors to protect their faces and eyes when spraying overhead; washable cotton overalls; and field boots.

Insecticide poisoning and first aid measures

Failing to follow correct procedures during spraying operations can result in undesired exposure to insecticides or accidental insecticide poisoning. Below are some of the signs and symptoms of insecticide poisoning:

- ✓ General – extreme weakness and fatigue;
- ✓ Skin – irritation, burning, excessive sweating, obvious staining
- ✓ Eyes – irritation, burning, excessive running, blurred vision, narrowing or widened pupils;
- ✓ Digestive system – burning in mouth and throat, excessive salivation, nausea, vomiting, stomach cramps or pains, diarrhoea;
- ✓ Nervous system – dizziness, confusion, restlessness, headaches, muscle twitching, staggering, slurred speech, fits or convulsions, unconsciousness;
- ✓ Respiratory system – breathing with difficulty, wheezing, coughing.

The routes of entry, possible prevention and general first aid measures are tabulated below

Table 3. Route of entry and first aid measures for insecticide poisoning

ROUTE OF ENTRY	PREVENTION/PROTECTION	FIRST AID MEASURES
Skin	Proper application techniques; Proper skin protection including use of gloves and protective clothing; Clean protective equipment before re-use.	Remove contaminated clothing and wash skin with soap and water
Eye	Use of eye protection (face shield or goggles) Flush eyes with clean water for at least	15 minutes
Respiratory system	Avoid inhalation of fine dust and mist by using face masks Move to fresh air	Avoid inhalation of fine dust and mist by using face masks Move to fresh air

Waste management: Insecticides can be hazardous to people and to the environment if they are not properly managed. Insecticide management should always include minimizing waste by recycling and disposing of empty sachets or containers through special incineration. This should be done at appropriate facilities designed for this specific purpose.

IRS supervisors and team leaders are responsible for: ensuring that their teams follow the progressive rinse method or that they recycle water used for washing sprayers; ensuring that insecticide spillages are cleaned and; ensuring that contaminated materials are disposed of through incineration. Special attention should be given to preventing contamination of food and of the floor areas of houses where children and animals would be especially exposed.

Table 4. Waste minimization management guide

WAYS IN WHICH INSECTICIDE WASTE CAN BE GENERATED	WAYS TO MINIMIZE WASTE GENERATION OR DISPOSAL
Surplus spray solution	Proper planning of needs; Prepare only enough insecticide to spray the area to be covered; Do not leave spray mixture in sprayer overnight
Empty chemical containers e.g. sachets, bottles, drums	Collect and return empty containers to a central location for safe storage, destruction, incineration or burial
Sprayer leakages contaminating absorbent material	Mend leakages in sprayer to avoid spillages
Little or no agitation (especially with propoxur) resulting in sediment in pump that requires disposal; Sprayer washing and rinsing.	Constant agitation during spraying to avoid sedimentation; Implement progressive rinse method using appropriate containers and recycle rinsing water for next day's use
Chemical fall/bounce back out during spraying	Correct spray technique

Programme Organization and Responsibility

Responsibility at national level: The national malaria control programme the overall programme implementation with responsibilities delegated to a national vector control or IRS coordinator working with the national entomologist. As outlined above, the national program is usually supported by a national vector control or advisory committee, and by a national research institution with a central entomology laboratory. Duties at national level include:

- Preparing national IRS proposals, planning, coordination, formulation of policy;
- Setting standards and preparation of operational guidelines;
- Providing IRS technical advisory services and providing feedback for remedial action where appropriate;
- Maintaining a database on epidemiological, entomological, demographic and operational information with integrated GIS;
- Managing of resources for IRS by defining specifications and procuring insecticides, sprayers, transport;
- Securing staffing and financing;
- Managing the finance and accounting systems for operational field costs (note in some countries this is managed at the local government level);
- Organizing distribution of supplies, including insecticides; monitoring and coordinating all IRS activities carried out by the provinces/states and related agencies and providing feedback for remedial action;

Responsibility of regions/zones: The regional /zonal malaria control officer and an IRS officer coordinate the implementation of the IRS programme in all the districts and help to put policies and guidelines from the national level into practice. Duties at regions and zones include:

- planning and management of IRS operations in target districts;
- Providing estimates for operational requirements of insecticides, equipment, human resources
- And finance;
- Providing support and training to district coordinators;
- Providing scheduled supervision of IRS district coordinators;
- Taking responsibility for tracking implementation in each of the districts;
- reporting on coverage and quality of IRS in districts;
- supporting district entomological monitoring

Responsibility at district level: The district health officer, district malaria coordinator or district IRS coordinator is in charge of the implementation of all IRS operations and activities within the district. At operational level, IRS activities are managed through the sub-district field coordinators and malaria spray team group leaders. Duties at district level include:

- Implementing day-to-day running of IRS operations;
- Recruiting and managing IRS control personnel;
- Coordinating and/or conducting annual training;
- Costing, budgeting and financial reporting;
- Managing payroll, local rentals and other operational costs;
- Estimating overall operational requirements of IRS in the district;
- Monitoring and evaluation of the quality of interventions;
- Updating geographical reconnaissance information;
- Ensuring security and safe use of insecticides, equipment and transport;
- Implementing information, education and communication activities.

Roles of health centers and HEWs in IRS operations: As IRS is now decentralized to the kebele level, the responsibility for planning, and organizing a spray operation is shared between the district health offices, the health center and the health post. Therefore:

- The district will send enough insecticides to spray the village to the health post.
- Spray pumps will be made available at the health post;
- The district will have a store to keep the spray pumps and insecticides separate from other items;
- HEWs will supervise IRS operations at kebele level with assistance from health center personnel.

Decentralization of IRS operations will have several

advantages compared to the previous method of planning and undertaking it from the district. For example:

- The operation could be more quickly organized at the community level and implemented to control epidemics;
- The spray is undertaken by HEWs acting as squad chiefs. The acceptability of the operation should be improved since HEWs are a familiar person in the community and local spray operators would be involved in the IRS operations;
- Pumps will now be readily available at the district level and can be used for other malaria control purposes such as larviciding whenever necessary.

The responsibility of HEWs in IRS operations will be to:

- Select capable spray operators from the community;
- In collaboration with the district health office and health center, train spray operators for six days (e.g. in spray techniques, communication, safe handling of chemicals);
- In consultation with kebele leaders, plan when to start and finish the IRS operations in their kebeles;
- Undertake the IRS operations as a leading person guiding and supervising the spray operators;
- Mobilize the community to cooperate and participate in IRS operations;
- Educate communities about the benefits of IRS and what to do after their houses have been sprayed;
- Keep records of daily output of IRS operations and consumption of insecticides.

Although HEWs are squad chiefs, operations undertaken in each sprayed kebele will be supervised by the health center and experts from the district health office. This will ensure that HEWs have the technical support they may require to carry out successful IRS operations.

Spray application supervision

IRS spray application requires close supervision from team leaders, IRS supervisors and IRS coordinators in order to be successful. This should be provided daily by the team leader, weekly by the IRS supervisors, and monthly by the IRS district coordinators throughout the period of the spray operations. It may be important that communities are informed of proper mixing volumes so that when spray operators are mixing insecticides and sprayer charges, villagers can be assured that spray is not being incorrectly diluted. Inspections should be based on the approved forms and checklists to ensure uniformity, accuracy, and completeness

The main purpose of supervision is:

- To ensure that the spray team movement schedule is strictly adhered to and the agreed target numbers of houses to be sprayed per day are being maintained;
- To take immediate corrective measures on spray application techniques and take note of any equipment deficiencies for remedial action;
- To motivate, stimulate, encourage and advise on good communication with householders and village or community leaders;
- To ensure good team work for total and complete coverage of areas to be sprayed;
- To ensure that strict discipline and standard operating procedures are maintained;
- To assess, evaluate and encourage the work output of the teams;
- To make constructive and feasible recommendations to improve quality, coverage and timely implementation of operations.

5. Long Lasting Insecticide Treated Nets

LLINs are effective tools to significantly reduce morbidity and mortality due to malaria. Additionally, when coverage rates are high and if a large proportion of human biting by local vectors takes place after people have gone to sleep, LLINs also can have an impact on vector populations. LLINs have three main functions: i) When mosquitoes are in contact with the net, it has a knock-down effect, temporarily incapacitating or even killing mosquitoes; ii) It has a repellent effect; and, iii) It reduces contact between the person sleeping under the net and mosquitoes by acting as a physical barrier.

The National Strategic Plan for Malaria Control and Prevention in Ethiopia (NSP) 2017-2020 aims to consolidate the achievements made to date and sustain their impacts. The status of coverage of the major interventions was measured in the Malaria Indicator Survey (MIS) 2007, 2011 and 2015. The MIS 2015 results show tremendous achievements by Ethiopia's malaria control program. Thus, between 2011 and 2015, insecticide-treated net (ITN) coverage increased from 55.2% to 64%, with ITN use by children under five years of age and pregnant women increasing to nearly 45% in malaria-endemic areas and to over 70% in households that owned at least one ITN. Overall, 71.7% of households in malaria-endemic areas were protected by ITN and/or indoor residual spraying (IRS) of households with insecticide. It is believed that the vector control interventions have contributed greatly to a reduction in the burden of the disease. In general, more than 89 million LLINs have been distributed to households since 2005/6.

5.1 LLIN target areas

LLINs should be provided to households in malaria-endemic areas, i.e. areas that are stratified as low, moderate and high malaria transmission will be targeted for universal (100%) LLIN coverage with one LLIN per sleeping space on average. Woreda health staff, together with personnel from health centers and health posts, should compile lists of kebeles in malaria-endemic areas.

Note: urban areas, as long as they are considered malaria-endemic, will also be targeted for LLIN distribution.

The strategy since 2005 has been to provide, on average, one LLINs per 2 persons in malaria-endemic areas. The majority of LLINs have been distributed on a kebele-by-kebele basis, where selected kebeles are provided with enough LLINs for full coverage of at risk population. Thus, each kebele receives enough LLINs to protect all families in their respective jurisdictions. In this way, mass LLIN coverage is achieved within a short time.

5.2 LLIN procurement

All LLINs must meet minimum standards as determined by WHO (see Annex C), i.e. should have WHO approval. In addition, all insecticides for net treatment must be approved and registered by the relevant Ethiopian authorities. Non-LLINs (e.g. untreated nets or nets that require annual re-impregnation with insecticide) will not be distributed in Ethiopia.

In terms of off-shore procurement of LLINs, arrangements for the procurement and shipping of LLINs for public sector distribution will be made with recognized manufacturers, suppliers and distributors. This can be implemented in consultation with FMOH, RHBs and other partners supporting the FMOH in procuring nets. Local manufacturing of LLINs should be encouraged in the long-term, provided that minimum requirements/specifications are met.

5.3 LLIN distribution

Distribution mechanisms

This strategy describes distribution mechanisms needed to replace nets due to different reasons; worn-out, lost during the previous three years and new establishments. In addition, distribution of LLINs may occur through the commercial sector particularly in urban areas.

The LLIN replacement scheme through campaign is the most significant component of the National Strategy for Malaria Prevention and Control implemented through the HEP to ensure that all households have access to LLINs and those households without LLINs are identified and encouraged to own and sleep under LLINs. The main advantages of distributing LLINs through the HEP are:

- LLIN distribution will be integrated through existing health systems;
- LLINs will be available through an estimated 10,000 health posts in nearly all malaria-endemic kebeles in Ethiopia.

Once established, the replacement scheme will be maintained every three years to ensure protection of families at risk of malaria

For the overall management of the LLIN replacement scheme, HEWs will consolidate their kebeles' LLIN registers. Many HEWs already have LLIN registers, which they use to assist with identifying families needing new LLINs. These records will be used for monitoring as well as management of the scheme. The records also feed into LLIN databases at woreda and regional levels and eventually in the national HEP database. LLINs can be distributed through more than one method, tailored to the situation in each kebele. Two methods are outlined below:

Mass distributions through campaigns (catch-up strategy)

The catch up strategy is the main distribution strategy conducted through the standalone campaigns. In this scheme, LLINs are distributed in a short period of time to all households in identified malaria risk kebeles. Social mobilization is conducted to invite people to distribution points and these could be usually at health posts, or other routinely used central points where families are given LLINs based on the family size.

Routine LLIN distribution (keep-up strategy)

This method of LLIN distribution ensures a continuous supply of LLINs at the kebele level. The result will be that systems are developed, primarily through the HEP, to ensure that all households have access to LLINs at all times and that those households needing LLINs are identified and encouraged to own and sleep under LLINs. The main advantages of distributing LLINs through the HEP are:

LLIN distributions will be integrated through existing health systems;

LLINs will be available through an estimated 10,000 health posts in nearly all malaria-endemic kebeles in Ethiopia;

Once established, the replacement scheme will provide a consistent supply of LLINs, ensuring all families at risk of malaria with continuous access to LLINs and will reduce the proportion of people who have damaged or lost nets;

Continuous and predictable demand for LLINs at the kebele level is the basis for micro planning and provide better market conditions for local LLIN manufacturers to provide the correct quantities and types. For the overall management of the LLIN replacement scheme, HEWs will consolidate their kebele LLIN registers. These records will be an important monitoring tool for management of LLINs and feed into woreda, regional and, eventually, national databases.

Activities for distribution of LLINs at the community level

- Transportation of LLINs from Woreda directly to health posts/ Kebeles based on annual malaria commodity micro plans developed by woreda staff using data from health posts.
- Health extension workers and Kebele administrators provide LLINs to the communities based on their family size at health posts /other central location by registering; to make sure that all households have received LLIN in the targeted catchment area;
- Approval from the HEWs will be required for households to be eligible to receive for replacement LLINs before the actual distribution day. A record will be kept information on all families receiving LLINs.

The aim of LLIN distribution is to cover all at risk populations in malaria-endemic areas and to maintain universal coverage. Kebele-level registration of the number of sleeping spaces of each household could help to identify and fill gaps and for monitoring utilization of nets. The following general guide can be used to determine the LLIN requirement of a household, using family size.

Table 5. General guide to determine the number of nets per household based on family size

Family size	Number of LLINs to be supplied
1 to 2	1
3 to 5	2
6 to 7	3
More than or equal to 8	4

Increasing LLIN use

One of the overriding challenges to the successful implementation of LLINs to protect people from malaria is increasing the consistent use of LLINs. In Ethiopia, the MIS 2015 found that despite 64% of households in malaria-endemic areas owning LLINs, only forty percent of the population slept under an LLIN the night before the survey, while 45 percent of children and 44 percent of pregnant women slept under an LLIN the previous night. Nevertheless, only 32 percent of households have at least one LLIN for every two people that stayed in the house the night before the survey and about half of the household population have access to an LLIN. Knowledge about malaria and the importance of sleeping under LLINs is the basis for behavior change, the next step in the public process of increasing utilization rates of LLINs. While mass media and IEC materials, such as posters and banners, provide information and contribute to increasing correct use of LLINs, interactive community-based social communication strategies are known to bring about more significant behavior changes. The LLIN strategy encourages the implementation of community-based social communication to help increase the use of LLINs in Ethiopia. Social behavior change communication (SBCC)

The HEP offers a highly effective opportunity to provide nationwide information and conduct SBCC activities to improve LLIN use in nearly all malaria-endemic communities across Ethiopia. The main strategies for the HEP to increase use of LLINs include: 1) use of SBCC materials, such as posters, pamphlets and mass media systems; and 2) implementation of community-based social communication activities, including SBCC toolkits at focal discussion groups, and at the household level.

The role of the HEW in the LLIN program

HEWs are expected to perform the following activities in order to effectively and efficiently undertake LLIN distribution in their respective kebeles:

i. Determine the number of households in the kebele;
ii. Determine the average family size in the kebele (the total number of people in a kebele divided by the total number of households);
iii. Prepare a record of the number of people in each family and if possible the number of sleeping sites in each household;
iv. Submit an LLIN distribution plan, including the above data, to the district health office;
v. Discuss with community leaders and elders and with HDAs how to distribute the nets as quickly as possible and involve them in the distribution of nets;
vi. Transport the required number of nets from the district health office to the health post;
vii. Arrange temporary storage of LLINs;
viii. Train HDAs on distribution procedures and key messages on proper and consistent use to be communicated to households during distribution;
ix. Always give priority to children under five years of age and pregnant women when there are not enough nets to cover the whole population and pass the right message to the households;
x. Distribute LLINs as soon as the nets arrive at the health post;
xi. Consider distributing the LLINs through house-to-house visits as this will be the best way to assist the households with hanging the nets and teaching them the proper use of the nets;
xii. Ask households to remove badly damaged LLINs, tear them down to be used as window screens or put them under the mattress or mat. Never allow households to keep using damaged LLINs while keeping new LLINs unused;
xiii. Always unpack LLINs before distributing to beneficiaries;
xiv. Convince households to repair damaged LLINs promptly in order to extend their life;
xv. Monitor proper use of LLINs by regularly checking for:
    - whether all LLINs given to a family are physically present in the household;
    - whether the LLINs have been hung properly;
    - whether everyone in the household slept under the LLINs the previous night;
    - the physical condition of LLINs; advise the family to repair minor damages;
    - the names of the family members who sleep under each LLIN; if possible, ask them what time children under 5 years of age and adults normally go to sleep in the evening; advice alternative solutions if outdoor sleeping or staying up late is an issue;
    - Address any concerns or problems from the household.

6. Other Malaria Prevention Options

Malaria can also be prevented by using other personal protective measures to augment the effect of the main vector interventions described above or in instances where conditions do not permit their implementation. For example, in some contexts, the use of mosquito repellents, insecticide-treated tents or blankets can be effective in protecting people from malaria. The selection of residential sites and repellents could be important preventive measures to protect workers from malaria in new development project areas that involve irrigation or mining. Repellents are normally applied directly to skin, arms and legs to irritate and deter biting mosquitoes. Repellents are recommended for people going to sleep late or staying outdoors at night for work or other reasons. HEWs should encourage communities to use traditional and modern mosquito repellent methods to supplement other malaria prevention measures. However, the use of repellents for personal protection should be left to the decision of individuals and non-governmental entities. Similarly, due to the rapid expansion of commercial farming in the country and the location of these farms in malaria-endemic areas, investors should be advised to consider implementing the malaria prevention methods described above (i.e. environmental management, IRS and LLINs).Mosquito repellents and other protection measures could be feasible and useful in protecting their workforce form malaria. Investors should also be aware that incorporating malaria prevention into their business plan could be critical for the success of their investment (e.g. in terms of workforce productivity).

7. Environmental Compliance

Procedures for the safe handling and disposal of public health insecticides, including insecticide-treated/contaminated materials, will be institutionalized in accordance with Ethiopia's Environmental Protection Authority and WHO global regulations.

Conditions to ensure environmental safeguards during spray operations include:

- Occupational exposure to insecticides must be minimized through PPE (according to WHO specifications and national standards);
- Targeted households will be educated through SBCC activities;
- Implement strict auditing of pesticide stocks and best practices about handling, usage, washing and disposal of waste, to prevent/ minimize environmental contamination. Use of ablution blocks; construction of evaporation tanks and progressive rinse-reuse of water; comprehensive accounting and collection of empty sachets for environmentally sound disposal in accordance with WHO/FAO specifications; strict compliance with national pesticide handling procedures;
- Provide training support to strengthen the supervisory capacity within target districts for day-to-day monitoring of IRS operations;
- Collect all empty insecticides sachets in a secure central location until a decision on environmentally sound disposal of the sachets is reached;
- Train relevant categories of workers involved in IRS operations (e.g. storekeepers, pesticide transporters/drivers, spray operators, team leaders, supervisors, coordinators and district program managers) on best practices in accordance with national and international pesticide regulations (e.g. Special Decree no. 20/1990);
- Establish district capacity for managing pesticide poisoning;
- Provide insecticide poisoning management training to relevant health workers;

- Use district hospitals as reference points for insecticide poisoning and support them to manage insecticide poisoning incidents;
- Initiate environmental monitoring (baseline and routine monitoring) of pesticides used in IRS to the extent feasible and relevant through baseline sampling;
- Identify appropriate pesticide storage facilities for storing insecticide and other IRS equipment in accordance with UN FAO pesticide storage and stock control standards.

Factors that expose external environment to potential risks:

- Lack of evaporation tanks and wash areas for collecting DDT wash and disposal of non-DDT insecticide waste.
- Absence or inadequate pesticide storage facilities;
- Lack of insecticide solid waste disposal facility;
- Inadequate supervision of spray operators;
- Poor insecticide packaging at the manufacturing point leading to spills;
- IRS environmental consequences.

Positive effects: The positive effects of IRS include providing protection to households against malaria. This protection is expected to reduce the incidence of malaria-related morbidity and mortality because of malaria, miscarriages caused by malaria during pregnancies, low birth-weight among children, and adverse effects on fetal neural development. It will also reduce the incidence of malaria-related childhood anemia and its complications, i.e. organ failure and death.

Indirect effects: Indirect effects of IRS can be considered equivalent to "irreversible commitments of resources", where malaria vector control interventions may result in the procurement of pesticides, equipment, storage facilities, vehicles, or other commodities that can be used for purposes other than those intended or that adhere to best practices.

Risk mitigation measures: Risk mitigation measures include a mix of SBCC approaches targeting residents and spray operators and team. Measures also include provision of PPE to spray operators while emphasizing effective training, construction of waste disposal infrastructure (evaporation tanks, wash areas, soak pits), adequate storage facilities for the pesticides as well as supervision and monitoring.

8. Communication in Vector Control

Communication skills are an essential element of malaria vector control. Spray operator, field coordinators and supervisors should have adequate skills to communicate with government officials at various levels, communities and households. The main objectives of communication in malaria vector control are to gain the acceptance and cooperation of stakeholders during and after IRS as well as to influence behavior at the household level for proper and consistent use of LLINs. HEWs play an important role by providing information about malaria in general and prevention methods in particular.

Key messages and instruction during IRS operations:

- Spray operators must inform households of the spraying schedule and the purpose of spraying, giving them time to prepare and vacate the house;
- Occupants must leave houses before spraying;
- Rooms occupied by sick people who cannot be moved must not be sprayed;
- Remove all household items, including water, food, cooking utensils and toys from the house;
- Move, cover or take out furniture to allow easy access for spraying walls;
- Furniture and other items that cannot be removed should be well covered;
- Households should make water available during spraying;
- Cage or tether pets and domestic animals away from the house;
- Advise the occupants to stay outside until the applied insecticide spray is dry (i.e. two hours);
- Advise occupants to sweep or mop the floor before children or pets are allowed to re-enter the house;
- Advise occupants not to clean the sprayed surfaces;
- Advise occupants not to replaster a sprayed home for six months after spraying.

Key messages for proper and consistent utilization of LLIN (Figure 8):

- Properly hang LLINs around sleeping areas;
- Completely insert the end of the LLIN under the mattress;
- All family members should sleep under LLINs every night;
- Give priority to pregnant women and children under five when there is a shortage of LLINs;
- Wash your LLIN with regular soap;
- Hang LLINs (or lay to dry) in the shade after wash;
- Do not sell or use LLINs for other purposes.
- Care for nets and repair those nets which are torn
- Do not sell LLIN or use for purposes other than prevention of malaria.

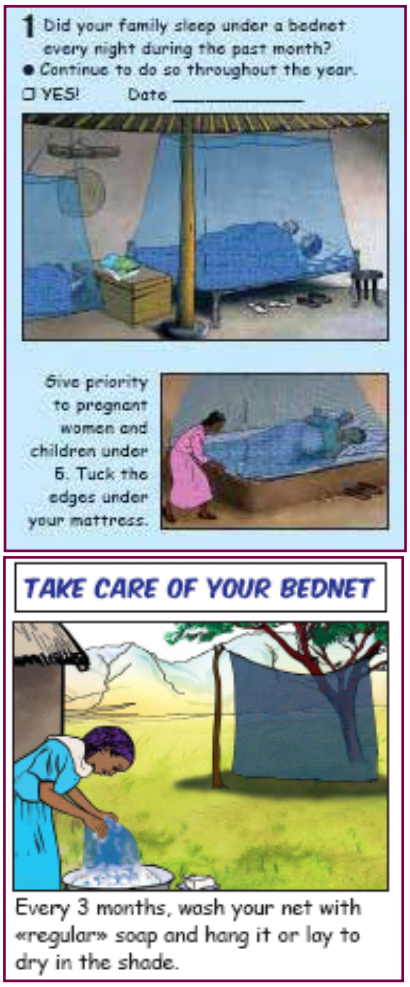


Figure 6.LLIN-specific SBCC

9. Partnerships and Coordination

Effective implementation of the proposed strategy will require strong partnership and commitment from all partners to ensure LLINs are available, affordable and demanded at the consumer level and that IRS operations are implemented successfully. For the partnership to be sustained, the roles and responsibilities of each partner must be clearly defined.

Roles and responsibilities of partners

FMOH: The primary role of the government authorities at the central level is to create an enabling environment for the uptake and use of LLINs, and the implementation of IRS operations. This includes:

- Demonstrate political commitment;
- Encourage enterprise initiatives for local production of LLINs;
- Promote generic demand through a national communication program;
- Establish policy frameworks;
- Ensure that vulnerable groups are provided with LLINs in emergencies;
- Coordinate activities and partners through:
- Establishment of institutional and collaborative frameworks;
- Provision of technical support, development of guidelines, and training and educational materials;
- Establishment of technical specifications for LLINs and insecticides used in IRS operations;
- Insecticide resistance monitoring;
- Provide training to health workers;
- Provide monitoring and supervision of operational program activities;
- Assist in customs clearance of vector control commodities and/or in-country product registration.

RHBs

- Regional level planning, identification of target groups for LLIN distribution and IRS;
- Mobilization of resources;
- Monitoring, evaluation, and supervision.

Peripheral/Community Level

- Identification of worn-out LLINs;
- Distribution of LLINs;
- Planning of community-level vector control activities;
- Information, training, education, sensitization;
- Collaborate with local level NGOs, community associations, schools, churches/religious
- centers, commercial outlets, and health and non-health networks;
- Monitoring and supervision of LLIN distribution and IRS operations.

Other Support Agencies (such as UN organizations and bilateral agencies)

- Provide technical assistance to the FMOH and RHBs for the planning, implementation, and monitoring and evaluation of vector control activities, including LLIN procurement and distribution, and IRS operations;
- Provide financial and logistic support for operational program activities;
- Provide "seed" nets;
- Participate in relevant activities, e.g. training, development of training and educational
- materials, guidelines and systems for LLIN strategies;
- Contribute to development of information systems.

NGOs: Responsibilities or contributions will vary depending on the type of NGO, its mission statement, geographical location, financial resources, but are likely to include some or all of the following:

- Provide technical assistance to the FMOH and RHBs for the planning, implementation, and monitoring and evaluation of vector control activities, including LLIN procurement and distribution, and IRS operations;
- Assist in ensuring that equity is achieved in targeting of vulnerable groups through the innovative use of subsidies;
- Provide LLINs to vulnerable groups during emergencies;
- Provide financial, logistic and management support to community-based activities;
- Participate in community capacity development activities.

Private sector/industry

- Make LLINs widely available to the public at commercial prices, ensuring sustainability;
- Contribute to service delivery through use of already established distribution networks;
- Undertake local manufacture of nets at competitive price and quality, compared with imported nets;
- Contribute to LLIN promotion/demand creation.

Social marketing agencies

- Contribute to demand creation through promotion of nets;
- Make affordable, quality nets widely available;
- Serve as an entry point and catalyst for unassisted private sector distribution of LLINs;
- Work closely with public health system, community-based and NGO distribution of LLINs.

Research and academic institutes and scientists

- Conduct operational research, including on vector control interventions, insecticide resistance monitoring, and community vector control intervention knowledge-attitude-practice surveys;
- Dissemination of research results.

Individuals/households at risk of malaria

- Use LLINs correctly and regularly;
- Ensure that household members most vulnerable to malaria are given priority to sleep under LLINs.

Partners can be categorized generally as:

- Public sector;
- Development partners;
- Civil society;
- Private sector.

10. Monitoring and Evaluation

Comprehensive monitoring and evaluation framework to measure the program (please also refer to the National Plan for Malaria Monitoring and Evaluation):

LLINs: The FMOH will coordinate the monitoring and evaluation of the national LLIN activities, ensuring that all possible sources of malaria-relevant information are being used, including the Demographic and Health Survey, MIS, RHB data from districts and facilities, microplan data, data from malaria surveillance activities and other surveys. Implementation progress will be reviewed on a quarterly basis using the MCST / TAC as the forum. Through this mechanism, the sharing of information between partners will be fostered.

IRS: One of the most overlooked aspects of IRS operations is monitoring and evaluation. In IRS operations monitoring and evaluation should be a continuous process. Monitoring should conduct at each level and the results communicated to all concerned.

Section 2

MALARIA DIAGNOSIS AND TREATMENT

20. Introduction

Malaria has been a major public health problem in Ethiopia and has been consistently reported as one of the leading causes of morbidity and mortality. Malaria burden has been decreasing in the last decade and according to world malaria report, 2016, Ethiopia has demonstrated more than 40% reduction of malaria mortality and incidence between 2010 and 2015.

P. falciparum and P. vivax are the two dominant parasite species causing malaria in Ethiopia, with relative frequencies of about 60% and 40%, respectively. This proportion varies from place to place and from season to season. P. falciparum is the dominant parasite species in malaria epidemic situations, and this species causes severe and complicated manifestations and almost all malaria deaths. P. falciparum has a remarkable biological diversity including an ability to develop resistance rapidly to a number of anti-malarial drugs, creating a major challenge in providing patients with this infection with effective malaria chemotherapy.

A nationwide study conducted in 1997-98 documented high chloroquine treatment failure rates in uncomplicated P. falciparum malaria, prompting a treatment policy change substituting sulfadoxine-pyrimethamine (SP) as the first-line drug for the treatment of uncomplicated P. falciparum malaria and retaining chloroquine for the treatment of P. vivax malaria. At the time of introducing SP in 1998 as the first-line drug, the level of treatment failure observed was only 5% for P. falciparum. In subsequent years, however, unpublished reports from isolated case series and health providers indicated increasing SP treatment failure rates that necessitated a nationwide representative assessment of P. falciparum SP susceptibility by 2003.

A national study on the therapeutic efficacy of SP for the treatment of uncomplicated P. falciparum malaria was conducted in 11 sentinel sites in late 2003. The study showed a mean SP treatment failure rate of 35.9% for 14-days follow-up and 71.8% for 28-days follow-up. In 2004, an in-vivo therapeutic efficacy and safety baseline study on the ACT artemether-lumefantrine (AL) was conducted, which showed no treatment failure cases and no significant drug side effects after a follow-up period of 14 days.

Following this study, a national consensus-building workshop was organized and the 2004 National Malaria Diagnosis and Treatment Guidelines were developed, stressing the importance of ACTs (specifically AL) for the management of P. falciparum in Ethiopia. The efficacy of AL for P. falciparum and chloroquine for P. vivax has been monitored regularly and so far, there is no evidence of drug resistance for these drugs. Therefore, these drugs remain the first line antimalarial drugs in Ethiopia.

Subsequently advances in diagnosis and treatment of malaria are documented, including the use of single dose primaquine for reducing transmission of plasmodium falciparum, 14 days course of primaquine for the radical cure of plasmodium vivax for all transmission settings, escalation of Artesunate dose for children less than 20 kg and the documented safety of Artemether lumefantrine for infants less than 5 kg prompted the forth revision of the National Malaria Diagnosis and Treatment Guidelines.

For effective management of malaria patients, health workers at all levels of the health care delivery system should understand the principles and follow the procedures outlined in malaria diagnosis and treatment guidelines. At the hospital and health center levels, clinicians are expected to make an accurate diagnosis of malaria based on the result of microscopic examination of patient blood smears rather than relying on clinical assessment alone. All clinicians should strictly follow the treatment approaches outlined in this guideline. Nurses working at health facilities must provide optimal nursing care for hospitalized patients. Laboratory technicians should undertake microscopic investigation to identify species of malaria and density of parasite. At the health post level, HEWs are expected to make a diagnosis of malaria by multi-species RDT rather than by clinical assessment alone. HEWs should refer patients with severe malaria immediately. They should give rectal artesunate for children less than 6 years of age as a pre-referral treatment. In addition to this, health workers at all levels should provide patients with SBCC on prevention and control of malaria as well as on promoting adherence to effective anti-malaria treatment

21. The Health Care Delivery System and Implementation of Malaria Diagnosis and Treatment Guidelines

The health service delivery system in Ethiopia is tiered into primary, secondary and tertiary levels. The primary health care unit comprises of a primary hospital with its catchment health centers and health posts. Health posts are staffed by health extension workers. HEW diagnoses malaria using multispecies RDT and treat using first line antimalarial drugs. In health centers, all types of hospitals and private facilities with microscopes, malaria is diagnosed with microscopy and treated using the recommended antimalarial drugs. These facilities are also expected to diagnose and treat malaria treatment failures and severe malaria.

All stakeholders, including NGOs and private sector working in the malaria prevention and control must use the guidelines. The implementation of the guidelines should be ensured through continuous monitoring and technical supervision of all health staff in the different health facility levels. Regular supplies of laboratory reagents and materials, anti-malarial drugs and other supportive treatments, should be made available on a regular basis and in adequate amounts at all levels of the health system.

22. Malaria Diagnosis and Treatment Approaches

Ensuring prompt and effective treatment of cases with uncomplicated malaria within 24hours after symptom onset will prevent most cases from progressing to severe and fatal illness. For this effective malaria treatment, improved malaria diagnostic set up (i.e. laboratory-based microscopy or use of multi-species RDTs), well-trained health workers in both the public and private health sectors and ensuring prompt and constant availability of highly efficacious medicines as close to the patient as possible is very important. Communities should also be well aware of the importance of seeking early diagnosis and treatment and adhering to prescribed drug regimens for malaria.

Best practices in malaria control require the regular updating of malaria treatment guidelines and their dissemination to all tiers of the health care delivery system and a sound monitoring and supervision system. The different approaches of malaria diagnosis are presented below:

22.1 Clinical diagnosis

A clinical diagnosis entails making a clinical assessment by taking reliable history of the illness and performing a complete physical examination. Clinical diagnosis of malaria is made when a patient from malaria endemic area has fever or history of fever in the last 48 hours or if a patient from non-malaria endemic area has fever or history of fever in the last 48 hours and has a history of travel to malaria-endemic areas within the last 30 days. Making the diagnosis of malaria on clinical features alone is not recommended, as this often has low specificity and increases the chances of the patient being misdiagnosed. Malaria treatment based on clinical diagnosis must be the last option when there is no availability of RDTs or microscopy. WHO recommends universal parasitological diagnosis of malaria to ensure targeted use of anti-malarial drugs for those individuals who actually have malaria.

The health worker examining a suspected malaria case should look for other causes of fever (e.g. typhoid fever, relapsing fever, acute respiratory tract infections, meningitis, schistosomiasis, visceral leishmaniasis) and manage the case accordingly and malaria should still be considered, even if the individual has another obvious cause for the fever. The national algorithm of the Integrated Management of Neonatal and Childhood Illness (IMNCI) and Community-based Case Management (CCM) should also be employed for the management of the sick child presenting with fever.

22.2 Parasitological diagnosis

Microscopic diagnosis and RDTs are the methods employed for confirmation of malaria etiology. Light microscopy using thick blood films can be very sensitive, detecting as few as 5 parasites/µl of blood. Thin blood film stained with Giemsa is useful for identifying the malaria parasite species and has a sensitivity of 20 parasites/µl. The recommended method to determine parasite load is by quantifying the number of malaria parasites per microliter of blood on thick blood film. Currently multi-species RDTs capable of specifically detecting both P. falciparum and P. vivax, are being supplied by FMOH to health posts, enhancing malaria diagnosis by species at the periphery and reducing the need for empiric treatment and wastage of anti-malarial drugs. It also provides the opportunity to accurately identify parasite-negative patients in whom another cause of fever (diagnosis) must be sought immediately. Patients who test negative by malaria RDT or microscopy do not need anti-malarial medications.

22.3 Treatment approach

Treatment of malaria should be based upon a parastiologically confirmed diagnosis whenever the situation permits (Figures 8 and 9). Laboratory evidence providing confirmation of malaria (i.e. microscopy or RDTs) by malaria species requires prompt treatment with the appropriate anti-malarial drugs. If the RDT or microscopy test indicates a P. falciparum infection, then the patient should be treated with appropriate doses of AL and single dose primaquine administered with the first dose of AL and ensure whether the patient is able to swallow the drugs and does not vomit. If the RDT or microscopy reveals a P. vivax infection only, then chloroquine treatment should be dispensed, also make sure that the drug is well tolerated.

To prevent relapse in P. vivax malaria, treat children and adults (except pregnant women, infants less than 6 months of age, women breast feeding infants less than 6 months, women breast feeding older infants unless they are known not to be G6PD deficient and people with G6PD deficiency) with a 14 day course of primaquine in all transmission settings at all levels of the health system. Health workers should be vigilant to detect side effects of primaquine. A standard protocol that is developed by FMOH should be used during primaquine treatment. Mixed infection confirmed by microscopy should be treated with AL and 14 days course of primaquine but if it is confirmed by RDT at health post treat with AL and single dose primaquine. Although severe malaria illness is usually caused by P. falciparum, occasionally, P. vivax infection can also result in severe malaria illness. Severe malaria illness whether it is due to P. falciparum or P. vivax infection should be treated in the same manner (see section 14.2. for details): with intravenous or intramuscular Artesunate followed by full course of Artemether lumefantrine as preferred therapy at hospital or health center.

Pregnant women in the first trimester should be treated with oral quinine when uncomplicated P. falciparum infection is present. For pregnant women during second and third trimester period the treatment is the same as the non-pregnant women. Pregnant women with P. falciparum infection should not be treated as severe malaria unless they have severity signs. Pregnancy by itself is not sign of severity of malaria. Chloroquine is safe in all trimester of pregnancy and for infants. When there is a negative laboratory result by RDT or microscopy for malaria, no malaria medications should be provided, but a thorough search for other causes of acute febrile illness should continue. Early referral to health centers or hospital may be necessary if the cause of fever is not known. By testing as many patients as possible with clinically suspected malaria by RDTs or microscopy, and by treating patients according to malaria laboratory test result, the waste of anti-malarial medications can be reduced and eliminated.

Overtime, the number of patients with suspected malaria but without laboratory confirmation should approach zero, and the number of patients who must be treated for presumptive malaria without laboratory confirmed diagnosis should eventually approach zero. To ensure appropriate intake of prescribed drugs, direct observation of treatment is also important, especially for the first dose. Directly observed treatment is also recommended when feasible for radical cure using primaquine. However, as the patient load could sometimes be beyond the capacity of the health facility, there will be a need to give drugs to patients/guardians on hand. In such circumstances, patients/guardians should be well informed about the proper anti-malarial medication treatment schedule to ensure intake of the complete treatment dose. To support this effort, improving the role of community-based health workers should also be strengthened, so that these can be trained to assist in malaria case management.

Table 5. Recommended first line antimalarial drugs at health post and Health Center/Hospital

Parasite	Health post (RDT)	Health center/Hospital (microscopy)
P. vivax	CQ + PQ (radical cure)	CQ + PQ (radical cure)
Uncomplicated *P. falciparum*	AL + PQ (single dose)	AL + PQ (single dose)
Uncomplicated mixed infection	AL + PQ (single dose)	AL + PQ (radical cure)

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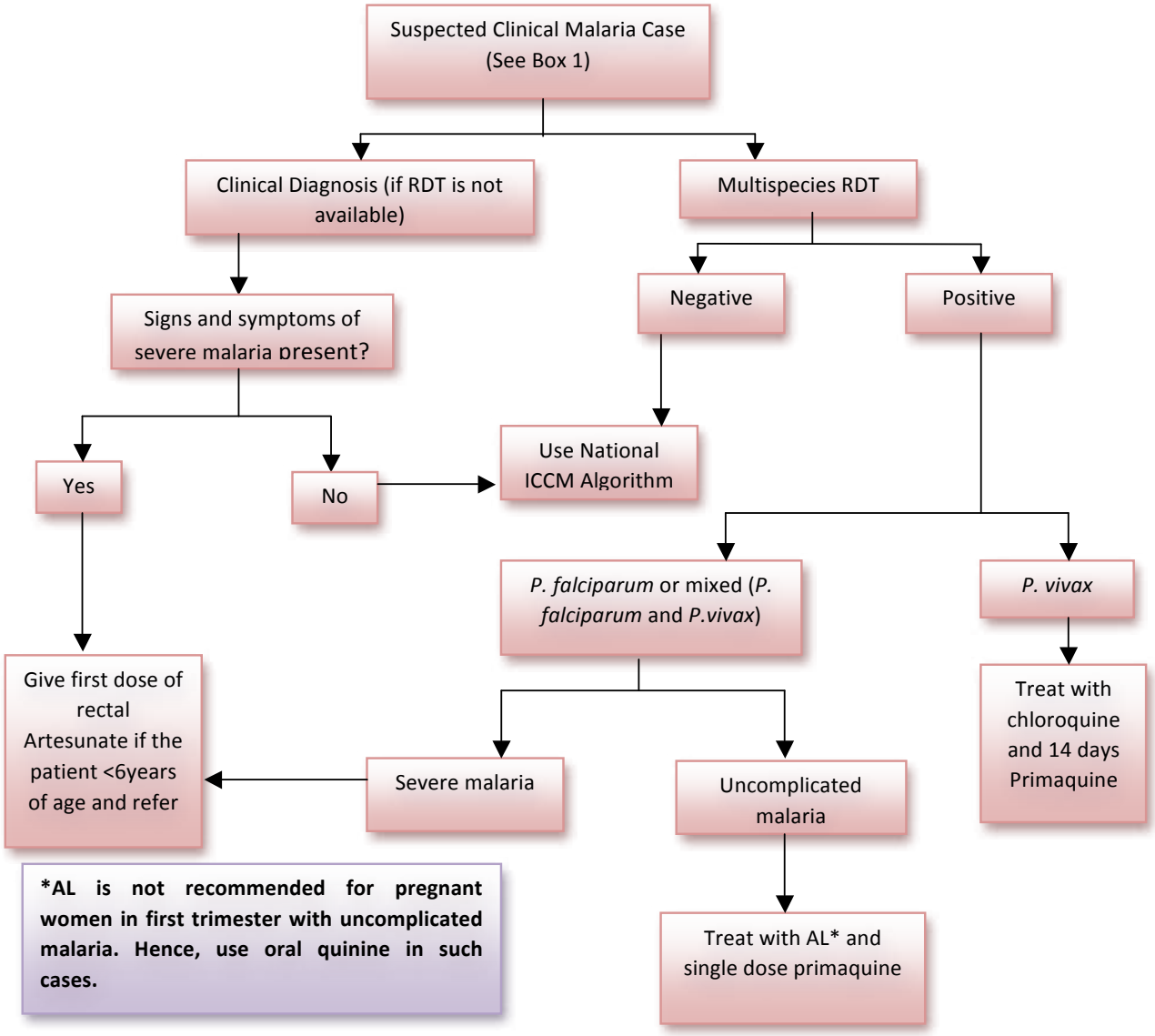


Give a single dose of 0.25 mg/kg bw primaquine with ACT to patients with *P. falciparum* malaria (except pregnant women, infants aged < 6 months and women breastfeeding infants aged < 6 months) to reduce transmission

Box 1.

Patient with fever or history of fever in the last 48 hours and lives in malaria-endemic areas or has history of travel within the past 30 days to malaria-endemic areas.

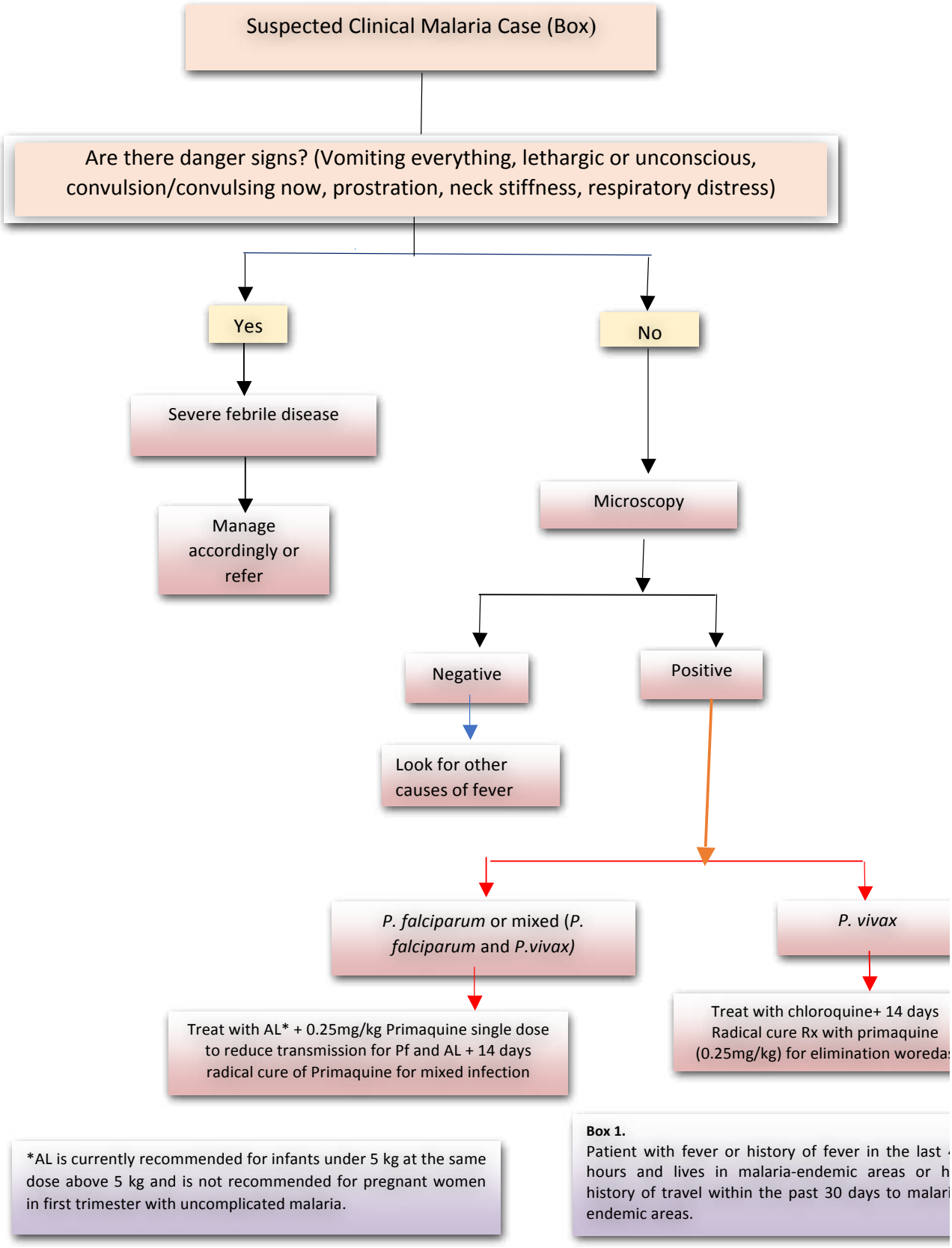


Figure 8. Diagnosis and treatment of malaria at Health Center and Hospital level

23. Uncomplicated Malaria

23.1 Management of uncomplicated malaria

Diagnosing uncomplicated malaria at health post level. A malaria diagnosis at the health post level (Figure 10) should be based on:

- Taking a history (including travel history of the suspected case);
- Physical examination and clinical assessment for other causes of fever; AND
- Parasitological testing (i.e. use of multi-species RDTs).

REMEMBER:

Look for other causes of fever – use the national CCM guideline/algorithm;

Look for danger signs in the patient (see Box 2, below);

If any of the danger signs for malaria are present, give pre-referral treatment (see section 14.2. below) and refer the patient to a higher-level facility as soon as possible.

23.1.1 Treatment of uncomplicated malaria

First line of treatment of uncomplicated malaria

P. falciparum positive by multi–species RDT: AL and single dose primaquine is the recommended first-line drug. AL tablets are given according to body weight in six doses over three days (Annex A).Treat infants weighing < 5 kg with uncomplicated P. falciparum malaria with AL at the same mg/kg body weight target dose as for children weighing 5 kg.

The first dose should be given under direct supervision of the health worker. AL should preferably be taken with food or fluids. A fatty meal or milk improves absorption of the drug. If vomiting occurs within half an hour after the patient swallows the drug, the dose should be repeated and the health worker/pharmacist should provide the patient with a replacement dose to ensure completion of treatment.

AL is available in co-formulated tablets containing artemether 20 mg and lumefantrine 120 mg per tablet. The dose ranges from 1-4 tablets (depending on the patient's body weight) taken every 12 hours for 3 days.

To reduce the transmission of P. falciparum infection give a single dose of 0.25 mg/kg body weight primaquine with AL (except pregnant women, infants aged < 6 months and women breastfeeding infants aged < 6 months. and testing for G6PD deficiency is not required during primaquine treatment (Annex C).

To assist in finding the correct dose for a given patient refer to Annex A. Remember that all anti-malarial drug doses should be calculated according to body weight, so it is vital that the patient is weighed first. The first dose of AL should be given by the HEW or by the mother and witnessed by the HEW (i.e. direct observation).

P. vivax, and malaria species positive other than P. falciparum by RDT: The first line drug of choice is chloroquine plus primaquine radical cure. Chloroquine preparation is 150 mg base tablet OR chloroquine syrup 50 mg base (Annex B for recommended dosage). A tablet of 250 mg chloroquine phosphate ("salt") is the same as chloroquine 150 mg base.

Note: the ideal chloroquine dose is 10 mg base/kg po immediately (Day 1), followed by 10 mg base/kg po at 24 hours (Day 2), and 5mg base/kg po at 48 hours (Day 3) for a total dose of 25 mg chloroquine base/kg over three days with a maximum total of 1,500 mg chloroquine base (= maximum of 2,500 mg chloroquine phosphate salt) over three days in three divided doses. This practical regimen is listed in **Annex B.**

Primaquine is given at a dose of 0.25mg/kg per day for 14 days, the dose and regimen is shown in Annex D.

Multi-species RDT is positive for P. falciparum and P. vivax (mixed infection): The recommended first-line treatment for mixed infection is AL and single dose primaquine **(Annex A and C).Note**: do not treat a patient with confirmed mixed infection with both AL and chloroquine.

Multi-species RDT negative for malaria: If the result of the multi-species RDT is negative for all malaria species, malaria is unlikely. Other causes of fever should be investigated. Treat or refer to health center or hospital as per the CCM algorithm.

23.1.2 Alterante treatment for uncomplicated malaria

AL maybe used to treat P. vivax infection when chloroquine is not available (Annex A). If AL is not available for P. falciparum or mixed malaria infections, use oral quinine. If both chloroquine and AL are not available for P. vivax infection, use oral quinine.

23.1.3 Supportive treatment

If patients, especially children present with axillary temperature record of ≥37.5°C , treat with antipyretics and, if necessary, fanning and tepid sponging. Paracetamol (acetaminophen) 15 mg/kg every 4 hours is widely used; it is safe and well tolerated, given orally or as a suppository **(Annex N).**

Provide supportive therapy as per National CCM guidelines, and as needed from section **14.2.** below.

23.1.4 Referral

It is important that all patients be assessed for the presence of danger signs (see Box 2). If a patient presents at a health post with danger signs or is found to have any of the following danger signs, they require **URGENT** medical attention and should be referred to a higher-level facility as soon as possible.

Box 2: Danger signs of severe malaria

- Altered consciousness (e.g. sleepiness, confusion, drowsiness, coma)
- Prostration, i.e. generalized weakness so that the patient is unable to walk or sit up without assistance
- Unable to eat or drink
- Repeated vomiting, resulting in inability to retain oral medication, inability to eat or drink
- Severe dehydration
- Convulsion or recent history of convulsions
- Difficult breathing
- Jaundice (yellowish discoloration of the eyes)
- Anemia (paleness of palms is most reliable symptom in children)
- Hemoglobinuria (cola colored urine)
- Abnormal spontaneous bleeding
- No urine output in the last 24 hours

Any patient presenting with any of the above-mentioned danger signs, **regardless of whether the RDT result is negative or positive,** should be referred to the next higher-level health facility as soon as possible. However, if patients are children <6 years of age, they should be given pre-referral treatment (see section **14.2** below).

REMEMBER: A delay in referral could cause death of the patient.

23.2 Pre-referral treatment at the health post level

The conscious patient: At the health post level, treat children under six years of age with a single dose of rectal artesunate (10mg/bw) and refer immediately to an appropriate facility for further care. Do not use rectal artesunate in older children and adults. **(Annex H).** Patients older than six years should be referred immediately to higher health facility for further investigation and management

- If high fever is present, give paracetamol **(Annex N);**
- Encourage fluid intake during the transfer; continue breastfeeding in young infants;
- Ensure that the referral form is completed with detailed information including:
  - Clinical presentation/patient's medical history;
  - Suspected diagnosis;
  - Any tests performed and results (i.e. RDTs);
  - List of all drugs/medication given, route, dose and time of administration;
  - Reason for transfer.

The unconscious patient: The unconscious patient requires special attention prior to transfer:

- Ensure the airway is not blocked
- Show family members how to position the patient on side (Figure 10) to ensure a clear airway is maintained;
- Give rectal artesunate as a pre-referral treatment for children under six years of age.
- Do tepid sponging and give paracetamol suppositories for high fever if possible. This will prevent vomiting and convulsions;
- Nurse the unconscious patient on alternate sides to protect the airway, prevent aspiration and avoid pressure sores.

23.3 Management of uncomplicated malaria at the health center or hospital level

23.3.1 Diagnosing uncomplicated malaria

Malaria diagnosis at the health center or hospital level should be based on:

- Reliable and complete history (including travel history); **AND**
- Complete Physical examination and clinical assessment; **AND**
- Parasitological testing (use of microscopy); **AND**
- Other laboratory investigations to aid diagnosis and to rule out other medical conditions resembling malaria.

23.3.2 Treatment of uncomplicated malaria at the health center and hospital level

First line treatment of uncomplicated malaria:
First-line treatment of uncomplicated P. falciparum malaria at the health center or hospital level is nearly the same as that outlined above in section 4.1.2., including the advice and supportive treatment. Mixed infections are treated with AL. They also should be treated with primaquine for 14 days. Though the prevalence of G6PD deficiency is very low in Ethiopia, health workers should closely follow-up patients started on primaquine for hemolysis by directly observing the treatment, doing serial hemoglobin test and checking for darkening of urine. If there is evidence of hemolysis, primaquine should be discontinued and should not be given to the patient in the future. Regarding supportive treatment, the difference from health posts is that health workers at health center and hospital level can assess and manage mild and moderate anaemia.

Treatment failure:
Treatment failure is defined as failure of anti-malarial drug to resolve fever and/or parasitemia. For clinical purpose, consider treatment failure in a patient with malaria who was treated for malaria in the past 28 days. Treatment failures may result from drug resistance, poor adherence or inadequate drug exposure (i.e. from under-dosing, vomiting or unusual pharmacokinetic properties in that individual), drug interaction, misdiagnosis or substandard medicines. Anti-malarial drug resistance refers to the ability of a parasite strain to survive and/or multiply despite the administration and absorption of a medicine given in doses equal to or higher than those usually recommended, but within tolerance of the subject, and the drug must gain access to the parasite or the infected red blood cell for the duration of the time necessary for its normal action and anti-malarial drug resistance can cause treatment failure but not all treatment failure is due to parasite resistance to the drugs. It is important to determine from the patient's history whether the antimalarial was vomited or whether the full course was not completed Monitoring treatment failure is very important because it can signal the appearance of anti-malarial drug resistance.

Treatment failure within first 28 days:
Owing to the potency of AL, treatment failure within 28 days of receiving an AL is very unusual. The majority of treatment failures occur after 2 weeks of initial treatment. Recurrence of P. falciparum malaria may be the result of a reinfection, or a recrudescence (i.e. treatment failure). In an individual patient, it may not be possible to distinguish between recrudescence and reinfection, although if fever and parasitemia fail to resolve, or recur within 4 weeks of treatment, then treatment is considered to have failed. Wherever possible, treatment failure should be confirmed parastiologically, preferably, a blood smear should be obtained and labelled properly to verify–amongst others– Plasmodium species and parasite count, and to rule out other diseases (e.g. relapsing fever). RDTs may remain positive for weeks after the initial infection even without recrudescence so this requires referring a patient from health post to health center where microscopy is available; referral may also be necessary to obtain second-line treatment. .

Treatment failure after 28 days:
The majority of treatment failures occur after two weeks of initial treatment. Such failures can result from either recrudescence or a new infection. This distinction can only be made through parasite genotyping by PCR, which is not used in patient management in Ethiopia. Thus to simplify operational management and medicine deployment, all presumed treatment failures after four weeks of initial treatment should be considered as new infections, and be treated with the first-line antimalarial drug, which is AL for P. falciparum and CQ for P. vivax. Primaquine should be given as appropriate.

Management of treatment failure:
The following recommendations should be followed after a full history, clinical assessment and laboratory examination:

- If a cause for treatment failure is identified (e.g. anti-malarial drug is vomited), such cause must be addressed and treatment reinstituted with the first-line anti-malarial drug;
- If a P. falciparum or P. vivax-infected patient returns to the health facility with fever or history of fever between days 4 to 28 of treatment, a microscopic blood examination should be made (Note: do not use RDTs). If parasites are detected, the treatment should be changed to the second-line drug, i.e. quinine tablets;
- In patients who are suspected to have treatment failure after 28 days, the first-line anti-malarial drug should be used;
- If the blood smear is negative and no other obvious causes are found, the patient should be reevaluated, or referred to the next level of health care for proper management.

Appropriate management of treatment failure, is important because the patient may progress to severe malaria, and resistant parasites may be present and transmitted to others.

NB: All malaria patients should be asked for history of malaria treatment in the past 28 days. If they have such history they should be diagnosed at least at health center level with microscopy, health extension workers should refer such patients

24. Management of Severe Malaria

24.1 General principles of treatment

The patient presenting with severe malaria needs **URGENT** medical attention. A delay in diagnosis and treatment is serious and can lead to unnecessary death of the patient. The health post does not have the specialist services required to care for these patients. Therefore, suspected cases that are less than six years old presenting at the health post level will first be given pre-referral treatment (see **section 24.2**), then referred to the nearest higher-level facility. Those greater than six years old should be referred to as soon as possible. Many suspected severe malaria cases can be managed at either the health center or primary hospital level. Cases that develop serious complications need referral, for better management, to a general or specialized hospital.

24.2 Diagnosing severe malaria

- Taking a reliable history (including travel history); **AND**
- Complete physical examination (ophthalmoscopy if available); **AND**
- Parasitological testing (use of microscopy); **AND**
- Other laboratory investigations to aid diagnosis and rule out other infections resembling malaria.

A patient should be regarded as having severe P. falciparum malaria if there are asexual forms of P. falciparum in a blood film and the patient shows any of the clinical features presented in **Table 6** below. Note that occasionally, P. vivax infection can also cause severe malaria illness, but the treatment and management is the same.

Table 6 Severe manifestation of malaria and frequency in adults and children

Clinical features	Frequency in	
	Children	Adults
Prostration (unable to sit unsupported (>1yr) or inability to drink or breastfeed (<1yr)	+++	+++
Impaired consciousness or un-rousable coma	+++	++
Respiratory distress (acidotic breathing/deep breathing or in-drawing of chest wall)	+++	+
Multiple convulsions	+++	+
Circulatory collapse or shock	+	+
Pulmonary edema or difficulty in breathing	+/-	+
Bleeding tendency/abnormal bleeding	+/-	+
Jaundice	+	+++
Haemoglobinuria	+/-	+
Laboratory findings		
Severe anemia (hemoglobin <5g/dl, haemocrit < 15%)	+++	+
Hypoglycemia (<2.2 mmol/L or 40 mg/dL)	+++	++
Acidosis (bicarbonate <15 mmol/L)	+++	++
Hyperlactatemia (>5 mmol/L)	+++	++
Hyperparasitemia (>4%) (non-immune person)	++	+
Renal impairment (creatinine >3mg/dl)	+	+++

24.2.1 Parasitilogical tests

Microscopy is used for initial confirmation of diagnosis and for follow-up and monitoring of the level of parasitemia linked to the clinical evolution of the patient. In non-immune individuals, high numbers of parasites (>4% parasite density or >200,000 parasites per ul of blood) is generally associated with severe disease. If clinical features strongly suggest severe P. falciparum malaria, treatment maybe started, even though results are not yet confirmed. Health care providers should be encouraged by local public health officials to seek the advice and consultation of available malaria experts at the zonal, regional and national levels for especially challenging clinical and diagnostic situations.At the health center and hospital levels, the following essential laboratory tests (where available) should be performed to aid management of the severe malaria patient and differential diagnosis **(Box 3).**

Box 3: Essential laboratory tests

- Parasitological test (microscopy)
- Blood glucose level
- Hemoglobin (Hb) estimation or packed cell volume (hematocrit)
- Lumbar puncture
- White blood count

Differential diagnosis: Malaria must be distinguished from other febrile illnesses (Box 4).

Box 4: Differential diagnosis of severe malaria

Decreased Level of Consciousness

- Viral encephalitis
- Bacterial meningoencephalitis
- Cerebral typhoid
- Cerebro-vascular event (stroke)
- Complicated typhus, relapsing fever
- Febrile illness with hypoglycaemia
- Sepsis
- Convulsion in a patient with fever

Renal failure

- Glomerulonephritis
- Acute tubular necrosis due to hypovolemia or hypotension

Jaundice associated with fever

- Viral hepatitis
- Yellow fever
- Acute cholecystitis
- Choledocholithiasis

24.2.2 Treatment of severe malaria

First-line treatment of severe malaria: If clinical features strongly suggest severe P. falciparum malaria, treatment maybe started even though results are negative **(Note:** This should be a **VERY** rare circumstance). The clinical record, however, must reflect the negative laboratory results and clinicians must consider other causes listed in **Box 4.**

First line treatment for severe malaria at the health center and hospital level is either:

- IV or IM artesunate (preferred) **(Annex I)**; OR
- IM artemether (alternate) **(Annex J)**; OR
- IV quinine infusion (if artesunate or artemether is not available); OR
- IM quinine (if artesunate is not available).

When available, IV or alternatively IM artesunate is the preferred drug for severe malaria in Ethiopia. IV or IM artesunate has been shown to reduce the risk of death from severe malaria significantly (by about 35%) compared to IV or IM quinine. For adults and children weighing more than 20 kg with severe malaria or who are unable to tolerate oral medicines, artesunate 2.4 mg/kg body weight IV or IM given on admission (time = 0), then at 12 hrs and 24 hrs, then once a day until the patient tolerates po drugs. Children weighing < 20 kg should receive a higher dose of artesunate (3 mg/kg bw per dose) than larger children and adults (2.4 mg/kg bw per dose) to ensure equivalent exposure to the drug.

IV artesunate will substitute for rectal artesunate or any other IM anti-malarial treatment that may have been started as pre-referral therapy. The injectable artesunate, which contains 60 mg powder within a 7 ml glass vial, must first be reconstituted by mixing with a 1 ml glass ampoule of 5% sodium bicarbonate solution (provided) prior to administration and then shaken 2-3 minutes for better dissolution. To prepare an IV infusion of artesunate (10 mg/ml), next add 5 ml of 5% glucose (D5W) or Normal Saline to the just-reconstituted 7 ml vial, and then infuse slowly intravenously (i.e. 3-4 ml per minute IV). To prepare artesunate for IM injection, add 2 ml of 5% glucose (D5W) or Normal Saline to the reconstituted 7 ml vial to make 3 ml of artesunate (20 mg/ml) for IM injection. One reconstituted vial provides a single dose for a person weighing up to 25 kg. A second vial must be prepared and reconstituted for persons weighing more than 26 kg, since they will need one full vial and at least a fraction of the second vial. The shelf life of artesunate is three years from production date, to be stored below 30°C temperature and protected from sunlight.

Once the patient with severe malaria regains consciousness and tolerates oral therapy, a full course of oral AL therapy should be started to complete the treatment, as in **Annex A.** If AL is contraindicated, continue treatment with quinine tablets. Additionally, a single dose primaquine will be added for P. falciparum cases. A full course of oral chloroquine and a 14-day primaquine should be given for P. vivax cases.

Important points about quinine infusion when this is used as alternative therapy:

- The dose of quinine is 20mg dihydrochloride salt/kg bw (loading dose) diluted in 10ml isotonic fluid/kgbw IV infusion over 4 hours; followed by 8 hourly maintenance dose of quinine 10mg salt/kgbw over 4 hours, calculated from the beginning of the previous infusion, until the patient can swallow. If for any reason quinine cannot be administered by IV infusion, quinine dihydrochloride can be given in the same dosages by IM injection in the anterior thigh (not in the buttock). The dose of quinine should be divided between two sites – half the dose in each anterior thigh. If possible, for IM use, quinine should be diluted in normal saline to a concentration of 60–100mg salt/ml;
- Rapid administration of quinine is not safe and may cause sudden death due to arrhythmia or refractory hypotension. Each dose of parenteral quinine must be given as a slow, rate-controlled infusion (usually diluted in 5% dextrose and infused over four hours). The infusion rate should not exceed 5 mg salt/kg body weight per hour. If it is possible, continuous infusion should be given;
- For all patients with severe malaria, IV quinine infusion should be given at least for the first 48 hours;
- In patients requiring more than 48 hours of parenteral therapy, the quinine maintenance dose should be reduced by one-third to one-half (i.e. 5-7 mg salt/kg of body weight every eight hours). It is unusual to have to continue IV infusions of quinine for more than 4-5 days;
- A loading dose of quinine should not be used if (i) the patient received quinine within the preceding 24 hours; (ii) mefloquine within the preceding 24 hours; or (iii) mefloquine within the preceding seven days;
- Quinine is not given by subcutaneous injection;
- Quinine is safe in pregnancy and in anemic patients, if the doses are carefully calculated by body weight.

REMEMBER: Always calculate drug doses according to the body weight of the patient. Where available use a burette to ensure correct fluid volumes and to prevent fluid overload in the patient (see pre-referral treatment schedule in **Annex H and 15.2.3 below).**

REMEMBER: Patients with severe malaria should not be treated with oral antimalarial drug.

24.2.3 General management of the patient with severe malaria

Emergency treatment may need to be administered especially if the patient presents in an unconscious state. Management of severe malaria is complex and requires follow-up on many issues. Sometimes life-saving parameters like hypoglycemia or quinine infusion rate may not be followed adequately. The use of a treatment/progress observation chart, as detailed in **Annex M,** is recommended.

- Start immediate resuscitation measures. **REMEMBER** the basics:
  - A = airway: In the unconscious or convulsing patient, it is imperative that the airway is free of obstructions. In the convulsing child, the jaw may be thrust forward to ensure a clear airway;
  - B = breathing: Check that the patient is breathing by looking for chest movements and listening for breath sounds; and support breathing by giving oxygen.
  - C = circulation: Feel hands and check for capillary refill, check, monitor and record vital signs, i.e. blood pressure, pulse, respiratory rate. In addition, support circulation by giving IV fluids preferably the plasma expanders.

Once basic resuscitation has been implemented, assess and record the Glasgow Coma Scale or Blantyre score (**Annex K** and L). Proceed to:

- Establish an IV infusion. If this cannot be achieved, perform either venous cut down OR in life threatening situations, establish an intra-osseous infusion;
- Take blood while establishing an IV line for:
  - Malaria blood slide (thick and thin)
  - Hematocrit or Hb determination
  - WBC (total and differential count)
  - Glucose level
- Correct hypoglycaemia (<2.2 mmol/l OR 40 mg/dl) if present by infusing dextrose over a period of 3-5 minutes. This can consist of any one of the following:
  - 1 ml/kg of 50% dextrose diluted with an equal volume of normal saline(1ml/kg saline)IV slowly over several minutes OR
  - 5 ml/kg of 10% dextrose by slow IV infusion **OR**
  - For other strengths of dextrose, calculate accordingly.
- This should be followed by intravenous infusion of 10% dextrose) given slowly;
- Re-check blood glucose every 2-4 hours during the course of treatment, particularly in the pregnant or comatose patient because hypoglycemia can recur even after an IV bolus of glucose.
- Assess the patient's fluid requirements. Look for evidence of fluid depletion or overload in order to calculate the appropriate rate of infusion. Children with severe metabolic acidosis may benefit from a resuscitation bolus of fluid, preferably a plasma expander, e.g. normal saline. The usual route for fluid infusion is IV **(this must be monitored very carefully as fluid overload could lead to acute pulmonary edema resulting in the death of the patient, especially in children).** However, this may not be possible due to shock or peripheral shut down of the patient, in which case intraosseous (IO) should be performed and fluid given via this route;
- Re-check malaria blood smear by microscopy after 48 hours to assess effects of anti-malarial treatment on blood parasite density;
- A body temperature of greater than 38°C requires attention. This is best done by giving:
  - Children: paracetamol (15 mg/kg body weight) as in Annex N by mouth if possible, alternatively by suppository or NG tube;
  - Adults: give 1 g of paracetamol orally if possible or via suppository or NG tube;
  - In addition, remove the patient's clothes and start tepid sponging and fanning. Relatives can help with this task.
- Control convulsions: correct hypoglycemia, if present, as explained above. If convulsions continue for more than 5 minutes, a slow IV injection of diazepam (0.15 mg/kg of body weight, maximum of 10 mg for adults) can be administered. In children always **calculate according to body weight** to avoid dangerous respiratory depression. The IV diazepam can also be given intra-rectally using a rectal tube or NG tube (0.5-1.0 mg/kg of body weight) if injection is not possible. Monitor breathing carefully. Ensure that resuscitation equipment is at hand

when administering diazepam. Alternative anticonvulsants are: paraldehyde 0.1 ml/kg IM1; phenytoin 20 mg/kg (slow IV) as a loading dose;

- Consider the need for blood transfusion. The most common indication for blood transfusion is severe anemia. Assess the patient's clinical condition rather than relying on the hematocrit and/or Hb level. "Does the patient need blood?" is a more important question than what the packed cell volume (PCV)/Hb is. As a rule of thumb:
  - If the hematocrit is below 15%, blood transfusion is indicated;
  - If the patient's life is threatened by anemia-associated acidosis, shock or the parasitaemia is so high that you can predict a critical drop, give packed cells or whole blood transfusion urgently;
  - If the patient has spontaneous bleeding, give whole fresh blood if available or a platelet transfusion (if possible);
  - Reassess the need for blood transfusion if no transfusion has been given in the first 24 hours; the patient may be stabilizing and may recover without the need for blood transfusion.
- If the patient is unconscious, insert a naso-gastric tube and start the management of the comatose patient;
- Decide whether to insert a urinary catheter. This is necessary if either acute renal failure or pulmonary edema is suspected, in order to guide fluid balance;
- Decide whether a central venous pressure line is to be set up. This is of most value where pulmonary edema is suspected, and may be useful in the patient with shock or impending renal failure. It requires the necessary facilities, sterile procedures, expertise and a sufficient number of trained staff to use it properly;
- If facilities allow, consider the need for intubation and mechanical ventilation;
- Provide meticulous nursing care; nurse patient in the lateral position to reduce the risk of aspiration, report any changes in behavior as soon as possible.

24.2.4 Salient clinical features and management of complications of severe malaria

Behavioral change and coma:
Causes are:

- Effect of malaria on the brain (cerebral malaria);
- Convulsion (in behavioral change due to convulsion, consciousness is usually restored within a few minutes to a few hours. If it persists more than 30 minutes, consider cerebral malaria or other causes.);
- Hypoglycemia;
- Other diseases like pyogenic meningitis, drug or alcohol intoxication, encephalitis like rabies, metabolic failure like hepatic failure and renal failure (see Annex K and L for how to assess coma.

Management: A coma score is based on the patient's ability to move and speak in response to commands and painful stimuli. In infants who have not yet acquired speech, you can assess the cry and the child's ability to watch its mother's face, and the response to pain. Coma can be graded according to one of the two scales (**Annexes K and L**).

The Glasgow Coma Scale **(Annex K)** is suitable for adults and older children. For young children who are preverbal, the Blantyre Coma Scale **(Annex L)** may be used. Assessment of coma in younger infants is difficult. It is best to describe how the child responds to a standard painful stimulus.

Unconscious patients should receive meticulous nursing care as described in **section 14.2.**
Management of the patient with behavioral change and coma includes:

- Diagnosing and managing hypoglycemia. If random blood sugar cannot be determined, the patient should be given dextrose as indicated in section 15.2.3;
- Look for and treat convulsions. Convulsions can be subtle, so it is important to look for them carefully;
- Check the rate of quinine infusion as sub-optimal dosing is a recognized cause of behavior change or for deterioration of patients after improvement;
- If other causes, such as pyogenic meningitis, are identified, institute specific treatment.

[1] Note: Paraldehyde should, if possible, be given from a sterile glass syringe; a disposable plastic syringe may be used provided the injection is given immediately the paraldehyde is drawn up and that the syringe is never reused.

Convulsions: Relatives may describe what they believe are convulsions, occurring before the patient came to the clinic/hospital. Ask a person who witnessed the event, and request details including movements of hands and face, biting of tongue, incontinence. In some patients, especially children, convulsions may be accompanied with very minor movements, which may not be noticed unless carefully looked for. These "subtle convulsions" may be responsible for coma and require treatment with anti-convulsant drugs.

Differential diagnosis: the possibility of febrile convulsions should be ruled out.
Febrile convulsions: this is a convulsion or 'fit' in a child triggered by fever. Most febrile convulsions occur in the first twenty-four hours of an illness and are also triggered by fevers from non-malarial illnesses including:

- Ear infections;
- Roseola;
- Upper respiratory infections caused by a virus.

Management: Ensure the patient is in a safe environment. Do not pin the patient down or try to put something in his mouth. Try to get the patient onto his side to protect the airway or gently thrust the jaw forward.

Children: Diazepam 0.15 mg/kg body weight IV OR 0.5 mg/kg body weight rectally
Adults: Diazepam 0.15 mg/kg body weight IV (up to 10 mg maximum)

Diazepam can cause respiratory depression. Therefore, an Ambu bag and resuscitation equipment should be at hand when used. Correct underlying causes like hypoglycemia and other metabolic disorders.

Anemia

Anemia associated with malaria is partly due to the destruction of red cells that contain parasites (hemolysis). Several other mechanisms may accelerate the development of anemia: non-parasitized red cells are destroyed more quickly than normal cells during malarial illness, and the bone marrow does not function adequately. Anemia is worsened if there is abnormal bleeding, intravascular hemolysis or renal failure.

Note: Co-infection with other parasitic diseases (e.g. Schistosomiasis, Visceral Leishmaniasis, soil-transmitted helminthes) may further increase anemia.

Clinical features: The most common clinical sign of anemia is pallor of the palms and is the most reliable sign for detecting anemia in children. Other signs include pallor of:

- Conjunctivae;
- Nail beds;
- Tongue.

Note: Only about one third of patients with mild anemia show pallor and patients may have moderate anemia without showing pallor. To confirm that anemia is present, Hb levels should be measured. Patients with severe anemia may present with palpitation, dyspnoea or tachypnoea.

Severe or rapidly developing anemia may contribute to both cerebral signs (e.g. confusion, restlessness, coma /altered consciousness and retinal hemorrhages) and cardiac failure. Signs of cardiac failure in adults include:

- Gallop rhythm;
- Raised jugular venous pressure;
- Hepatomegaly;
- Crackles in the lung bases.

Signs of cardiac failure in infants include:

- Grunting;
- Intercostal or subcostal retractions;
- Nasal flaring;
- Enlarged liver.

Severe anemia may be associated with secondary bacterial infection and retinal hemorrhage. Nutritional anemia is common in pregnancy, lactation and rapid growth, for example, in premature infants, which is often compounded by the anemia of malaria. The only accurate method to determine the degree of anemia is by laboratory measurements of the Hb.

Defining anemia: The WHO defines anemia as:

Population	Non-anemia (in gram/dl)	Anemia		
		Mild (in gram/dl)	Moderate (in gram/dl)	Severe (in gram/dl)
Children 6-59 months of age	11 or higher	10-10.9	7-9.9	Lower than 7
Children 5-11 years of age	11.5 or higher	11-11.4	8-10.9	Lower than 8
Children 12-14 years of age	12 or higher	11-11.9	8-10.9	Lower than 8
Men 15 years of age and above	13 or higher	11-12.9	8-10.9	Lower than 8
Non pregnant women 15 years of age and above	12 or higher	11-11.9	8-10.9	Lower than 8
Pregnant women	11 or higher	10-10.9	7-9.9	Lower than 7

Management of mild or moderate anemia: The National CCM algorithm should be used at health post level whereas anemia should be treated after identifying its cause at the health center and hospital levels.

Management of severe anemia: Assessment of the clinical condition and parasite density is more important than relying on the Haematocrit/Hb level. The question "Does the patient need blood?" is more important than "What is the Hb?"

As a rule of thumb:

- If haemoatcrit is below 15% (hemoglobin less than 5g/dl) in a normally hydrated child or adult, a blood transfusion is indicated: 10 ml of packed cells OR 20 ml whole blood/kg of body weight. Follow national guidelines for blood transfusion.
- If the patient's life is threatened by anemia associated with acidosis, shock or high parasitemia, give packed cells or whole blood transfusion as soon as possible. Follow the national guidelines for blood transfusion.

REMEMBER: The volume of all blood products should be included in the overall fluid balance of the patient. The patient should be closely monitored during the blood transfusion and half-hourly general observations (BP, P, T, RR) should be recorded throughout the duration of the transfusion and hourly for four hours following a transfusion.

Fluid electrolyte and acid base disturbances

Patients with severe malaria often show clinical evidence of hypovolaemia and acidosis.

Hypovolaemia: presents with low jugular venous pressure, postural hypotension and oliguria with high urine specific gravity.

Acidosis: can be due to a relative shortage of oxygen in tissues occupied by sequestered parasites. This shortage of oxygen is made worse when there is hypovolaemia and/or severe anemia, as both of these conditions may impair the supply of oxygen to tissues. This lack of oxygen forces tissues to obtain energy by other biochemical pathways not dependent on oxygen; one result of this is the release of lactic acid, leading to metabolic acidosis. Drugs containing salicylates, often given to lower the fever, may exacerbate this metabolic acidosis.

Acidosis usually presents as deep breathing (not necessarily rapid) with in drawing of the bony structures of the chest wall, in the absence of localizing chest signs. Lactic acidosis is a common complication of severe malaria and both blood and cebrospinal fluid lactic acid concentrations are raised. Perfusion is improved by correcting hypovolaemia.

Clinical signs of severe dehydration (two or more of the following: decreased skin turgor (skin pinch goes back very slowly), change in mentation (lethargy/coma), dry buccal mucosa, dark urine, sunken fontanelle in infants or sunken eyeball.).

Management: Correct severe dehydration: 30 ml/kg over one hour for infants then 70ml/kg over 5 hours. Maintain fluid balance, monitor JVP, and maintain normotension. If there is concomitant anemia, transfusion is needed.

Acute renal failure

Acute renal failure – acute tubular necrosis – is a common complication in adults, but is rarely seen in children. It is worsened by hypovolemia and hypotension. It is highly preventable if fluid balance and blood pressure is maintained.

If a patient has oliguria, first correct fluid deficit and try to correct blood pressure, however if there is persistent oliguria (<17 ml/hour in adults: 0.3 ml/kg/hour in children) despite adequate correction of dehydration or hypotension, renal failure is present or imminent. Hiccup may be an indicator of advanced renal failure.

Management: Correct dehydration and maintain fluid balance, maintain normotension, monitor JVP, do peritoneal dialysis.

Pulmonary edema and Adult Respiratory Distress Syndrome (ARDS)

Pulmonary edema is a grave complication of severe malaria and has a high mortality rate. It may appear several days after chemotherapy has been started and at a time when the patient's general condition is improving and peripheral parasitemia is diminishing. It must be differentiated from iatrogenically produced pulmonary edema resulting from fluid overload (caused by poor management of the intravenous infusion). Monitoring respiratory rate, patient weights on a daily basis and daily fluid intake and output may assist in the clinical evaluation.

ARDS appears to be due to the direct effect of parasites sequestered in the lungs, possibly through release of cytokines. It is indistinguishable for pulmonary edema but both of these complications are unusual in children.

Clinical presentation: Hyperventilation (rapid breathing) is the initial manifestation, emphasizing the need to follow respiratory rate. Crackles are present on auscultation, and pink frothy sputum (severe cases).

Management: Position patient upright (sitting position), give oxygen therapy; give diuretics, e.g. furosemide 40 mg IV. If no response increase dose progressively to maximum 6mg/kg/day: assess the need for intubation and mechanical ventilation including positive end expiratory pressure (PEEP), perform regular suction (via endo tracheal tube or oral/ naso pharangeal airway).

Hemoglobinuria: Hemoglobinuria results from the rapid breakdown of red blood cells (massive intravascular hemolysis) in the circulation.

Clinical presentation: The urine is dark, and tests strongly positive for blood (Hb) but contains no red cells on microscopy. The plasma may also be dark because of the hemoglobin released from the red cells.

Management: Maintain hematocrit above 15%; monitor JVP to avoid fluid overload and hypovolaemia; if oliguria develops and blood urea and serum creatinine levels rise, consider peritoneal dialysis or hemodialysis; continue anti-malarial therapy.

Jaundice

Jaundice is more common in adults than in children and is due partly to hemolysis and partly to liver dysfunction.

Clinical presentation: Yellowing of the sclerae of the eyes or the frenulum of the tongue is quite commonly seen in severe P. falciparum malaria in adults, but is uncommon in children. Signs of hepatic failure are rare. Jaundice in malaria occurs at the same time as fever, unlike jaundice due to hepatitis. If jaundice is present, look for other complications.

Shock

Shock is due to inadequate cardiac output and poor tissue perfusion. In some patients, it may occur concurrently with bacteremia. Shock is not usually associated with malaria alone, and, therefore, additional bacteremia should be suspected.

Clinical presentation: Low blood pressure; feeble pulse; impaired tissue perfusion with cold clammy skin and peripheral cyanosis. In children delayed capillary refill is a useful sign; signs of dehydration.

Management: Maintain fluid balance, administer 20 ml/kg fluid bolus; check for bacteremia (blood cultures, WBC) give appropriate antibiotic, monitor vital signs.

Bleeding tendency

In P. falciparum malaria, the platelet count is typically reduced. Nevertheless, spontaneous bleeding is rare in both children and adults. When it develops, it results from disseminated intravascular coagulation (DIC).

Management: Check bleeding time of the patient, crossmatch blood, give whole fresh blood or platelet infusion as needed to correct blood loss and bleeding. See Table 6 for the frequency of these complications in adults and children.

24.2.5 Treatments contra-indicated in the patient with severe malaria

The following treatment should not be administered to patients with severe malaria:

- Corticosteroids and non-steriodal anti-inflammatory agents (ibuprofen, aspirin);
- Other agents given for cerebral edema (urea, mannitol);
- Low molecular weight dextran;
- Epinephrine (adrenaline);
- Heparin;
- Epoprostenol (prostacyclin);
- Pentoxifylline (oxpentifylline);
- Hyperbaric oxygen;
- Cyclosporine (cyclosporin A.).

24.2.6 Common errors in diagnosis and management of severe malaria

Common errors in the diagnosis and management of the patient with severe malaria can have a fatal outcome. Many of these errors and subsequent deaths can be avoided with diligence and awareness.

- The most common error is failure to consider malaria or severe malaria in a patient with either typical or atypical illness;
- Failure to elicit a history of malaria exposure, i.e. recent travel history, from the patient or relatives;
- Failure to identify P. falciparum in a dual infection with P. vivax or to recognize mixed morbidities (malaria and influenza or viral encephalitis, hepatitis typhus, etc.), especially failure to diagnose other associated infections (bacterial or viral respiratory diseases);
- Failure to calculate quinine dose based on body weight and giving the same dose for all adult patients;
- Failure to monitor the rate of quinine infusion;
- Failure to recognize respiratory distress (metabolic acidosis) or hypoglycemia in a patient with severe malaria;
- Failure to perform ophthalmoscopic examination for the presence of papilloedema and retinal hemorrhages;
- Failure to monitor fluid balance.

24.2.7 Nursing care

Nursing care of the patient with severe malaria is of vital importance as this can directly affect patient outcome. The patient with severe malaria requires 24-hour meticulous nursing care. Such care can be lifesaving especially for the unconscious patient. For optimal follow-up and favorable outcome, the patient should be strictly monitored by using the observation chart **(Annex M).**

In the unconscious patient: Maintain a clear airway. The patient with a reduced level of consciousness is more likely to have a compromised airway as the tongue falls into the back of the mouth. Comatose patients are prone to chest infections and aspiration of fluid into the lungs therefore it is vital that a clear airway is maintained. This is achieved by nursing the patient in the semi prone or recovery position as seen in **Figure 10** below.

Figure 9. Semi-prone or recovery position

Guedal airways (see Figure 11) can be very useful in maintaining a clear airway, especially if the jaw is small or there is some other oro-facial abnormality. It is important the correct size of airway be used. Choose an airway that reaches the angle of the jaw (Figure 11) when the flange is under the nose, and make sure it passes over the tongue and does not merely push the tongue further back. Put the airway into the mouth in the way you want it to lie after insertion. In the pediatric patient, do not turn it round during insertion as is generally done when using such an airway in an adult patient.

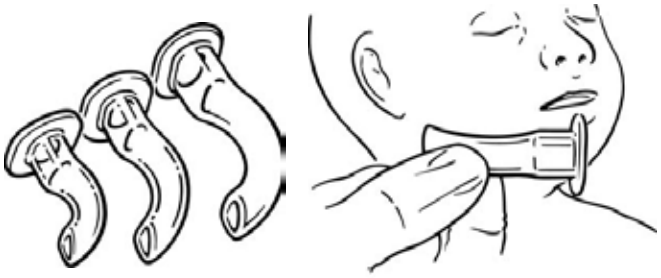


Figure 10. Various sizes of Guedal airway and choosing the correct size

A. Aspiration pneumonia is a potentially fatal complication; the risk of this occurrence can be reduced by:
   - Nursing patient in semi-prone or recovery position;
   - Performing suctioning as necessary to remove secretions;
   - Frequent turning of the patient (twice hourly) paying attention to pressure points when doing so;
   - Administering physiotherapy;
   - Giving antimicrobials as prescribed by the physician;
   - Insert NG tube for feeding and to minimize risk of aspiration pneumonia.

A. Maintaining a strict balance of all fluids going in and out of the body. It is vital to monitor the frequency of the fluid intake, intravenous fluids; blood products, NG feeds to ensure they are running according to schedule and that they are not running too slow or too fast.
   - Monitoring and recording ALL crystalloid fluids going into the patient.
   - Mismanagement of IV fluids can have fatal effects on the severely ill patient especially in the pediatric patient as procurement of 250 ml bottles of IV fluids or less is often difficult. Fluid overload can result in fatal pulmonary edema; on the other hand, fluid deficit can result in acute renal failure. For this reason, care should be taken when administering IV fluids and drug infusions and fluid intake should be equal to output. IV fluids and drug infusions should be given via a burette (Figure 12). If burettes are not available the nurse should either:
     - Measure off the bottle of fluid with tape or a marker pen so that the drip may be turned off once the required amount has been infused.
     - Remove excess fluid from the bottle so only the required amount remains in the bottle (this may be seen as wasting IV fluids but can save lives).

Fluids that should be considered into the overall fluid balance of the patient include:
   - IV fluids;
   - NG fluids;
   - IO (intraosseous) fluids;
   - Oral fluids;

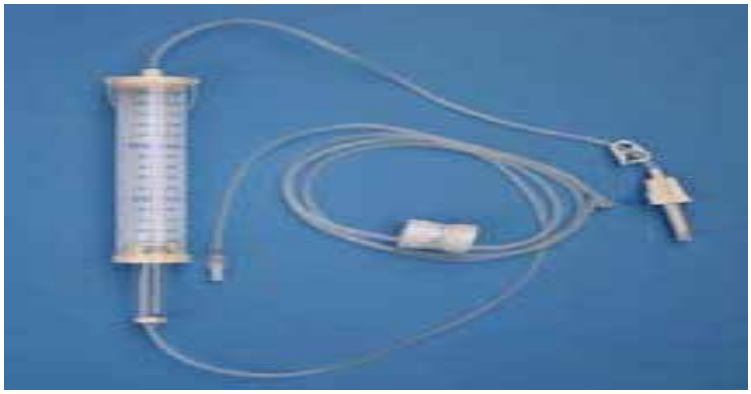


Figure 11. Burette for administering IV drugs and infusion

   - Monitor and record all colloid fluids going into the patient, including:
   - Whole Blood;
   - Packed cells;
   - Other blood products (e.g. albumin, platelets);
   - Haemaccel or gelofusin.

Calculating drip rates
   - 1 ml = 20 drops in standard giving set
   - Drops / min = ml/hr with a standard giving set
   - With a micro-dropper infusion giving set 1ml = 60 micro-drops
   - Monitor and record all colloid fluids going out of the patient, this includes consistency of the fluids (if containing blood, dark 'coca cola urine', mucous, bile stained, etc.) including:
     - Urine;
     - Vomit;
     - NG aspiration;
     - Excessive blood loss (pay attention to pregnant women);
     - Excessive sweating;
     - Bowel movements (include episodes of diarrhea); and
     - Insensible loss.

B. Monitor and record vital signs and level of consciousness. This should be done according to the condition of the patient, reducing the frequency as the patient shows signs of improvement. Vital signs include:
   - Temperature, pulse, blood pressure, respirations, if convulsions and level of consciousness (Glasgow Coma Scale or Blantyre Coma Scale) (Annex K and L);

- If temperature is higher than 39°C give paracetamol as prescribed (Annex N) and try to cool the patient by:
  - Tepid sponging;
  - Fanning the patient.

Family members can assist with reporting any changes in level of consciousness, occurrence of convulsions or changes in behavior pattern of the patient. All such changes suggest developments that require additional treatments.

C. It is imperative to the patient's outcome that all medicines, fluids, investigations are provided as prescribed or ordered by the attending physician. Ensure you:
   - Give all drugs as prescribed;
   - Give all fluids/nutrition as prescribed;
   - Ensure patients receive all medical tests requested and that medical orders are carried out.

D. Monitoring and recording: This is of vital importance when managing the severely ill patient. Ensure that:
   - All drugs on the patient chart are recorded, providing the date, time and quantities given(Annex M);
   - All fluids going in and out or the patient (see Number 3 above) are recorded;
   - The times when all tests are performed is recorded and all results are noted in the patient notes;
   - Vital signs are recorded (see Number 4 above);
   - The general condition of the patient throughout a shift is recorded;
   - All correspondence and communication regarding the patient is signed and dated.

E. Other points for general nursing care of the unconscious or severely ill patient:
   - Maintain the patient's dignity at all times;
   - Ensure the patient is clean. Do not allow the patient to lie in a wet or soiled bed, this can lead to breakdown of the skin and pressure sores;
   - Using 0.9% normal saline, perform every 4 hours care for the patient's eyes and mouth using patient tooth brush or mouth swabs (if available) to ensure mucous membranes remain moist and intact;
   - If the patient is unable to close his eyes spontaneously, consider lightly taping the eyes closed to prevent corneal dryness and scarring;
   - Perform two hourly turns (changing position) on the unconscious patient to prevent pressure sores from developing;
   - If urinary catheter in place, care for the catheter every 4 hours;
   - Perform physiotherapy as prescribed;
   - Perform passive movements 'leg, foot, arm, hand exercises' to prevent joint stiffness, deep venous thrombosis and muscle atrophy.

25. Management of Malaria in Special Groups

25.1 Pregnant women

Malaria in pregnancy is associated with premature labor, low birth weight, anemia, and, in low-transmission areas, the risk of development of severe malaria is high. Therefore, pregnant women with symptomatic acute malaria are a high-risk group and must promptly receive effective anti-malaria treatment. The first-line treatment for P. falciparum infection in pregnant women in the first trimester of pregnancy is oral quinine administered at 10 mg/kg salt or 8.3 mg/kg base (up to 600 mg quinine sulfate salt or 542 mg quinine base) three times a day for seven days (Annex G) for recommended dosage). The first dose should be given under the direct supervision of the health worker. If vomiting occurs within half an hour of the patient swallowing the medicine, the dose should be repeated and the health worker/pharmacist should provide the patient with a replacement dose to ensure completion of treatment.

AL is indicated in first trimester pregnancy only if this is the only treatment available for P. falciparum malaria; oral quinine is preferred for patients with first trimester pregnancy. If pregnant women have P. falciparum or mixed infection and are in their second or third trimester, they will be treated with AL.

Pregnant women with only P. vivax will be treated with chloroquine in all trimesters (Annex B). Primaquine is contraindicated in all trimester of pregnancy and lactating mothers during the first 6 months.

The recommended treatment for severe malaria in all patients including pregnant women is artesunate injection (Annex I), or alternatively artemether IM during the second and third trimester (Annex J) or alternatively quinine infusion if both of these are unavailable. Special precaution should be taken to prevent hypoglycaemia in pregnancy. Mefloquine as prophylaxis is contraindicated during pregnancy. Intermittent preventive treatment (IPTp) with SP is not recommended in Ethiopia.

25.2 Children<5 kg body weight

AL is recommended in children below 5 kg of body weight. For infants less than 5 kg of body weight, treat uncomplicated P. falciparum malaria with AL at the same mg/kg body weight target dose as for children weighing 5 kg Chloroquine is a safe drug that can be used in all children with only P. vivax infection (Annex B).

25.3 HIV

Treatment of malaria is similar in HIV-infected and HIV-uninfected patients. There is limited information regarding drug interaction between anti-malarial and anti-retroviral drugs. Pharmacovigilance is recommended to document observed interactions.

26. Adherence to Treatment

Adherence to malaria treatment is necessary for successful malaria treatment outcome. Poor adherence to treatment is one of the factors associated with the development of malaria drug resistance and can contribute to ongoing transmission of malaria. All health workers should thoroughly assess patients with malaria to determine which are at risk of poor adherence and ensure that high-risk groups are taking the medication properly. Health workers should ensure that patients are receiving the recommended drug regimen to treat malaria and use best practices and interventions that aid people in taking the correct treatment to maximize their effectiveness. The goal of malaria case management is to provide psychosocial support along with effective clinical treatment.

Adherence to malarial medication is related to knowledge about malaria, access to information on medication for malaria, and the perceived benefit of taking antimalarial medication. Good communication between healthcare workers and patients is critical to the treatment adherence

26.1 Identifying high-risk patients

During clinical history taking and clinical assessment, patients with suspected malaria should have a laboratory RDT/microscopic investigation to confirm

malaria diagnosis and determine the optimal treatment plan. A psychosocial assessment should consider barriers to adherence with medications and treatment plan. The following variables have to be assessed to label that the patient requires intensive or assertive care.

Table 7. Variables to assess high-risk patients

No	Clinical/social indicators for non-adherence	(X)
1	Patient with chronic medical issues (TB/HIV, HTN)	
2	Lack of transportation	
3	History of psychiatric conditions	
4	Lack of economic support	
5	Pregnant mothers	
6	History of poor drug adherence for anti-malaria treatment (if s/he had previous malaria infection)	
7	Other (specify)	

Intensive case management refers to patients requiring close follow-up by clinicians at the health center level or HEWs at the health post level.

Assertive case management refers to patients requiring support of family members or community health promoters. Variable numbers 1, 5 and 6 can be categorized as intensive case management.

26.2 Role of health workers in managing patients at high risk for poor adherence

Along with malaria treatment, health workers will provide psychosocial support, adjust the treatment plan to account for these potential barriers and arrange an enhanced follow up schedule for patients who are at risk of poor adherence. All patients who are not improved within three days require further clinical assessment and should be referred to a higher level of care for definitive diagnosis. Patients treated at the health center level are referred to HEWs for follow-up for uncomplicated malaria. HEWs (for patients investigated at the health post level) will conduct the follow up by themselves or link the patient to community volunteers and other health promoters or family members. Family members, caretakers, friends or relatives play the role of adherence supporter. During the first contact, when the patient becomes an identified as a case of malaria, the following actions and key messages should be conducted at the facility level:

- Ensure that the first dose of malaria treatment is received at the health post/health center premises and is well tolerated and not immediately vomited;
- Visit the patient at least on the second day of treatment and ensure that the patient takes the drugs properly (this can be aligned with the routine home visit of HEWs);
- Make sure that the appropriate drug package was dispensed properly and collected from the pharmacy or health post;
- Link patient follow-up to volunteer community health promoters or family members when appropriate.

26.3 Key messages and instructions

The problem of poor treatment-seeking behaviour and treatment adherence may be overcome with appropriate SBCC messages even when the majority of individuals are illiterate and lack formal education. Additionally, health worker should clearly explain malaria diagnosis and treatment, e.g. making patients understanding drug labels and instructions. SBCC messages should include the following:

- Malaria is a killer disease if treatment is not sought early and treatment is taken properly.
- Whenever a family member has a fever, take them to the nearest health facility, immediately or at least within 24 hours.
- Do not interrupt taking medication. Take all (full course) of the anti-malarial drugs, prescribed by health personnel.
- Do not share drugs with others, including family members.
- Come back to the health facility after three days if no improvement in symptoms after malaria treatment or any time if there is worsening of symptoms.

Messages should be completed by other SBCC messages on prevention and control, including:

- All family members, especially the patients with recent malaria infection should sleep under LLINs every night.
- Give priority to pregnant women and children under five years of age to sleep under LLINs every night.

27. Chemoprophylaxis

Persons who travel to malaria-endemic areas are at risk of acquiring malaria. Health workers should advise all persons traveling to such areas to avoid mosquito bites, specifically by using mosquito repellent and sleeping under LLINs at night. Chemoprophylaxis is an option and mefloquine and atovaquone-proguanil can be used as anti-malarial chemoprophylaxis in Ethiopia. (Annex O and refer to WHO travel health guidelines).

28. Pharmacovigilance

Pharmacovigilance is the science and activity of detecting, assessing, understanding and preventing the adverse effects or any other possible drug-related problems, such as substandard medicines, medication errors, lack of efficacy reports, use of medicines for indications that are not approved and for which there is inadequate scientific basis, case reports of acute and chronic poisoning, assessment of drug-related mortality, abuse and misuse of medicines and adverse interactions of medicines with chemicals, other medicines, and food. The rationale towards the importance of this activity is the limitation of drug safety information obtained during the initial premarketing phases of drug development.

In order to maintain safety and prevent the public from injury because of the use of medicines at large, a national adverse event monitoring system or pharmacovigilance is necessary. In Ethiopia, a pharmacovigilance center was established in 2002 and is situated at the Food Medicine and Health Care Administration and Control Authority. This important activity is carried out through the active collaboration of various stakeholders and partners, including health providers, health facilities, academic institutions, drug manufacturers, professional associations, consumers and the media. To help carry out these lifesaving activities the pharmacovigilance center has developed an adverse drug event guideline and yellow page postage prepaid reporting form to be used by all health providers in the country to report suspected drug-related injuries, including anti-malaria drugs, observed and suspected to be caused as a result of using modern drugs, traditional and complementary drugs, blood products, biological, vaccines, medical devices, medicated cosmetics and any other chemicals. It is clearly stated in the report form **(Annex P)** what and to whom to report these instances. It is also possible to report drug reactions directly by telephone (011 552 3142, 011 552 3205) and via email by downloading the reporting form that is available at http://www.fmhaca.gov.et. Experts will analyze each individual report and measures will be taken based on the information obtained to protect drug-related injury.

Section 3

MALARIA SURVEILLANCE

29. Introduction

29.1 Surveillance

A surveillance system consists of the tools, procedures, people and structures that generate information on cases and deaths, which can be used for planning, monitoring and evaluating disease programs. Moreover, having a strong surveillance system will help programs direct resources to the populations most in need and respond to unusual trends, such as epidemics or the absence of a decrease in the number of cases despite widespread implementation of interventions.

Similarly, an effective malaria surveillance system enables program managers to identify the areas or population groups most affected by malaria; identify trends in cases and deaths that require additional interventions; and assess the impact of the different control measures. In short, a strong surveillance system helps in monitoring progress of malaria control and avoid wastage of resources.

Objectives of surveillance:

- To predict epidemics, which will help in making the necessary preparation and abort the occurrence of epidemic
- To detect epidemics/outbreaks promptly and be able to control timely
- To monitor trends of priority diseases so that changing trends inform policy decision
- To evaluate effectiveness and efficiency of an intervention and be able advice policy makers

Ethiopia uses an integrated disease surveillance system in which various surveillance activities become integrated into one system within the broader national health system. It also emphasizes all functions of surveillance activities to be carried out using similar structures, processes and personnel. It is clear that surveillance could not be carried out for all diseases and conditions; therefore, priority should be given to those diseases that are of interest at national and international levels. Accordingly, in Ethiopia, 20 diseases (13 immediately reportable and 7 weekly reportable) are selected to be included into the routine surveillance at the moment. Malaria is one of the weekly reportable diseases.

Functions of surveillance:

Surveillance system is composed of 5 functional components, case detection, recording, analysis, reporting and response (epidemic response). Each component is discussed below.

29.2 Case detection

Detection of the case is logically considered as the first component of disease surveillance. It can be passive or active.

Passive case detection is defined as the regular and periodic collection of routine data from case reports or registers of health care facilities in which patients seek health care at their own discretion. Passive case detection can also include mobile health services at defined posts, additional fixed health posts in high-transmission or problem areas and treatment in community-based programs at which patients seek care by themselves. Passive case detection is the usual method when a program aims in controlling but not eliminating disease.

Active case detection on the other hand involves searching for malaria cases and diagnostic testing at the community or household level by health workers on regular or occasional visits. Testing may be confined to patients with fever, or everyone may be tested (mass screening). Active case detection can be done to fill gaps created by relying on passive case detection systems (e.g. to detect cases in populations with limited access to services, such as migrant populations). This is sometimes known as 'proactive' case detection, in which a population is examined even though there may be no evidence of confirmed cases. Active case detection may also be undertaken in response to a confirmed case or cluster of cases, in which a defined population potentially linked to a confirmed case is identified, and symptomatic cases are tested (possibly with RDT then by blood slide for confirmation) as well as asymptomatic cases (by blood slides only). This is sometimes known as 'reactive' case detection. Active detection is very essential when program aims at elimination of a disease/malaria.

29.3 Recording

Communities and health posts

A register should be kept by community health workers and health posts that records, for each attendance, the date of attendance, patient's name, village of residence, sex, age, whether it is a new attendance or repeat visit for the same episode of illness and the malaria test result, diagnosis and treatment given. Such information will allow community health workers or staff at health posts to identify the epidemiological characteristics of malaria in their area (such as the age and sex breakdown of cases and the locations in which most cases originate). In low transmission settings, travel history and work location may help identify sources of infection. The register should indicate any cases that are subsequently referred.

Health centers and hospitals

Outpatients: A register should be kept at health facility level for each outpatient attendance, which records the date of attendance, patient's name, residence, sex, age, whether it is a new attendance or repeat visit for the same episode of illness, initial diagnosis, type of malaria test, test result, final diagnosis and treatment given. This information will enable staff at the health facility to identify the epidemiological characteristics of malaria in their area (such as the age and sex breakdown of cases and the locations in which most cases originate). In low transmission settings, travel history and work location may help identify sources of infection. The register should include cases for which the patient is subsequently admitted; attempts should also be made to include inpatients who bypass the outpatient department, so that a complete record is kept of all cases attending the health facility. As outpatient registers are used for all outpatients, and not just people with malaria, the existing registers may have to be modified to allow for collection of this information, by the addition of columns or changing column headings.

Inpatients: Health facilities should maintain inpatient register which should contain the date of admission, the patient's name, residence, age, sex, diagnosis, length of stay and reason for leaving (discharged, died, transferred, escaped and discharged against medical advice). This information should be abstracted from the patient's file and put on the register by the health care worker managing the patient or if available and feasible by appropriately trained staff.

29.4 Analysis

Collected data if not analyzed will remain a meaningless number but if analyzed will be a source of vital information for health care providers, program managers and policy makers. Health care providers and program managers need to be aware of the data analysis values and receive basic training on data analysis. The value of analyzed data at the site of generation for continuous program and service improvement should be emphasized and reporting of data without analysis should be discouraged at all levels. In the initial phase of malaria control in high-transmission settings, there are so many malaria cases hence, is not possible to examine and react to each case individually; rather, much analysis is based on aggregate counts of cases and deaths, and action is taken at a population level, e.g. deciding which populations would benefit from additional measures, such as indoor residual spraying. The counts might, however, have to be adjusted to take into account population size, diagnostic activity or other factors, thus transforming numbers into 'indicators', so that they provide more meaningful information. The following indicators are particularly useful for malaria surveillance in the control phase.

- Number of confirmed malaria cases per 1000 population per specified time
- Number of inpatient malaria cases per 10 000 population per specified time
- Number of inpatient malaria deaths per 100 000 population per specified time
- Percentage of suspected/fever cases receiving a malaria diagnostic test per specified time
- Malaria test positivity rate (RDT and/or slide positivity rate)
- Percentage of cases due to P. falciparum
- Percentage of inpatients with a discharge diagnosis of malaria
- Percentage of inpatient deaths due to malaria

29.5 Reporting

Ensuring reliable reporting of surveillance data throughout the country is important so that program managers, surveillance officers and other health care staff can use the information for action. The routine flow of surveillance data is usually from reporting sites to the next level up to the central level. The community and health facilities especially health posts are the main source of information. The information collected from this site is compiled in standard forms, analyzed and then forwarded, to the Woreda health office. Woreda level uses standard

formats to compile aggregate, and send the data to zone/region, from which the central level receives. Feedback and information sharing will follow the same route. Report all tested and confirmed (Pf, Pv, Mix) cases of malaria on a weekly basis. If the epidemic threshold is surpassed then start reporting on daily basis.

29.6 Malaria epidemics

Malaria epidemics are the occurrence of number of cases above what is expected in a place and particular period. They are sometimes hard to distinguish from usual seasonal patterns of malaria. Malaria epidemics can be one of the most serious public health emergencies. They may occur with little or no warning and may challenge the health system to prevent or effectively respond to the problem. Malaria epidemics may strain health facilities and systems, and cause public outcry resulting in intense political pressure for rapid and decisive intervention.

29.7 History of malaria epidemics in Ethiopia

A devastating malaria epidemic occurred in 1958, involving about three million cases and 150,000 deaths, and covering about 100,000 square miles (259,000 square kilometers) of highland area. Since 1958, major epidemics of malaria have occurred at approximately 5-8 year intervals. However, between1990s and early 2000s, there has been a trend towards smaller-scale, more frequent, sporadic epidemics and seasonal case build-ups. Nonetheless, in 1998 a widespread severe malaria epidemic occurred in most highland as well as lowland areas in the country. Moreover, localized but severe outbreaks of malaria occurred in Amhara and SNNP Regional States, leading to widespread epidemic malaria in highland and highland fringe areas (up to 2,300 meters) in 2003. Since 2003, however, there has not been any major malaria epidemics in the country.

29.8 Causes of epidemics

Malaria epidemics can occur because of variability or changes in the rate of infection and population immunity. Generally, epidemics can occur in places where there is low and unstable malaria transmission, and where people have low or no immunity. However, there could be epidemics in high transmission areas if there is deterioration of health system, interruption of anti-malarial measures or migration of non-immune individuals, such as population movement in search of labor to these areas. Other triggering factors include:

- Unusual local weather phenomena and activities resulting in environmental modification that increase vector population;
- Increased vulnerability of population due to famine and malnutrition;
- Interruptions of anti-malarial measures which have kept malaria under control;
- Resistance to anti-malarial medications and/or insecticide used for vector control.

29.9 Prediction and prevention of epidemics

Predicting epidemics from early warning signs (climate predictions) is not yet very accurate. Epidemics can, however, be cut short and the effects reduced. Epidemic precipitating factors should be monitored regularly. If an epidemic seems likely, we can strengthen health promotion, implement preventive measures, and strengthen surveillance and detection systems as well as stock adequate case management supplies to cut the epidemic short.

29.10 Detection and control of epidemics

In most instances epidemic conditions build-up over several weeks, allowing some time for effective detection and mitigation in the early stages. The most important factor in reducing impact of an epidemic is to take effective control measures as soon as the epidemic or case build up episode is detected. It is always important to ensure adequate supplies of RDTs, ACTs, sdPQ and chloroquine. Among the most important actions is notifying healthcare supervisors by telephone or other means as soon as possible about the status of these supplies and the anticipated number of days left of remaining supplies so that these can be replenished before facilities run out of them. It is also important to report the number of RDT positive/laboratory confirmed malaria cases by species.

Patients within the malaria transmission area affected by the case build-up or epidemic should be urged to promptly seek medical care and malaria treatment whenever they get ill with fever, to take anti-malarial medications as prescribed, and to use LLINs properly. Such rapid response depends on effective surveillance systems. The longer an epidemic goes undetected without effective control measures, the higher the potential cost in terms of morbidity and mortality.

30. Epidemic Forecasting and Early Warning

With the move to universal coverage of interventions, i.e. blanket coverage of major interventions in all risk areas, equity is no longer a major problem. Additionally, major malaria epidemic is not expected once a universal coverage is achieved and maintained. Therefore, the role of early warning gradually will shift to monitoring, and detecting trends in drug and insecticide resistance, as well as overcoming challenges to universal coverage, such as non-use and non-adherence to interventions and failure to maintain supply chains. A distinction between forecasting and early warning systems and how these tools could be utilized will be discussed in the following section.

30.1 Forecasting

Forecasting refers to predictions based on seasonal climate forecasts that are available two to four months or so in advance of the main transmission season. These forecasts are generated by several climate outlook forums and can predict overall likelihood of whether a particular rainy season will be above or below average.

Forecast information on major climate variability with global-scale consequences, such as those precipitated by el Niño, could be utilized for early warning, and inform decisions on preparedness and proactive interventions throughout the health system. The HMIS/PHEM and its infrastructure is responsible for archiving as well as monitoring this type of data. Based on warning signs, responsible unit will issue alert and trigger appropriate response.

Some examples for sources of seasonal forecast information at different scales that are relevant to Ethiopia are listed below:

i) Global level: Columbia University's International Research Institute seasonal forecasts: located at http://iridl.ldeo.columbia.edu/maproom/.IFRC/.Forecasts/
ii) Regional level: IGAD Climate Prediction and Applications Center climate outlook forum for the Great Horn of Africa located at http://www.icpac.net/
iii) National level: Ethiopia Meteorological Services Agency (NMA) and its regional branches for more localized information located at http://www.ethiomet.gov.et/index.php?Page_No=4.8&Category=Climatology&Type=Monthly&item=6

30.2 Early warning

This is a continuum of forecasting and refers more to direct indicators of an impending epidemic, including the amount of rainfall in a local area. The lead-time is about 1-2 months. With abnormally high amounts of rainfall or conversely, if there is unusually low rainfall and drying of usually flowing rivers, increased mosquito breeding and malaria cases are likely in the subsequent month or two. This is often sufficient time to stock supplies and perform additional SBCC or vector control activities. Because rainfall is so variable, such early warning is only possible on a local scale. The drawback is that it requires measurement and distribution of rainfall amounts and anomalies on a rapid schedule. If abnormal rainfall is followed by an increased larval or adult mosquito density, the likelihood that an epidemic will occur is high. Entomological indicators, particularly mosquito density, can be used for early warning of malaria epidemics with a good level of accuracy, but with shorter lead-time for prevention.

31. Sources of Early Warning Information

The PHEM could raise warning "flags" signaling the need for increased level of alertness, preparedness and proactive interventions. For proper data archiving, monitoring and analysis and interpretation, the HMIS/PHEM should work with local, national, regional and international sources dealing with climate and health issues, National Meteorology Agency (NMA) and its regional branches, including local weather stations for actual rain, temperature and humidity reports.

Flag level 1: This signals strengthening preparedness at higher scales at federal and regional levels.

Flag level 2: Advanced level of warning signaling development of focused plan of action for integrated interventions.

Flag level 3: Final level of warning signaling implementation of plan (operation).

32. Epidemic Preparedness

Preparedness includes trained human resources, diagnostics, anti-malarial drugs, supplies and insecticides. District level or health center level contingency operational funds and essential anti-malaria commodities should be allocated for malaria epidemic control. As a rule, an additional 25% of the annual drug requirement should be kept as contingency at the above-stated levels, since there is always uncertainty regarding where the epidemic will occur. However, based on the recent drugs consumption data and caseload information, the FMOH/NMCP believes a 10% contingency will be suffice in the country's context to deal with any unprecedented emergencies. The contingency AL must be rotated back into normal stocks within one calendar year to avoid expiry of the drug. The additional 10% need only to be spent until a verified malaria epidemic occurs, following the response to an epidemic, the contingency stock would have to be replenished. Stocks of AL that are shared with neighboring districts in an emergency or an outbreak should be the items that are closest to expiry, since these medications will likely be consumed almost immediately. Essential consumable contingency supplies (drugs, diagnostics supplies and insecticides) for epidemic management include:

For health posts (can be kept at health centers):

1. Chloroquine tablets
2. Chloroquine syrup
3. AL tablets
4. AL dispersible
5. Quinine tablets
6. Single dose primaquine (sdPQ)
7. Rectal artesunate
8. Malaria epidemic monitoring charts
9. Multi-species RDTs
10. Bench aids for appropriate use of RDTs
11. Kebele maps with 1 km^2 grids

For health centers or at other higher levels:

All of the above listed minus items 7-11

1) Quinine tablets
2) Quinine injection
3) Microscope slides and functional microscope
4) Slide's rack
5) Lancets
6) Safety box (to dispose of used lancets)
7) Timer
8) Giemsa stock solution
9) Immersion oil
10) Cotton wool
11) Alcohol, denatured
12) Insecticide for IRS
13) LLINs
14) Temephos 50% EC
15) Spray pumps and accessories
16) Artesunate injection (intravenous or intramuscular): requires 5 ml Normal Saline for final dilution

The amounts of contingency supplies to be kept at each level must be determined in consultations with the FMOH /NMCP and PFSA), regional, zonal, and district offices. Contingency supplies must be transported to the various levels well in advance. All

RHBs and woredas should plan, request and budget the amount of contingency supplies required at each level as accurately and realistically as possible. This is part of the annual malaria commodity planning process.

All levels of the public health system should report at least monthly to higher levels the status of their inventories of critical supplies such as numbers of AL treatment doses in inventory (as well as expiry status) so that these may be reallocated quickly when acute shortages arise, beginning at districts closest to the outbreak. The persons with authority to release supplies when needed, and the triggers for such release, must be clearly defined.

33. Epidemic Prevention

33.1 Targeting areas for epidemic prevention

To plan specific preventive measures involves identifying epidemic-prone areas, particularly 'high epidemic risk' kebeles, i.e. hot spots, while keeping in mind that any malaria-endemic area may experience an epidemic. 'High epidemic risk' kebeles are those that show a large variation from one year to another in the number of malaria cases. These can be identified from previous malaria morbidity records and seasonal transmission patterns. Health offices should be aware of supplies anticipated for delivery during the next year. In addition to the actual case numbers, classifications could be based on estimated entomological inoculation rates and parasitemia prevalence, rainfall, elevation, and other factors if available. Epidemic prevention also depends on close monitoring of the epidemic's precipitating factors described above, such as movement of non-immune people into malaria-endemic areas, development activities in malaria-endemic areas, and mass emergencies.

33.2 Methods of epidemic prevention

IRS is an important preventive measure. Appropriate targeting and timing is essential in order to have a significant effect on prevention of epidemics and reduce the incidence of transmission. IRS should be applied prior to the transmission season or the anticipated epidemic (or as soon as possible in emergencies).

Malaria hotspot woredas, resettlement and development areas with labor forces, refugee camps and areas under complex emergencies within malaria-endemic zones are priority areas considered for LLIN intervention with complementary IRS. This must be supplemented with SBCC activities encouraging LLIN use, early treatment seeking and acceptance as well as cooperation in making IRS operations successful.

34. Epidemic Detection and Mitigation

34.1 Epidemic detection

In this guideline, two methods of epidemic detection are described. Method 1 is the classic method, based on norm charts and thresholds. This is currently recommended and probably will continue to be used for some time in areas of higher–moderate transmission. Method 2 (cluster mapping) will be applicable, as malaria incidence and transmission in an area falls to low levels. Such cluster mapping method will improve management of the relatively few clusters of malaria infection that remain within communities. Action to be taken, which should be immediate, is described together with each detection method in two flowcharts.

In a strict sense, an epidemic of malaria is defined as a situation when the number of malaria cases is in excess of the normal number at a specific period of time and place. Therefore, the "normal" expected number has to be estimated. One way to do this is by using past weekly data of up to five previous years to construct a third quartile (second largest number) threshold line in an epidemic monitoring chart (Method 1). In the absence of data, HEWs and health workers will collect data and report to the next higher level the evidence of a case build-up, the apparent population and areas affected, and the status of remaining malaria treatment supplies.

It is best to anticipate and avoid stock-outs as soon as possible, backed up with reporting of confirmed malaria caseloads per week and remaining supply inventories.

Many, if not most, malaria illness in Ethiopia probably represents micro-clustering of local malaria transmission near a home, whereas isolated non-clustered infections might represent importations or relapses (though possibilities of indigenous transmission should be scrutinized and ruled-out). Local "micro-clusters" of malaria infections are defined as three or more indigenous cases of malaria of the same species occurring in homes within 1 km distance of one another within a 28-day interval, indicating probable local transmission. These should be detectable early by the HEW at the health post, when approximate map sector locations of homes of ill persons with malaria are systematically documented in malaria registers along with date of illness (Method 2).

One or more malaria micro-clusters probably occur in many kebeles, especially during peak transmission seasons. There may be several malaria micro-clusters (or micro-foci) detected within a kebele at the same time. Sometimes several sectors with micro-clusters will be adjacent to each other. The micro-cluster with the most malaria cases detected within the 1 km sector in the last month has the most intense recent local malaria transmission compared to other micro-clusters. We can predict that for the next 28 days in the future, new malaria cases are most likely to be detected from homes within 1 km of the most intense malaria micro-clusters or nearby the most newly detected micro-clusters.

The key principles of epidemic detection and action (using any detection method) are:

i) Defining epidemics according to a particular period of time and area (usually health facility catchment area). The basic unit of time is a week; epidemics in Method 1 are defined according to a weekly threshold, while Method 2 uses a time window of up to four weeks.
ii) In both cases, taking actions to avert the epidemic should be as soon it is detected.
iii) Both methods use a combination of active surveillance and other containment actions (e.g. promoting LLIN use, other vector control, requesting supplies and further support if needed) once an epidemic has been detected. Method 2 provides an evidence basis for SBCC efforts and other resources focused on areas within the kebele with the most intense recent malaria transmission, i.e. malaria "micro-cluster" hotspots localized to within 1 km sectors.
iv) There is no need to wait for formal confirmation of an epidemic before starting active surveillance and containment actions. Epidemics, which spread beyond the kebele or woreda level, may need further support and confirmation from zonal, regional or national levels to release additional resources supplies.

34.2 Method 1: Norm charts and thresholds

To establish a threshold for 'normal' for any given week, the health facility's past data by week should be compiled and a threshold determined using the 'third quartile' method. Current data may then be compared with the threshold. If an increase above the weekly threshold is observed, it implies that there may be an epidemic.

Under Method 1, an epidemic is defined as "The occurrence in a health facility catchment area of cases of an illness, clearly in excess of normal expectancy".

Definition involves clear time, place, and person
For this, we need to know:

1. Where? Which health facility catchment or other defined area
2. When? What time period ("occurrence")
3. What is "normal expectancy" for that area and time period?
4. What do we mean by "cases" (case definition)? How many of these and what proportion tested have malaria by RDT or microscopy?
5. What is regarded as "excess"?
6. Who has become ill?

"How to know" is defined here:

- **Health post or kebele:** is the smallest administrative/operational unit to monitor and will be defining epidemics in its catchment area. Hence, recording the address of people in registers is mandatory, as people from other catchment area may prefer your facility for various reasons (e.g. proximity, availability of drugs). Catchment area population may appear

to change due to temporary malfunctioning of adjacent facilities or because of newly created facilities. However, district health offices, health centers (primary health care units) can also monitor malaria trends using kebele-level disaggregated data, since aggregated data might mask what is happening in individual kebeles. **Period:** the week is the primary time unit. 'Week' is defined in a standard way by WHO week number **(Annex T). Normal expectancy** is defined based on that same case definition, catchment and week in previous years. We have two choices, depending on what information we have.

"Normal" is:

- The third quartile (second highest number from the five previous years' data for that week);
- The previous year's number of cases in that week multiplied by two.
- **Case definition:** Choose ONE indicator as the primary one for defining epidemics. Ideally, it would be CONFIRMED malaria cases (either as evidenced by a positive RDT or a positive microscopy slide) in all age groups. If confirmation is not possible in your location then use clinical malaria cases, but these must be classified as presumptive malaria (not parasitologically confirmed). The threshold must be based on the same indicator, which is the most challenging requirement of Method 1, since often at facility-level that malaria cases are diagnosed both clinically as well as parasitologically based on the availability of RDTs or microscopy at facilities.
- **Excess:**
  - If you have five years' previous data (all years must be normal years, without an epidemic), you can definitely determine that when malaria cases exceed the third quartile number (or line on the chart) then there is an epidemic for that week.
  - If you have less than five years' data, you can say that any number of malaria cases more than double the number in the same week of last year's data is an epidemic.

Note: In a strict sense, if no historical data (the last 5 years) is available at all for the catchment area, an epidemic cannot be detected, since there is no known "normal". However, an alarmingly rapid rise in cases or mortality can be detected by doing a week-to-week comparison of case registers. Consult your supervisors if you subjectively judge there is an unusual situation, especially if you are nearing a malaria commodity stock-out situation. In consultation with your supervisors, you can raise the alarm and start case management and control measures. However, note that proportions and percentages based on small numbers of examined patients and detected positives can be misleading. Alternatively, Method 2 could be used to monitor the malaria situation if the system is established.

Why do we need a threshold? It can be very difficult to distinguish an epidemic from a normal seasonal case increase. Once it is apparent that the seasonal case increase is much higher than normal, the epidemic is well underway. Because health staff often move around to different health facilities, they may not be aware of the expected number of cases in the local area.

How to calculate the threshold. The following tables give examples of how to tabulate data for estimating a threshold by two methods. The data in the tables is illustrative and for this example only. **Table 7** is the empty sheet. **Table 8** is filled in with the past five years' data and shows the third quartile threshold. **Table 9** shows what to do if you only have one year's data.

Thresholds can be calculated for any health facility or any other unit including kebele, woreda or zone. An epidemic in a health facility catchment area may not show up initially in the whole woreda or zone, but it might if it spreads unchecked. It is important to define epidemics according to defined units with known (or estimated) populations. In this guide, the heath post catchment area (usually kebele) is defined to be the smallest geographic area for monitoring epidemics. This will help in planning responses. However, higher levels could also monitor epidemics if the data thresholds for monitoring are disaggregated by health post catchment area.

Length of an epidemic. An epidemic starts when the number of cases in a given week is higher than the threshold number (either the third quartile or double the number in previous year). An epidemic continues while the case numbers per week stay above the threshold for that week. An epidemic ends when the weekly case numbers drop below the threshold for that week. An epidemic may last only one week or several weeks. There may be more than one epidemic in a year in the same place.

Table 8. Chart for assessing usual number of weekly cases and threshold at health facility

WHO Week No.	Year 1	Year 2	Year 3	Year 4	Year 5	Third Quartile or second largest number or 2x last year's cases (if 5 year data not available)	This year's cases
1							
2							
’							
’							
’							
51							
52							
(53)							

Note:

1) Week number: the WHO week number system is used, and weeks run from Monday to Sunday. However, there will be corresponding Ethiopian date for each week to avoid any confusion.
2) If 5 years of data are available, the Third Quartile can be filled in (Table 8). The Third Quartile is the second highest number from the five values for each week.
3) The current year's data should be added in right column, by week ("this year").
4) If only last year's data is available, a threshold of twice the last year's number for that week should be entered.
5) A new chart must be prepared each year, adding the new annual data (unless an epidemic year) and dropping the oldest year.
6) The data can be plotted manually onto a norm chart with the threshold line and the current year by week (Table 7).
7) For higher-level health workers with computer capacity, a Microsoft Excel file for the can be used to estimate the third quartile. For example, the formula for third quartile in a second week (row-3) with five years' data (B3 to F3) of a Microsoft Excel work book sheet is given by =QUARTILE(B3:F3, 3). Then, draw charts (Table 8) and update the threshold each year.

Table 9. Construction of the threshold when five years' historical data are available

WHO Week No.	Year 1	Year 2	Year 3	Year 4	Year 5	Third Quartile or second largest number or 2x last year's cases (if 5 year data not available)	This year's cases
1	8	42	6	36	14	36	20
2	12	42	27	38	17	38	22
3	10	42	43	49	21	43	35
4	20	17	34	59	32	34	26
5	34	17	46	20	30	34	25
6	18	10	34	22	23	23	20
7	12	19	33	24	25	25	21
8	37	10	27	61	23	37	25
9	32	18	37	29	26	32	16
10	31	24	28	17	13	28	5
11	22	19	22	12	23	22	15
12	17	39	31	22	43	39	25
13	5	19	19	16	21	19	16
14	22	19	28	25	21	25	30
15	29	16	28	19	13	28	45
16	17	32	25	6	11	25	60

17	28	11	32	8	8	28	62
18	17	34	40	13	9	34	60
19	12	17	27	9	10	17	25
20	16	18	14	1	9	16	10
21	31	34	29	2	8	31	15
22	38	22	23	1	9	23	16
23	29	33	14	1	17	29	17
24	19	32	35	1	32	32	18
25	27	10	25	1	34	27	22
26	36	20	34	1	47	36	30
27	15	32	36	4	62	36	35
28	19	42	44	8	38	42	36
29	52	49	47	10	62	52	101
30	31	44	45	12	73	45	122
31	31	51	53	94	142	94	135
32	97	67	56	114	104	104	176
33	42	73	67	94	67	73	200
34	74	61	71	82	124	82	250
35	53	123	46	57	130	123	261
36	41	58	92	79	129	92	261
37	76	136	118	70	125	125	255
38	116	113	134	37	87	116	244
39	94	145	128	73	138	138	230
40	93	102	194	103	139	139	269
41	108	692	171	52	178	178	267
42	34	178	168	59	208	178	233
43	49	165	232	59	164	165	199
44	27	183	145	44	114	145	145
45	16	283	111	34	103	111	67
46	55	141	150	40	105	141	53
47	33	133	112	20	105	112	52
48	40	122	87	25	81	87	45
49	40	95	102	30	42	95	
50	19	67	71	30	33	67	
51	26	56	21	38	27	38	
52	23	55	34	29	6	34	
(53)							

Note: The threshold is the 3rd quartile. The epidemic weeks in the current year are shaded in the right column.

Table 10. Construction of threshold with single recent year morbidity data

WHO Week No.	Year 1	Year 2	Year 3	Year 4	Year 5	Threshold (norm) = 2x last year's cases	This Year's cases
1					14	28	20
3					21	42	35
4					32	64	26
5					30	60	25
6					23	46	20
7					25	50	21
8					23	46	25
9					26	52	16

10					13	26	5
11					23	46	15
12					43	86	25
13					21	42	16
14					21	42	30
15					13	26	45
16					11	22	60
17					8	16	62
18					9	18	60
19					10	20	25
20					9	18	10
21					8	16	15
22					9	18	16
23					17	34	17
24					32	64	18
25					34	68	22
26					47	94	30
27					62	124	35
28					38	76	36
29					62	124	101
30					73	146	122
31					142	284	135
32					104	208	176
33					67	134	200
34					124	248	250
35					130	260	261
36					129	258	261
37					125	250	255
38					87	174	244
39					138	276	230
40					139	278	269
41					178	356	267
42					208	416	233
43					164	328	199
44					114	228	145
45					103	206	67
46					105	210	53
47					105	210	52
48					81	162	45
49					42	84	
50					33	66	
51					27	54	
52					6	12	
(53)							

Note: The threshold (norm) is 2x the previous year's value for the week. The epidemic weeks in the current year are shaded in right column.

Notes on Tables 8 and 9:

- **Table 8** uses the third quartile data while **Table 9** uses double (2x) last year's cases as a threshold for monitoring current year's morbidity data.
- Both thresholds identify two epidemics in the current year (highlighted in right column). However, the epidemics identified in **Table 9** (i.e. threshold using 2x last year's data) are shorter

than those in **Table 8** (threshold using 3rd quartile) because the 2x last year's data threshold is more specific and it is harder to exceed that threshold.

- The numbers and thresholds from **Tables 8 and 9** are shown graphically in **Figure 14** and **Figure 15**. The advantage of having five years' data is seen in the smoother curve and clearer epidemic definition in **Figure 14** (3rd quartile threshold).
-

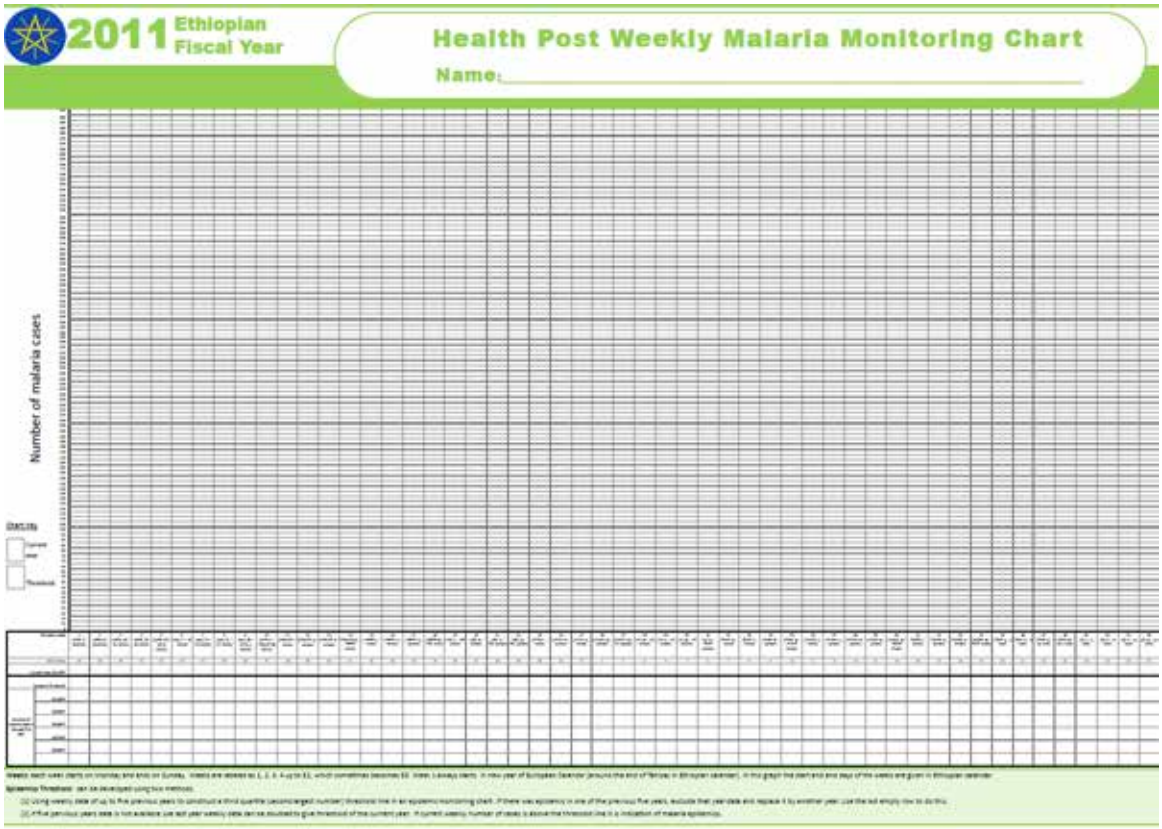


Figure 12. Norm chart for plotting weekly morbidity data: confirm or clinical cases

There is no 'right answer' about which is the best threshold. It depends on what information is available and what is useful in practice. The most important thing is to use the data to predict the rate of consumption of medications and RDTs and to make sure as best as possible that those local supplies are not completely exhausted before re-supply.

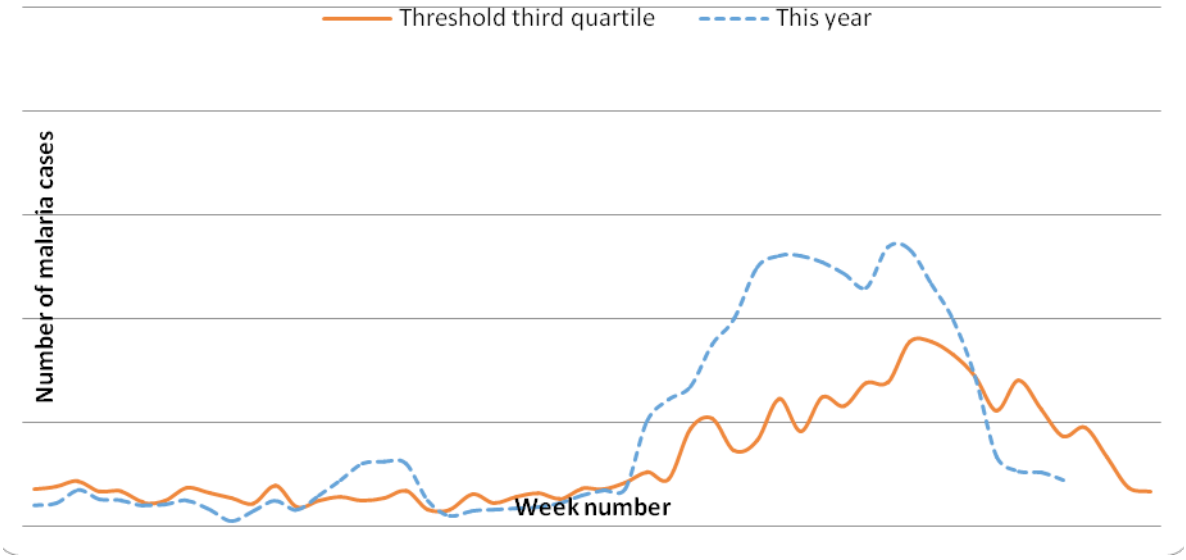


Figure 13. Chart drawn from Table 8 showing epidemic weeks in current year above third quartile threshold

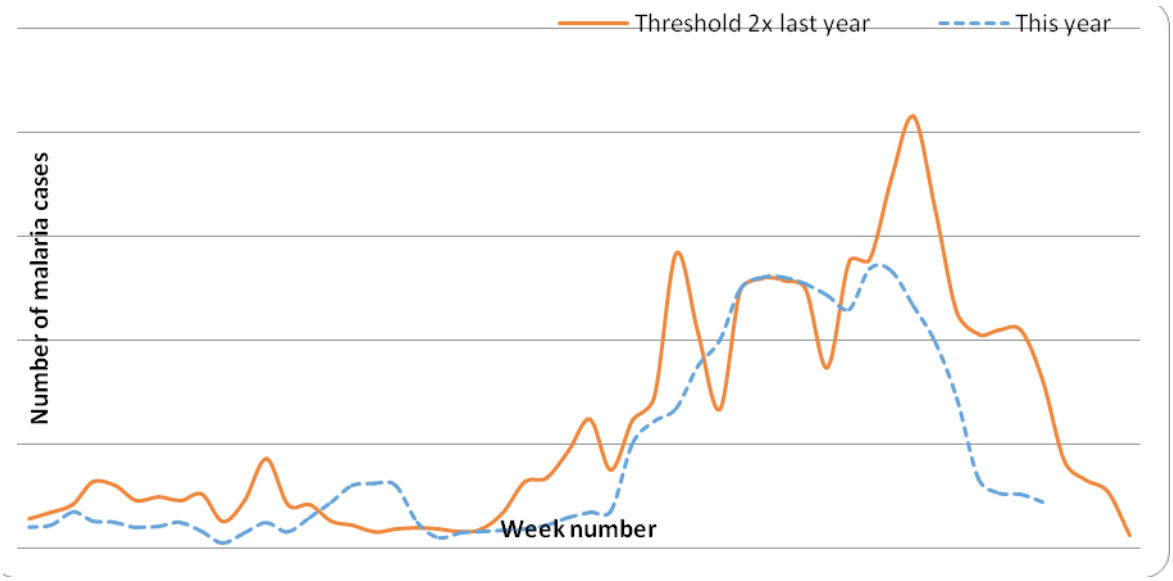


Figure 14. Chart drawn from Table 9 showing epidemic weeks in current year based on doubling of last year's cases

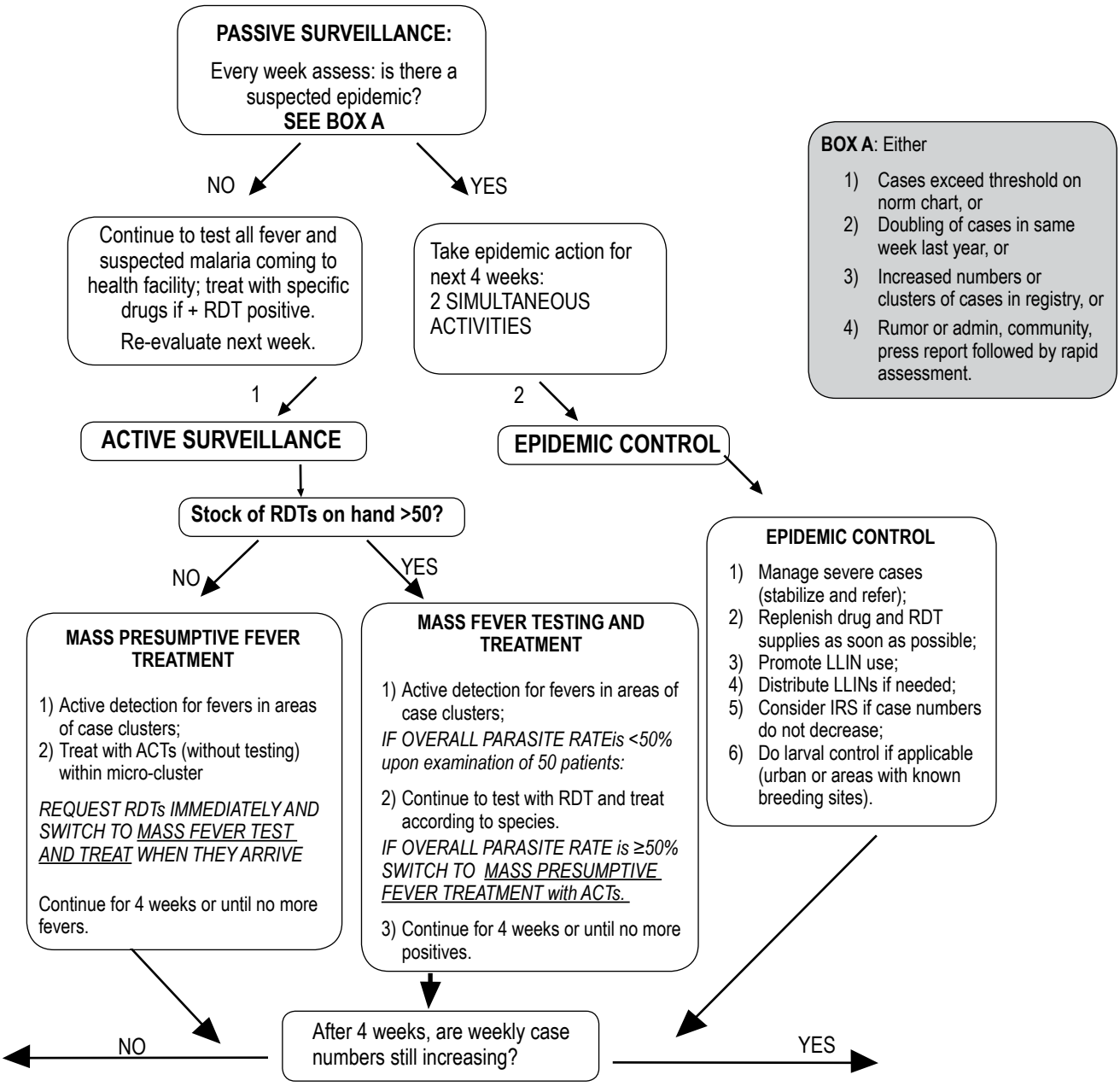


Figure 15. Flowchart of METHOD-1: Epidemic detection and control using threshold method (combined passive/active surveillance)

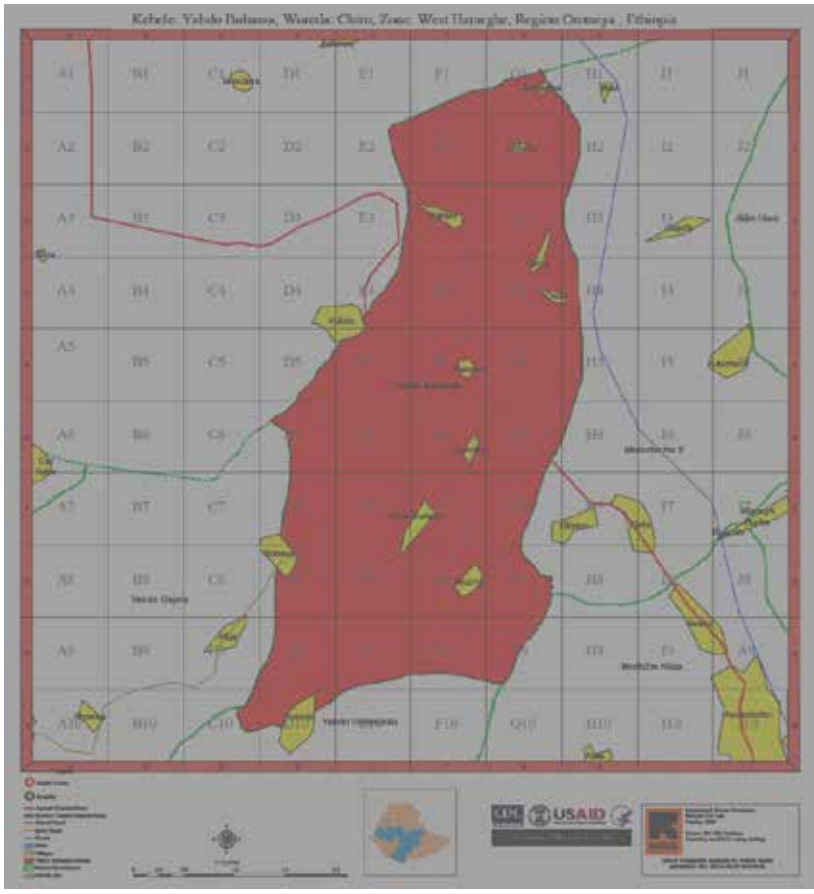
34.3 Method 2: Mapping clusters

Method 2 uses a new definition of epidemic that is based on documenting the approximate location of recent malaria cases and clusters. Visualizing cases on a map of a health facility's catchment area makes use of more spatial information in the data to define clusters of cases documenting foci of probable active malaria transmission. This new malaria "micro-cluster" definition documents and analyzes malaria cases by time (i.e. recent means 0 to 28 days), place (i.e. homes located within 1 km distance of at least three recent malaria cases), and person (i.e. ill with fever and positive with same malaria species by malaria RDT or microscopy). This method assumes that most malaria transmission occurs within homes at night, and the home locations of the most recent malaria cases help to predict the home locations within 1 km of the next malaria cases for the next 4-8 weeks. This creates dynamic maps of malaria transmission documenting both micro-foci or hotspots, and defining other areas with comparatively lower short-term malaria transmission risk.

The most fundamental knowledge of health service staff at health posts is familiarity with local population demographics, locations of residences, and geography. Malaria transmission, at least at the early stages of an epidemic, tends to be clustered in time within nearby households. Anopheline mosquitoes are typically limited to within a 500-1,000 m flight range, and the mosquito life cycle is typically completed in about one month. Hence, early identification and mapping of three or more geographically clustered same-species indigenous malaria illnesses (e.g. within 500-1,000 m within 28 days) could suggest focal transmission that could be quickly addressed through, at minimum, heightened surveillance for acute febrile illness and SBCC messaging (e.g. emphasizing the use of LLINs and seeking immediate care if acute febrile illness) within a 1 km radius of these homes. PFSA hubs or district health offices and/or health centers should be notified if anti-malarial medications are in very low supply so that contingency plans can be made and, if needed additional resources can be requested or mobilized to control the emerging outbreak/epidemic at the kebele level. Micro-clusters represent a tool for HEWs to document and quantify areas within the community where malaria transmission is present, and allows them to prioritize their efforts at detection and prevention based upon data collected within the most recent 4-6 weeks. This should be a more predictive tool to help anticipate where small-scale case build-ups might occur and to assist HEWs in quickly disrupting local malaria transmission events within the community.

Each health facility catchment area (kebele) will have maps produced on paper from the digital files. Maps will be marked with 1,000m (1 km) grids, with sectors will be labeled in a standard way (e.g. A1, A2…B1, B2……Z1, Z2, etc.) as shown in **Figure 16** or uniquely labeled with 5 digit letters with an HMIS-linked sector label scheme as shown in **Figure 17**. The health posts and other facilities already keep a register of cases. The patient's name, date, sex and household location, RDT or microscopy results, treatment, referral to hospital (y/n) are documented in the standard patient registry. The patient's household location should be visualized or plotted on a standardized map, including in its approximate sector location **(Table 10)** and their sector location should be documented on the malaria registry. Such information collected as part of the routine health service delivery at health posts can be extremely useful in detecting early build-up of cases.

Figure 16. Example of kebele map with 1 km square sectors



The only modification required is that the sector coordinates of the patient's household (within a 1

km grid) should be documented in malaria case registries. In some cases the village name might be more useful or efficient for HEW use, but analysis of data and computer coding at the district and regional levels would be easier if a simple sector code was used instead, and such data could ultimately be communicated by SMS and other practical means.

Table 10 Example of malaria registry at health post

MALARIA REGISTRY: DATES_____ YEAR_____

REGION_____ ZONE_____ WOREDA_____ KEBELE_____HEALTH POST_____

No	Date		Name	Age (yrs)	Sex	Map sector	Slide result	RDT result	Dx	Rx	Other
	Onset of symptoms	Consultation									
1	1 Oct 2017	3 Oct 2017	Yusef Ibrahim	30	M	D8	N/A	Pf	Pf	Coartem, sdPQ	HE
2	4 Oct 2017	5 Oct 2017	Dawit Solomon	35	F	F3	Pf	N/A	Pf	Coartem, sdPQ	HE
3	4 Oct 2017	6 Oct 2017	Melu Moges	25	F	D8	N/A	Pf	Pf	Coartem, sdPQ	HE
4	6 Oct 2017	10 Oct 2017	Yerusalem Melu	27	F	D8	N/A	PF/PAN	Pf + Pv	Coartem, sdPQ	HE

N/A: not available; HE: health education
Summary: 4 suspected malaria cases in 10/2017, all 4 laboratory-confirmed *P. falciparum*: 1 microscopy positive, 3 RDT positive, 1 *P. vivax* case in mixed infection.
Comments: Cluster of 3 *P. falciparum* cases at D8, apparent hot zone of transmission. The case in F3 seems isolated. Expect more *P. falciparum* cases in other homes in Sector D8 in the next 4-8 weeks compared to other sectors
Note: See **Figure 16** for standard kebele map and map location coordinates. Using the case registry, assess each week whether there are clusters of cases arising in particular 1 km^2 sectors. **Figure 17** summarizes the epidemic detection and action steps for Method 2.

A similar approach is also currently being rolled out through the national HMIS, where kebeles are divided into standardized, pre-coded grids **(Figure 17).** It is envisaged that data reported in the grid would be automatically fed into a HMIS database at facility level.

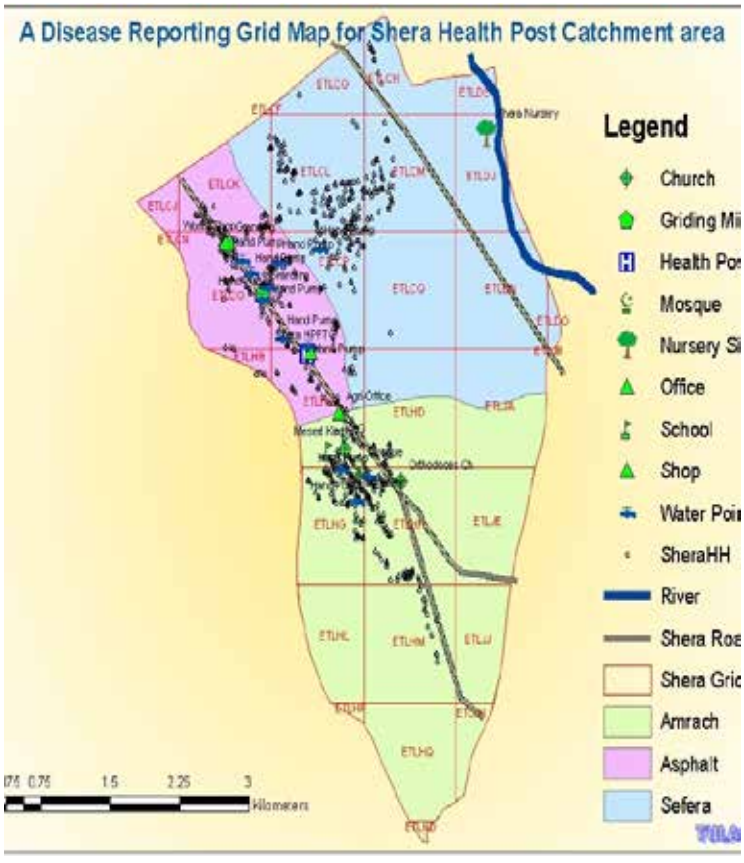


Figure 17. Disease reporting grid map with standardized grid scheme linkable to HMIS.

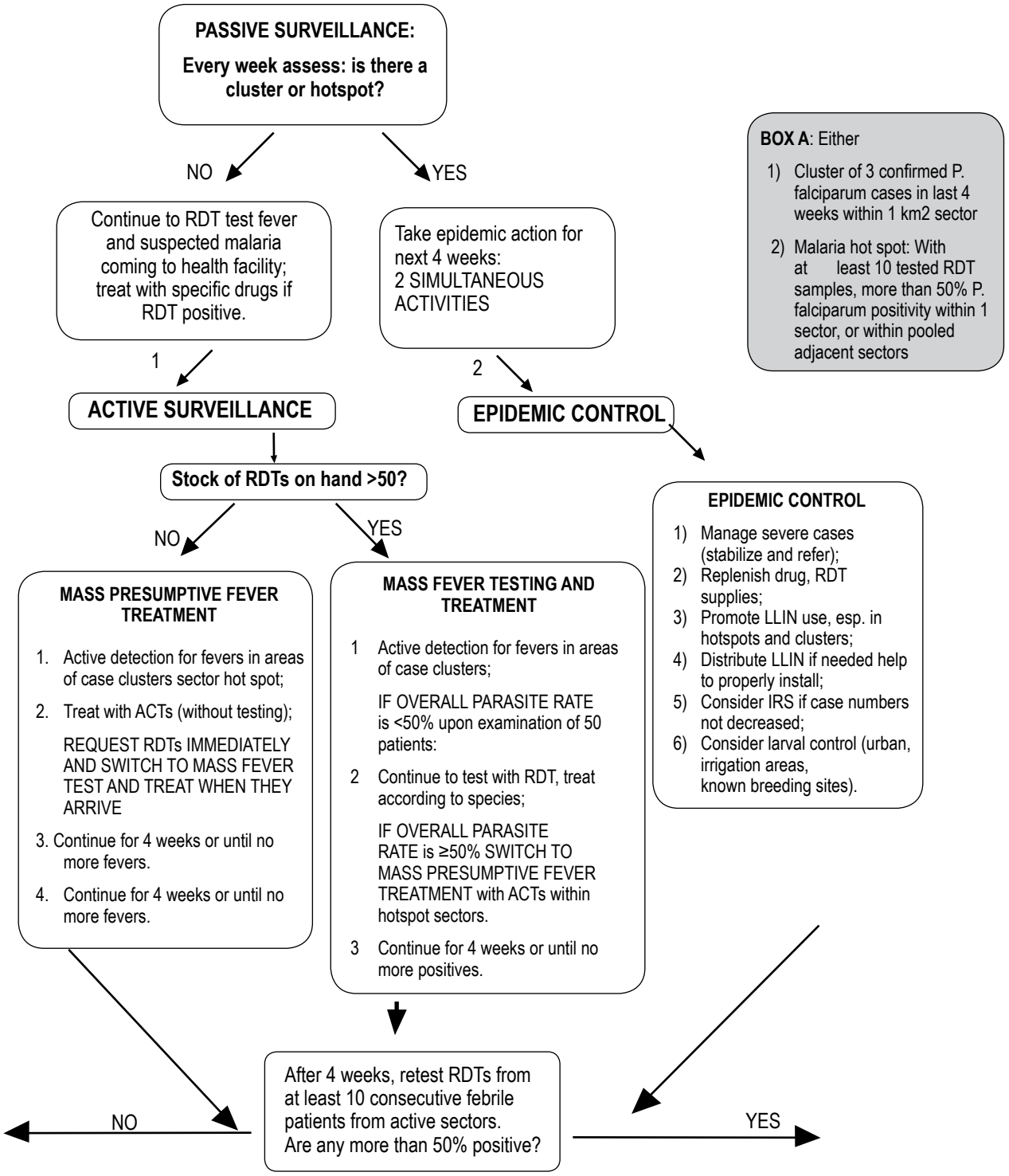


Figure 18. Flowchart of METHOD-2: Epidemic detection and control using mapping of cases (combined passive/active surveillance)

Note: This method, which involves a mapping tool, might be increasingly important as the country moves towards elimination, and when there are fewer than 20 malaria cases per kebele per month. The surveillance system will demand even more refined household level mapping and tagging and will help link morbidity information with preventive information of households and tracking of case clustering and response. In the meantime, the FMOH and partners will research technology solutions to have household mapping at a reasonable cost and time.

34.4 Epidemic confirmation

Epidemics detected through health facility registers using norm charts) by definition are epidemics and do not need additional confirmation, assuming that they were based upon RDT or laboratory confirmed cases. The active surveillance strategies (Mass Test and Treat or Presumptive Treatment) will provide data to confirm the epidemic. Epidemics detected by mapping of micro-clusters of cases also assume RDT or microscopy verification, and should be handled immediately by HEWs. The active surveillance strategies will provide data to confirm the epidemic and conserve resources. In both situations, large epidemics will require that microscopy slides be collected for analysis by FMOH (EPHI) experts; and in certain cases dried blood spots on filter paper may be collected for serological analysis.

Various actors outside the health sector, such as woreda/zonal administration councils, farmers' associations, development projects, non-governmental organizations and especially the media, may also report a suspected epidemic or disease outbreak. Although epidemic calls from such sources are useful in that they alert responsible bodies and mobilize responses, the information obtained may be incomplete or inaccurate or the problem may be due to another epidemic disease. Rapid assessment of the situation, including RDT or laboratory confirmation, is also required but should be done quickly. Initially, the most important information needed for an assessment will be:

a) How many suspected malaria cases (persons) were documented within a specified time interval (week, month) within a specific district or kebele (place)?
b) How many of these suspected malaria cases were tested by RDT or microscopy?
c) How many of the suspected malaria cases tested were also diagnosed as positive for malaria
d) How many laboratory-confirmed malaria cases were P falciparum and how many were P. vivax?
e) How many deaths, hospitalizations and severe malaria cases occurred?
f) Are there adequate supplies of RDTs, AL and chloroquine (and quinine, rectal artesunate, IV artesunate, sdPQ)?
g) If available, compare current malaria case numbers with previous malaria registry data.

Entomological studies may be necessary in some situations, but generally, in order to contain epidemics early, the cause and scale of most epidemics can be seen in an analysis of routine health facility data, including RDT and microscopy results. This should be assessed first, and response to contain the epidemic should not wait for other epidemiological studies.

Implementing a 'mass fever test and treat' strategy with RDTs will serve both to confirm an epidemic and answer questions A-F above, and respond appropriately to the epidemic. This strategy may need to be modified if AL or RDTs are in short supply.

To investigate administrative and press reports on epidemic rumors: A team designated to investigate epidemic rumors should test 50 clinically suspected patients in a village using RDTs or microscopy to determine whether the cause of the illness was malaria or not, and, if malaria was the cause, to identify the parasite species responsible.

Make the following decisions according to the prevailing situation:

1) Generally, rates exceeding the usual health post and/or season specific thresholds of RDT or microscopy slide positivity rate should be considered an epidemic;
2) In the absence of the above data, if the positivity rate (RDT or microscopy slide) is at least 50% out of at least 50 specimens tested, this is considered as the occurrence of an epidemic in the health facility catchment area and the team should start urgent mitigation activities.

You may also substantiate your investigation by:

- Examining health facility registers, the norm chart if it exists, or health facility catchment area map. In particular, review health facility data on microscopy slide or RDT positivity rate in tested cases;

- Conducting a breakdown by age group and sex may be useful. Confirmed, speciated cases will also help to determine if the epidemic is caused by P. falciparum, P. vivax or mixed;
- If possible, estimating the case fatality ratio (overall and malaria specific) in children under five years and over five years of age. An increase in the case fatality ratio suggests drug resistance or decline in quality of care;
- Estimating the burden of the epidemic (e.g. % of outpatient visits, number of cases, proportion of population and area affected). Be sure to visit different villages, worksites, or camps, looking for new graves, asking different individuals such as religious leaders, local political figures, government officials, and non-governmental organizations in the area;
- Reviewing diagnostic and drug stocks such as RDTs and AL;
- Identifying local capacity to control transmission and reduce morbidity.

For large epidemics (several woredas or zones), a detailed emergency plan of action should be rapidly, but carefully, prepared in order to optimally use available personnel, finance, transportation, supplies and time. In this plan, the responsibilities, localities to be covered and schedule of work for each control team should be shown clearly and shared as appropriate at the kebele, zonal and regional levels.

34.5 Mitigation steps

Once an epidemic is detected, certain active surveillance and other control actions are triggered and should continue for up to one month or until no further cases are detected for at least two months. These actions are summarized in **Figures 15 and 18** above. At the end of the four-week period, epidemic status should be reassessed and a decision made to continue active surveillance or revert to normal passive surveillance and treatment. If an epidemic is detected, the active surveillance should be as follows (MFTT or MPFT plus iii), which is compulsory for both options):

Mass fever testing and treatment (MFTT): Test everyone with fever and treat those with confirmed malaria. This step should be taken when sufficient RDTs are in stock and as long as RDT positivity is below 50%, upon examination of 50 febrile patients. Treatment must be species-specific (refer to **Figure 20)**. RDTs serve to reduce waste of the most vital medication, AL, since patients testing negative for multi-species malaria RDTs do not need to take AL.

Mass presumptive fever treatment (MPFT): When, upon examination of 50 febrile patients, RDT positivity is equal to or greater than 50%, action should switch to MPFT (treat all persons with fever presumptively). This should be done when stocks of RDTs are low (while waiting for supply), or if RDT positivity among at least 50 actively detected and tested suspected cases increases to more than 50%. MPFT indicates treatment with AL, unless the cause of the epidemic is definitely confirmed to be P. vivax only.

Both MFTT and MPF are most rational within malaria 'hot zones' (i.e. households especially within 500 meters of a cluster of known recent malaria transmission/cases) beginning with the nearest homes. Registers must be kept of persons actively tested and treated.

Note: Though used in Ethiopia in past years, mass drug administration (MDA), i.e. treatment of the entire population, irrespective of their clinical status or whether they have fever, should not be used. The use of MDA with AL is not cost-effective, especially when RDTs are available. Also, AL is not recommended for pregnant women in the first trimester (see the National Malaria Diagnosis and Treatment Guidelines). Hence, MDA should never be practiced. However, it is to be noted that a targeted MDA (tMDA) can be considered in elimination designated districts to curb the circulating parasites in a given community.

Other interventions to be taken simultaneously with MFTT and MPF: Treat and refer severe malaria cases; request more supplies to replace those expended; use effective anti-malarial medication that are closest to expiry date; SBCC for improving LLIN use and improve LLIN supply if needed; consider IRS spraying if evidence from epidemiological analysis ensures that transmission will continue despite treatment interventions (e.g. due to sustained high vector population).

Vector control measures include:

IRS: IRS of all houses quickly impacts transmission. Because of the time it takes to organize and implement, it may have a role only in widespread and uncontrolled epidemics. In epidemic control, IRS is highly reliable and recommended, since its efficacy has little or no dependency on human behavior.

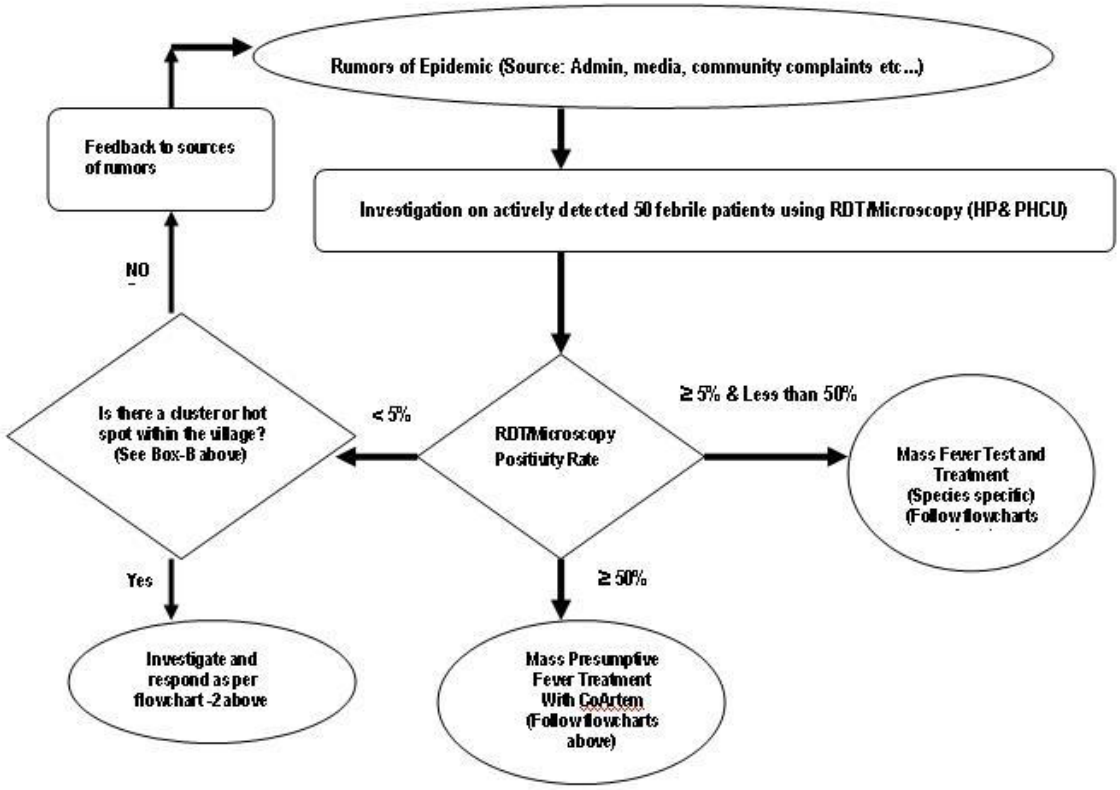


Figure 19. Epidemic investigation and decision on treatment approach

In the future, it might be possible to justify focal IRS spraying within kebeles, such as within micro-clusters or hot spot sectors as discussed in Method 2.

However, IRS maybe wastage of time and resources when mitigation is too late. The use of IRS should be evidence-based (e.g. following the collection of entomological data showing abundance of indoor-biting mosquitoes) and limited to situations in which it is believed that transmission will continue for an extended period due to favorable epidemiological factors.

LLIN: LLINs could be used where IRS is not feasible. Their impact on halting transmission is highly dependent on human behavior (i.e. compliance in proper use of LLINs). Rapid distribution of LLINs should reach greater than 85% use by all members of the population. Additionally, LLINs should be installed immediately within homes of persons who have confirmed RDT or microscopy-confirmed malaria. Infected and at-risk populations should always be reminded to use their LLINs properly and regularly.

Larval control activities (including source reduction and larviciding): These can be undertaken in some malaria-affected areas, such as those map sectors with micro-clusters together with the above measures, if supplies are available and breeding sites are well-defined; otherwise, uncovered breeding sites are capable of producing sufficient vector density to sustain transmission. Larval control can be applied: (i) In urban centers; (ii) Near irrigation projects; (iii) In rural villages and in arid areas with limited and well known breeding habitats.

34.6 Reporting

- **From health post**

  Every week health posts should report summary patient registry data on the PHEM weekly form. When the number of cases in a week rises above the threshold, or when clustering of cases are observed on the map, this should be reported to the HEW supervisor located at the responsible health center and/or the woreda health office. Listings of persons tested and treated during 'mass fever treatment' or 'mass test and treat' active surveillance must be reported. The following table may be used for recording 'mass fever treatment' or 'mass test and treat'.

  Starting from one randomly selected household in the highly affected part of the village, take 20 houses in sequence and fill in the following format:

Table 11 Reporting form for active surveillance and treatment

HH No.	Total no. of HH members	No. of sick (febrile) household members	No. of blood samples (RDT or microscopically) examined if applicable)		No. and proportion of positives out of examined (if applicable)		Treatment given
			RDT	Microscopy	RDT	Microscopy	
1							
2							
.							
.							
20							
Total							
Note: Indicate the type of diagnosis, i.e. RDT or microscopy. Then determine fever rate and test positivity rate from the sampled households. Health posts should also report status of malaria supplies inventory (**Table 12**).							

- **From health center, command center of PHCU**

  Whether an epidemic is detected by Method 1 or 2 anywhere in the satellite health post's catchment area, the report must be immediately relayed to all responsible higher levels. The mitigation activities initiated by the health post must be supervised and leveraged by the health center and woreda health office. Any epidemics beyond the capacity of the health center should be handled at the woreda level using local contingency supplies. Progress on mitigation activities and gaps must be reported to higher levels on a daily and weekly basis.

- **From woreda health office**

  When an epidemic is detected and reported by any primary health care units, this must be immediately relayed to all responsible higher levels. The mitigation activities initiated must be followed-up and supportive supervision planned and implemented if necessary. Any epidemics beyond the capacity of the woreda should be handled by the zone/RHB. Progress on mitigation activities and gaps must be reported to higher levels on a daily/weekly basis throughout the mitigation process. The woreda health office can complete **Table 11** using combined data from all health facilities in the woreda. Once an epidemic is evident at the woreda level, the situation is probably quite serious and the zone as well as the RHB must be informed. The epidemic report form (PHEM form) must be completed and disseminated to higher levels. An overview of the epidemic data/ information flow is indicated under **Figure 20** below.

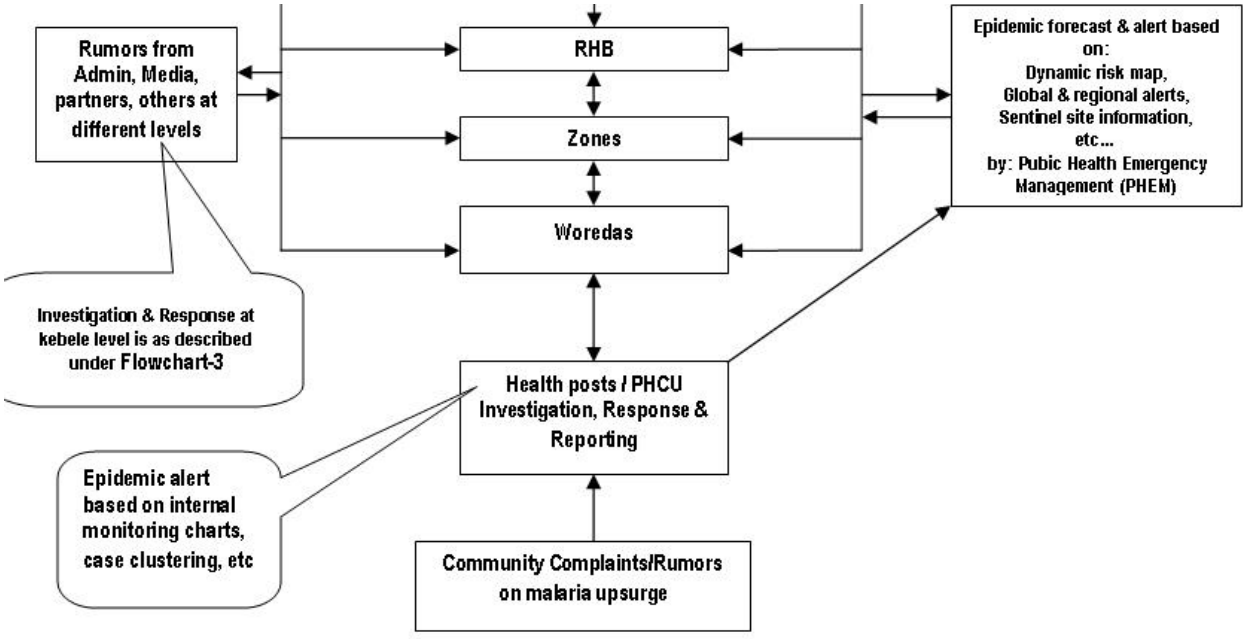


Figure 20. Epidemic data/information flow (reporting system)

Table 12 Monthly inventory report

DATE_____ YEAR_____
REGION_____ ZONE_____ WOREDA_____ KEBELE_____ HEALTH POST_____

AL (Coartem®) treatment doses				Chloroquine tablets				Chloroquine syrup			Quinine tabs		Artesunate suppository (rectal artesunate)		sdPQ		Primaquine tablets		RDTs in stock		LLINs in stock
Adult doses in Inventory (6*4)	Expiry date	Child dose in inventory (6*3, 6*2, 6*1)	Expiry date	Dose in mg	No of tabs per tin	No of Tins	Expiry date	Dose (g/5ml)	No of bottles	Expiry date	Dose in mg	No of tins	Doses on hand	Expiry date	Doses on hand	Expiry date	Doses on hand	Expiry date	In inventory	Expiry date	

35. Malaria Case Management during Epidemics

35.1 Management of uncomplicated malaria

P. falciparum epidemics: AL (Annex C) is the first-line anti-malarial drug recommended for the treatment of uncomplicated P. falciparum malaria). Oral quinine is recommended for the treatment of pregnant women with uncomplicated malaria (see **Annex I).** Single dose primaquine (sdPQ) also will be administered to P. falciparum cases to reduce transmission **(Annex E).**

P. vivax epidemics: Use chloroquine if the cause of the epidemic has been established as only P. vivax **(Annex D).** Anti-relapse therapy with primaquine for P. vivax malaria is recommended in in malaria elimination-designated districts **(Annex F).**

Mixed P. falciparum and P. vivax epidemics: Use AL treatment for mixed P. falciparum and P. vivax infections. Anti-relapse therapy with primaquine for P. vivax malaria is recommended in malaria elimination-designated districts (Annex D and F).

35.2 Management of severe malaria

Severe malaria is defined as the presence of one or more signs and symptoms of severe illness and a demonstrable malaria parasitemia in a peripheral blood sample. Severe malaria is a potentially life-threatening medical emergency that requires intravenous or alternatively IM anti-malarial drugs as soon as possible since oral medications will not be absorbed well enough to be effective. Management of severe malaria in epidemic situations should take place in hospitals and health centers using intravenous medications, whenever possible. Hence, severe malaria cases diagnosed in health posts or community level should be referred to the nearby health center or hospital as promptly as possible **(Annex J, K, and L).**

Stabilizing therapy, such as artesunate suppositories for children less than six years of age or IM artemether **(Annex J and L),** may be needed in temporary posts or situations in which staff shortages and high workloads make intensive care monitoring difficult. The following should be done before referral of the patient:

- Always nurse patients in a coma in a lateral position to avoid aspiration;
- Give 40% or 50% glucose to all patients with severe manifestations;
- Use tepid sponging as needed,

Record all your findings and drugs given in a referral slip and refer the patient to the nearest health center or hospital (refer to National Case Management Guidelines (section 2) for details).

36. Post-Epidemic Evaluation

The main objective of a post-epidemic report and evaluation is to gather experiences and lessons that may strengthen public health systems, improve monitoring, prevention and control activities and prepare for future epidemics. For appropriate documentation of these experiences, a systematic post-epidemic evaluation should be conducted. The post-epidemic evaluation should assess all levels of the health system (district, zonal, regional and federal) in order to identify problems encountered in the early warning, early detection, prevention and/or control of malaria epidemics.

For the full assessment of a post-epidemic situation, the following information should be gathered and properly analyzed to effect corrective action.

36.1 Adequacy of forecasting and early warning system

Information on meteorological events should be available at regional and national levels and should also be communicated to district health offices. Local meteorological reports and other vulnerability indicators should be researched and investigated to assess whether they were or could have been of use. These include:

- Meteorological reports indicating normal or abnormal situations (rainfall, temperature);
- Drought and famine;
- Migration of non-immunes;
- High incidence of other diseases;
- Data or opinions on the efficacy of anti-malarial drugs and insecticides;
- Environmental changes (dams, agricultural projects).

36.2 Adequacy of epidemic detection and response

Investigate if an appropriate malaria EDS was in place. The early detection tools in use include malaria epidemic monitoring chart using the 3rd quartile method or doubling of cases, or cluster mapping.

Identify both the strengths and drawbacks of the response to the epidemic to build on the former and take appropriate corrective actions on the later. The investigation should primarily focus on how efficient the system was in confirming the epidemic situation, status of preparedness (i.e. availability of drugs, insecticides, financial resources, manpower, logistics and transportation), timing and impact of intervention measures, resource utilization efficiency and the participation of the community and other partners.

36.3 Adequacy of assessing clinical factors

The number of people presenting at each health facility gives an indication of whether the epidemic is still building up or subsiding. In a large epidemic, it is often easier and more informative if the numbers are collected, graphed and mapped daily.

Assess whether the strategies of MPFT or MFTT were properly applied given the positivity rate and caseload. Assess case fatality rates and whether the most severe cases were appropriately referred to health centers and hospitals. Deaths in the community should be recorded, noting whether these had acute febrile illnesses that were consistent with malaria.

36.4 Adequacy of epidemic preparedness and control

- Investigate if there was a valid epidemic preparedness plan. (Requires observation of the plan.)
- Was application of IRS performed, necessary and helpful?
- When was IRS carried out and was it timely and in well-targeted areas?
- Were other vector control measures (e.g. LLINs or larval source reduction) used appropriately for the situation?

The adequacy of the efforts employed to mobilize the community and partners in achieving the needed participation should be assessed: who, what, where, when and why?
It must be confirmed that an epidemic has ended by carefully evaluating the patient load in the area

compared to the normally acceptable levels (e.g. norm chart), supplemented with data showing that there is no longer clustering of cases (for epidemics detected using Method 2). It is also very critical to work to mitigate conditions that may favor an epidemic situation, such as natural and manmade problems and lack of safe and effective drugs. The final post-epidemic evaluation report and evaluation should lead to recommendations for strengthening prevention and control activities.

36.5 Evaluation the overall response to the epidemic

Consider the following points in evaluating the overall response to the epidemic:

- Investigate if there was a valid epidemic preparedness plan (Requires observation of the plan).
- Was application of IRS performed, necessary and helpful?
- When was IRS applied and was it timely and in well-targeted areas?
- Were other vector control measures (e.g. LLINs or larval source reduction) used appropriately for the situation?
- The adequacy of the efforts employed to mobilize the community and partners in achieving the needed participation should be assessed: who, what, where, when and why?

It must be confirmed that an epidemic has ended by carefully evaluating the patient load in the area compared to the normally acceptable levels (e.g. norm chart), supplemented with data showing that there is no longer clustering of cases (for epidemics detected using Method 2). It is also very critical to work to mitigate conditions that may favor an epidemic situation, such as natural and manmade problems and lack of safe and effective drugs. The final post-epidemic evaluation report and evaluation should lead to recommendations for strengthening prevention and control activities.

36.6 Evaluating the overall response to the epidemic

- Indicators will help you to monitor the success of the intervention. See the following indicators:
- Input indicators
- Amount of contingency fund reserved for emergency purposes
- Availability and quality of active monitoring chart
- Data/information management
- Stockpile of anti-malaria commodities, mainly RDTs, ACTs, other anti-malarial drugs and insecticides (health post/district level)
- Personnel onboard, including volunteers
- Logistics for commodities and personnel
- Technical assistance requested

Process indicators

- Number of unit structures sprayed
- Valid epidemic preparedness plan
- Number of trained village volunteers for emergency intervention
- Number of surveillance meetings during major transmission season with stakeholders
- Adequacy community mobilization for environmental management after the rainy season
- Adequacy of communication on key malaria messages in the pre-transmission period and during epidemic
- Quality of curative and vector control intervention services (e.g. diagnosis using RDTs and IRS performed, LLINs distributed to households)

Output indicators

- Volunteers trained and people educated
- Coverage of vector control measure, i.e. IRS and LLINs
- Adequacy of coordination of stakeholders and partners
- Adequacy of supportive supervision carried out
- Proportion of population protected

Outcome indicators:

- Time to treatment, within 24hrs from onset of the symptoms
- Compliance with treatment
- Percentage of patients developing severe disease
- Case-fatality ratio
- Flattening or sharp falling of epidemic curve
- Achieve and maintain high intervention coverage, access of services and utilization of services

Participants in post-epidemic assessment: Epidemic prevention and control staff, together with regional and woreda level staff, should lead the field assessment since they are in charge of developing and monitoring strategic operations related to malaria epidemic prevention and control. The team should preferably include partners and stakeholders from multiple sectors to have a comprehensive overview of problems encountered at the national and district level.

37. Responsibilities of Stakeholders

37.1 Community level

- The community participates in source reduction activities that should be carried out every week prior to the main transmission season in rural and peri-urban areas based on area-specific evidence regarding breeding sites.
- Community and village health workers have a very important role in detecting epidemics early and reporting them to health posts (HEWs) and other concerned officials and to encourage populations at risk to seek effective medical care promptly and to take preventive measures such as using LLINs and presenting for malaria treatment immediately after fever onset.
- Community and religious leaders participate in promotion of malaria prevention and control measures.

37.2 Health posts (HEWs)

- Establish locality thresholds and monitor epidemics;
- Provide malaria case management based on the national guidelines;
- Implement/ follow vector control interventions;
- Notify malaria situation of the locality on a regular basis to responsible health center and woreda health offices, at least monthly or when in danger of running out of medications before expected re-supply;
- Participate in the investigation of deaths to confirm whether cause of death was due to malaria;
- Check and request supplies, logistics and manpower if needed;
- Collect and analyze kebele malaria patient registry data and enhance mapping of malaria cases to identify malaria transmission clusters/hot zones on a weekly basis;
- Submit regular information of the epidemic on a daily/weekly basis to all concerned administrative entities. Know phone numbers and emails of HEW supervisors, district health officers, and neighboring HEWs;
- Take part in post-epidemic evaluation.

37.3 Health centers

- Monitor malaria situation in all catchment health posts/kebeles;
- Carry out fever survey in the affected areas, when necessary;
- Properly manage severe malaria cases according to malaria diagnosis and treatment guideline;
- Replenish drugs, insecticides and other necessary supplies needed by health posts;
- Take part in post-epidemic evaluation;
- Submit regular information, including morbidity and mortality data, to all concerned bodies.

37.4 Hospitals

- Properly manage severe and complicated malaria cases referred from health centers;
- Report trends in malaria-specific mortality and morbidity (especially admissions);

37.5 Woreda health offices/HEW supervisors

- Develop an epidemic preparedness plan for the district catchment area;
- Coordinate malaria epidemic prevention and control activities;
- Discharge responsibilities effectively through their supervisors need to collect and analyze malaria data on a weekly basis, and take necessary measures;
- Identify and list villages and populations prone to repeated attacks of epidemics; further stratify malaria-endemic villages based on similarities and differences in epidemic risk;
- Maintain a separate file with malaria data, monitoring chart and map for each health post that includes health center and hospital data;
- Monitor and verify malaria supplies, such as inventories of RDTs, ACTs, chloroquine and LLINs in all kebeles and facilities within the woreda;
- Support HEWs in establishing a locality threshold to monitor malaria epidemics;
- Establish a rapid response team for malaria other emergencies; share telephone contact numbers between all officials.
- Conduct a post-epidemic evaluation;
- Divert or share resources/resupply between health posts and kebeles as necessary in response to evolving epidemic.

37.6 health desks/departments and Regional Health Bureaus

- Provide technical assistance to lower levels of the health system in detection, prevention and control of malaria epidemics;

- Monitor and evaluate disease management (i.e. chemotherapy), vector biology and control and other components of the malaria control program according to the procedures set by FMOH. Employ corrective measures as necessary and/or notify health centers of problems;
- Declare the occurrence of epidemics and coordinate the mobilization of manpower and logistics needed to contain epidemics in the zone/region, including drugs, RDTs and LLINs;
- Provide follow-up on meteorological forecast and information from nearby stations and use of such information for epidemic forecasting and preparedness;
- Ensure allocation of adequate budget and follow-up of administrative and financial matters for procurement of supplies and operational activities;
- Promote inter-sectoral collaboration and the involvement of governmental, non-governmental and international organizations in the control of malaria;
- Divert or share resources/resupply as necessary between zones and districts in response to evolving epidemic.

37.7 FMOH

- Link data collection and reporting with integrated disease surveillance and response to improve surveillance and response on malaria epidemics;
- Solicit and receive technical advice generated through FMOH MCST/TAC on malaria. Develop national guidelines and plans for malaria control in general and epidemic control in particular;
- Coordinate overall regional capacity building in manpower, logistics and finance so that the control of malaria can be effectively implemented at all levels;
- Develop systems for monitoring, evaluation and follow-up of the implementation of the national malaria control strategies and guidelines;
- Disseminate new knowledge derived from operational research and routine monitoring and evaluation of control activities; organize and conduct training of trainers; and develop a system for training and supervision at the RHB level;
- Provide material assistance to regions for epidemic control as necessary;
- Disseminate meteorological information to RHBs for early warning and epidemic forecasting purposes;
- Promote inter-sectoral collaboration and the involvement of governmental, non-governmental and international organizations in the control of malaria;
- Facilitate the procurement and distribution of malaria supplies, including insecticides, drugs, RDTs, LLINs, and spray pumps;
- Facilitate resource sharing between regions or between other government facilities and agencies in response to epidemics.

37.8 Partners

Responsibilities of partners including Malaria Control Support Team (MCST/TAC):

- Advise and guide the FMOH on national malaria policy, strategy and priorities and on the RBM Global Malaria Action Plan and cross-border issues;
- Advise and support the FMOH in advocating for resources for malaria epidemic control;
- Review the status of drug and insecticide resistance and make recommendations as needed;
- Provide expert consultation as necessary and offer suggestions for appropriate revisions and updates of national and regional malaria guidelines and other public health strategies;
- Support and contribute to the development of the national malaria communication strategy, coordinated by FMOH with partners;
- Develop and oversee the implementation of a strategy for dissemination of research findings relevant to the National Malaria Prevention and Control Strategy implementation, and epidemic control.

37.9 Other development sectors

- Some of the development activities in, for example, agriculture, land use, population settlement programs, water development schemes, construction, or mining, may have unintended consequences, including malaria-precipitating factors. Relevant institutions, such as the Environmental Protection Authority, should ensure that development sectors include appropriate health safeguard components in all development projects.

37.10 Research and academic institutions

- Conduct operational research (e.g. susceptibility to insecticides, drug efficacy, diagnostic performance of RDTs);
- Disseminate research results.

Annexes

ANNEX A1. SPRAY OPERATORS AND SQUADS TRAINING CURRICULUM

See also detailed FMOH Guideline for Indoor Residual House Spraying, 2007.

Day One

- Explain job, conditions of work and payment
- What is expected of the spray operator?
- Why do we spray? Reasons and objectives.
- Areas to be treated and methods used.
- Personal protective equipment and its proper use
- Property of insecticide in use and its effect on the handlers and beneficiaries
- Human and environmental safety measures of insecticide in use

Day Two

Demonstrate:

- Use of personal protective equipment
- Spray tank and equipment.
- Sachet or charges of insecticide.
- Funnel, paddle and bucket (if water dispersible powder is in use).
- Show suspension line marked inside the bucket.
  - Issue personal protective materials each spray operator
  - Issue each spray operator a spray thank
  - How to carry a spray pump.
  - Adjusting the strap.
  - Handling lance when in use.
  - Placement of lance when sprayer is not in use
  - How to open and close cover assembly.
  - How to fill sprayer using filler funnel.
  - How to release pump sprayer pressure (shut-off lever).
  - How to release pressure in the sprayer (valve pin assembly)
  - How to handle operating lever
  - How to agitate the sprayer

Day Three

- Operation of sprayer; how the sprayer operates under pressure
- Detach pump assembly: explain function and parts
- Explain functions of:
  - air cushion
  - dip tube
  - pressure gauge
  - pressure release valve
- Dismantle the discharge line; show various parts and tell their function.
- What causes a nozzle tip to block; and how is this prevented?
- How to clean a blocked nozzle tip (compressed air, washing, and a piece of grass).
- Discuss the care for nozzle tips and why they are so important.
- Demonstrate how to clean the sprayer.
- Distance and speed:

- Show proper distance (45cms); explains significance.
- Show trainees the forearm distance of about 45 cms.
- Explain speed or rhythm.
- 19m2 to be covered in one minute (3.0 x 6.3 m.)
- Nine swaths to be sprayed in one minute (effective swath of 70 cms.)
- One meter swath should be covered in 2.33 seconds
- Each swath 3 meters high must be covered in 7 seconds

- Review sprayer parts
- Let each spray operator clean his/her spray tank.
- Attach wooden guide (45 cm) to the lances.
- Demonstrate stance facing the training wall.
- Demonstrate practice spraying with wooden lance.
- Allow spray operator to practice in front of wall (correct stance timing, distance)
  - To assist spray operator in acquiring proper speed have them count "one thousand one, one thousand two" etc. This can be done in the local language. Upon spraying "one thousand six" they should have sprayed one 3-meter swath.
  - Trainees to practice raising and lowering the lance at the correct speed and distance while at the training wall spray operator will hold operating lever when practicing
  - Spray operator will raise and lower the lance keeping the wooden guide almost touching the surface.
- Spray operator will lean forward for reaching above 3 meters and step back for close surfaces.
- Spray operator will shake their sprayers from time to time while glancing at the pressure gauge.

Day Four

- To mix the suspension using a 45 cm paddles so that there are no lumps.
- To use the screened filler funnel.
- To fill the sprayer to the correct level.
- To keep the nozzle tip 45 cm from the surface to be sprayed
- To spray at the correct speed.
- To allow an over-lap of not more than 5 cms.
- To shake the sprayer from time to time to avoid settling of the insecticide.
- To maintain the proper pressure in the sprayer.
- To use extension rod or bamboo for high walls and ceilings.
- To assist householders in clearing the house for spraying (remove articles from walls, remove furniture to outside, remove or cover foodstuffs).
- To remove children, chickens and other animals from the house before spraying.
- To cover bee-hives before spraying.
- To treat property of the householder with respect.
- To wash and clean the spray pump after the completion of each day's work.
- To clean blocked nozzle tips with grass and/or air pressure, never with a pin or wire.
- To use the correct size tools to open sprayer for cleaning and repair.
- To always be courteous and polite to house owners.

Day Five

- Each spray operator to fill his sprayer to 8 litres with water (using bucket and filler funnel).
- Each spray operator will be tested over the 19m2 which should be covered in 60 seconds (58-62 sec. limits).
- Make sure that each spray operator carries out the correct procedures emphasized on the 3rd day.

- Repeat this test until all trainees successfully pass the test. Special cases:
- Explain "special cases" where spray operator must perform additional duties aside from general house spraying.
- These include such things as the following: what to do if chairs, boxes or other obstacles prevent access to a room.
- What to do when bottles, pictures, harnesses, ploughs are hanging on the walls.
- How to treat large pieces of furniture, skins, other containers which are in the way
- How to spray tables, beds.
- How to spray in confined places
- How to cover beehives before spraying
- Equipment and method of spraying high ceilings and walls
- How to spray doors and windows which open in the inside
- How to spray eaves.
- Show sachet of insecticide in use
- Show insecticide mixed in a glass beaker
- Explain that, when undisturbed, it settles to the bottom
- Explain the need, therefore, to shake the sprayer frequently
- Take pail (bucket), funnel and paddle.
- Show the marked line on the inside of the pail which indicates the 8- litre mark.
- Add insecticide to pail or follow the instruction on sachet label
- Show trainees how to mix by adding a small quantity of water to the powder to make a paste. When the powder is thoroughly mixed into a paste using the paddle, add water through the filler funnel to the 8 liter mark.
- Allow some of the spray operator to mix a sachet of insecticide
- Emphasize that poor mixing causes lumps and blocked nozzle tips
- Emphasize the necessity of obtaining from each householder sufficient water to spray his own house.

Day Six

- Review again the spraying procedures
- Explain some of the various defects of spraying, what to look for.
- Demonstrate, using suspension, the correct spraying techniques (proper speed, distance agitation, stance).
- Special measures to be taken to see that all infants. Chickens and other animals are removed from the house prior to actual spraying.
- How to place spray equipment and supplies out of reach of children and animals.
- Do not spill insecticide powder or suspension near houses; do not contaminate water sources.
- Review duties of a spray operator:
- Responsibility in case of damage or lose of materials and personal issues.
- Explain what is expected of a spray operator.
- Explain conditions of work and pay.
- Explain that they will be expected to walk long distances each day.
- The need for respect and care of the householder's property.
- Indicate the surface area of a house in m2, and the number of charges, of insecticide which should be sprayed on average each day.
- Orders and instructions from respective squad chiefs and technicians must be obeyed.
- Need for cleanliness.
- Regulations about smoking.
- Need for wash daily, before eating and at the end of the day's work.
- Spraying practice.
- Spraying test.

Day Seven

- Demonstration and practice on triple rinsing of spray tanks
- Key message to households
- Importance of public relations; need to have good relations with local population, especially with locality leaders, elders, religious leaders and government officials, etc.
- How to approach the people.
- How much advice to give the people and how to warn them of the hazards of the insecticide.
- What assistance the squad requires from the community.
- What goods are to be removed from the house
- What assistance the spray operator may give.
- The need to obtain water from the people to spray each house.
- Discuss the sequence of spraying a house. Start at the door and proceed from left to right

Day Eight

- Final practical spraying and triple rinsing.
- Examination
- Selection of the spray operator
- Payment
- Preparation for spraying operations

The training should cover in detail at least the following areas. The previous 6 days training should extend to eight and cover environmental compliance component.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Introduction • Spray tank and equipment used • How to carry sprayer • Dismantling and assembling spray pump *Operation of sprayer* • How to clean sprayer • Distance of nozzle and surface • Speed or spraying	**Review sprayer parts** • Spraying successive swaths, practice spraying with wooden extension. • Applying pressure to the sprayer	**Practice spraying** • Spraying with • water • First test "Special Cases"	**Spraying techniques** • Preparation of the suspension • Techniques of spraying a house • How to check the spraying • Usual defects in spraying. • Marking sprayed houses. • Marking of sprayed houses after inspection • Use of house visit cards • Numbering houses using metal tags, die sets and house visit cards. • Training of spray operator • Importance of total coverage • Repairs to the sprayer • Testing the sprayer • Testing nozzle output at 40 p.s.i.	**Environmental compliance practices and IEC** • Human and environmental safety measures • Safe use of pesticides • PPE • Triple rinsing • Empty sachets, cartons, broken gloves, used masks and other insecticide contaminated materials • Key IRS messages to householders and the community	*The spray forms* • Spray records, charts, graphs • Organization of a spray squad, team. • Responsibilities and duties of a squad chief • Duties of spray operator, porters, camp guards • Hiring of workers and animals • Supervision: definition and Supervisory techniques • Locality map: reading and updating of maps. • Review sprayer repair, • maintenance (daily, weekly) • Camp-site locating, • organization, cleanliness • Care of tents, camp equipment and supplies • Examination

ANNEX A2. House spray card

District name _____ kebele _____ Village_____
House ID No _____ Date Sprayed _____ Head of household_____

Sprayed date	Spray operator	No. of occupants		No. of rooms		Insecticides used name	comments
		Adult	Children	Sprayed	Unsprayed		

ANNEX A3.Daily reporting form for spray operators

District _____ kebele_____Village/got_____
Date _____ Name and /or ID No of Spray Operator _____
Signature _____

	Target h/ Hold id Number	No of People in Household		Total no of Rooms/structures In household	Total no of Rooms/structures/units In household sprayed	Total no of Rooms/structures/units In household unsprayed	
		Children <5	Adults>5			Locked	refused
1							
2							
3							
4							
5							

Insecticide used:
Compound _____ Formulation _____ Dosage Concentration _____
Total sachets issued for the day _____ Total number of empty sachets bags/bottles returned _____ Spray Operators remarks on operational problems and suggested solutions_____

Spray team leaders' daily calculation

1. Daily house hold coverage: (Total number of sprayed houses/Total number of houses)
   _____
2. Daily rooms/structure coverage: (Total # of sprayed rooms/structures/Total # of rooms/structures)
   _____

Spray team leader remarks _____

ANNEX A4. Daily/weekly reporting form for spray team leaders

District _____ kebele _____ Village/Gote_____
Date _____ Name and ID No of Spray Leader _____

Day/ Week	Spray Operator	Total no. Of households Sprayed	Total no. Of rooms, Structures, Units in Household	Total no. Of rooms, Structures, units In household Sprayed	Proportion Of households Not Sprayed (%)	Total number of Insecticide sachets/ Bottles used		Total number of empty sachets/bottles	
						Type i insecticide	Type ii Insecticide	Type i insecticide	Type ii Insecticide

Spray Team leader remarks on operational problems and suggested solutions _____
_____
_____
Signature of spray team leader _____

ANNEX A5. Final reporting form for district IRS coordinators

Region_____ Zone_____ District _____
kebele_____Village/Gote _____ Date_____Name and ID No of Spray Leader_____

S.n	Targeted Kebele name	Total no. Of households Targeted To be Sprayed In targeted kebele	Total no. Of rooms, Structures, Units in Household	Total no. Of rooms, Structures, units In household Sprayed	Total no. Of rooms, Structures, units In household Unsprayed	Proportion Of households Not Sprayed (%)	Total No. Of People in Sprayed Household	Total number of Insecticide sachets/ Bottles used		Total number of empty sachets/bottles	
								Type i insecticide	Type ii Insecticide	Type i insecticide	Type ii Insecticide
1											
2											
3											
4											
5											

ANNEX B. MINIMUM STANDARDS FOR NETS AND INSECTICIDE

Characteristics of nets can be divided into (1) minimal technical norms (which could be the subject of a national quality assessment) and (2) other characteristics that are purely the result of user preferences. Technical norms for net products have been developed by the WHO and are therefore internationally recommended as minimum standards for production:

Minimum standards

- Mesh Size: Minimum 24 holes/cm^2 (156 holes /in^2)
- Net Material mass 30g/m^2 for 75 denier Yarn 40g/m^2 for 100 denier yarn with a tolerance of ± 5%
- Dimensional stability: ± 5%
- Bursting strength: Minimum 250 kpa for 75-denier yarn (7.3) cm
- 405 kpa for 100-denier yarn
- Fire safety; Class 1 (16CFR Part 1610)
- Odor: Odorless
- Appearance of insecticide on nets :Invisible
- Wash resistance: Insecticidal efficacy for more than 20 washes (above 95% knock down and above 80% mortality)
- Standard labeling with type of net, washing instruction etc…It is recommended that the consumer has as much choice as possible:
- Rectangular/circular
- Width/length/height (a standard name for certain sizes would be useful)
- Range of colors including white, blue, green (rural areas prefer dark green and blue)
- Brand choice

ANNEX C. Tablet containing 120 mg Artemether plus 20 mg Lumefantrine in a fixed dose.

Weight (KG)	Age	Day 1		Day 2		Day 3		Color code
		Immediate	After 8 hours	Morning	Evening	Morning	Evening	
<5kg	< 4 months	1 tablet	1 tablet	1 tablet	1 tablet	1 tablet	1 Tablet	Yellow*
5-14 kg	4mns- 2 years	1 tablet	1 tablet	1 tablet	1 tablet	1 tablet	1 Tablet	
15-24 kg	3 to 7 yrs	2 tablets	2 tablets	2 tablets	2 tablets	2 tablets	2 tablets	Blue*
25-34 kg	8 to 10 yrs	3 tablets	3 tablets	3 tablets	3 tablets	3 tablets	3 tablets	Brown
>35	=>10 years	4 tablets	4 tablets	4 tablets	4 tablets	4 tablets	4 tablets	Green

* (Yellow, Blue) flavored pediatric formulation (dispersible tablets) of Artemether-Lumefantrine (AL) is available for enhancing its use in young children.

Contraindications:

- Persons with a previous history of reaction after using the drug;
- Pregnant women in the first trimester
- Persons with severe and complicated malaria should not be treated with oral medications.

ANNEX D. Chloroquine Treatment Schedule

Chloroquine is available as tablet (250 mg, which is equal to 150 mg base) or as syrup (50 mg base per 5 ml). The dose is 25 mg/kg which is given in divided doses over three days.

Weight (kg)	Age	Day 1	Day 2	Day 3
5 – 6	< 4 months	½ tablet OR 5 ml syrup	¼ tablet OR 5 ml syrup	¼ tablet OR 2.5 ml syrup
7 – 10	4 – 11 months	½ tablet OR 7.5 ml syrup	½ tablet OR 7.5 ml syrup	½ tablet OR 5 ml syrup
11 – 14	1 – 2 years	1 tablet OR 12.5 ml syrup	0.5 tablet OR 12.5 ml syrup	0.5 tablet OR 7.5 ml syrup
15 – 18	3 – 4 years	1 tablet OR 15 ml syrup	1 tablet OR 15 ml syrup	1 tablet OR 15 ml syrup
19 – 24	5 – 7 years	1 ½ tablets OR 20 ml syrup	1 ½ tablets OR 20 ml syrup	1 tablet OR 15 ml syrup
25-35	8-11 yr	2 ½ tablets	2 tablets	1 tablet
36-50	12-14 years	3 tablets	2 tablets	2 tablets
51+	15 years + adult	4 tablets	4 tablets	2 tablets

Contraindications:

- persons with known hypersensitivity
- persons with a history of epilepsy
- persons suffering from psoriasis

ANNEX E. Primaquine phosphate dose: 0.25 mg base per kg (single dose primaquine for P. falciparum cases)

Weight (kg)	Age (years)	7.5 mg tablet
19 – 24	5 – 7	¾
25 – 35	8 – 10	1
36 – 50	11 – 13	1 ½
50+	14+	2

ANNEX F. Primaquine phosphate dose: 0.25 mg base per kg daily schedule for 14 days for P. vivax

Weight (kg)	Age (years)	Number of tablets per day for 14 days	
		7.5 mg tablet	15 mg tablet
19 – 24	5 – 7	¾	-
25 – 35	8 – 10	1	½
36 – 50	11 – 13	1 ½	¾
50+	14+	2	1

Contraindications:

- Pregnancy
- In breast feeding mothers less than six months infants
- Infants under six months
- Any condition that predisposes to granulocytopenia, such as active rheumatoid arthritis & systemic lupus erythematosus.

Side effects:

Anorexia, nausea, vomiting, abdominal pain and cramps are dose related and relatively rare at daily doses up to 0.25 mg base/kg. They may also be accompanied by vague symptoms such as weakness and uneasiness in the chest.

It can induce hemolysis especially in G6PD deficient patients

ANNEX G. Protocol for Primaquine radical cure at health post level

Mode of implementation

It will be implemented in selected districts from malaria elimination districts then it will be scaled up nationally.

Adverse Events

Primaquine is generally well tolerated.

- Dose-related gastrointestinal discomfort, including abdominal pain, nausea and vomiting (Administration with food improves tolerability).
- The most important adverse effect is hemolysis in some patients. This adverse event may be seen occasionally in Ethiopian patients. Fortunately, primaquine is eliminated from the body rapidly, so that hemolysis stops once the drug is stopped.

Contraindications

- Known hypersensitivity to primaquine
- Women breast feeding infants less than six months old
- Infants less than six months
- Pregnancy
  - Use the following checklist to reasonably rule out pregnancy

No	Questions	Yes	No
1	Did your last menstrual period start within the past 7 days?		
2	Have you abstained from sexual intercourse since your last menstrual period or delivery?		
3	Have you been using a reliable contraceptive method consistently and correctly since your last menstrual period or delivery?		
4	Have you had a baby in the last 4 weeks?		
5	Did you have a baby less than 6 months ago, are you fully or nearly fully breast feeding, and have you had no menstrual period since then?		
6	Have you had a miscarriage or abortion in the past 7 days?		

Interpretation:

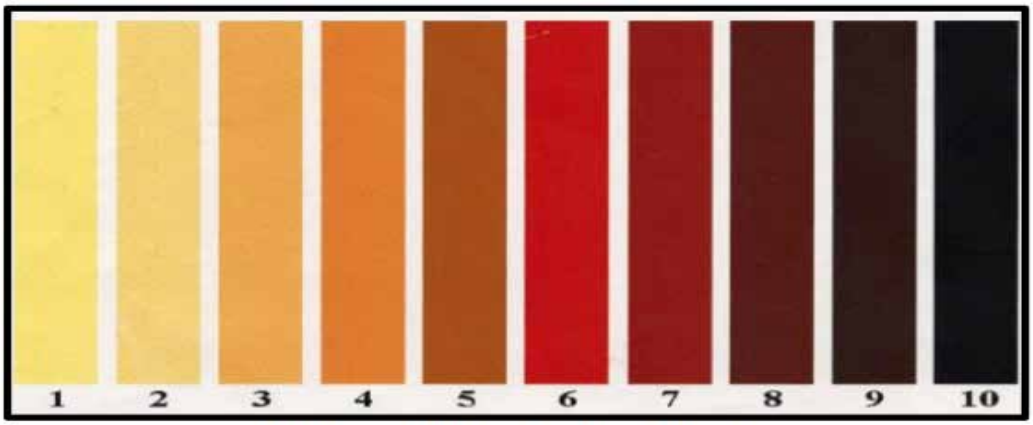
1. If the client answered YES to at least one of the questions and she is free of signs or symptoms of pregnancy (see below), you can be reasonably sure she is not pregnant.
2. If the client answered NO to all of the questions, pregnancy cannot be ruled out using the checklist. Refer her to health center for pregnancy test or wait until the next menstrual cycle to start primaquine

Signs and symptoms of pregnancy

- Increased frequency of urination
- Increased sensitivity to odors
- Mood changes
- Weight gain
- Nausea and/or vomiting
- Breast tenderness
- Fatigue

Procedure

- The health extension worker will assist the patient to select treatment supporter from the household or neighborhood. The treatment supporter will assist the patient in taking all courses of the primaquine.
- The health extension worker will provide health education and client education material for patients and treatment supporters
- The patient will come to the health post for follow up at prescheduled days. The day of initial treatment is designated as day zero. The patient will be seen at the health post at days 3, 7 and 13 to check symptoms of anemia and urine color.
- The symptoms of anemia are fatigue, palpitation or dyspnea (shortness of breathing) on exertion
- Additionally ask for the symptoms of malaria (fever) at each visit
-
- Observe the urine of the patient with the Hillmen colour chart
    - Hillmen urine color estimation for haemoglobinuria: urine should be placed in a clear glass container and held up against a white piece of paper, in a well illuminated area, before estimating the colour compared to the Hillmen Colour Chart. Urine colour estimation should be carried out as soon after voiding as possible. A score of 5 or above is considered evidence of haemoglobinuria.



Hillmen Urine Colour Chart

When to stop PQ (Refer patient to health center)

- Symptomatic anemia
- Urine color: a score of 5 or above on the Hillmen urine colour chart

Federal Ministry of Health

Follow up Register for Primaquine Radical cure

For Health posts

Identification	Day	Date	Number of Chloroquine doses taken	Number of AL doses taken (if applicable)	Number of primaquine doses taken	Fever (Yes/No)	Fatigue on exertion (Yes/No)	Palpitation (Yes/No)	Dyspnea on exertion (Yes/No)	Urine color score on Hillmen color chart	**Action taken** 1. Appoint for next visit 2. Support aherence to medications 3. If patient has fever, managed according to the national guideline 4. Patient has fatigue on exertion and referred to health center 5. Patient has palpitation and referred to health center 6. Patient has dyspnea on exertion and referred to health center 7. Patient has urine color score of more than 5 and referred to health center	Date of Next visit	On day 13, write the number of days the patient took primaquine
Name:	0												
	3												
	7												
MRN:	13												
	Unscheduled visit												
Name:	0												
	3												
	7												
MRN:	13												
	Unscheduled visit												
Name:	0												
	3												
	7												
MRN:	13												
	Unscheduled visit												
Name:	0												
	3												
	7												
MRN:	13												
	Unscheduled visit												

ANNEX H. Protocol for Primaquine radical cure at health center and hospital levels

Mode of implementation

It will be implemented in selected districts from malaria elimination districts then it will be scaled up nationally.

Indications for PQ

Primaquine is to be used at selected elimination targeted areas for all patients diagnosed with Plasmodium vivax malaria. It should also be given for patients diagnosed with mixed infection using microscopy

Adverse Events/ Effects

Primaquine is generally well tolerated.

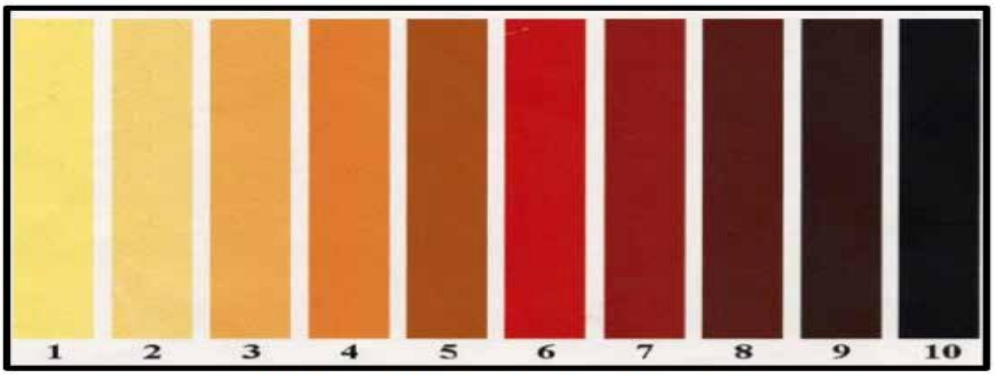
- Dose-related gastrointestinal discomfort, including abdominal pain, nausea and vomiting (Administration with food improves tolerability).
- The most important adverse effect is hemolysis in patients with glucose-6-phosphate dehydrogenase (G6PD) deficiency. The degree of hemolysis is proportional to the dose, duration of exposure, and degree of G6PD deficiency. A study conducted by EPHI showed the nonexistence of African and Mediterranean variants of G6PD which are expected to be present in Ethiopia. Fortunately, primaquine is eliminated rapidly, so that hemolysis stops once the drug is stopped.

Contraindications

- Known hypersensitivity to primaquine
- Women breast feeding infants less than six months old
- Infants less than six months
- Pregnancy (rule out with pregnancy test)

Procedure

- The health worker will assist the patient to select treatment supporter from the household or neighborhood. The treatment supporter will assist the patient in taking all courses of the primaquine.
- The health worker will provide health education and client education material for patients and treatment supporters
- The patient will come to the health center/ hospital for follow up at prescheduled days. The day of initial treatment is designated as day zero. The patient will be seen at the health facility at days 3, 7 and 13 to check symptoms of anemia, urine color and hemoglobin measurement.
- Ask for anemia symptoms at each visit. The symptoms of anemia are fatigue, palpitation or dyspnea (shortness of breathing) on exertion
- Measure hemoglobin on days 0, 3, 7 and 13
- Ask for the symptoms of malaria (fever) at each visit
- At each visit observe the urine of the patient with the Hillmen colour chart
    - Hillmen urine color estimation for haemoglobinuria: urine should be placed in a clear glass container and held up against a white piece of paper, in a well illuminated area, before estimating the colour compared to the Hillmen Colour Chart. Urine colour estimation should be carried out as soon after voiding as possible. A score of 5 or above is considered evidence of haemoglobinuria.



Hillmen Urine Colour Chart

When to stop PQ (Refer patient to hospital)

- Hemoglobin < 5 g/dL
- Hemoglobin drop of >50% of the baseline
- Hemoglobin < 7 g/dL AND Hemoglobin drop from baseline of >25%
- Symptomatic anemia
- Urine color: a score of 5 or above on the Hillmen urine colour chart

Federal Ministry of Health
Follow up Register for Primaquine Radical cure
For Health centers and hospitals

Identification	Day	Date	Number of Chloroquine doses taken	Number of AL doses taken (if applicable)	Number of primaquine doses taken	Fever (Yes/No)	Fatigue on exertion (Yes/No)	Palpitation (Yes/No)	Dyspnea on exertion (Yes/No)	Urine color score on Hillmen color chart	Hemoglobin	**Action taken** 1. Appoint for next visit 2. Support aherence to medications 3. If patient has fever, managed according to the national guideline 4. Patient has symptoms of anemia and managed/referred to hospital 5. Patient has urine color score of more than 5 and managed/referred to hospital 6. Patient has significant drop in hemoglobin and managed/referred to hospital	Date of Next visit	On day 13, write the number of days the patient took primaquine	Remark
Name:	0														
	3														
	7														
MRN:	13														
	Unscheduled visit														
Name:	0														
	3														
	7														
MRN:	13														
	Unscheduled visit														
Name:	0														
	3														
	7														
MRN:	13														
	Unscheduled visit														
Name:	0														
	3														
	7														
MRN:	13														
	Unscheduled visit														

ANNEX I. ORAL QUININE TREATMENT SCHEDULE

Oral quinine dosage is 8.3 mg base/kg (=10 mg quinine sulphate salt/kg) three times daily for seven days. (The maximum adult dose is 600mg quinine sulphate (salt) three times daily for seven days.)

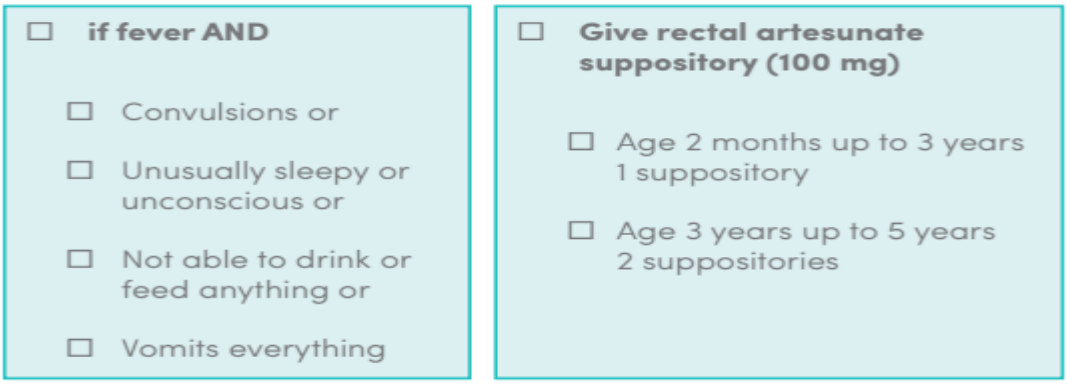
Weight (kg)	Age (years)	Oral (tablets) Dosage to be given 3 times daily	
		200 mg salt	300 mg salt
4 – 6	2 – 4 months	¼	-
6 – 10	4 – 12 months	1/3	¼
10 – 12	1 – 2 years	½	1/3
12 – 14	2 – 3 years	¾	½
14 – 19	3 – 5 years	¾	½
20 – 24	5 – 7 years	1	¾
25 – 35	8 – 10 years	1 ½	1
36 – 50	11 – 13 years	2	1 ½
50+	14+	3	2

Side effects:

- Dizziness, ringing in the ears, blurred vision and tremors, known collectively as "Cinchonism". At the above dosages, these symptoms are not severe enough to stop treatment and subside spontaneously when administration of the drugs ends.
- Hypoglycemia may be caused by quinine.

Contraindications:

No contraindication to the oral administration of the drug within the above dosage.

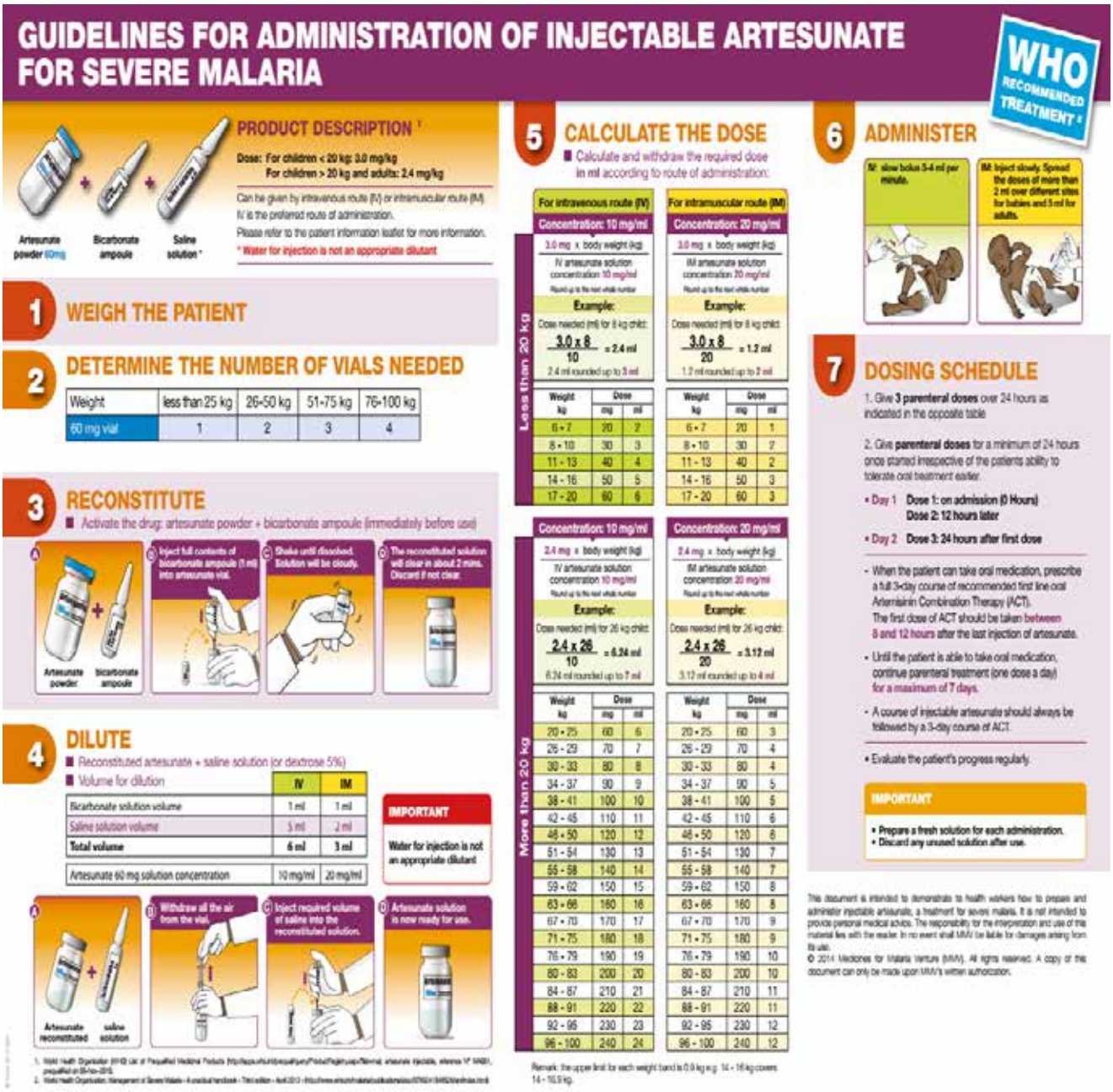


ANNEX J. Rectal artesunate treatment for emergency pre-referral therapy for severe malaria dosed at 10mg/kg body weight

Note

Rectal artesunate is not recommended for above age of six and adults

ANNEX K. Artesunate Injection for severe malaria



ANNEX L. Artemether injection

	Day 1	Day 2	Day 3
Artemether IM	3.2 mg/kg body weight	1.6 mg/kg body weight	1.6 mg/kg body weight

Artemether injection is given at a loading dose of 3.2 mg/kg on the first day followed by 1.6 mg/kg daily for two days. Then if the condition of the patient improves, will be followed by full dose AL

Side effects:

Adverse effects may include headache, nausea, vomiting, abdominal pain, itching, drug fever, abnormal bleeding and dark urine.

Relative Contraindications:

IM Artemether should only be used during the first trimester of pregnancy when IV/IM artesunate (preferred) and IV/IM quinine are both unavailable.

ANNEX M. GLASGOW COMA SCALE

The Glasgow coma scale for adults and older children	
	Score
Eyes open: • Spontaneously • To speech • To pain • Never	 4 3 2 1
Best verbal response: • Orientated • Confused, disoriented • Inappropriate words • Incomprehensible sounds • None	 5 4 3 2 1
Best motor response: • Obeys commands • Localizes pain • Withdraws (flexion) • Abnormal Flexion posturing • Extension posturing • None	 6 5 4 3 2 1
TOTAL	**3-15**

To calculate the Glasgow coma score, take the score for each section, then add the three figures to obtain a total score.

- Unrousable coma is defined as having a score < 10.
- Patients scoring 3 or 4 have an 85% of chance of dying or remaining vegetative.
- Patients scoring above 11 indicate only a 5 to 10 percent likelihood of death or vegetative state and 85 % of chance of moderate disability or good recovery.

ANNEX N. BLANTYRE COMA SCALE

Blantyre coma scale for young children who are preverbal	
	Score
Eye movements: • Directed (followed mother/caretakers face) • Not directed	 1 0
Verbal response: • Appropriate for age (cry) • Moan or inappropriate for age (cry) • Gasp/none	 2 1 0
Best motor response: • Localizes painful stimulus (rub your knuckles firmly on the patients sternum) • Withdraws limb from pain (press firmly on patients thumbnail bed with the side of a horizontal pencil) • None specific or absent response	 2 1 0
Total	**1-5**

Blantyre scale: Unrousable come is defined as having a score of < 3

The scores can be used repeatedly to assess improvement or deterioration.

ANNEX O. TREATMENT / PROGRESS / OBSERVATION CHART

Date of admission: ...../...../..... **Time (h/min):** ...../.....

Name of patient: _____

		Hours										
Record No. _____ Age: _____ Sex: _____ M ☐ F ☐ Weight _____ Medicines given before admission (including OPD) _____ _____		1			4				8			
	Real time (h) minutes											
Investigations done on admission	Temperature (2x/day) Pulse (2x/day)											
Parasite count	Respiratory rate (2x/day)											
Haemotocrit/Hb	Blood pressure (2x/day)											
Blood sugar	Glasgow/Blantyre coma scale (3x/day)											
Urine analysis												
Cerebral spinal fluid (CSF)	Convulsions (Y N)											
Blood group	Able to drink (Y N)											
	Able to sit (Y N)											
	Parasite count											
	Haemotocrit/Hb											
	Blood sugar											
	iv artesunate or quinine in mg											
	iv fluids – dextrose saline											
	Other medicines, e.g. iv diazepam/antibiotics											
	Urine volume											
	Blood transfusion											

ANNEX P. PARACETAMOL TREATMENT SCHEDULE

Dosage of Paracetamol [100mg and 500mg tablets (up to 15 mg/kg every 4 hours)]

Age	Weight	100 mg tablet	500 mg tablet
Child 0-2 Months	< 4kg	½ tablet x 3 times per day x 3 days	
Child 2 -11 Months	4.1 – 8 kg	1 tablet x 3 times per day x 3 days	
Child 1 – 4 yrs	8.1– 15 kg	2 tab x 3 times per day x 3 days	½ tab x 3 times per day x 3 days
Child 5 – 14 years	15.1– 35 kg		1 tab x 3 times per day x 3 days
Adult over 15 years	Over 35 kg		2 tab x 3 times per day x 3 days

ANNEX Q. CHEMOPROPHYLAXIS REGIMEN

a. Mefloquine

5 mg /kg mefloquine salt once weekly

Weight (Kg)	Age (approx.)	Number of tablets per week
<9	< 3 months	Not Recommended
9 – 19	3 – 23 months	¼
20 – 30	2 – 7 year	½
31 – 45	8 – 10 year	¾
36 – 50+	11 – 14+	1

a. Atovaquone-proguanil

Weight (kg)	Atovaquone/ Proguanil HCl Total Daily Dose	Dosage Regimen
11-20	62.5 mg/25 mg	1 Pediatric Tablet daily
21-30	125 mg/50 mg	2 Pediatric Tablets as a single dose daily
31-40	187.5 mg/75 mg	3 Pediatric Tablets as a single dose daily
>40	250 mg/100 mg	1 Tablet (adult strength) as a single dose daily

ANNEX R. ADVERSE DRUG REACTION REPORTING FORM

DRUG ADMINISTRATION AND CONTROL
AUTHORITY OF ETHIOPIA
Adverse Drug Reaction Reporting Form

Patient Initial	Card No:	Age: (DOB)	Sex:	Weight: .....
Ethnic Group		Substance of Abuse		
Information on Suspected Drug/ Vaccine S=suspected C= Concomitantly used drugs				

Drug Name (use Brand Name, indicate manufacturer and batch no. if applicable.)	S/C	Route	Dose/ Dosage form	Frequency	Date D/M/Y Drug Started	Date D/M/Y Drug Stopped	Indication (Reason for drug use)

Adverse Drug Reaction Description (Including Laboratory test results):

Date of onset of Reaction: D/M/Y

Reaction necessitated:	Reaction subside after D/C of Suspected Drug
Discontinuation of drug/s/ ☐ Yes ☐ No	☐Y ☐N ☐NA
Prolonged Hospitalization ☐ Yes ☐ No	Reaction reappear after Restart of Suspected Drug ☐Y ☐N ☐NA

Treatment of reaction:

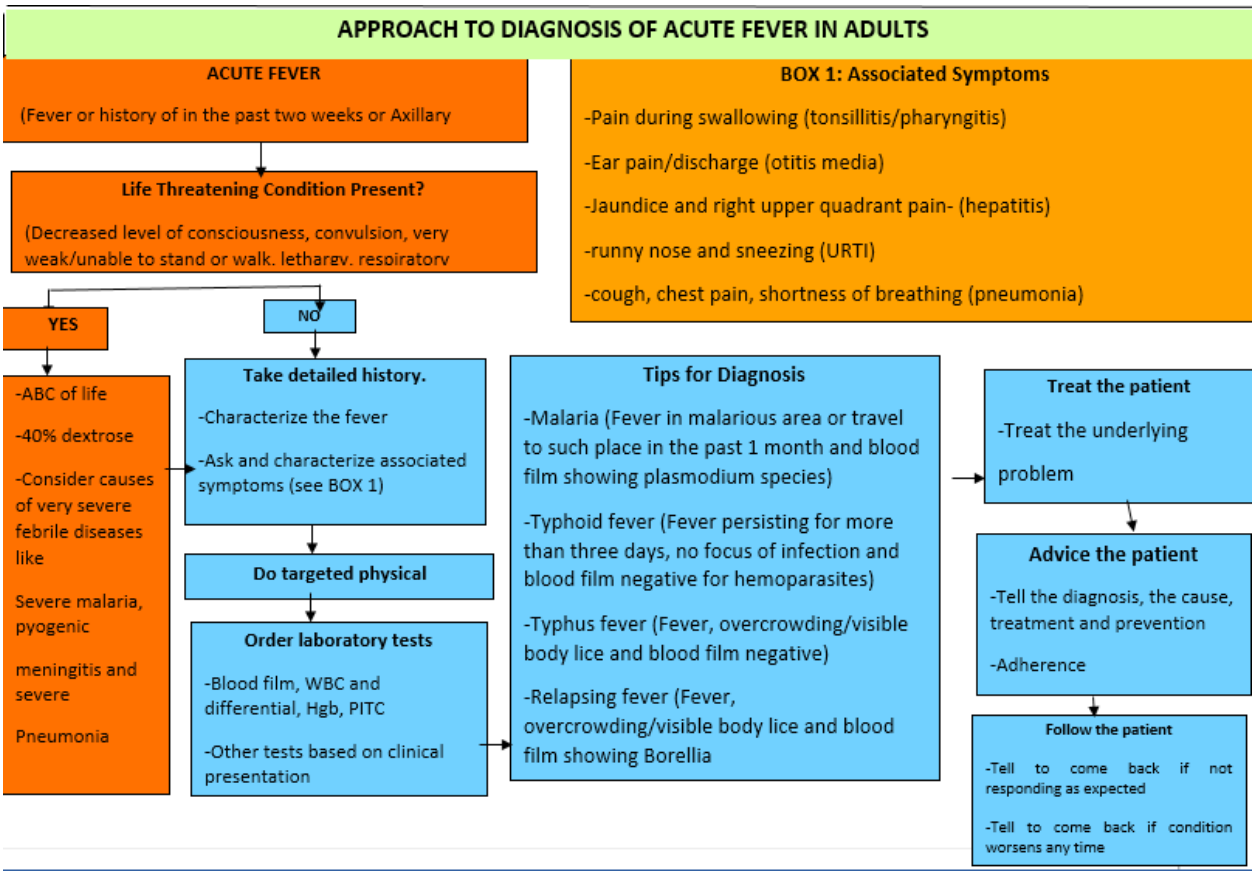
Outcome: ☐ Died due to adverse reaction ☐Died, drug may be contributory ☐ Not yet recovered
☐ Recovered with out sequelae ☐ Recovered with sequelae ☐Unknown

Sequelae:

Relevant medical conditions such as allergies, renal disease, liver disease, other chronic disease, pregnancy, etc.

Reported by: Name	Profession	e-mail:	Tel. No. .....
Name of Health Institutions		Date	

ANNEX S: Approach to diagnosis of acute fever in Adults



ANNEX T. WHO WEEK NUMBERS FOR HEALTH POSTS (EFY 2010-2015)

WHO Week number	Ethiopian week number	Week start and end dates in Ethiopian Calendar					
		2010	2011	2012	2013	2014	2015
28	1	03/11/09-09/11/09	02/11/10-08/11/10	01/11/11-07/11/11	29/10/12-05/11/12	05/11/13-11/11/13	04/11/14-10/11/14
29	2	10/11/09-16/11/09	09/11/10-15/11/10	08/11/11-14/11/11	06/11/12-12/11/12	12/11/13-18/11/13	11/11/14-17/11/14
30	3	17/11/09-23/11/09	16/11/10-22/11/10	15/11/11-21/11/11	13/11/12-19/11/12	19/11/13-25/11/13	18/11/14-24/11/14
31	4	24/11/09-30/11/09	23/11/10-29/11/10	22/11/11-28/11/11	20/11/12-26/11/12	26/11/13-02/12/13	25/11/14-01/12/14
32	5	01/12/09-07/12/09	30/11/10-06/12/10	29/11/11-05/12/11	27/11/12-03/12/12	03/12/13-09/12/13	02/12/14-08/12/14
33	6	08/12/09-14/12/09	07/12/10-13/12/10	06/12/11-12/12/11	04/12/12-10/12/12	10/12/13-16/12/13	09/12/14-15/12/14
34	7	15/12/09-21/12/09	14/12/10-20/12/10	13/12/11-19/12/11	11/12/12-17/12/12	17/12/13-23/12/13	16/12/14-22/12/14
35	8	22/12/09-28/12/09	21/12/10-27/12/10	20/12/11-26/12/11	18/12/12-24/12/12	24/12/13-30/12/13	23/12/14-29/12/14
36	9	29/12/09-05/13/09	28/12/10-04/13/10	27/12/11-03/13/11	25/12/12-01/13/12	01/13/13-02/01/14	30/12/14-01/01/15
37	10	01/01/10-07/01/10	05/13/10-06/01/11	04/13/11-04/01/12	02/13/12-03/01/13	03/01/14-09/01/14	02/01/15-08/01/15
38	11	08/01/10-14/01/10	07/01/11-13/01/11	05/01/12-11/01/12	04/01/13-10/01/13	10/01/14-16/01/14	09/01/15-15/01/15
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45	18	27/02/10-03/03/10	26/02/11-02/03/11	24/02/12-30/03/12	23/02/13-29/02/13	29/02/14-05/03/14	28/02/15-04/03/15
46	19	04/03/10-10/03/10	03/03/11-09/03/11	01/03/12-07/03/12	30/02/13-06/03/13	06/03/14-12/03/14	05/03/15-11/03/15
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50	23	02/04/10-08/04/10	01/04/11-07/04/11	29/03/12-05/04/12	28/03/13-04/04/13	04/04/14-10/04/14	03/04/15-09/04/15
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52	25	16/04/10-22/04/10	15/04/11-21/04/11	13/04/12-19/04/12	12/04/13-18/04/13	18/04/14-24/04/14	17/04/15-23/04/15
1	26	23/04/10-29/04/10	22/04/11-28/04/11	20/04/12-26/04/12	19/04/13-25/04/13	25/04/14-01/05/14	24/04/15-30/04/15

WHO Week number	Ethiopian week number	Week start and end dates in Ethiopian Calendar					
		2010	2011	2012	2013	2014	2015
2	27	30/04/10-06/05/10	29/04/11-05/05/11	27/04/12-03/05/12	26/04/13-02/05/13	02/05/14-08/05/14	01/05/15-07/05/15
3	28	07/05/10-13/05/10	06/05/11-12/05/11	04/05/12-10/05/12	03/05/13-09/05/13	09/05/14-15/05/14	08/05/15-14/05/15
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5	30	21/05/10-27/05/10	20/05/11-26/05/11	18/05/12-24/05/12	17/05/13-23/05/13	23/05/14-29/05/14	22/05/15-28/05/15
6	31	28/05/10-04/06/10	27/05/11-03/06/11	25/05/12-01/06/12	24/05/13-30/05/13	30/05/14-06/06/14	29/05/15-05/06/15
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15	40	01/08/10-07/08/10	30/07/11-06/08/11	28/07/12-04/08/12	27/07/13-03/08/13	03/08/14-09/08/14	02/08/15-08/08/15
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17	42	15/08/10-21/08/10	14/08/11-20/08/11	12/08/12-18/08/12	11/08/13-17/08/13	17/08/14-23/08/14	16/08/15-22/08/15
18	43	22/08/10-28/08/10	21/08/11-27/08/11	19/08/12-25/08/12	18/08/13-24/08/13	24/08/14-30/08/14	23/08/15-29/08/15
19	44	29/08/10-05/09/10	28/08/11-04/09/11	26/08/12-02/09/12	25/08/13-01/09/13	01/09/14-07/09/14	30/08/15-06/09/15
20	45	06/09/10-12/09/10	05/09/11-11/09/11	03/09/12-09/09/12	02/09/13-08/09/13	08/09/14-14/09/14	07/09/15-13/09/15
21	46	13/09/10-19/09/10	12/09/11-18/09/11	10/09/12-16/09/12	09/09/13-15/09/13	15/09/14-21/09/14	14/09/15-20/09/15
22	47	20/09/10-26/09/10	19/09/11-25/09/11	17/09/12-23/09/12	16/09/13-22/09/13	22/09/14-28/09/14	21/09/15-27/09/15
23	48	27/09/10-03/10/10	26/09/11-02/10/11	24/09/12-30/09/12	23/09/13-29/09/13	29/09/14-05/10/14	28/09/15-04/10/15
24	49	04/10/10-10/10/10	03/10/11-09/10/11	01/10/12-07/10/12	30/09/13-06/10/13	06/10/14-12/10/14	05/10/15-11/10/15
25	50	11/10/10-17/10/10	10/10/11-16/10/11	08/10/12-14/10/12	07/10/13-13/10/13	13/10/14-19/10/14	12/10/15-18/10/15
26	51	18/10/10-24/10/10	17/10/11-23/10/11	15/10/12-21/10/12	14/10/13-20/10/13	20/10/14-26/10/14	19/10/15-25/10/15
27	52	25/10/10-01/11/10	24/10/11-30/10/11	22/10/12-28/10/12	21/10/13-27/10/13	27/10/14-03/11/14	26/10/15-02/11/15
					28/10/13-04/11/13		

Malaria Glossary

Terminology	Definition
Anemia	A reduction in the number of circulating red blood cells or in the quantity of hemoglobin.
Anopheles	A genus of mosquito; some species can transmit human malaria.
Anorexia	Lack of appetite and a lack of desire or interest in food.
Anthropophilic	Mosquitoes that prefer to take blood meals on humans.
Antibody	A specialized serum protein (immunoglobulin or gamma globulin) produced by B lymphocytes in the blood in response to an exposure to foreign proteins (*antigens*). The antibodies specifically bind to the antigens that induced the immune response. Antibodies help defend the body against infectious agents, including bacteria, viruses, or parasites.
Antigen	Any substance that stimulates the immune system to produce antibodies. Antigens are often foreign substances: invading bacteria, viruses, or parasites.
Autochthonous	Malaria transmitted by mosquitoes that can be indigenous (in a geographic area where malaria occurs regularly) or introduced (in a geographic area where malaria does not occur regularly).
Cerebral malaria	A complication of *Plasmodium falciparum* malaria with cerebral manifestations, usually including coma (Glasgow coma scale < 11, Blantyre coma scale < 3). Malaria with coma persisting for > 30 min after a seizure is considered to be cerebral malaria.
Chemoprophylaxis	Taking antimalarial drugs to prevent the disease.
Cinchonism	Side effects from quinine or quinidine, including tinnitus, headache, nausea, diarrhea, altered auditory acuity, and blurred vision. The term comes from cinchona bark, the natural source of quinine.
Clinical cure	Elimination of malaria symptoms, sometimes without eliminating all parasites. See *radical cure* and *suppressive cure/treatment*.
Coma	A decreased state of consciousness from which a person cannot be awakened.
Congenital malaria	Malaria in a newborn or infant, transmitted from the mother at birth.
Control	Reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts.
Cryptic	A case of malaria where epidemiologic investigations fail to identify how the patient acquired the disease; this term applies mainly to cases found in non-endemic countries.
Drug resistance	The result of microbes changing in ways that reduce or eliminate the effectiveness of drugs, chemicals, or other agents to cure or prevent infections.
Dyspnea	Shallow, labored breathing.
Efficacy	The power or capacity to produce a desired effect.
Elimination	The interruption of local mosquito-borne malaria transmission in a defined geographical area, creating a zero incidence of locally contracted cases. Imported cases will continue to occur and continued intervention measures are required.
Elimination of disease	Reduction to zero of the incidence of a specified disease in a defined geographical area as a result of deliberate efforts.
Elimination of infection	Reduction to zero of the incidence of infection caused by a specified agent in a defined geographical area as a result of deliberate efforts.
Endemic	Where disease occurs consistently.

Endophagic	A mosquito that feeds indoors.
Endophilic	A mosquito that tends to inhabit/rest indoors.
Epidemic	The occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time.
Epidemiology	The study of the distribution and determinants of health-related states or events in specified populations; the application of this study to control health problems.
Eradication	Permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts;
Erythrocytic stage	A stage in the life cycle of the malaria parasite found in the red blood cells. Erythrocytic stage parasites cause the symptoms of malaria.
Exoerythrocytic stage	A stage in the life cycle of the malaria parasite found in liver cells (hepatocytes). Exoerythrocytic stage parasites do not cause symptoms.
Exophagic	A mosquito that feeds outdoors.
Exophilic	An exophilic mosquito tends to inhabit/rest outdoors.
Extinction	The specific infectious agent no longer exists in nature or in the laboratory.
G6PD deficiency	An inherited abnormality that causes the loss of a red blood cell enzyme. People who are G6PD deficient should not take the antimalarial drug primaquine.
Gametocyte	The sexual stage of malaria parasites. Male gametocytes (microgametocytes) and female gametocytes (macrogametocytes) are inside red blood cells in the circulation. If a female Anopheles mosquito ingests them, they undergo sexual reproduction, which starts the extrinsic (sporogonic) cycle of the parasite in the mosquito. Gametocytes of *Plasmodium falciparum* are typically banana or crescent-shaped (from the Latin *falcis* = sickle).
Hypnozoite	Dormant form of malaria parasites found in liver cells. Hypnozoites occur only with *Plasmodium vivax* and *P. ovale*. After sporozoites (inoculated by the mosquito) invade liver cells, some sporozoites develop into dormant forms (the hypnozoites), which do not cause any symptoms. Hypnozoites can become activated months or years after the initial infection, producing a relapse.
Hypoglycemia	Low blood glucose; can occur with malaria. In addition, treatment with quinine and quinidine stimulate insulin secretion, reducing blood glucose.
Immune system	The cells, tissues, and organs that help the body resist infection and disease by producing antibodies and/or cells that inhibit the multiplication of the infectious agent.
Immunity	Protection generated by the body's immune system, in response to previous malaria attacks, resulting in the ability to control or lessen a malaria attack.
Immunization	The process or procedure by which a subject (person, animal, or plant) is rendered immune or resistant to a specific disease. This term is often used interchangeably with vaccination or inoculation, although inoculation does not always result in immunity.
Imported malaria	Malaria acquired outside a specific geographic area.
Incubation period	The interval of time between infection by a microorganism and the onset of the illness or the first symptoms of the illness. With malaria, the incubation is between the mosquito bite and the first symptoms. Incubation periods range from 7 to 40 days, depending on the species.
Indigenous malaria	Mosquito-borne transmission of malaria in a geographic area where malaria occurs regularly.

Induced malaria	Malaria acquired through artificial means (for example, blood transfusion, shared needles or syringes, or malariotherapy).
Infection	The invasion of an organism by a pathogen, such as bacteria, viruses, or parasites. Some, but not all, infections lead to disease.
Introduced malaria	Mosquito-borne transmission of malaria from an imported case in a geographic area where malaria does not regularly occur.
Merozoite	A daughter-cell formed by asexual development in the life cycle of malaria parasites. Liver-stage and blood-stage malaria parasites develop into schizonts, which contain many merozoites. When the schizonts are mature, they (and their host cells!) rupture, the merozoites are released and infect red blood cells.
Oocyst	A stage in the life cycle of malaria parasites, oocysts are rounded cysts located in the outer wall of the stomach of mosquitoes. Sporozoites develop inside the oocysts. When mature, the oocysts rupture and release the sporozoites, which then migrate into the mosquito's salivary glands, ready for injection into the human host.
Outbreak	An epidemic limited to a localized increase in disease incidence, e.g. in a village, town or closed institution.
Pandemic	An epidemic occurring over a very wide area, crossing international boundaries and usually affecting a large number of people.
Parasite	Any organism that lives in or on another organism without benefiting the host organism; commonly refers to pathogens, most commonly to protozoans and helminths.
Parasitemia	The presence of parasites in the blood. The term can also be used to express the quantity of parasites in the blood (for example, *a parasitemia of 2 percent*).
Paroxysm	A sudden attack or increase in intensity of a symptom, usually occurring at intervals.
Pathogen	Bacteria, viruses, parasites, or fungi that can cause disease.
Plasmodium	The genus of the parasite that causes malaria. The genus includes four species that infect humans: *Plasmodium falciparum, Plasmodium vivax, Plasmodium* ovale, and *Plasmodium malaria*e.
Presumptive treatment	Treatment of clinically suspected cases without, or prior to, results from confirmatory laboratory tests.
Radical cure (also radical treatment)	Complete elimination of malaria parasites from the body; the term applies specifically to elimination of dormant liver stage parasites (hypnozoites) found in *Plasmodium vivax* and *P. ovale.*
Recrudescence	A repeated attack of malaria (short-term relapse or delayed), due to the survival of malaria parasites in red blood cells. *Radical treatment:* see *radical cure*.
Relapse	Recurrence of disease after it has been apparently cured. In malaria, true relapses are caused by reactivation of dormant liver stage parasites (hypnozoites) found in *Plasmodium vivax* and *P. ovale.*
Residual insecticide spraying	Spraying insecticides that have residual efficacy against houses where people spend nighttime hours. Residual insecticide spraying is done to kill mosquitoes when they come to rest on the walls, usually after a blood meal.
Resistance	The ability of an organism to develop strains that are impervious to specific threats to their existence. The malaria parasite has developed strains that are resistant to drugs, such as chloroquine. The Anopheles mosquito has developed strains that are resistant to DDT and other insecticides.
Rigor	Severe shaking chill.
Schizogony	Asexual reproductive stage of malaria parasites. In red blood cells, schizogony entails development of a single trophozoite into numerous merozoites; a similar process happens in infected liver cells.

Schizont	A developmental form of the malaria parasite that contains many merozoites. Schizonts are seen in the liver-stage and blood-stage parasites.
Sector	A 1 km square grid in a kebele map (in the context of this guideline).
Serology	The branch of science dealing with the measurement and characterization of antibodies and other immunological substances in body fluids, particularly serum.
Sporozoite rate	The proportion of female anopheline mosquitoes of a particular species that have sporozoites in their salivary glands (as seen by dissection) or that are positive in immunologic tests to detect sporozoite antigens.
Sporozoite	A stage in the life cycle of the malaria parasite. Sporozoites, produced in the mosquito, migrate to the mosquito's salivary glands. They can be inoculated into a human host when the mosquito takes a blood meal on the human. In the human, the sporozoites enter liver cells where they develop into the next stage of the malaria parasite life cycle (the liver stage or exoerythrocytic stage).
Suppressive treatment	Treatment intended to prevent clinical symptoms and parasitemia by destroying the parasites in red blood cells. It does not prevent infection because the parasite stages inoculated by the mosquito (sporozoites) will survive and invade the liver and develop liver-stage parasites. The parasites are destroyed when they leave the liver cells to invade the blood. Because the blood-stage parasites cause the disease, eliminating these stages will prevent symptoms.
Tachycardia	Increased heart rate.
Tachypnea	Increased rate of breathing.
Tinnitus	Ringing sound in the ears, a common side effect of quinine treatment.
Trophozoite	A developmental form during the blood stage of malaria parasites. After merozoites have invaded the red blood cell, they develop into trophozoites (sometimes, early trophozoites are called *rings* or *ring stage parasites*); trophozoites develop into schizonts.
Upsurge	Sometimes used as euphemism for an outbreak or epidemic.
Vaccine	A preparation that stimulates an immune response that can prevent an infection or create resistance to an infection.
Vector competence	The ability of a vector (for example, Anopheles mosquitoes) to transmit a disease (for example, malaria).
Vector	An organism (for example, Anopheles mosquitoes) that transmits an infectious agent (for example, malaria parasites) from one host to the other (for example, humans).
Virus	A microorganism made up of a piece of genetic material — RNA or DNA — surrounded by a protein coat. To replicate, a virus must infect a cell and direct its cellular machinery to produce new viruses.
Zoophilic	Mosquitoes that prefer to take blood meals on animals.

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