

NATIONAL MALARIA GUIDELINES

Third Edition



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Ministry of Health**

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Abbreviations and Acronyms

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	Emulsifiable concentrate
EDS	Early detection system
EHNRI	Ethiopian Health and Nutrition Research Institute
EOS	Enhance outreach strategy
EPI	Expanded programme on immunizations
FAO	Food and Agriculture Organization
FBO	Faith-based organization
FMOH	Federal Ministry of Health
G6PD	Glucose-6-phosphate 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 of households with insecticide
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	National Meteorology Agency
NMCP	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
RED	Reach every district

REHH	Reach every household
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. Consequently, malaria epidemics are serious public health emergencies. In most situations, malaria epidemics develop over several weeks, allowing some lead-time to act proactively to avoid larger numbers of illnesses and to prevent transmission. Approximately 52 million people (68%) live malaria-endemic areas in Ethiopia, chiefly at altitudes below 2,000 meters. Malaria is mainly seasonal in the highland fringe areas, and of relatively longer transmission duration in lowland areas, river basins and valleys. Although historically there have been an estimated 10 million clinical malaria cases annually, cases have reduced since 2006.

Malaria Prevention and Control

The feasibility of preventing epidemic occurrences within the available lead-time depends on the level of decentralized responsibility through the health system and the capacity of the health system to make use of available data at each level to early detect malaria, if not forecast epidemics. 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. Even when an epidemic is evolving, it may take several weeks to peak, so there are possibilities for effective mitigating interventions provided that there is an early detection system (EDS) with an epidemic preparedness plan for a rapid response. Two major types of alert thresholds (including a new mapping technique) are suggested in this guideline: the weekly second largest number in a five year dataset (the third quartile threshold) for health posts with five years data set, and doubling of the recent year weekly cases threshold for health posts with at least single year data. The mapping technique is a new approach, consistent with the diminishing malaria incidence recently observed with the scale up of malaria interventions for impact (SUFII), the large increase in health workers at the periphery and the expected availability of digital maps at the kebele level. The mapping technique is based on analyzing for build-up of absolute numbers of malaria illnesses every 30 days within communities, documenting approximate map locations of recent cases within 1 km sectors, and promoting rational community case management on a continuous basis to prevent small case clusters from spreading into larger epidemics. The technique avoids delay caused by lengthy requirements for confirmation of an epidemic. Management of most small and medium sized case build-ups are the same, i.e. increased social behavior change communication (SBCC) to encourage ill or febrile persons to seek immediate care, especially within 1 km sectors where the most malaria cases occurred within the last 30 days, and to be tested for malaria, and treated promptly with effective medicines by health extension workers (HEWs). Moreover, persons living within 1 km of recent malaria cases should be advised to sleep under their long-lasting insecticidal nets (LLINs).

It is expected that the role of forecasting, early warning and early detection continuum will diminish through time as the fight against malaria moves towards universal coverage of all effective interventions and their spatio-temporal sustenance; 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: i) Public Health Emergency Management (PHEM) of the FMOH should clearly demarcate epidemic-prone areas and populations at risk to allow possible prediction of epidemics by updating the dynamic components of the national malaria risk map and alert the health system accordingly, to enable them take appropriate prevention measures and ensure adequate malaria supplies are available. When this fails for various reasons the EDS should be able to early capture epidemics and respond at the lowest possible spatial scale (kebele) to: i) implement the preparedness

plan (rapid assessment and response, and fast mobilization of the resources planned to intervention areas); ii) conduct post epidemic evaluation to assess the adequacy of the epidemic preparedness plan and implementation; and iii) disseminate evaluation results and lessons learnt to prevent future failures.

For the early detection system this guide recommends that weekly monitoring must be strengthened in all health posts, and this should be plotted against the norm/threshold of the catchment area (i.e. health post) based on the availability of data for the health post. The major challenge anticipated in this system is the inconsistency in case definition across time and space. For example some health posts may sometimes be beyond the reach of consistent supply of rapid diagnostic tests (RDTs) and clinically diagnose malaria cases. Malaria EDS is part and parcel of the integrated disease surveillance systems and is managed by the PHEM throughout the health system. This is likely to be beneficial in terms of improving data quality, enhancing system efficiency and ownership of the process within the health system.

Another challenge in case management is a lack of compliance to a recommended drug regimen. Mechanisms for ensuring compliance must be considered as a major intervention component of epidemic mitigation management. Artemisinin-based combination therapies (ACT) are the only appropriate treatment for uncomplicated malaria in an epidemic caused by *Plasmodium falciparum*. In an epidemic caused exclusively by *P. vivax*, chloroquine remains the drug of choice. Artesunate suppositories are recommended as pre-referral treatment. If artesunate suppositories are not available, intramuscular injectable artemether is the drug of choice as a pre-referral management of severe disease during epidemics. Where referral is impossible, treatment with rectal artesunate should be continued until the patient is able to swallow ACTs.

Once malaria has been suspected or established as the cause of an epidemic or significant case build-up, notification by telephone or short-message-sending (SMS) should occur as soon as possible to all higher levels of the health system, such as the HEW supervisor, health center, district health office, zonal or regional health bureau (RHB). Each health care worker should have the contact number of his/her supervisors. Among the critical information needed is the number of malaria cases suspected or confirmed in the last week by species and number of days of remaining supply of ACTs, RDTs and chloroquine at current rate of consumption. A mass test and treat strategy will be maintained in most situations and mass presumptive fever treatment (MPFT) with ACTs is appropriate when there are no RDTs for mass-screening or test positivity rate is $\geq 50\%$ upon examination of at least 50 suspected cases. While the first priority in an epidemic is the prompt and effective diagnosis and treatment of malaria patients, the rapid assessment made by an investigating team may recommend additional vector control interventions to reduce the force of malaria transmission and prevent the resurgence of the epidemic in a community. Therefore, rapid epidemic assessments including entomological and suitability of environment for sustained transmission should inform decisions on the need for supplementary intervention requirements, mainly indoor residual spraying of households with insecticide (IRS) to effectively halt an ongoing epidemic.

The effectiveness of LLINs for epidemic control depends on whether most at-risk populations have sufficient LLINs and are using available LLINs properly. This requirement limits the suitability of LLINs in most epidemic situations unless a rapid assessment indicates the importance of LLINs as an intervention. All patients, however, should be notified when they are in a malaria “hot zone” (i.e. an area of increased risk of malaria), and should be strongly advised to use available LLINs to the maximum extent possible, especially pregnant women and young children.

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.

Malaria Vector Control Guidelines

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; *Anopheles pharoensis* is also widely distributed in the country and is considered to play a secondary role in malaria transmission.

The National Strategic Plan for Malaria Control and Prevention in Ethiopia (NSP) 2006-2010 aimed to rapidly scale-up malaria control interventions to achieve a 50% reduction of the malaria burden, in line with global Roll Back Malaria (RBM) partnership objectives. The status of coverage of the major interventions was measured in the Malaria Indicator Survey (MIS) 2007. The MIS 2007 results show tremendous achievements by Ethiopia's malaria control program. Thus, between 2005 and 2007, insecticide-treated net (ITN) coverage increased 15-fold, with ITN use by children under five years of age and pregnant women increasing to nearly 45% in malaria-endemic areas and to over 60% in households that owned at least one ITN. Overall, 68% of households in malaria-endemic areas were protected by at least one ITN and/or indoor residual spraying of households with insecticide (IRS). It is believed that the vector control interventions have contributed greatly to a reduction in the burden of the disease. More than 20 million LLINs have been distributed to 10 million households between 2005 and 2007. With respect to IRS activities, evidence shows that 30% of IRS-targeted areas were sprayed in 2007 and in 2008 the coverage increased to 50%. So far, the main vector control activities implemented in Ethiopia include IRS, LLINs and mosquito larval source reduction. The Malaria Vector Control Guidelines also addresses vector control interventions found to be effective in past decades. The insecticides commonly used in the country include dichloro-diphenyl-trichloroethane (DDT), malathion and deltamethrin. Due to resistance of malaria vectors to DDT, the use of this insecticide for IRS has been discontinued in 2009. Deltamethrin is currently being used as an interim substitute insecticide for DDT in IRS operations. However, the selection of insecticides for IRS use in Ethiopia will be determined annually based on the insecticide resistance pattern of the vectors and other factors. Environmental management, supported by active participation of the community and use of larvicides are other preventive measures addressed in this guideline. The guideline incorporates the three major vector control measures, namely environmental management, IRS, and LLINs. In particular, with regards to IRS and LLINs, the NSP 2011-2015 has the following targets:

- 100% of villages with development projects in malaria-endemic areas will incorporate malaria preventive and control measures during the planning, implementation and post implementation phases.
- Scale up IRS coverage to 90% of the targeted areas by 2013 and maintain this coverage until 2015.
- 100% of households in malaria-endemic areas own one LLIN per sleeping space.
- At least 80% of people at risk for malaria use LLINs properly and consistently.

Malaria Diagnosis and Treatment Guidelines for Health Workers

As outlined in the NSP 2011-2015, 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 third edition revises and updates the second edition of the Malaria Diagnosis and Treatment Guidelines developed by the FMOH in 2004.

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 and for children of less than 5 kg. Chloroquine is used for treatment of *P. vivax*. Radical cure with primaquine is recommended for patients with *P. vivax*, residing in non-malaria-endemic areas that are treated at the health center or hospital level. Primaquine is not currently recommended at the health post level, because the prevalence of glucose-phosphate-dehydrogenase (G6PD) deficiency is not known in Ethiopia. As a result, it is difficult to detect and manage complications of primaquine at this level. AL is used for mixed infections due to both *P. falciparum* 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. Patients arriving at a health post with severe malaria are given rectal artesunate (or intramuscular [IM] artemether when rectal artesunate is unavailable) as pre-referral treatment. At the health center 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 should be replaced by 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.

SECTION 1

MALARIA VECTOR CONTROL

1. INTRODUCTION

Approximately 52 million people (68%) live in malaria risk areas in Ethiopia, primarily at altitudes below 2,000 meters. Malaria is mainly seasonal with unstable transmission in the highland fringe areas and of relatively longer transmission duration in lowland areas, river basins and valleys. Historically, there have been an estimated 10 million clinical malaria cases annually. Since 2006, however, cases have reduced substantially. On average, 60%-70% 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.

Ethiopia is also one of the most malaria epidemic-prone countries in Africa. Rates of morbidity and mortality increase dramatically (i.e. 3-5 fold) during epidemics. 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 as a result 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 consolidating and refining malaria reduction interventions, through integrated programming for impact. This will involve gradually moving from scaling-up for impact to programming (integrated within the overall health system) for sustainable and equitable long-term impact. The challenge now is maintaining the existing high LLIN coverage and increasing utilization rates. Further, targeting IRS based on a epidemiologically sound, affordable and sustainable approach continues to be a challenge.

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 stages (**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 type 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).

The larvae hatch from the 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. It has several groups of hairs that are useful in identifying the species. Each abdominal segment has hairs, which are useful for distinguishing different 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 by the size of the larvae. 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 adult stage. The length of each stage is dependent on a range of environmental conditions, including temperature. In favorable conditions, it takes an average of seven to ten days from egg to emerging adult.

Figure 1 Mosquito life cycle

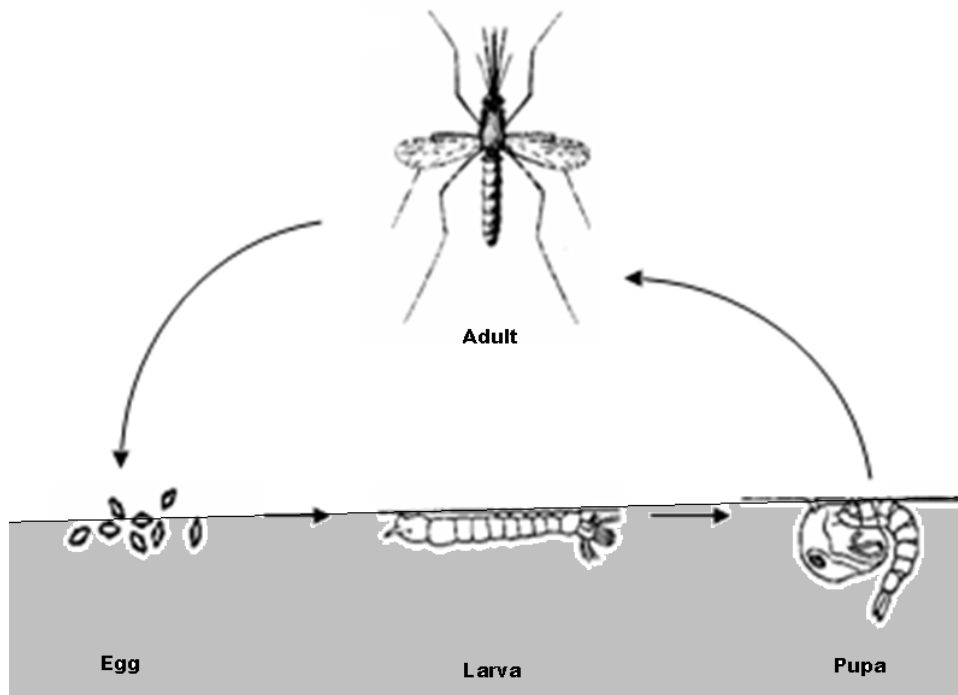


Figure 2 Differentiation of *Anopheles*, *Aedes* and *Culex* mosquitoes at various stages of development









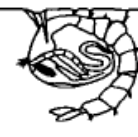
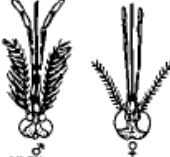





	ANOPHELINES	CULICINES	
	ANOPHELES	AEDES	CULEX
EGGS			
LARVA			
PUPA			
HEAD			
RESTING POSITION			

Table 1 Distinguishing Anopheline and Culicine mosquitoes

	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
Male Adults	Palps as long as proboscis, club-shaped at tips	Palps longer than proboscis, with tapered tips

Vector distribution: *An. arabiensis* is the only species from the *An. gambiae* 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*. *Anopheles funestus* occurs frequently in localities along the swamps of the Baro and Awash rivers and the shores of Lake Tana in the north, and the Rift Valley in the south; *An. nili* is found in Gambella Regional State.

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 is 100% (FMOH, 2007).

Breeding habitat: *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. Though its abundance is scarce at present, *An. funestus* shares the breeding habitat of *An. pharoensis*. *An. nili* breeds in brackish water and is much more localized in its distribution.

Resting and biting behavior: *An. arabiensis* is endophilic and endophagic in most localities in the intermediate highlands, except a few localities in the Rift Valley where an exophilic tendency occurs. Biting occurs in the latter part of the night.

Night time flight: The normal flight range of *An. gambiae* 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* 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 the *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: Insecticide resistance can be defined as the ability of a population of insects to tolerate doses of an insecticide that would prove lethal to the majority of individuals in a normal population of the same species, developed as a result of selection pressure by insecticide. A

population is termed resistant only when marked divergence from the norm has been confirmed by a standard test of a sample of the insects. 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. As DDT has been in use for IRS since 1966 in Ethiopia, the main malaria vector in Ethiopia has become resistant to DDT. Additionally, preliminary results show resistance to deltamethrin, lambda-cyhalothrin and malathion. This indicates the need to use alternative insecticides and vector control measures, prepare a comprehensive insecticide management strategy, and highlights the need for maximum precaution and continuous monitoring of the status of vectors' susceptibility/ resistance to insecticides at field level.

3. ENVIRONMENTAL MANAGEMENT AND LARVAL CONTROL

3.1. Environmental management

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. This 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.

Environmental management 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.

The following measures can be implemented in potential mosquito breeding sites to prevent and control malaria:

- Clearing bodies of water, filling and leveling burrows and pits, and removing undesirable materials that contain water;
- Breeding sites in swampy and marshy areas can be dried up by constructing drainage ditches and planting trees (e.g. eucalyptus) that consume large amounts of ground water can be planted;
- In dry seasons, intermittent rivers and streams that form stream beds, pools and side water pockets can be filled, drained or connected to the main course of water;

-
- Intermittent irrigation of paddy fields with weekly flooding and drying periods, and grading of paddies and ditches for rapid dewatering and vegetation;
 - Water containers used for storage of water (e.g. pots, wells, barrels) should be covered; and
 - Any items inside and outside the home that collect and hold water should be removed or destroyed.

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

1. Identifying the number and distribution of mosquito breeding sites;
2. Determining the amount of manpower needed;
3. Identifying working tools by type and number, e.g. spade, pick-axe, sickle, cutting knife, sack and wheelbarrow;
4. Determining the time required to complete the implementation of the environmental vector control measures;
5. 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;
6. Coordinating and managing the environmental control program on the scheduled day and place; and
7. Keeping a record of the tasks accomplished.

These environmental management vector control measures require significant human resources and their successful implementation can be assured only through the active participation of communities. Vector control measures should be repeated as necessary throughout the malaria transmission season. HEWs should educate and mobilize communities to participate in the identification of mosquito breeding sites and the measures to be undertaken and provide technical support as necessary.

3.2. Larviciding

Larvicides can be used to address collected water that cannot be managed through environmental control measures. Similar to environmental control measures, the success of larvicides depends on the identification of all mosquito breeding sites and their distribution in the entire target area, followed by sustained weekly spraying of chemicals. Larvicide control measures should be applied in conjunction with environmental control measures. The most common water-soluble chemical used to kill mosquito larvae in Ethiopia is temephos (Abate®). 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 also 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).

Preparation for spraying temephos:

1. Identify in square meters the size of the breeding sites positive for anopheline larvae but being used by humans and animals;
2. Prepare one cc of temephos in one liter of water for use in 40 square meters area;
3. Prepare the solution in the spray pump;
4. Pump by hand 60 times to produce the necessary level of air pressure in the sprayer;
5. Use experienced spray men; and
6. Keep record of the accomplished activities.

It is not advisable to spray temephos during the rainy season or other rainy periods, because the chemical will be washed away.

4. INDOOR RESIDUAL SPRAYING (IRS)

IRS is the application of long-acting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area, in order to kill adult vector mosquitoes that land and rest on these surfaces. IRS is one of the primary vector control interventions for reducing and interrupting malaria transmission, and one of the most effective methods for obtaining rapid large-scale impact on both vector populations and malaria morbidity/mortality. The effectiveness of IRS in reducing malaria transmission and disease burden was first demonstrated in the 1930s in South Africa and India. The primary effects of IRS towards curtailing malaria transmission are:

1. Reducing the life span of vector mosquitoes so that they can no longer transmit malaria parasites from one person to another; and
2. Reducing the density of vector mosquitoes.

Some insecticides used in IRS also repel mosquitoes, reducing human-vector contact by reducing the number of mosquitoes entering a sprayed room. IRS using DDT became a major component of globally-coordinated malaria eradication campaigns in the 1950s and 1960s, and significant reduction of the disease and even eradication were achieved in Europe, Asia, the Middle East, Latin America and Southern Africa. 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. Though the malaria prevention and control program in the country has employed several organizational approaches, from the highly centralized vertical malaria eradication setting to an integrated and decentralized approach, IRS remains a key component of the national malaria prevention and control strategy. Until the recent funding support by the Global Fund to Fight AIDS, Tuberculosis and Malaria and the U.S. President's Malaria Initiative, IRS operations were exclusively funded by the GoE after the eradication program came to an end. Shortages of equipment, trained human power, and operational funds resulted in limited coverage and affected the quality of spraying. At present, most districts operate IRS, albeit under varying conditions, and often lack adequate trained and experienced staff in vector control, particularly IRS, who can conduct a necessary eco-epidemiological assessment for better targeting of IRS operations as well as effectively organize and implement IRS operations. The staff attrition rate in the health sector is high, threatening all health programs, including malaria vector control. IRS equipment, including spray pumps, is limited and the equipment available is often old and defective, and in need of maintenance. IRS demands timely and intensive logistics' management, which puts it in competition with other priority health programs, leading to interruptions or delays in IRS operations. The average IRS coverage was approximately 20% (i.e. about 1 million unit structures sprayed each year) until 2007, though this has varied across the years, and great improvement has been made since that time. At present, coverage is about 50%, with some variation among regional states.

With the exception of malathion (50% WP), which was used in highly DDT-resistant areas, DDT (75% WP) was in use until 2007, when widespread vector resistance to DDT was first documented. Since then, pyrethroids (i.e. deltamethrin) have mainly been used in IRS operations, though it is anticipated their use could be discontinued as increasing resistance to pyrethroids has been detected. Insecticide resistance monitoring activities are being carried out to continuously monitor anopheline mosquito insecticide resistance in Ethiopia. Results of these monitoring activities are expected to guide policy decisions in the annual selection of insecticide(s) for IRS operations in the country.

Supervision of IRS activity is weak due to a shortage of trained personnel. Much remains to be done to meet the minimum WHO and Food and Agriculture Organization (FAO) standards of environmental compliance and human safety measures when using insecticides for IRS operations in Ethiopia. Though the FMOH has developed and endorsed insecticide storage standards, in practice only a few districts, if any, own separate and designated storage space for insecticides and IRS equipment. Intact and clean protective equipment for spray operators, squads and technicians are required to minimize exposure of the IRS workforce to insecticides. Owing to the shortage of operational budgets allocated for IRS operations at the district level, as well as the incomplete understanding of the risks of exposure to insecticides, personal protective materials for spray personnel tends to be not present at the district level. Proper disposal of insecticides and insecticide waste requires special arrangements and efforts. IRS materials washed in water should be contained in specially prepared leak-proof evaporation tanks or soak pits. Insecticide solid waste (e.g. empty sachets, cartons, broken gloves, used masks, and other insecticide-contaminated materials) should be incinerated at a minimum temperature of 800°C. Until such facilities are available in Ethiopia, insecticide solid waste must be collected from operation sites and contained in a secure place. Showering is a requirement for all workers after engaging in IRS operations, making showering facilities necessary.

Though Ethiopia has a long history of conducting IRS, community knowledge, attitude and practices with regards to IRS are limited. Community acceptance of IRS is variable, with some areas having high levels of replastering of household walls following the application of insecticides. An integrated and intensive effort in SBCC regarding IRS is necessary, using the HEP, schools, community-based organizations (CBOs) and various media outlets. In most cases, malaria transmission follows the bimodal rainfall pattern in Ethiopia, with rainy seasons usually occurring in March-April and June/July-September. IRS campaigns are time-consuming and require sufficient lead time as well as access to the entire community in targeted areas. Sufficient time is required to treat all target communities before the onset of transmission to avert possible epidemics. The timing should also allow the spray team access to all targeted communities (i.e. avoid cut-off due to rain interference, denied road access, full streams and gorges). The timing of IRS operations is usually determined by the residual efficacy period of the insecticide used and the length of the malaria transmission period. As a result, IRS operations in most parts of the country have taken place around the month of June. This timing was based on the six-month residual efficacy period of DDT and pyrethroids and the September-November main malaria transmission period. Because of mosquito resistance to DDT and pyrethroids, and the necessary switch to alternative insecticides with different residual efficacy (e.g. three months), an adjustment in the timing of spray operations is likely to take place in the future.

4.2. IRS target areas

Although there are marked geographical, temporal and spatial variations, generally, areas up to 2,000 meters above sea level are considered malaria-endemic in Ethiopia (Gish, 1992; Ghebreyesus, 2000). However, reports do exist of occurrence of malaria epidemics and transmission above 2,000 meters above sea level (Fontaine et al 1961; Tesfaye et al 2011). Areas below 2,000 meters are prone to seasonal epidemics, while those above 2,000 meters are occasionally affected due to unusual weather conditions compounded largely by deficient rainfall and high temperatures. As a result, on the basis of population settlement patterns, agro-industrial and other socio-economically important activities, areas between 1,000 and 2,000 meters above sea level could be considered IRS-targeted areas. Strong

surveillance, monitoring and forecasting must exist to appropriately prepare and immediately deploy IRS in areas above 2,000 meters when the need arises.

Many factors play a role in changing the micro-epidemiology of malaria, which necessitates continued surveillance of areas to include or exclude in IRS. In previous years there was a practice of reclassifying areas into spraying rounds (zero, one and two) each year as a part of planning exercises for IRS. The reclassification of areas into IRS rounds was based on the results of surveys made in the months of October and November to determine malaria prevalence in the surveyed areas that represent certain geographically homogenous areas, though perfect homogeneity may not exist. Today, malaria data collected at the community-level health posts could be a vital tool for this reclassification. Even though in practice for some years, spraying the same area year after year may not be epidemiologically sound. Also, community cooperation may decline, particularly in years when malaria transmission subsides or if insecticide resistance has developed and IRS is no longer perceived to be effective. The decision on whether to spray or not spray an area should be led by malaria caseload, in addition to other criteria (e.g. insecticide resistance). The list of kebeles to be sprayed should be revised each year on the basis of prevailing malariogenic conditions and malaria caseload. Maximum care must be made to take into account the decreased predictability of malaria epidemics in Ethiopia, the cyclic pattern of malaria epidemics, socio-economic, and other factors.

In general the following criterion should be used when select areas or kebeles for IRS:

1. Malaria case load – the lowest available health facility (e.g. health post) malaria case data should be used. A malaria incidence rate $\geq 5\%$ should be taken as a cut-off point to include or exclude areas in IRS, with areas having an incidence $\geq 5\%$ to be targeted for IRS;
2. Failure or interruption of major vector control interventions (e.g. LLINs) in clearly defined areas with high malaria transmission;
3. Preempt or interruption of epidemic outbreaks in defined areas; and
4. Areas with natural or man-made disasters – post disaster intervention

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 may be 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.

The Agriculture and Rural Development Sector has scaled-up its activities greatly, with further expansion expected in the next few years. The use of water for these development projects is great, and the risk of creating mosquito breeding sites is equally high. Large development projects are required to incorporate risk mitigation measures in pre-project preparation, during implementation and during the post project period. Communication between health sector and development partners is a key component of community empowerment and mobilization.

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 following should be strictly adhered to. 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.

Updated: October 2009

WHO recommended insecticides for indoor residual spraying against malaria vectors

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
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 WP, WG	PY	0.02-0.025	contact	3-6
Etofenprox WP	PY	0.1-0.3	contact	3-6
Lambda-cyhalothrin WP, CS	PY	0.02-0.03	contact	3-6

(1) CS: capsule suspension; EC = emulsifiable concentrate; SC = 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. However, the particles are smaller than those of water dispersible powders, and 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.

4.5.1. Commonly used insecticides

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/m² 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.

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.

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.

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.

Cypermethrin

- *Commonly available formulations:* 5% and 25% emulsifiable concentrate;

- *Dosage:* 0.5 g/m²;
- *Residual efficacy:* Remains effective for four months or longer.

4.6. Insecticide requirement

The required amount of insecticide (water dispersible powder and emulsifiable concentrates) for IRS operations can be calculated using the following formula:

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 m² per unit structure
 d = dosage of insecticide's active ingredient in gm/m²
 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 (m²) covered by 1 liter suspension
 d = recommended application rate (g/m²)
 c = concentration of active ingredient in formulation

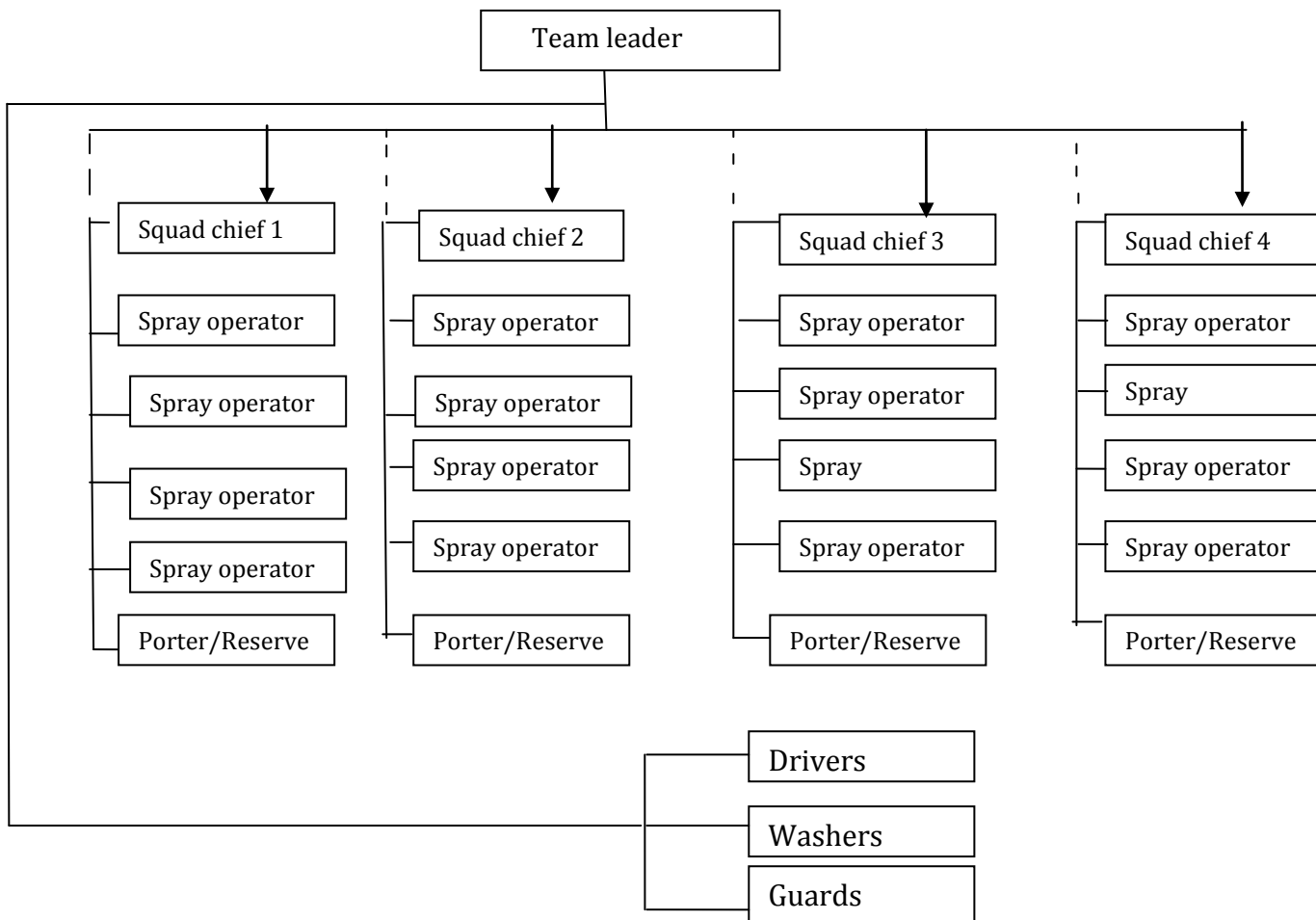
4.7. Organization of IRS operations

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 15 structures per spray operator per day, assuming five spray operators per health post are used. This time could be shortened either by increasing the number of spray operators or increasing daily output.

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.

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 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 and methods of IRS training (**Annex A**).

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 kits
- Tool kit
- Camping materials:
 - tents
 - camp coats or folding mattress
 - canvas chair
 - kerosene lamps
- Transportation (as required):
 - vehicles

4.7.3. Preparation of houses before spraying

Correct spraying requires the careful preparation of the houses to be sprayed. In particular, all food, cooking utensils, bedding and clothes must be protected from the insecticide by taking them outside the house before spraying starts. All portable furniture and any pieces of furniture leaning against the walls should be removed so that the walls and all sides of all the pieces of furniture can be sprayed. It is therefore necessary to inform the population in advance of the day and time that the spray team will conduct the spraying so that the house can be prepared before the spraying is due to start. This advance notification will help maximize IRS coverage in the community and could be done through the kebele administration (the lowest administrative level) in addition to the HEWs (wherever IRS is organized at the district level).

Figure 4 Personal protective equipment

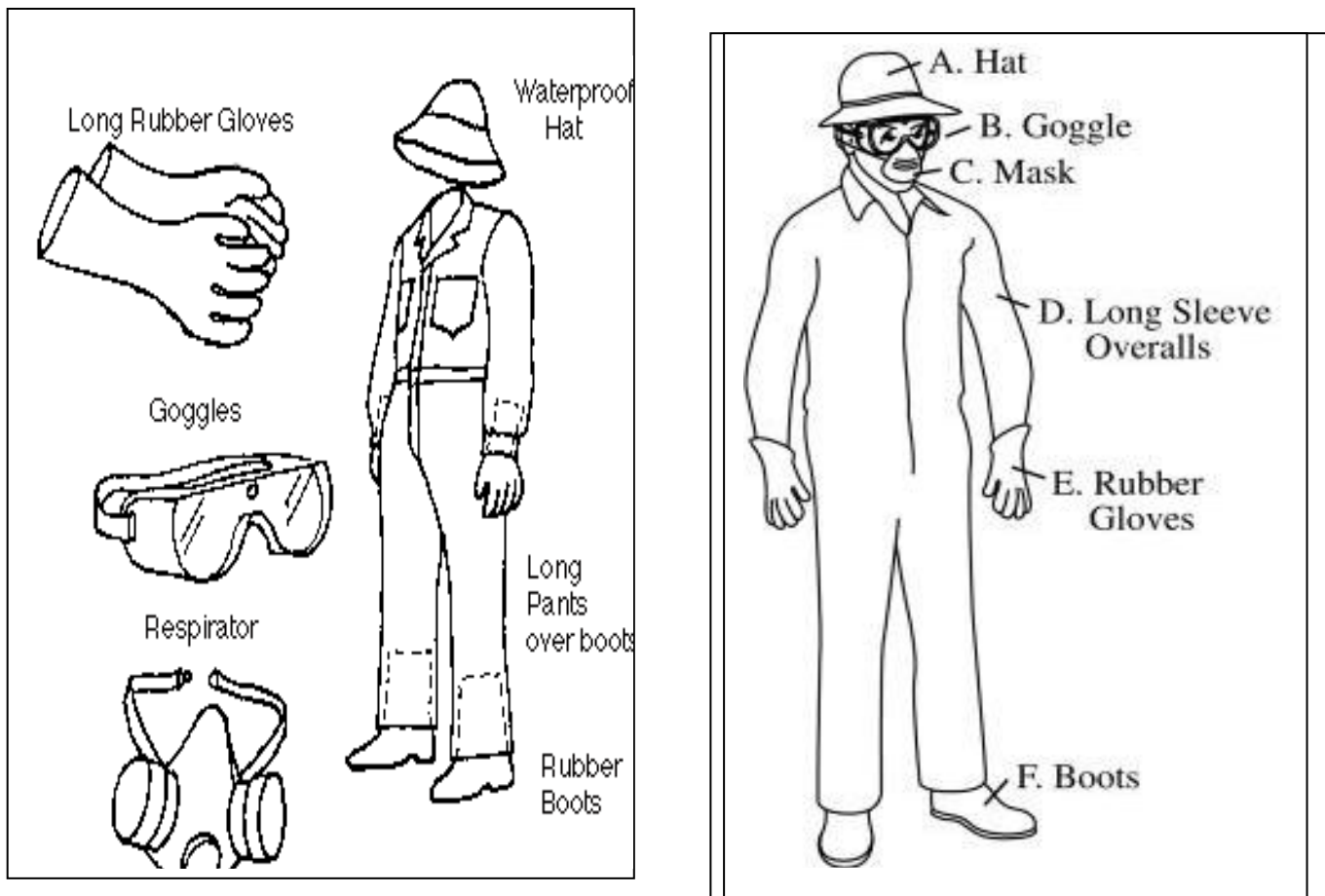
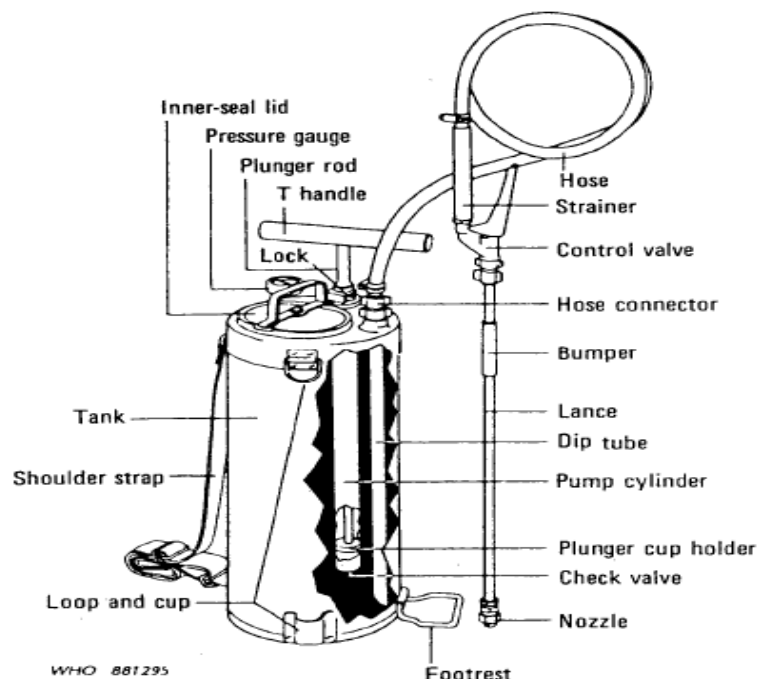


Figure 5 Cutaway diagram of a hand-compression sprayer



4.7.4. 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 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;
- The nozzle tip aperture size;
- The distance from the nozzle tip to the surface being sprayed;
- The speed of application over the surface.

In Ethiopia eight-liter working capacity spray 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 m² at a constant rate within a minute. This will allow applying 40 ml of suspension on one m² of sprayable surface (or one liter of suspension covers 25 m²) when the nozzle tip is effectively kept at a 45 cm distance from the spray surface.

4.9. Role of HEWs, health centers, district health offices 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 office, the health center and the health post. Therefore:

1. The district will send enough insecticides to spray the village to the health post.
2. Spray pumps will be made available at the health post;
3. The district will have a store to keep the spray pumps and insecticides separate from other items;
4. 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:

1. The operation could be more quickly organized at the community level and implemented to control epidemics;

-
2. 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;
 3. 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:

1. Select capable spray operators from the community;
2. 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);
3. In consultation with kebele leaders, plan when to start and finish the IRS operations in their kebeles;
4. Undertake the IRS operations as a leading person guiding and supervising the spray operators;
5. Mobilize the community to cooperate and participate in IRS operations;
6. Educate communities about the benefits of IRS and what to do after their houses have been sprayed;
7. 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.

5. LONG LASTING INSECTICIDE TREATED NETS

By protecting people from being bitten by infected mosquitoes, LLINs are an effective tool 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. A LLIN has 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.

LLINs also have an effect on other insects, such as head lice, sandflies, ticks and other household pests (e.g. bedbugs and cockroaches).

5.1. LLIN target areas

As outlined in the HSDP IV and the National Malaria Strategic Plan 2011-2015, LLINs should be provided to households in malaria-endemic areas, i.e. areas that are below 2,000 m above sea level. Additionally, some kebeles above this altitude may be targeted for LLIN distribution as well, if there is documented evidence of repeated malaria outbreaks. Woreda health staff, together with personnel from health centers and health posts, should compile lists of kebeles in malaria-endemic areas. To date, approximately 489 woredas or 13,000 malaria-endemic kebeles (HEP database and reports from woredas) will be targeted for universal (100%) LLIN coverage with one LLIN per sleeping space on average. *Note: urban areas, as long as they are considered malaria-endemic, will also be targeted for LLIN distribution.*

More than 20 million LLINs were distributed in Ethiopia between 2005 and 2007; a further 15 million were distributed in 2010 and 2011 to replace LLINs distributed previously. These LLINs have been distributed through a variety of channels, based on plans developed by regional states as well as circumstances at the time of distribution. The majority of LLINs have been distributed through stand-alone campaigns and others through campaigns integrated with the Expanded Program on Immunizations (EPI) and the Enhanced Outreach Strategy (EOS) or from static health facilities. The

duration of these campaigns varied from one week to two months. In addition, smaller numbers of LLINs have been distributed via antenatal care services, including using voucher schemes, via non-governmental organizations (NGOs) in rural communities, or through social marketing and the commercial sector in urban areas. Approximately 500,000 LLINs have been distributed as part of the response to droughts, floods or other emergencies in affected areas.

The strategy since 2005 has been to provide, on average, two LLINs per household in malaria-endemic areas, i.e. providing access to LLINs to an estimated 10 million households. 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 households. Thus, each kebele receives enough LLINs to protect all families. As new LLINs arrive, plans are developed to apply the same approach to neighboring communities. In this way, mass LLIN coverage is achieved within a short time.

Despite this rapid complete coverage of each kebele since 2005, it is unlikely that all LLINs are still in use after three years. This is supported by MIS 2007 results, which showed that actual LLIN ownership and use fall short of predictions based on “administrative” coverage rates. Field visits and experience show that a substantial number of LLINs are damaged beyond use before their expected lifespan (i.e. 3-4 years). Some reports show that it is likely that up to 40% of LLINs are ‘lost’ (e.g. due to wear and tear, or alternative use) by the end of the second year of ownership. This loss is primarily a result of not having a plan for maintaining continuous, high LLIN coverage through replacement of old nets during the scale-up period. To address this, the new strategy outlined below includes (i) mechanisms for ensuring a continuous replacement of ‘lost’ nets with new ones so that all families at risk of malaria can protect themselves; and (ii) approaches to cover those households in malaria-endemic areas that did not receive LLINs in previous distributions (e.g. due to LLIN shortages or increase in family size).

5.2. LLIN procurement

All LLINs must meet minimum standards as determined by WHO (see **Annex B**), i.e. have WHO Pesticide Evaluation Scheme (WHOPES) certification. In addition, all insecticides for net treatment must be WHOPES-approved and registered by the relevant Ethiopian authorities. Private sector wholesalers and retailers are encouraged to distribute LLINs that meet the WHO minimum standards and that are registered in Ethiopia. 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 (e.g. UNICEF). The local manufacturing of LLINs should be encouraged in the long-term, provided that minimum requirements/specifications are met (see above).

5.3. LLIN distribution

Distribution mechanisms

This strategy describes distribution mechanisms needed to replace worn-out LLINs (‘keep-up’), gap-filling for LLINs lost during the previous three years, households that have yet to receive LLINs (‘catch-up’). In addition, distribution of LLINs may occur, particularly in urban areas, through the commercial sector, which also includes social marketing and selling of subsidized ITNs.

The LLIN replacement scheme is the most significant component of the National Strategic Plan for Malaria Prevention and Control 2011-2015 and is the policy framework under which continuous supply of LLINs at the kebele level will be ensured. The plan implies that systems will be developed, primarily through the HEP, to ensure that all households have access to LLINs at all times and that

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 HEP LLIN replacement scheme will provide a consistent supply of replacement LLINs, thereby ensuring all families at risk of malaria have continuous access to LLINs. This will consequently reduce the proportion of people that have damaged or lost their nets.

The number of LLINs required for continuous replacement of worn-out nets will be developed by the HEWs based on information collected within their kebeles (i.e. a ‘bottom-up’ approach to supply needs and planning) and shared with districts. This is advantageous in that it empowers local communities and is likely to more accurately reflect actual LLIN requirements. Districts will then list and aggregate kebele-level data and share this with zones and RHBs at malaria commodity microplan meetings. Additionally, districts may use the kebele-level data in the overall woreda health planning process in order to budget for costs associated with, for example, LLIN distribution.

For the overall management of the LLIN replacement scheme, HEWs will consolidate their kebele LLIN registers. Many HEWs already have LLIN registers, which they use to assist with identifying families needing new LLINs. These records will be an important monitoring tool for management of this scheme and feed into LLIN databases at the woreda and regional levels and eventually into the national HEP database. A continuous and predictable demand for LLINs at the kebele level will also provide better market conditions for local LLIN manufacturers to provide the correct quantities and types.

LLINs can be distributed through more than one method, tailored to the situation in each kebele. Two methods are outlined below, although health staff at the regional, woreda, health center and health post levels can make the decision as to which distribution approach to use:

- Providing one LLIN to every newly pregnant woman in selected kebeles over a one-year period. The role of HEWs will be to maintain records of LLINs in their health posts and provide one new LLIN to every pregnant woman that attends antenatal care services, either at the health post or health centers or through home visits by HEWs;
- Providing LLINs to households with children and pregnant women not currently being protected with LLINs. Health staff will supervise HEWs to create a list of households requiring replacement nets as part of the kebele register. This list can be approved by village elders and the kebele chairman.

Mass distributions through campaigns (catch-up)

The LLIN replacement scheme may not be available for all communities or be appropriate where there are still large gaps in LLIN ownership. This includes kebeles that received LLINs more than four years ago and where all LLINs are deemed non-functional and, consequently, should be replaced. There are also many communities in Ethiopia where the HEP is not sufficiently strong to operationally implement the replacement scheme. In these areas, as well as those areas affected by floods and droughts, mass distribution is the most appropriate means of maximizing personal protection against malaria.

The majority of the 35 million LLINs distributed since 2005 were delivered through various forms of campaigns, and, as a result, there is substantial expertise at all levels of the health system and among NGOs to continue with this strategy. LLIN distribution through campaigns can fill gaps over a very short time period, providing immediate large-scale protection to entire communities. The objective

should be to ensure that each household in all campaign-targeted kebeles has, on average, two LLINs. Once this is achieved, if possible, the LLIN replacement scheme will begin to ensure long-term access to LLINs to all households. Taking into account increases in household size over the next five years, it is estimated that a total of 53 million new and replacement LLINs will have to be distributed.

Although an average of two LLINs per household is used for logistics/calculation purposes, the number of LLINs that a household can receive may be based on the following general principle:

1. An average family size is 5 people per household;
2. It is assumed that a family of two has only one sleeping place. Hence families with two members receive only one LLIN and families with three to five members receive two LLINs and families with more than five members receive three LLINs

Once this is achieved, there are two possible options for replacement of worn out LLINs:

- a) Repeat similar LLIN distribution campaigns every 3-5 years to replace all LLINs (**Table 3**). This procedure covers all households in one effort, with an average of two LLINs per household in malaria-endemic areas, but there are significant numbers of LLINs lost between campaigns. Using this method, it is not possible to sustain high coverage of nets unless the campaign distribution is supplemented by routine keep-up distributions.
- b) Using the existing health system, replacement of each worn-out LLIN on a regular basis, following an initial mass-distribution campaign (**Table 4**). For this approach to be effectively implemented a continuous supply of LLINs would be necessary on a yearly basis and the health system should routinely identify the actual kebele-level numbers of worn-out LLINs that need to be replaced. By doing so, high coverage of LLINs can be maintained for longer periods without any additional LLIN mass-distribution campaigns.

The distributor (e.g. HEW) must make sure that pregnant mothers and children under five years of age have access to LLINs. If this cannot be ensured, additional LLINs must be provided to the household. In the same way, the sleeping patterns/habits of the community must be taken into account during distribution of the nets (e.g. if one of the partners sleeps outside of the house giving additional LLINs has to be considered).

Note: The size and the shape of the house/hut can determine the number of the LLINs to be given to a household. Therefore, the distributor must have knowledge of a family's house structure.

5.4. Campaigns to distribute LLINs

5.4.1. Standalone LLIN campaigns

In standalone campaigns, LLINs are distributed in a short period of time to all households in selected kebeles. Social mobilization is conducted to invite people to distribution points (e.g. EPI, EOS, other routinely used distribution sites), where they are given LLINs based on the kebele LLIN register. Such LLIN distributions are not integrated with an actual EPI or vitamin A supplementation campaign, but may use similar systems and structures. Other campaigns that are integrated include:

Integrated with an EPI campaigns: LLINs are delivered through the same systems and structures as for the immunization campaign and use the same planning, implementation and monitoring systems.

Integrated through EOS: LLINs are delivered through the same systems and structures as for the bi-annual vitamin A supplementation, de-worming, and nutrition screening campaigns and use the same planning, implementation and monitoring systems.

Emergency response LLIN distribution campaigns: The implementation system varies depending on the situation and includes house-to-house distribution by health staff and volunteers, distribution through traditional channels using traditional hierarchies, and delivery to camps, displaced people and refugees using emergency mobile teams.

5.4.2. Routine free LLIN distribution (keep-up)

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 HEP LLIN replacement scheme will provide a consistent supply of replacement LLINs, ensuring all families at risk of malaria have continuous access to LLINs and reducing the proportion of people who have damaged or lost nets;
- The district requirements of LLIN planning for routine keep-up LLIN distribution can be estimated using 8%, 20% and 50% loss rate of LLINs for first, second and third year of distribution, respectively. However, the actual village-level required number of LLINs for continuous replacement of worn out nets will be developed by the HEWs, based on information collected within their kebeles (i.e. a 'bottom-up' approach to supply needs and planning). HEWs will provide this data to districts, which will aggregate and present them at malaria microplanning meetings. This is advantageous, as this approach is likely to more accurately reflect LLIN requirements. Such an approach also assists with the overall woreda health planning process (e.g. to estimate operational costs to distribute LLINs);
- Continuous and predictable demand for LLINs at the kebele level will 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. Many HEWs already have LLIN registers that they use to assist with identifying families needing new LLINs. These records will be an important monitoring tool for management of this scheme and feed into ITN woreda, regional and, eventually, national databases.

Table 3 Model for catch-up distribution every five years

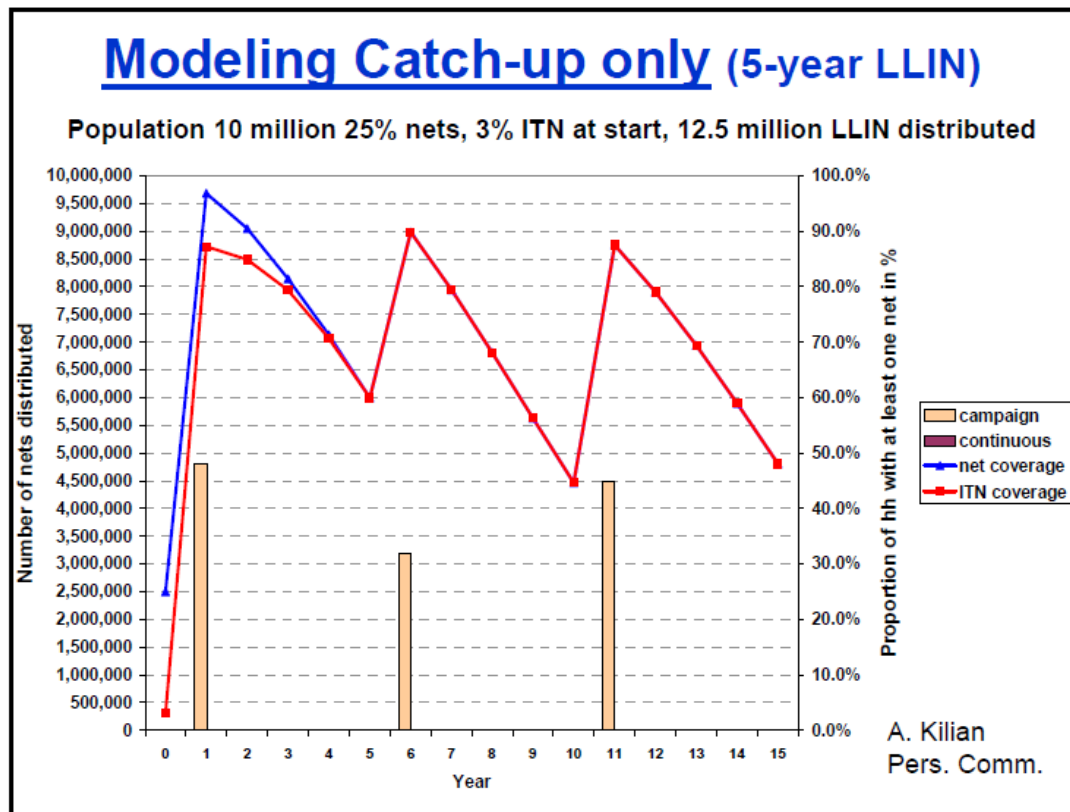
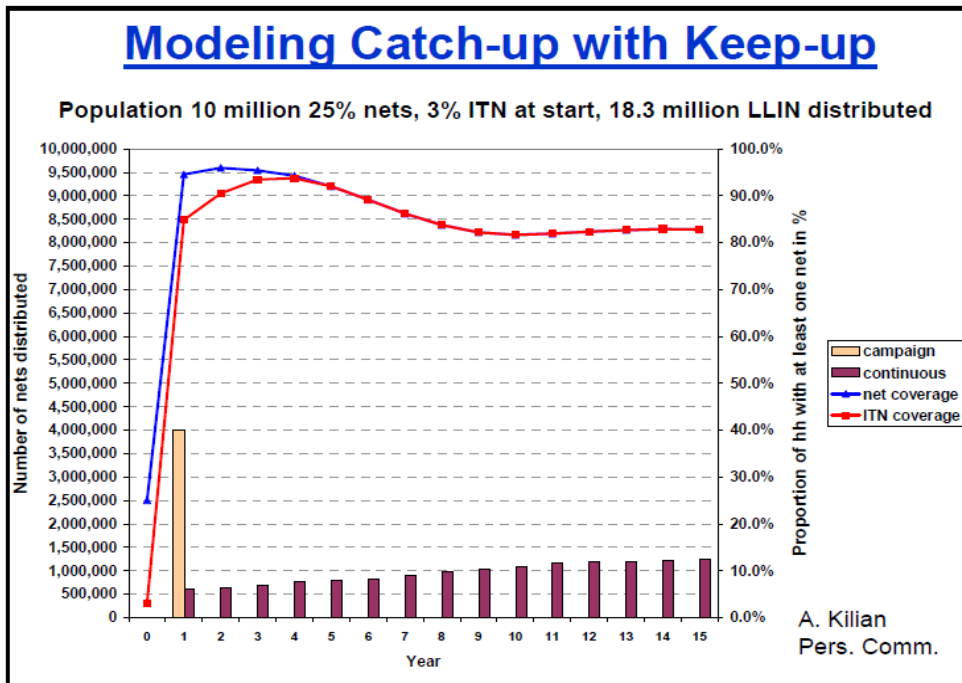


Table 4 Model for catch-up distribution by keep-up distribution



5.4.3. Activities for distribution of LLINs at the community level

- Transportation of LLINs from regional warehouses directly to health centers;
- Facilitation of distribution of a proportion of LLINs to health posts, based on annual malaria commodity microplans developed by health centers, health post and woreda staff;
- People will be able to visit health centers and health posts to register that they have received an LLIN;
- Approval from the HEWs will be required for households to be eligible to receive replacement LLINs. This will entail HEWs visiting families that have requested LLINs, to confirm that there is a need;
- A record will be kept of all families receiving LLINs, which will include whether they received replenishment nets or received nets for the first time (**Section 8 Monitoring and Evaluation**).

The aim of LLIN distribution is to cover all sleeping spaces in households in malaria-endemic areas so that universal coverage can be ensured. Kebele-level registration of the number of sleeping spaces of each household should be available for effectively achieving universal LLIN coverage. Although an average of two LLINs per household is used for logistic/calculation purposes, it is advisable that the kebele administration/development agents assist HEWs in the preparation of LLIN registration to collect information on the number of households, number of children under five years of age, number of pregnant women, and number of sleeping spaces for each household in malaria-endemic kebeles. The number of LLINs provided to each household will be equal to the number of sleeping spaces. This ensures the distribution of LLINs to achieve universal coverage of a population living in malaria-endemic areas.

In situations where it is difficult to obtain information on a kebele's household sleeping spaces, the following general guide can be used to determine the LLIN requirement of a household, using family size. **Note:** this approach is an approximate estimation of sleeping spaces (**Table 5**).

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

5.4.4. Commercial sector and social market of subsidized ITNs

Social marketing is the process of increasing the use of quality health products by low income and vulnerable groups to achieve health impact. To encourage sustained and appropriate use of products, demand creation activities and research-based communication strategies are employed. The social marketing approach can achieve high coverage of target groups in a relatively short period of time and serve as a catalyst for private sector LLIN distribution by overcoming barriers to private sector participation.

Market priming refers to public interventions on the supply side and usually involves the procurement and distribution of LLIN goods in order to promote demand and stimulate commercial markets. Market priming aims to stimulate the growth of the unsubsidized commercial market by:

-
- Demonstrating the commercial viability of trading in LLINs and/or insecticides;
 - Establishing and strengthening infrastructures and trading networks.

Market priming is most valuable where there is currently no commercial activity, as is the case in most areas in Ethiopia. It should be a temporary, transitional intervention. In the case of LLINs, social marketing can play the joint roles of sustained demand creation, time-limited market priming and stimulation of the private sector LLIN market.

Although the majority of LLINs will be distributed at a 100% a subsidy to end users (i.e. free LLINs) through the public sector, the commercial sector will continue selling LLINs at commercial rates or at subsidized rates, especially in urban communities.

The GoE's role in private sector distribution will be to create an enabling environment necessary for long-term sustainability of the commercial sector in the LLIN business.

5.5. 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. A number of household-based surveys across Africa show that up to 50% of LLINs are not used every night, failing to protect people from getting malaria. In Ethiopia, the MIS 2007 found that despite 68% of households in malaria-endemic areas owning LLINs, only 66% had slept under a LLIN the previous night (**Annex C**). There were also wide geographical differences in LLIN use, ranging from 25% in Oromia to 75% use in Gambella. The MIS showed lack of knowledge about the causes of malaria and the importance of LLINs as the best way for people to protect themselves from malaria. Knowledge about malaria and the importance of sleeping under LLINs is the basis for bringing about 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. Communication toolkits, community conversation manuals, radio and television are all approaches that can be used to improve LLIN use.

5.5.1. 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. By 2009, 15,000 kebeles in Ethiopia have newly constructed health posts (i.e. an average of one health post per 5,000 people) and more than 30,000 HEWs have been posted to each of these health posts. In addition, a substantial proportion of health posts now have a network of volunteer community health workers (CHWs), with each CHW managing 50 households. These CHWs will support HEWs to increase contact with each household in a more detailed way and would provide a significantly important opportunity to increase LLIN use in each kebele. 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, antenatal care clinics, during EPI and EOS campaigns, special events, and at the household level. LLIN possession and compliance should be an integrated component of the health system. All district HEW and regional/zonal supervisors would monitor whether health workers are discussing LLIN use at each antenatal care and EPI contact and at household-level visits, and ask about LLIN SBCC activities through HEW and CHW contacts with the community at meetings and EPI outreach sessions. Schools, marketplaces, places of worship and community meetings could be targeted. Regional supervisors would collect data about LLIN logistics and SBCC activities at the health facility and district levels that could be sent electronically to the national level every quarter for analysis by district. Woredas and kebeles with low LLIN use coverage

as monitored by the EPI contact and household meeting method would receive extra attention by district, regional, and national teams.

Social and behavioral aspects: Cultural factors that may determine ownership and use of LLINs must be taken into consideration to ensure that communication and advocacy activities contribute to effective use of LLINs. Misuse of LLINs as ‘*shash*’, curtains, fishing nets and not sleeping under LLINs have been reported. Operational research on local perceptions of mosquitoes, malaria, and washing practices is needed to inform the choice of messages, media and advocacy strategies for LLIN use.

Social communication through antenatal care and EPI: Health workers would be required to discuss LLIN possession and compliance at all antenatal care and EPI contacts. Health workers at all levels, including HEWs at the community level, would reinforce positive behavior and provide parents and pregnant women with information about compliance and/or possession for those who did not use LLINs the previous night, based on continuous surveying done at regular intervals. Most families would participate in 5-6 (1-2 antenatal care and four EPI) discussions about LLIN use. Multiple contacts and one-to-one interaction are known to be important factors in behavior change. Evidence from a research study in Benin indicates that women who were asked by health workers at an EPI contact about LLIN use during the previous night were 2.6 times more likely to have the child sleep under an LLIN the previous night as verified at a home visit.

Pregnant women should be asked at the second antenatal care visit and parents of children at DPT3 and measles vaccination visits, if they slept under an LLIN the previous night. The responses would be recorded on the EPI monthly form.

Social communication by civil society (NGOs, CBOs, and faith-based organizations [FBOs]): The proposed activities would complement the activities of NGOs at the worda and household levels and mass communication approaches. The health facility-community partnership, which is an integral part of this strategy, fits well with the proposal of improving partnerships (with NGOs) of health facilities and the communities that they serve. The EPI contact method and the household survey to be conducted by all levels, including the HEW (LLIN use coverage), can provide feedback to NGOs on the effectiveness of their activities.

In the absence of proper documentation and follow-up, it may be difficult to ascertain that all LLINs are in the hands of beneficiaries. Considering that lack of access is a main factor for non-use of LLINs, the following may be considered as factors of use, assuming that LLINs have been supplied to households.

- Lack of adequate knowledge and gaps in information between the provider and client (end user);
- Inadequate surveillance;
- Improper use of LLINs;
- Use of LLINs only during high transmission season

Therefore, proper follow-up in use of LLINs should be one of the elements of the strategic document in concern.

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:

1. Determine the number of households in the kebele;
2. Determine the average family size in the kebele (the total number of people in a kebele divided by the total number of households);

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3. Prepare a record of the number of people in each family and if possible the number of sleeping sites in each household;
 4. Submit an LLIN distribution plan, including the above data, to the district health office;
 5. Discuss with community leaders and elders and with CHWs how to distribute the nets as quickly as possible and involve them in the distribution of nets;
 6. Transport the required number of nets from the district health office to the health post;
 7. Arrange temporary storage of LLINs;
 8. Train CHWs on distribution procedures and key messages on proper and consistent use to be communicated to households during distribution;
 9. Always give priority to children under five years of age when there are not enough nets to cover the whole population and pass the right message to the households;
 10. Distribute LLINs as soon as the nets arrive at the health post;
 11. 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;
 12. Ask households to remove badly damaged LLINs, tear them down to be used as window screens or put them under the mattress or mat to kill other pests (e.g. bed bugs). Never allow households to keep using damaged LLINs while keeping new LLINs unused;
 13. Always unpack LLINs before distributing to beneficiaries;
 14. Convince households to repair damaged LLINs promptly in order to extend their life;
 15. 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; advise alternative solutions if outdoor sleeping or staying up late is an issue;
 - address any concerns or problems from the household.

As health workers providing antenatal care and EPI services to the community, HEWs should ask pregnant women at every antenatal care visit as well as parents of children at DPT3 and measles vaccination visits whether they have LLINs and are using them properly. HEWs should ask whether mothers and their children slept under LLINs the previous night and record their responses on the EPI monthly form.

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) and that

mosquito repellents and other protection measures could be feasible and useful in protecting their workforce from malaria. Investors should also be aware that incorporating malaria prevention into their business plan can 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 with regards to 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 run-off or lack of soak pits for 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 as a result 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 (detailed information on malaria SBCC is available in the National Communication Strategy).

Key messages and instruction during IRS operations (Figure 6):

- 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.

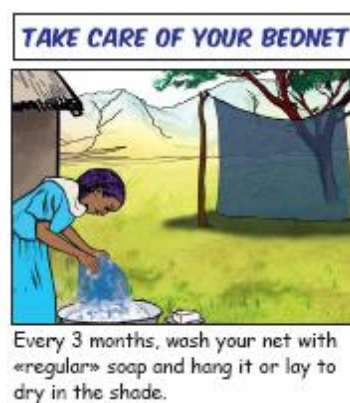
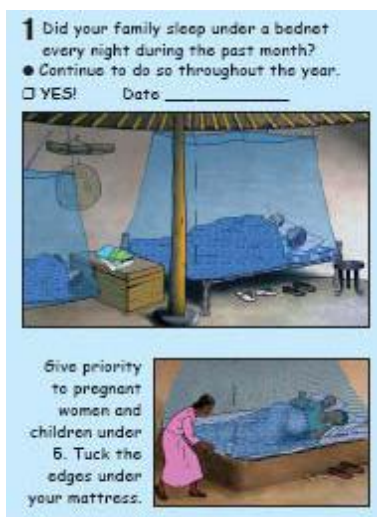
Figure 6 Remove all household items before spraying



Key messages for proper and consistent utilization of LLIN (Figure 7):

- Completely insert the end of the LLIN under the mattress;
- Give priority to pregnant women and children under five to sleep under LLINs;
- All family members should sleep under LLINs every night;
- Wash your LLIN with regular soap;
- Hang LLINs (or lay to dry) in the shade;
- Do not sell LLIN or use for other purposes.

Figure 7 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.

9.1. 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 and 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

11. INTRODUCTION

Malaria is a major public health problem in Ethiopia and has been consistently reported as one of the three leading causes of morbidity and mortality. A recent WHO assessment on the impact of LLINs and ACTs scale-up using data from a sample of health facilities revealed a significant reduction in malaria cases and deaths over the last few years. The weighted average decline for malaria cases and deaths in all ages between 2001/2004 and 2007 was 53% and 55%, respectively.

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.

Subsequent advances in diagnosis and treatment of malaria, including the operationalization of multi-species RDTs, and accumulating clinical evidence for several effective options for improved pre-referral care as documented in other African countries, prompted the revision of the 2004 National Malaria Diagnosis and Treatment Guidelines again in 2011. Accordingly, this third edition is developed for national use by healthcare workers in Ethiopia.

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. For patients needing referral to health facilities with more advanced capabilities because of severe malaria, a pre-referral treatment should be given by the HEW. 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 (**Annex Q**).

12 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 most peripheral level is the health post, a basic facility staffed by two HEWs, usually at the rural community level. Although HEWs primarily implement preventive and promotive activities, they also have the capacity to diagnose malaria using RDTs and to treat patients with ACTs or chloroquine according to the national treatment guidelines and RDT results. The next tier of health facilities includes the health centers, which together with the satellite health posts form primary health care unit. Finally, the most advanced medical capabilities exist at hospitals (including primary, general and specialized referral hospitals). Microscopy is available for malaria laboratory diagnosis at health centers and hospitals, but not at health posts, where multi-species RDTs are available.

These guidelines are intended to provide updated information for health workers on malaria diagnosis and case management appropriate at each clinical setting, or tier, within the health care system. The most recent National Malaria Diagnosis and Treatment Guidelines require training and educational sessions for all healthcare workers who evaluate and treat patients with malaria. The guidelines also target many other stakeholders in malaria prevention and control, including NGOs, private medical practitioners, private pharmacies, drug vendors and other medical professionals. Information on malaria should also be given to the general public through appropriately designed SBCC methods to improve early diagnosis and treatment-seeking practices, and compliance with prescribed drug dose regimens.

Moreover, for each health service delivery tier, including health posts, relevant parts of this guideline should be adapted in the form of wall charts and pocket size booklets and translated into local languages for easy reference. The implementation of this guideline should also 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.

Healthcare workers should become familiar with and monitor the epidemiological trends for malaria (e.g. case numbers), and susceptibility of parasite strains to commonly used anti-malarial drugs, the efficacy and effectiveness of anti-malarial medicines for each malaria species, medication tolerance and safety, as well as severe and life-threatening adverse effects of recommended treatments. Emphasis should particularly be given to regular monitoring and documentation of the validity of RDTs deployed as well as prompt identification of the emergence of resistance to the anti-malarial drugs in use.

13. MALARIA DIAGNOSIS AND TREATMENT APPROACHES

Ensuring prompt and effective treatment will prevent most cases of uncomplicated malaria from progressing to severe and fatal illness. To avoid this progression, treatment must begin as soon as possible, generally within 24 hours after symptom onset. Effective malaria treatment requires improved diagnosis of malaria (i.e. laboratory-based microscopy or use of multi-species RDTs); well-trained health workers in both the public and private health sectors; and, constant availability of highly efficacious medicines as close to the patient as possible to ensure prompt access. Communities

should be 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:

13.1 Clinical diagnosis

A clinical diagnosis entails making a clinical assessment by taking an accurate history of the illness and performing a physical examination. Clinical diagnosis of malaria is made in a patient who has fever or history of fever in the last 48 hours and lives in malaria-endemic areas or has a history of travel within the last 30 days to malaria-endemic areas. Basing the diagnosis on clinical features alone is not recommended, as this often has low specificity and increases the chances of the patient being misdiagnosed. Unless there is an ongoing malaria epidemic, careful laboratory testing typically reveals confirmed malaria parasites in fewer than 50% (probably in the range of 20-30%) of the clinically suspected malaria cases in most settings in Ethiopia. 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. 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.

13.2 Parasitological diagnosis

Microscopic diagnosis and RDTs are the methods employed for confirmation of malaria etiology. Currently, malaria microscopy is only available in health centers and hospitals, and in higher private health facilities; generally these facilities have electrical power and fresh water. Light microscopy using thick blood films can be very sensitive, detecting as few as 20 parasites/ μ l of blood. Thin blood film stained with Giemsa is useful for identifying the malaria parasite species and has a sensitivity of 20 parasites/ μ l. The recommended method to determine parasite load is by quantifying the percentage of parasitized red blood cells. In 2005, single-species RDTs were introduced at health posts in Ethiopia, greatly improving access to accurate *P. falciparum* malaria diagnosis at peripheral levels. 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 without delay. **Patients who test negative by malaria RDT or microscopy do not need anti-malarial medications.**

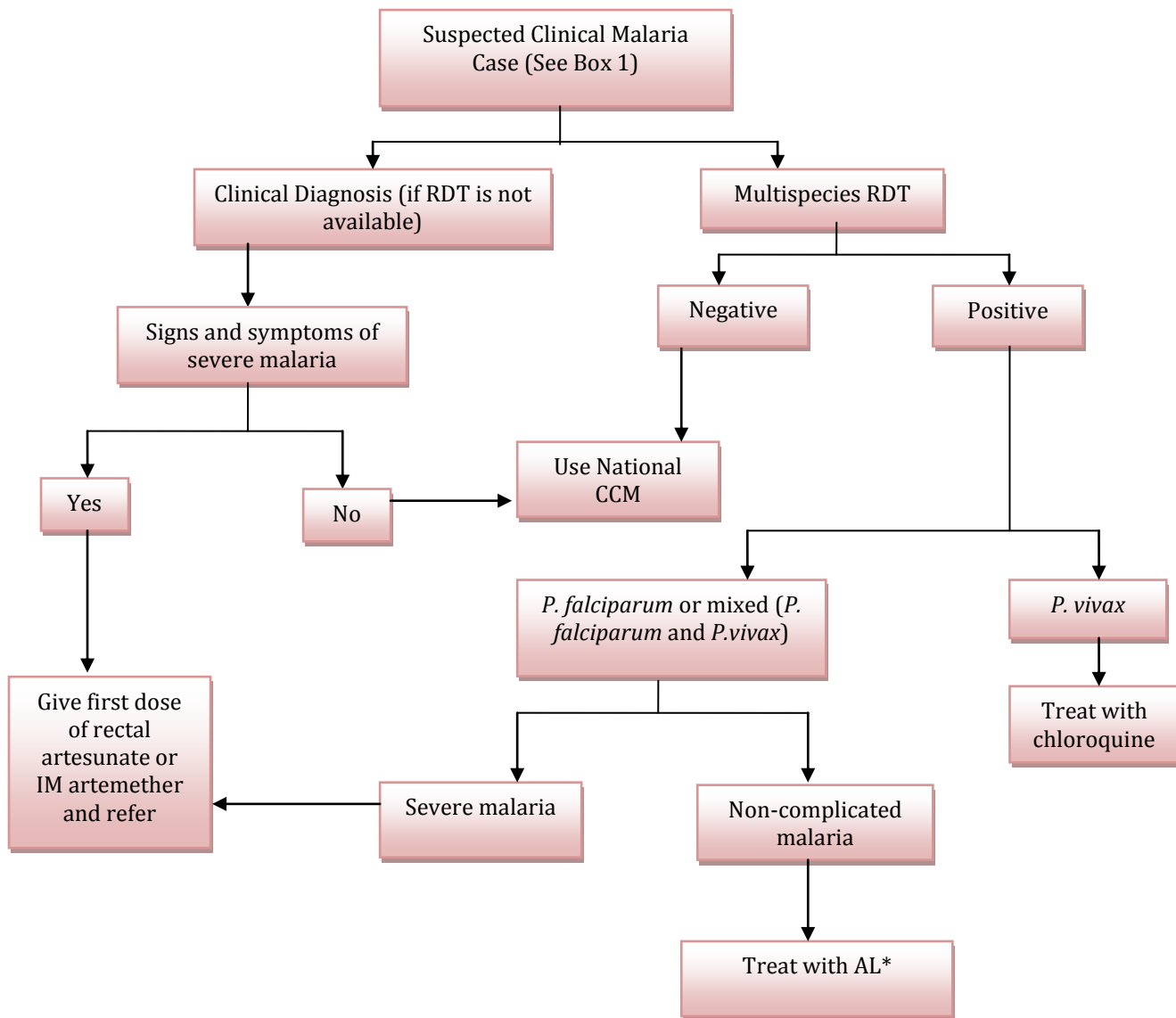
13.3 Treatment approach

Treatment of malaria should be based upon a parasitologically 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, ensuring the patient is able to swallow the medication, and does not vomit. If the RDT or microscopy reveals a *P. vivax* infection only (and no *P. falciparum*), then chloroquine treatment should be dispensed, also ensuring that oral medicine is tolerated. Although severe malaria illness is usually caused by *P. falciparum*, occasionally, *P. vivax* infection can also

result in severe malaria illness. Severe malaria illness should be treated in the same manner whether there it is due to *P. falciparum* or *P. vivax* infection (see section 14.2. for details): with rectal artesunate preferred pre-referral therapy to stabilize the patient, then intravenous artesunate as preferred therapy at hospital or health center. Radical treatment with primaquine is recommended at the health center and hospital level for patients with *P. vivax*, who are not living in malaria-endemic areas. Health workers should be vigilant to detect side-effects of primaquine. Mixed infection of *P. falciparum* and *P. vivax* should be treated with AL. Pregnant women in the first trimester and children weighing less than five kg should be treated with oral quinine when *P. falciparum* infection is present. Chloroquine is safe in 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, such as pneumonia, should continue; referral to health centers or hospital may be necessary. 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.

Over time, 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. 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.

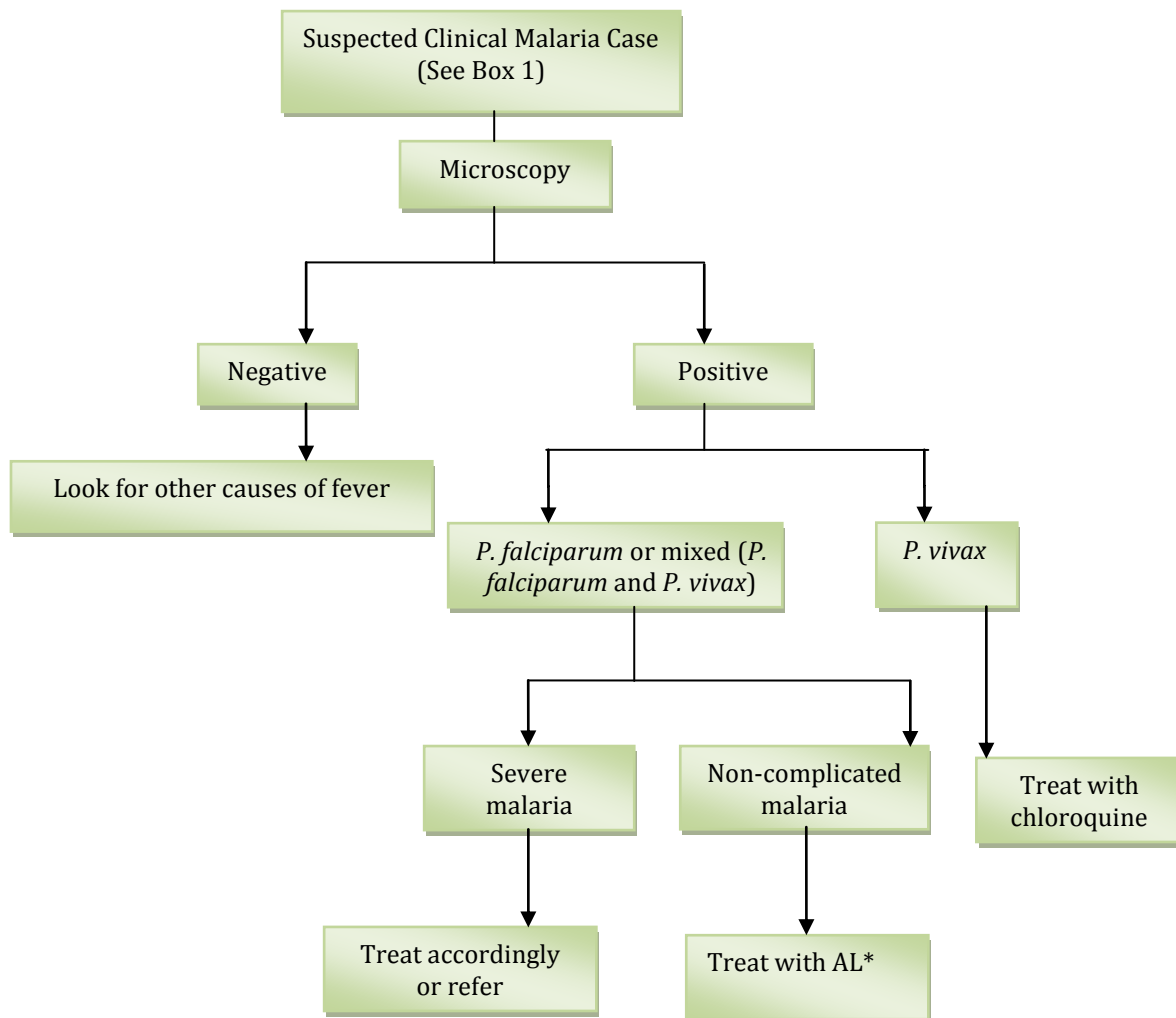
Figure 8 Flowchart for the diagnosis and treatment of malaria at health post level



***AL is not recommended for infants under 5 kg and pregnant women in first trimester with uncomplicated malaria. Hence, use oral quinine in such cases.**

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 9 Flow chart for the diagnosis and treatment of malaria at health center and hospital level



***Artemether-Lumefantrine is not recommended for infants under 5 kg and pregnant women in first trimester with uncomplicated malaria. Hence, use oral quinine in such cases.**

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.

Primaquine is given for radical cure for 14 days for patients who are not living in malaria endemic areas. Watch out for side-effects!

14. UNCOMPLICATED MALARIA

14.1 Management of uncomplicated malaria

14.1.1. Diagnosing uncomplicated malaria

A malaria diagnosis at the health post level (**Figure 8**) 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.

14.1.2. Treatment of uncomplicated malaria

14.1.2.1 First line of treatment of uncomplicated malaria

***P. falciparum* positive by multi-species RDT:** AL is the recommended first-line drug for the treatment of uncomplicated *P. falciparum* malaria. AL tablets are given according to body weight in six doses over three days (**Annex D**).

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 of the patient swallowing 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 assist in finding the correct dose for a given patient refer to **Annex D**. 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 150 mg base tablet *OR* chloroquine syrup 50 mg base (**Annex E** 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 E**.

Multi-species RDT is positive for *P. falciparum* and *P. vivax* (mixed infection): The recommended first-line treatment for mixed infection is AL (**Annex D**). **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.

No parasitological test available: Where multi-species RDT is not available, and the patient fulfills clinical criteria of malaria, AL should be given.

14.1.2.2. Second line treatment of uncomplicated malaria

AL may be used to treat *P. vivax* infection when chloroquine is unavailable (**Annex D**). If AL is not available for *P. falciparum* or mixed malaria infections, use oral quinine (**Annex F**). If both chloroquine and AL are not available for *P. vivax* infection, use quinine (**Annex F**).

14.1.2.3. Supportive treatment

If patients, especially children are present with axillary temperature $\geq 37.5^{\circ}\text{C}$, 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.

14.1.2.4. Referral

It is important that all patients are 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 given pre-referral treatment (see **section 14.2** below) and be referred to the next higher level health facility as soon as possible.

REMEMBER:

A delay in referral could cause the unnecessary death of the patient.

14.2. Pre-referral treatment at the health post level

The conscious patient: At the health post level, rectal artesunate or alternatively artemether IM or quinine IM will be available for pre-referral treatment (**Annex G**, **Annex H**, and **Annex K**).

- 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 (**Annex J**) prior to transfer:

- Ensure “ABC”
 - Airway
 - Breathing
 - Circulation
- Show family members how to position the patient on side (**Figure 10**) to ensure a clear airway is maintained;
- Give rectal artesunate or alternatively artemether IM or quinine IM (**Annex G** or **Annex H** or **Annex K** for dosages) as pre-referral treatment;
- 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.

14.3. Management of uncomplicated malaria at the health center or hospital level

14.3.1. Diagnosing uncomplicated malaria

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

- Taking a history (including travel history); **AND**
- 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.

14.3.2. 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. For *P. vivax*, radical cure with primaquine is recommended for patients with limited risk of malaria infection in the future, i.e. who are not living in malaria-endemic areas, in addition to chloroquine (**Annex I**). Mixed infections are treated with AL (followed by primaquine as described above, if risk of future reinfection is limited). The prevalence of G6PD deficiency is not known in Ethiopia. Hence, health workers should closely follow-up patients started on primaquine for hemolysis and instruct them to return immediately to the health institution if they notice 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 anemia.

Second line treatment of uncomplicated malaria: Second-line treatment is used when the first-line treatment is not available, or during failure or non-response to first-line treatment. The second-line treatment for both *P. falciparum* and *P. vivax* is oral quinine (**Annex F**).

Treatment failure: Treatment failure is defined as failure of anti-malarial drug to resolve fever and/or parasitaemia. Anti-malarial drug resistance can cause treatment failure but not all treatment failure is due to parasite resistance to 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 medicine must gain access to the parasite or the infected red blood cell for the duration of the time necessary for its normal action. 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. Monitoring treatment failure is very important because it can signal the appearance of anti-malarial resistance.

Treatment failure within first 14 Days: Owing to the potency of AL, treatment failure within 14 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 parasitaemia fail to resolve, or recur within 2 weeks of treatment, then treatment is considered to have failed. Wherever possible, treatment failure should be confirmed parasitologically, preferably by blood slide examination. RDTs may remain positive for weeks after the initial infection even without recrudescence. This requires referring the patient from health post to health center where microscopy is available; referral may also be necessary to obtain second-line treatment. Treatment failures may result from drug resistance, poor adherence or unusual pharmacokinetic properties in the individual patient. It is important to determine from the patient's history whether the antimalarial was vomited or whether the full course was not completed. Treatment failures should be treated with a second-line antimalarial, which is oral Quinine and inform experts by telephone at the district, zonal, regional or federal levels. 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).

Treatment failure after 14 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 routinely used in patient management in Ethiopia. Thus to simplify operational management and medicine deployment, all presumed treatment failures after two weeks of initial treatment should be considered as new infections, and be treated with the first-line antimalarial drug, which is AL.

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 reinstated with a 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 14 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. Blood smears should be saved, labeled and dated for further analysis by laboratory experts;
- In patients who are suspected to have treatment failure after 14 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.

15. MANAGEMENT OF SEVERE MALARIA

15.1. General principles of treatment

The patient presenting with severe malaria needs **URGENT** medical attention (**Annex J**). 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, all suspected cases presenting at the health post level will first be given pre-referral treatment (see **section 14.2**), then referred to the nearest higher level facility.

Many suspected severe malaria cases can be managed either at the health center or primary hospital level. Cases that develop serious complications need referral, for better management, to a general or specialized hospital.

15.2. Diagnosing severe malaria

- Taking a history (including travel history); **AND**
- Physical examination (including ophthalmoscopy); **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:** 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 ¹	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 (>2%) (non-immune person)	++	+
Renal impairment (creatinine >265 umol/L)	+	+++

15.2.1. Parasitological tests

At the level of health center and above, malaria microscopy should be available in most cases. 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 (>2% parasite density or >100,000 parasites per ul of blood) is generally associated with severe disease. If clinical features strongly suggest severe *P. falciparum* malaria, treatment may be 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: Other causes of febrile illnesses besides malaria in Ethiopia

Malaria differential diagnosis

Non complicated

- Relapsing fever
- Typhus fever
- Typhoid fever
- Fever with focal sign (urinary tract infection, respiratory tract infections, otitis media, sinusitis, tonsillitis, osteomyelitis, arthritis, dysentery)
- Influenza
- Visceral leishmaniasis

Complicated Malaria

Decreased Level of Consciousness

- Viral encephalitis
- Bacterial meningoenzephalitis
- Cerebral typhoid
- Cerebro-vascular event
- 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

15.2.2. Treatment of severe malaria

First-line treatment of severe malaria (see Management Pathway, **Annex J**): If clinical features strongly suggest severe *P. falciparum* malaria, treatment may be 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 due to *P. falciparum* at the health center and hospital level is either:

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

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 significantly (by about 35%) the risk of death from severe malaria compared to IV or IM quinine. For adults and children 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 for 5-7 days is the recommended treatment. 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 (Guilin Pharmaceutical Co, Guanxi, China) contains 60 mg powder within a 7 ml glass vial that 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, 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; adults over 50 kg weight need two full reconstituted and diluted vials at each dose, whether preparing for IV or IM injections. Complete doses are up to 360-480 mg artesunate over as many as five days for adults (**Annex L** for dosage details).

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, oral AL therapy should be started and substituted to complete therapy, as in **Annex D**. Followed by a full dose AL when the patient's condition improves, can take oral medication and there is no vomiting. If AL is contraindicated, continue treatment with quinine tablets.

Important points about quinine infusion (**Annex K**) when this is used as alternative therapy:

- 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 G, H and J, L, and 15.2.3 below**).

REMEMBER: PATIENTS WITH SEVERE MALARIA SHOULD NOT BE TREATED WITH ORAL MEDICATIONS.

15.2.3. General management of the patient with severe malaria

Emergency treatment may need to be administered especially if the patient presents in an unconscious state (see pathway for management of the patient with severe malaria **Annex J**). 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 therefore 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;
 - C = circulation: Feel hands and check for capillary refill, check, monitor and record vital signs, i.e. blood pressure, pulse, respiratory rate.

Once basic resuscitation has been implemented, assess and record the Glasgow Coma Scale or Blantyre score (**Annex O** and **P**).

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 estimation
 - 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 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.

REMEMBER: 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;
- Give quinine infusion, as indicated in **Annex K**. 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 39°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** so as to avoid dangerous respiratory depression. Diazepam can also be given intra-rectally (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 IM²; 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 ASAP.

15.2.4. 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 O** and **P** for how to assess coma.

² 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.

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 also the response to pain. Coma can be graded according to one of the two scales (**Annexes O and P**).

The Glasgow Coma Scale (**Annex O**) is suitable for adults and older children. For young children who are preverbal, the Blantyre Coma Scale (**Annex P**) 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.

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 both to 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:

- Mild anemia:
 - Hb 10.0 – 11.9 g/dl (Hb 10.0 – 10.9 in pregnant women and children;) in women
 - Hb 10.0 – 12.9 g/dl in men)
- Moderate anemia:
 - Hb 7.0 – 9.9 g/dl
- Severe anemia:
 - Hb <5.0 g/dl

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 haematocrit 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 cerebrospinal fluid lactic acid concentrations are raised. Perfusion is improved by correcting hypovolaemia.

Clinical signs of dehydration (decreased skin turgor, dry mucous membranes, dark urine, sunken fontanelle in infants, reduced ocular tension).

Management: Correct dehydration: 30 ml/kg over one hour for infants.

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 pharyngeal 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.

15.2.5. Treatments that are contra-indicated in the patient with severe malaria

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

- Corticosteroids and non-steroidal 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.).

15.2.6. 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.

15.2.7. 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

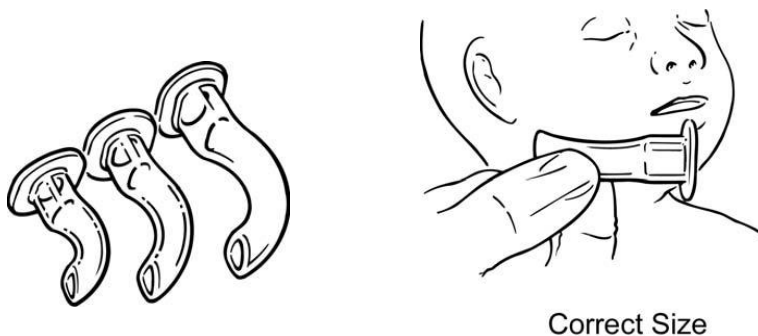
mouth. Comatose patients are prone to chest infections and aspiration of fluid into the lungs therefore it is vital that a clear airway is maintained. This is achieved by nursing the patient in the semi prone or recovery position as seen in **Figure 10** below.

Figure 10 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 is 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 11 Various sizes of Guedal airway and choosing the correct size



- 1) Aspiration pneumonia is a potentially fatal complication; the risk of this occurring 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.

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- 2) 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 12 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 = $\frac{\text{ml/hr}}{60}$ 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.
- 3) 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 O and P**);
 - 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.

- 4) 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.
- 5) 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 of 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.
- 6) 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.

16. MANAGEMENT OF MALARIA IN SPECIAL GROUPS

16.1. Uncomplicated malaria in 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 F**) 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* and are in their second or third trimester, they will be treated with AL and *P. falciparum* or mixed infection.

Pregnant women with only *P. vivax* will be treated with chloroquine in all trimesters (**Annex E**).

The recommended treatment for severe malaria in all patients including pregnant women is artesunate infusion (**Annex L**), or alternatively quinine infusion (**Annex K**) or alternatively artemether IM (**Annex H**) if both of these are unavailable. Pre-referral therapy for severe malaria in pregnant women is with rectal artesunate (**Annex G**), or IM quinine (**Annex K**) or alternatively IM artemether (**Annex H**) if both of these are unavailable. Special precaution should be taken to prevent hypoglycaemia in pregnancy. Primaquine and mefloquine are contraindicated during pregnancy. Intermittent preventive treatment with SP is not recommended in Ethiopia.

16.2. Uncomplicated malaria in children <5 kg body weight

AL is contra-indicated in children below 5 kg of body weight. For infants less than 5 kg of body weight, oral quinine (8.3 mg/kg base or 10 mg/kg quinine sulfate salt) THREE times a day for 7 days is the first-line treatment for *P. falciparum* infection (see **Annex F** for recommended dosage). Chloroquine is a safe drug that can be used in all children with only *P. vivax* infection (**Annex E**).

Artemether IM is the recommended treatment of malaria in malnourished children and treatment of patients with visceral leishmaniasis receiving sodium stibogluconate treatment (see **Annex H** for recommended dosage).

16.3. 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.

17. 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. Critical to patient adherence is good communication between healthcare workers and patients.

The flow chart (**Annex Q**) shows the flow of malaria case management (adapted from HIV/AIDS case management implementation guidelines).

17.1. 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.

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 CHPs. Variable numbers 1, 5 and 6 can be categorized as intensive case management.

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

The role of the case manager is played by HEWs and other clinicians working at the health facility level (**Annex Q**). 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 malaria case, the following are actions and key messages at the facility level should be conducted:

- Ensure the first dose of malaria treatment is received on the health post/health center premises and is well tolerated and not immediately vomited;

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- 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.

17.3. 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 understand 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.

18. 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 R** and refer to WHO travel health guidelines).

19. PHARMACOVIGILANCE

Pharmacovigilance is the science and activity of the 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 as a result 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 S**) 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.daca.gov.et>. Each individual report will be analyzed by experts and measures will be taken based on the information obtained so that the public will be protected from further drug-related injury.

SECTION 3

MALARIA EPIDEMIC PREVENTION AND CONTROL

20. INTRODUCTION

20.1. What are the aims of this guideline?

The Guideline for Malaria Epidemic Prevention and Control strengthens the malaria epidemic preparedness, detection and control capacity at all levels of the health service delivery system in Ethiopia so that the management of epidemics is improved. Since epidemics can occur anywhere, peripheral health services, particularly health extension workers (HEWs), are vital for early detection of epidemics and in preventive and control measures. The guideline also provides a framework for conducting comprehensive post-epidemic evaluation in order to ensure learning and proper management of future epidemics.

20.2. What are epidemics?

Malaria epidemics are the occurrence of numbers of cases above what is expected in a place in a particular time 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. Ethiopia aims to achieve malaria elimination in selected geographical areas with historically low malaria transmission by 2015, where universal coverage of malaria prevention interventions and strengthened surveillance has been well established. There will be an especially aggressive response to malaria case build ups and to epidemics within these areas.

20.3. History of malaria epidemics in Ethiopia

A devastating malaria epidemic occurred between 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, though recently there has been a trend towards smaller-scale, more frequent, sporadic epidemics and seasonal case build ups. In 1998, a widespread severe malaria epidemic occurred in most highland as well as lowland areas in the country. Many 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 2,500 meters) in 2003.

20.4. What causes epidemics?

Malaria epidemics can occur as a result of variability or changes in the rate of infection and population immunity. Generally epidemics 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 from famine and malnutrition;
- Interruptions of anti-malarial measures which have kept malaria under control;

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- Resistance to anti-malarial medications and/or insecticide used for vector control.

20.5. Can we predict and prevent 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 must be monitored and if they make an epidemic seem likely, we can strengthen health promotion, implement preventive measures (e.g. IRS), strengthen surveillance and detection systems as well as to maintain adequate case management supplies to ensure that control measures cut the epidemic short.

20.6. What can we do to detect and control 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 an epidemic's impact is to take effective control measures as soon as the epidemic or case build up episode has been detected. It is always important to ensure adequate supplies of ACTs (AL), RDTs) 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 when ill with fever, to take anti-malarial medications as prescribed, and to use LLINs properly especially for pregnant women and young children, and those who were recently treated for malaria. Such rapid response depends on effective surveillance systems so that abnormally increased numbers of cases can be recognized and so that shortages of ACTs and other malaria commodities can be avoided. The longer an epidemic goes undetected without effective control measures, the higher the potential cost in terms of morbidity and mortality.

21. EPIDEMIC FORECASTING AND EARLY WARNING

With the move to universal coverage of interventions (blanket coverage of major interventions in all risk areas), equity is no longer a major problem and the frequency of epidemics is expected to diminish. Therefore, the role of early warning gradually will shift to forecasting, 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. In this section, we will make a distinction between forecasting and early warning systems and how these tools could be utilized during the transition period.

21.1 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, including one in East Africa, 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 Public Health Emergency Management (PHEM) and its infrastructure is responsible for archiving as well as monitoring this type of data. Based on warning signs, PHEM can raise signals to provide warnings and trigger appropriate response.

Sources of seasonal forecast information at different scales that are relevant to Ethiopia are listed below:

- i) **Global level:** for example 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

21.2 Early warning

This is a continuum of forecasting and refers to more 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 highly likely in the subsequent month or two. This is often sufficient time to restock 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 dissemination of rainfall amounts and 'anomalies' (departures from normal conditions) 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, therefore, be used for early warning of malaria epidemics with a good level of accuracy, but with shorter lead-time for prevention.

22. SOURCES OF EARLY WARNING INFORMATION

The PHEM at different scales of the health system 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 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).

23. EPIDEMIC PREPAREDNESS

There are initiatives to develop a dynamic risk map by FMOH and malaria early warning by NMA. Until we will have these products for Given the current, relatively poor quality of seasonal forecasts and the absence of dynamic risk mapping for early warning and proactive operations, it is wise to adopt a worst case scenario and anticipate the occurrence of epidemics in any part of Ethiopia, particularly identified hot spots. The expected magnitude of cases will vary by village, woreda and zone according to normal incidence. Preparedness includes trained human resources, diagnostics, anti-

malarial drugs, supplies and insecticides. District level or health center level (if the supply condition allows) 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. For example, if the total annual requirement of AL (calculated from the total number of cases) is 100,000 tablets, an additional 25,000 tablets should be kept as a contingency; therefore, the budget allocated for AL must be sufficient for 125,000 tablets. The contingency AL must be rotated back into normal stocks within one calendar year to avoid the drug's expiry. The additional 25% need only be spent until a verified malaria epidemic occurs; following the response to an epidemic outbreak, the contingency stock would have to be replenished. Stocks of AL that are shared with neighboring districts in an emergency such as 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) have been identified. These essential supplies for epidemic management include:

At the health center level for health posts:

1. Chloroquine tablets
2. Chloroquine syrup
3. AL tablets
4. AL dispersible
5. Quinine tablets
6. Rectal artesunate
7. Malaria epidemic monitoring charts
8. Multi-species RDTs
9. Bench aids for appropriate use of RDTs
10. Kebele maps with 1 km² grids

At the district level for health centers or at other higher levels:

All of the above listed minus items 8-10

- 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) First-line insecticide
- 13) LLINs
- 14) Temephos 50% EC
- 15) Spraying pumps and accessories
- 16) Rectal artesunate
- 17) 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 through consultations between FMOH, regional, zonal, and district officials and donors. 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 "micro-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.

24. EPIDEMIC PREVENTION

24.1 Targeting areas for epidemic prevention

To plan specific preventive measures involves identifying especially 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. A recently identified best practice is to use this malaria data to create a malaria commodity “micro-plan” for estimating the annual requirement for supplies of RDTs, AL, chloroquine and LLINs. This is only a starting point, since hot spots can emerge in new areas in subsequent years. Health officers should be aware of supplies anticipated for delivery during the next year, their own inventories, and those of neighboring districts, and communicate at a zonal level, etc. 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 emergency situations.

24.2 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).

As LLIN ownership and use in the country reaches universal coverage and is sustained over time, the epidemic threat is expected to be diminished. Recently, epidemics have been reported in areas where LLIN coverage was imperfect, LLIN use was low, LLINs were misused, or worn-out LLINs were slowly replaced. Therefore, IRS should be used as a complementary operation in selected areas of the country where substantial seasonal malaria transmission predictably occurs until LLINs are scaled-up to universal coverage and their appropriate use is ensured. Hotspot woredas, resettlement and development areas with labor forces, refugee camps and areas under complex emergency situations 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.

25. EPIDEMIC DETECTION AND MITIGATION

25.1 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 transmission. Method 2 (cluster mapping) will be tested and gradually introduced, where applicable; as malaria incidence and transmission in an area falls to low levels this new 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 (see **section 23.2** and **23.3**).

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 practice, HEWs or other health staff may not always have this information for the current or previous year. In the absence of either of these, they collect data and report to the next highest 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.

Consider this familiar example to describe local micro-clusters of malaria transmission. We know that under a very dark rain cloud with lightning and visible rain in the distance, it is very likely to rain more intensely in the very near future under these dark clouds compared to areas that we can observe under lighter colored clouds or under clear sky areas. We can predict the direction and speed that the rain and clouds are moving. We know from the position of the dark clouds and visual evidence of current rain who should seek shelter immediately and how soon people in various areas and locations will soon get rain. The people receiving rain in this example are like the people who are becoming infected with malaria, and the dark clouds are like the mosquitoes that are transmitting malaria. By continuously mapping where people with most recent malaria illnesses live, we can determine where the dark clouds of ongoing malaria transmission are located, and we can advise people most at risk when to seek shelter. We can also predict where most new malaria infections will probably occur (i.e. we know home locations within 1km of those who will most likely be at risk of illness with malaria within 28 days).

The rate of accumulation of new malaria cases per day or week within sectors is also important in evaluating their relative importance within kebeles. For example, consider these two micro-clusters in **Figure 17**: Sector D5 had one *P. falciparum* case detected each day for the last 28 days for a total of 28 cases. Sector F8 had two *P. falciparum* cases detected on day one, four cases on day two, eight cases on day three, and 16 cases on day four; Sector F8 appears to be at risk of many more new malaria cases in the next few days compared to Sector D5, since the cases are accumulating much

more rapidly each day than in Sector D5. In this example, we do not need to wait for the entire 28 days of analysis to know there was a problem in focal malaria transmission in these sectors; in Sector D5 a micro-cluster would have been evident on day three of the month (with one case for each of the first three days of the month), and in Sector F8, the micro-cluster would have been evident on day two (two on the first day plus four on the second day). By day four, it would have been evident that Sector F8 had more intense local transmission compared to Sector D5.

After 28 days, if no additional malaria infections with the same species are detected within a previously identified malaria micro-cluster sector, the malaria micro-cluster has disappeared, providing evidence of reduced focal malaria transmission in that sector compared to the previous month. This would allow HEWs to concentrate malaria control and SBCC efforts in other sectors within the kebele where the most recent malaria cases were identified. In most cases, HEWs will routinely be managing small malaria micro-clusters on a continuous basis, and there is no need to specifically report them to higher levels unless there is concern about running out of supplies and medications, such as RDTs, ACTs and chloroquine, or larger case build-ups are evident that could also be described in epidemic charts as in Method 1. Again, the primary intent of Method 2 is to help quickly recognize and manage most small micro-clusters at the local level on an ongoing routine basis, and to help prevent these from developing into major epidemics.

This ongoing continuous analysis of recent malaria case data should empower HEWs to quantify, describe, understand and predict the unfolding malaria situation at the community level so they can manage resources at the health post level, deliver appropriate SBCC messages, and perhaps justify focusing other malaria resources. Micro-cluster analysis will likely be most useful for HEWs to use as an ongoing routine case management tool, when there is low to moderate malaria transmission, before a massive epidemic is evident. It is possible that in many communities, there may be intense malaria transmission in a few areas, and moderate to low transmission in many other areas. While there are always concerns about malaria in all areas within malaria-endemic kebeles, the intensity of malaria transmission is often uneven within kebeles, and there will be situations from month-to-month where very recent malaria illness reports can help improve management of malaria cases and suggest ways of interrupting intense malaria transmission within communities.

A scenario where three indigenous cases of malaria from the same malaria species occur within a 1 km radius on the same day is a micro-cluster, since this likely represents a local transmission. The HEW does not need to wait the entire month to take action: active surveillance and response must be initiated, especially warnings to local households in the area to use their LLINs properly for the next two months, and promptly seek care for an illness with fever.

Response to a small micro-cluster should not consume a great quantity of resources, but the mapping process should help localize areas of recent and ongoing malaria transmission and help focus resources such as malaria SBCC efforts. In particular, patients recently diagnosed and treated for malaria should sleep under LLINs, since they can be a source of gametocytes and new malaria infections, even while they are taking effective malaria treatment. Family members and immediate neighbors of these malaria patients are at especially high risk for malaria infections within the first 4-8 weeks. Mapping malaria cases (or at least documenting approximate home location in malaria registries) helps to document and visualize areas of intense local malaria transmission.

Unusual situations may also be recognized if day-to-day morbidity information from health service units is carefully analyzed. All health institutions already record line listings of patients with malaria illness in their registers. This should include name, age, date (two columns: onset of symptoms and consultation), sex, home location, RDT or microscopy result, treatment given and referral. In the absence of other information on what is 'normal', careful scrutiny of these numbers for a defined time period (at least weekly/monthly) should show unusual situations as they develop.

The most important morbidity data is that collected at the health post level by HEWs, but higher level health facilities should also monitor malaria data (disaggregated by village) within their catchment to

ensure that outbreaks are properly detected at lower levels. Information collected at health posts should be interpreted at least weekly by the same primary health care unit. Therefore, the responsibilities of detecting and acting on epidemics should be delegated directly to the health post in the specified kebele.

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

- i) Defining epidemics according to a particular time period 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 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” hot spots 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.

No delay or impediment should be put in the way of releasing RDTs and drugs when requested by health workers, provided they are accompanied by credible reports of cases detected and treated. Healthcare workers should avoid stock-piling drugs and supplies beyond their immediate needs while nearby districts have documented malaria caseloads that justify use of these medications and supplies immediately. Neighboring kebeles and districts should share supplies, even while requesting appropriate re-supply from zonal and regional offices. Even relatively large case build-ups could be handled locally as long as critical supplies are maintained and shared locally. Supervisors should work to minimize health posts with obvious over or under-supplies of critical medications and RDTs. While AL supplies are the most critical items to maintain in stock, RDT supplies are also important since they reduce the need for “presumptive”, “empirical” or “clinical” unfocused use of AL for persons without malaria, and allowing RDT evidence to support chloroquine treatment for those testing positive for only *P. vivax*, or justifying non-malaria therapy for those testing negative by malaria RDTs.

25.2 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 as a result 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.
- **Time 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 at higher facility levels, if available) 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 provided that 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 health 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 provided that 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 7 Chart for assessing usual number of weekly cases (confirmed or clinical) 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.
- 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 8 Construction of the threshold (norm) when five years' historical data are available to monitor the current year

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.

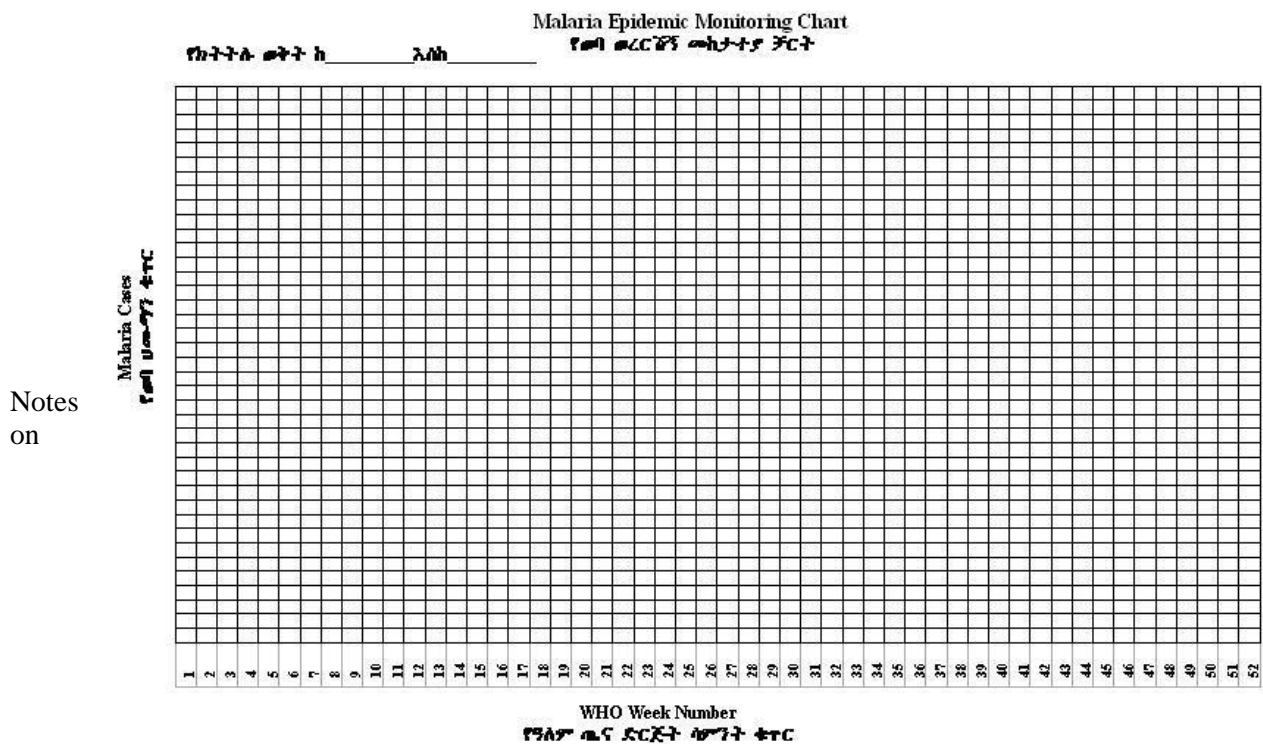
Table 9 Construction of threshold (norm) with single recent year morbidity data

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
2					17	34	22
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.

Figure 13 Norm chart for plotting weekly morbidity data: confirm or clinical cases



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).

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 14 Chart drawn from Table 8 showing epidemic weeks in current year above third quartile threshold

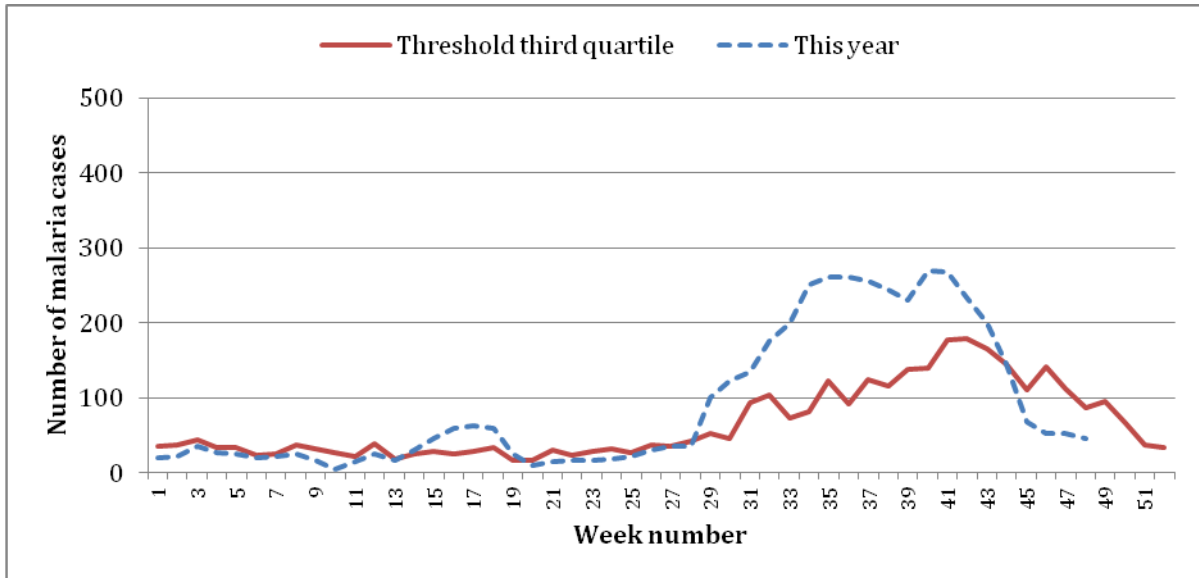


Figure 15 Chart drawn from Table 9 showing epidemic weeks in current year based on threshold of twice last year's weekly data

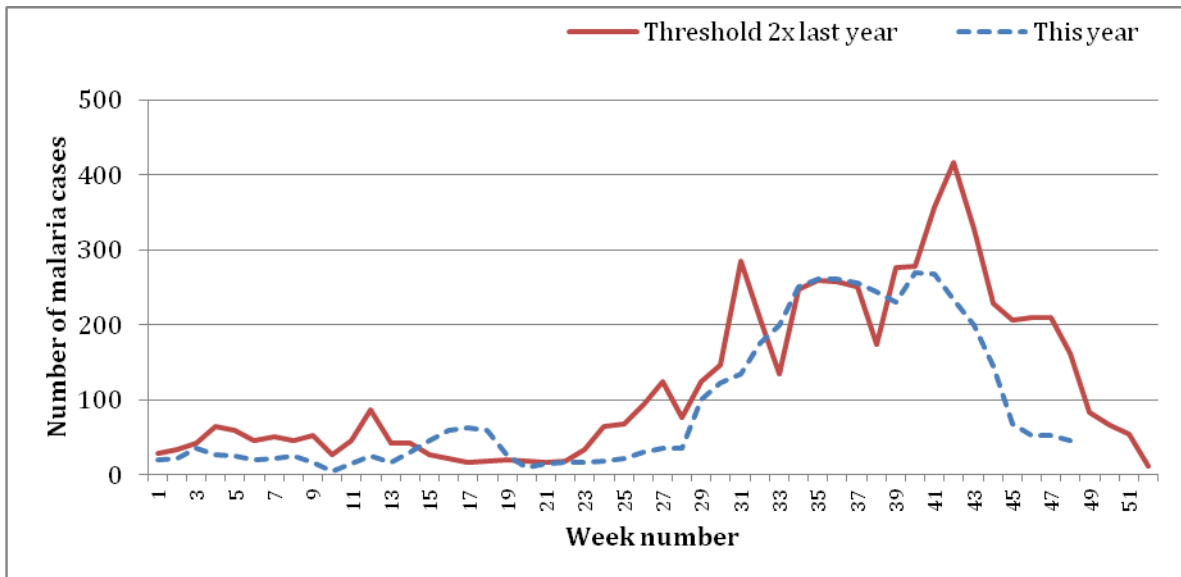
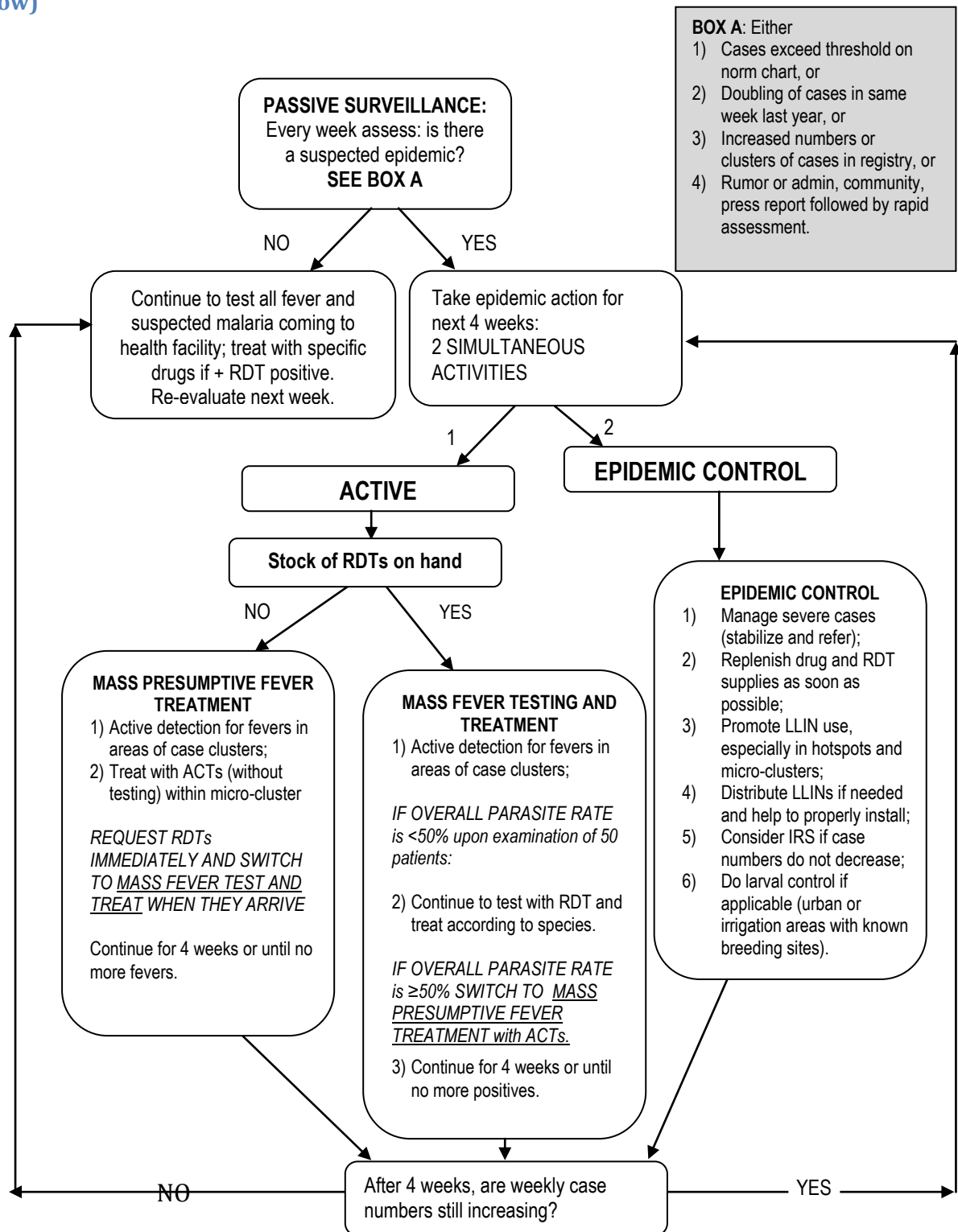


Figure 16 Flowchart of METHOD-1: Epidemic detection and control using threshold method (combined passive/active surveillance, conserving RDTs when RDT supplies are low)



25.3 Method 2: Mapping clusters

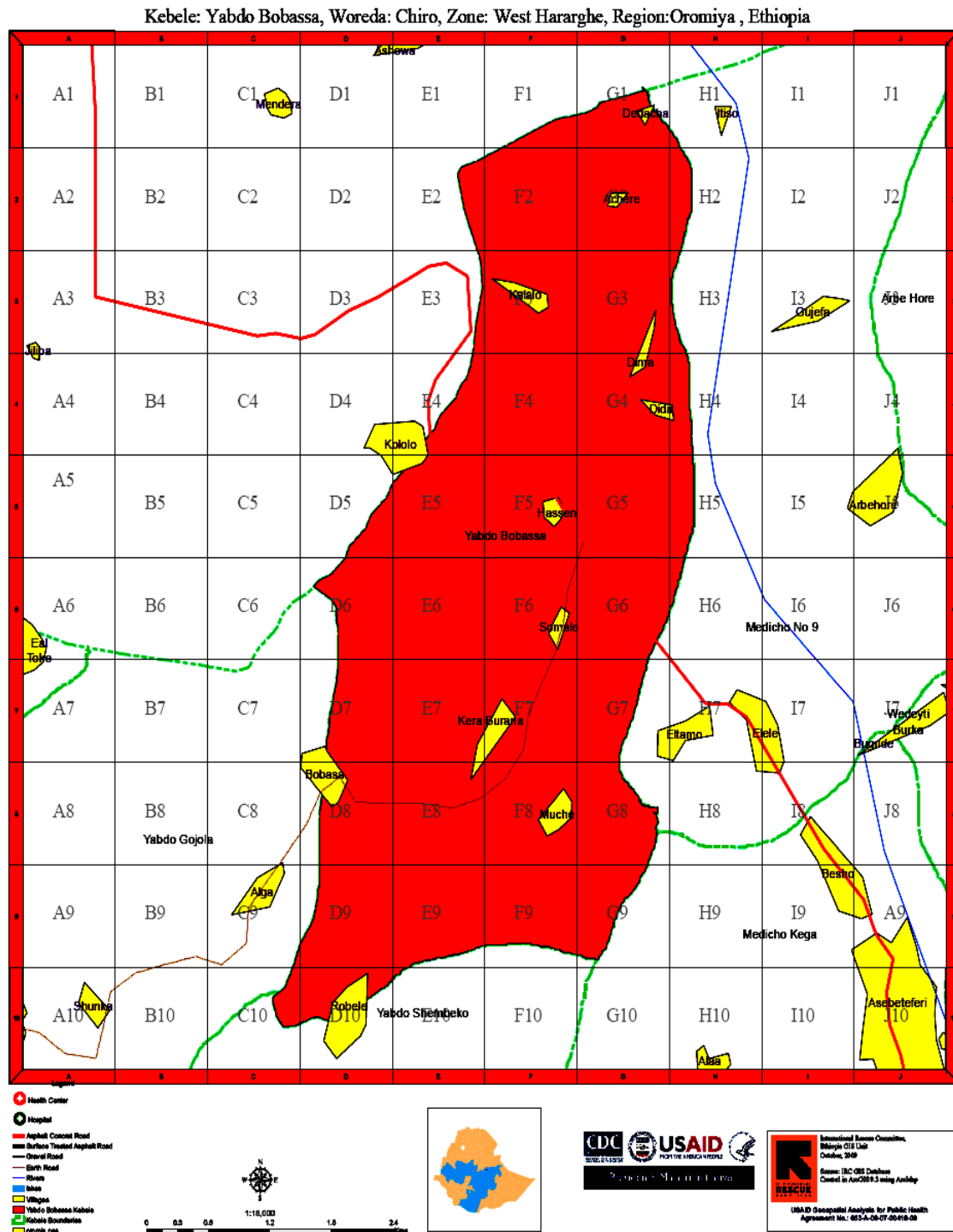
Method 2 uses a new definition of epidemic that is based on documenting the approximate location of recent malaria cases and clusters. Visualizing cases on a map of a health facility's catchment area makes use of more spatial information in the data to define clusters of cases documenting foci of probable 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 hot spots, 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. 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 17** or uniquely labeled with 5 digit letters with an HMIS-linked sector label scheme as shown in **Figure 18**

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 17 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 Sep 2009	3 Sep 2009	Yusef Ibrahim	30	M	D8	N/A	Pf	Pf	Coartem	LLIN for home
2	4 Sep 2009	5 Sep 2009	Dawit Solomon	35	F	F3	Pf	N/A	Pf	Coartem	LLIN for home
3	4 Sep 2009	6 Sep 2009	Melu Moges	25	F	D8	N/A	Pf	Pf	Coartem	LLIN for home
4	6 Sep 2009	10 Sep 2009	Yerusalem Melu	27	F	D8	N/A	PF/PAN	Pf mixed	IM artemether	To hospital

N/A: not available

Summary: 4 suspected malaria cases in 9/2009, 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 17** 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 km² sectors. **Figure 18** 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 18**). It is envisaged that data reported in the grid would be automatically fed into a HMIS database at facility level.

Figure 18: Disease reporting grid map with standardized grid scheme linkable to HMIS.

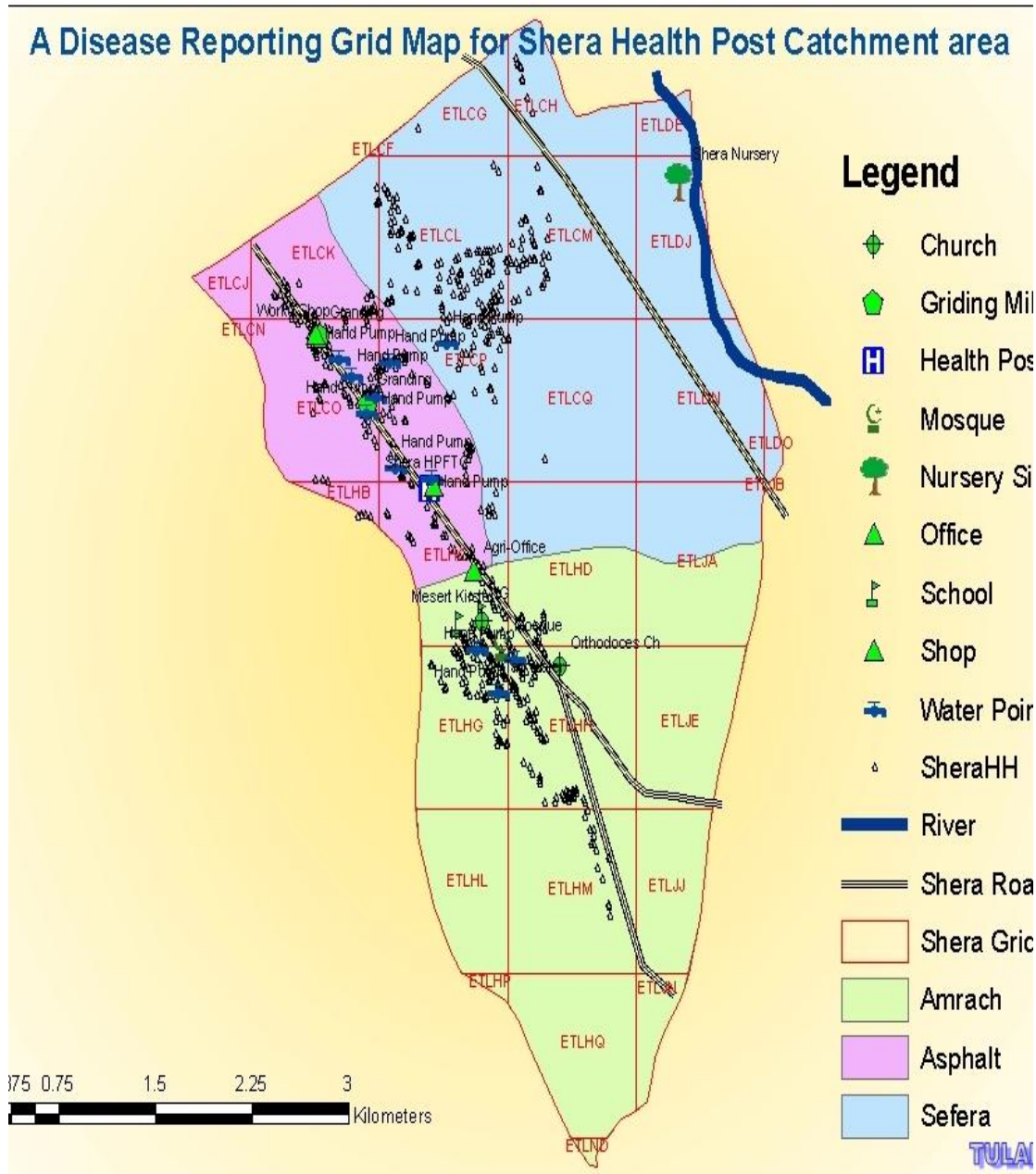
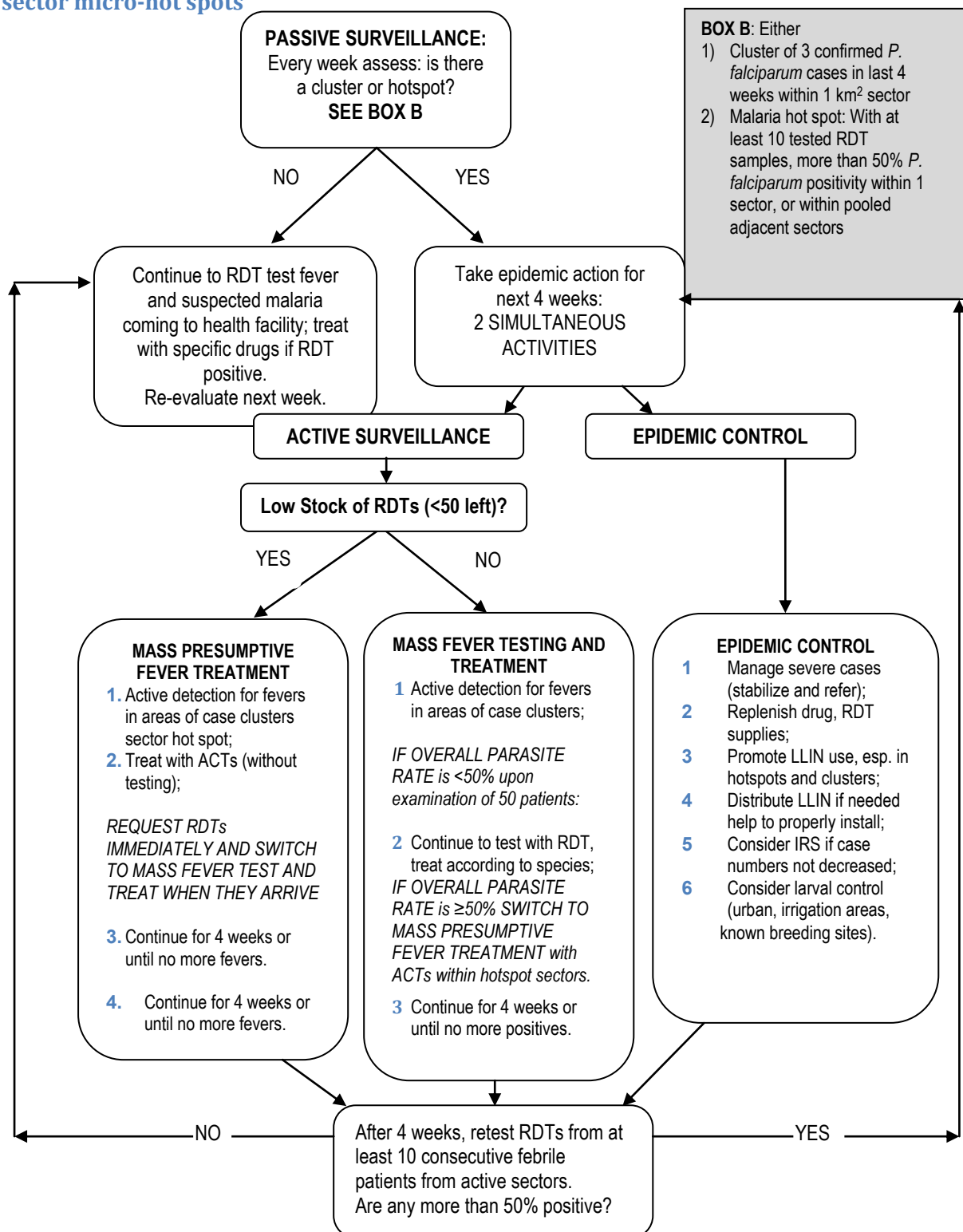


Figure 19 Flowchart of METHOD-2: Epidemic detection and control using mapping of cases (combined passive/active surveillance) helping to conserve RDTs within malaria sector micro-hot spots



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.

25.4 Epidemic confirmation

Epidemics detected through health facility registers using norm charts (Method 1) are by definition 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 Mass Fever Presumptive Treatment) will provide data to confirm the epidemic.

Epidemics detected by mapping of micro-clusters of cases (Method 2) also assume RDT or microscopy verification, and should be handled immediately by HEWs. The active surveillance strategies (Mass Test and Treat or Mass Fever Presumptive Treatment) 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 (EHNRI) 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)?
- 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.

25.5 Mitigation steps

Whether an epidemic is detected by Method 1 or 2, 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 16** 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.

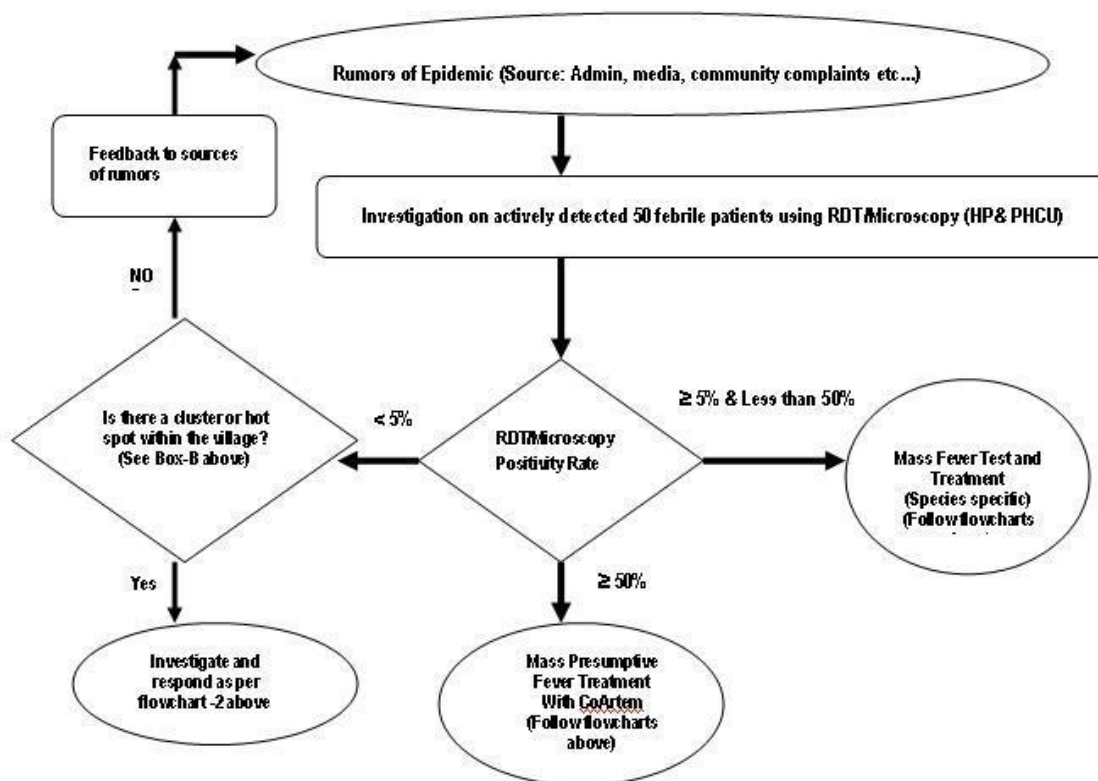
Mass presumptive fever treatment (MPFT): When, upon examination of 50 febrile patients, RDT positivity is equal to or greater than 50%, action should switch to MPFT (treat all persons with fever presumptively). This should be done when stocks of RDTs are low (while waiting for supply), or if RDT positivity 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 children under 5 kg and pregnant women in the first trimester (see the National Malaria Diagnosis and Treatment Guidelines, Section 14 and Annex D and F). Hence, MDA should never be practiced.

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).

Figure 20 Epidemic investigation and decision on treatment approach



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. 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, it should be noted that IRS may waste 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. If the epidemic is spread over larger geographical areas and resources are not sufficient, targeted LLIN distribution, particularly to pregnant women and children under five years of age, is a priority to prevent malaria-related mortality.

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 for the two months following documented nearby malaria transmission.

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.

25.6 Reporting

25.6.1 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**).

25.6.2 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.

25.6.3 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 21** below.

Figure 21 Epidemic data/information flow (reporting system)

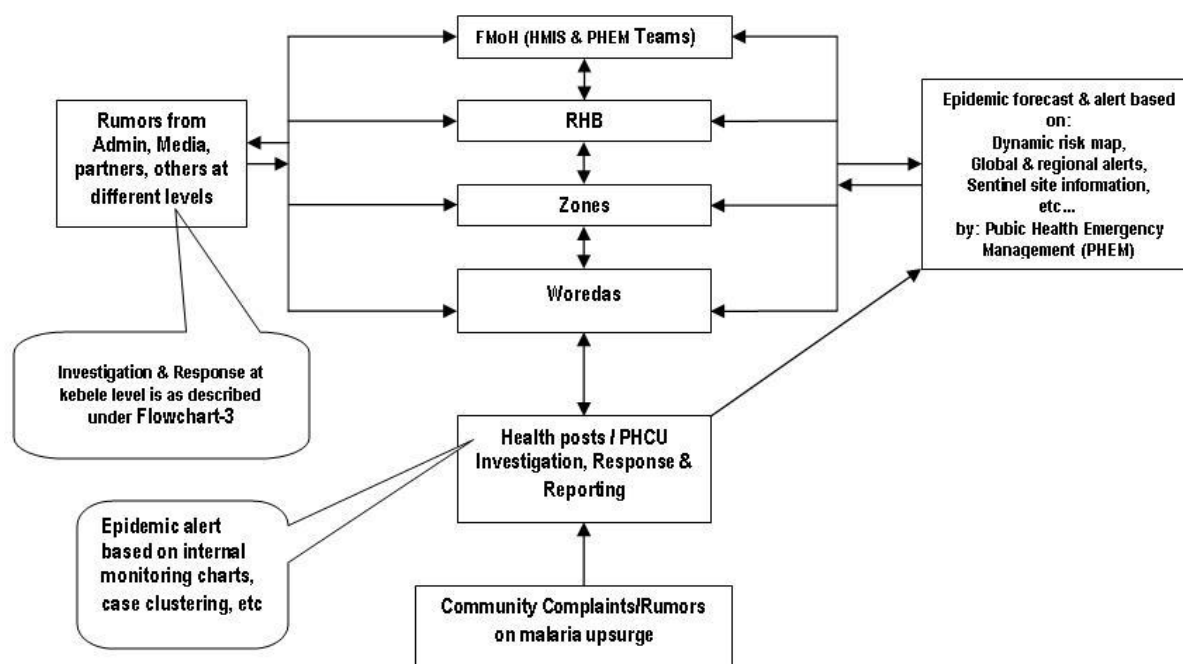




Table 12 Monthly inventory report

DATE _____ YEAR _____

REGION _____ ZONE _____ WOREDA _____ KEBELE _____ HEALTH POST _____

AL (Coartem®) treatment doses				Chloroquine tablets			Chloroquine syrup			Quinine tabs		Quinine injection			Artemether IM		Artesunate suppository		RDTs in stock		Microscopy slides in stock		LLINs in stock		
Adult doses in Inventory (6*4)				Child dose in inventory (6*3, 6*2, 6*1)			Dose (g/5ml)			No of bottles		Dose in mg			No of tins		Doses on hand		In inventory						
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	Expiry date	No of ampules	Expiry date	Doses on hand	Expiry date	Doses on hand	Expiry date	In inventory	Expiry date				

26. MALARIA CASE MANAGEMENT DURING EPIDEMICS

26.1 Management of uncomplicated malaria (See also Sections 11-17)

***P. falciparum* epidemics:** AL (**Annex D**) is the first-line anti-malarial drug recommended for the treatment of uncomplicated *P. falciparum* malaria). Oral quinine is recommended for the treatment of children under 5 kg body weight (age less than 3 months) and pregnant women with uncomplicated malaria (see **Annex F**).

***P. vivax* epidemics:** Use chloroquine if the cause of the epidemic has been established as only *P. vivax* (**Annex E**). Drug resistance to chloroquine rarely has been reported but should be kept in mind. Anti-relapse therapy with primaquine for *P. vivax* malaria is not currently recommended in malaria-endemic areas except in malaria elimination-designated districts. (**Annex I**).

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 not currently recommended in malaria-endemic areas, except in malaria elimination-designated districts (**Annex D** and **I**).

26.2 Management of severe malaria (See also Sections 11-17)

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 G, H, and J**).

Stabilizing therapy, such as artesunate suppositories or IM artemether (**Annex G** and **H**) or IM quinine (**Annex K**), 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 current National Case Management Guidelines for details).

27. 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.

27.1 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).

27.2 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.

27.3 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.

27.4 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.

27.5 Evaluation 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?

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27.6 Evaluating the overall response to the epidemic

Indicators will help you to monitor the success of the intervention.

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
- High coverage of vector control measure, i.e. IRS and LLINs
- Adequacy of coordination of stakeholders and partners
- Adequacy of supportive supervision carried out
- IRS coverage and proportion of population protected

Outcome indicators: Examples include:

- 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 from PHEM, 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.

28. RESPONSIBILITIES OF STAKEHOLDERS

28.1 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 species-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.

28.2 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.

28.3 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.

28.4 Hospitals

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

28.5 Woreda health offices/HEW supervisors

Major duties:

- 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 emergency situations; 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.

28.6 Zonal 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.

28.7 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.

28.8 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.

28.9 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.

28.10 Research and academic institutions

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

Annexes

ANNEX A. 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 tank
- 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 practising
 - 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
<p><i>Introduction</i></p> <ul style="list-style-type: none"> • Spray tank and equipment used • How to carry sprayer • Dismantling and assembling spray pump <p><i>Operation of sprayer</i></p> <ul style="list-style-type: none"> • How to clean sprayer • Distance of nozzle and surface • Speed of spraying 	<p><i>Review sprayer parts</i></p> <ul style="list-style-type: none"> • Spraying successive swaths, practice spraying with wooden extension. • Applying pressure to the sprayer 	<p><i>Practice spraying</i></p> <ul style="list-style-type: none"> • Spraying with water • First test "Special Cases" 	<p><i>Spraying techniques</i></p> <ul style="list-style-type: none"> • 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. 	<p><i>Environmental compliance practices and IEC</i></p> <ul style="list-style-type: none"> • 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 	<p><i>The spray forms</i></p> <ul style="list-style-type: none"> • 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 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/cm² (156 holes /in²)
- Net Material mass 30g/m² for 75 denier Yarn 40g/m² 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. MALARIA INDICATOR SURVEY 2007 DATA - SUMMARY

Key Malaria Indicators Reported in DHS 2005 and MIS 2007 at National Level and in Oromia.

<i>Indicator</i>	<i>DHS 2005</i>	<i>MIS 2007</i>		
	<i>National</i>	<i>National (< 2,000 m)</i>	<i>National (≤ 2,500 m)</i>	<i>Oromia (≤ 2,500 m)</i>
Percent households with at least one LLIN	3.4	65.3	53.1	41
Percent households with more than one LLIN	-	36.6	29.5	21.4
Percent children < 5 years of age sleeping under an ITN the previous night	1.6	41.5	33.1	24.3
Percent pregnant women sleeping under an ITN the previous night	1.1	42.7	35.2	25.6
Percent households reporting indoor residual spraying in the past 12 months	2.3	20.0	14.2	12.5
Percent children < 5 years of age with fever in past two weeks	-	24.0	22.3	21.5
Percent children with fever who took antimalarial drugs	0.7	11.9	9.5	6.6
Percent who took an antimalarial drug same or next day	-	4.8	3.9	1.3
Percent children with fever who sought treatment from facility/provider same/next day	-	16.3	15.4	16.4
Malaria prevalence by microscopy <i>P. falciparum</i> (%)	-	0.7	0.5	0.1
Malaria prevalence by microscopy <i>P. vivax</i> (%)	-	0.3	0.2	0.2

Note: A follow-up MIS is scheduled for 2011.

ANNEX D. ARTEMETHER-LUMEFANTRINE TREATMENT SCHEDULE

Tablet containing 120 mg artemether plus 20 mg lumefantrine in a fixed dose.

Weight (KG)	Age	Day 1		Day 2		Day 3		Color code
		Morning	Evening	Morning	Evening	Morning	Evening	
5-14 kg	From 4 months to 2 years	1 tablet	1 tablet	1 tablet	1 tablet	1 tablet	1 tablet	Yellow*
15-24 kg	From 3 years to 7 years	2 tablets	2 tablets	2 tablets	2 tablets	2 tablets	2 tablets	Blue*
25-34 kg	From 8 years to 10 years	3 tablets	3 tablets	3 tablets	3 tablets	3 tablets	3 tablets	Brown
>35	10 years & above	4 tablets	4 tablets	4 tablets	4 tablets	4 tablets	4 tablets	Green

* (yellow, blue) Flavoured pediatric formulation (dispersible tablets) of artemether-lumefantrine (AL) is available for enhancing its use in young children.

Side effects:

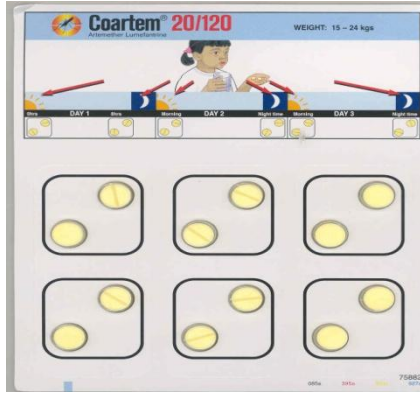
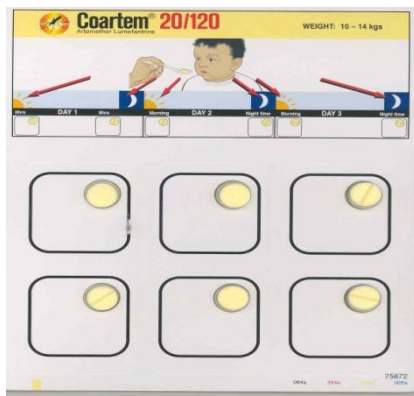
The following adverse effects have been reported; dizziness and fatigue, anorexia, nausea, vomiting, abdominal pain, palpitations, myalgia, sleep disorders, arthralgia, headache and rash.

Contraindications:

- ❖ Artemether-lumefantrine should not be used as malaria prophylaxis either alone or in combination;
- ❖ Persons with a previous history of reaction after using the drug;
- ❖ Pregnant women in the first trimester and infants less than 5 kg;
- ❖ Persons with severe and complicated malaria should not be treated with oral medications.

Note: Artemether-lumefantrine has a shelf life of only two years. The drug should be stored at temperatures of below 30°C and should not be removed from the blister if it is not going to be used immediately. One form of presentation of artemether-lumefantrine is shown below.

Example of artemether-lumefantrine pack



ANNEX E. CHLOROQUINE TREATMENT SCHEDULE

Tablets of chloroquine 150 mg base or syrup 50 mg base per 5 ml (Note, one 250 mg chloroquine phosphate salt tablet contains 150 mg chloroquine base). Total dose of 25 mg base per kg over 3 days (10 mg base per kg on Day 1, 10 mg base per kg on day 2, and 5 mg base per kg on day 3). (Never take more than four 250 mg chloroquine phosphate tablets in one day.)

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

Side effects:

Dizziness, skeletal muscle weakness, mild gastrointestinal disturbances (nausea, vomiting, abdominal discomfort and diarrhea) and pruritus. Pruritus may be severe but usually passes within 48-72 hours.

Contraindications:

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

ANNEX F. 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	1/2	1/3
12 – 14	2 – 3 years	3/4	1/2
14 – 19	3 – 5 years	3/4	½
20 – 24	5 – 7 years	1	¾
25 – 35	8 – 10 years	1 1/2	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 G. RECTAL ARTESUNATE TREATMENT SCHEDULE

Pre-referral treatment schedule for severe malaria

Evidence from recent studies demonstrates that in situations where parenteral medication is not possible and intramuscular injection impractical, using a single dose of rectal artesunate as pre-referral treatment reduces the risk of death or permanent disability in young children.

Rectal artesunate treatment dosage for children and adult patients (dosed at 10mg/kg body weight)

For children: One or more artesunate suppositories inserted in the rectum as indicated. The dose should be given once and followed as soon as possible by definitive therapy for malaria. In the event that an artesunate suppository is expelled from the rectum within 30 min of insertion, a second suppository should be inserted and, especially in young children, the buttocks should be held together, for 10 min to ensure retention of the rectal dose of artesunate. Dose of rectal artesunate may be repeated within 4-12 hours, then once daily for three days pending arrival at hospital if there is a delay in transportation. Once able to tolerate oral medicines, complete Artemether-lumefantrine (AL) treatment as in Annex D.

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

Weight (kg)	Age (approximate.)	Artesunate dose (mg)	Regimen (single dose)
3–8 kg	0–12 months	50mg	One 50mg suppository
9–12 kg	12–24 months	100mg	Two 50-mg suppositories
13–18 kg	2-4 years	150mg	Three 50-mg suppositories
19–22 kg	4–5 years	200mg	Four 50-mg suppositories (or one 200-mg suppository)
23-27 kg	6-8 years	250mg	Five 50-mg suppositories (or one 200-mg suppository)
28-39 kg	9-13 years	300 mg	Six 50-mg suppositories or One-and-one-half 200-mg suppositories
40 – 59 kg	> 14 years	400 mg	Two 200-mg suppositories
60-80 kg	>14 years	800mg	Four 200-mg suppositories
Above 80 kg	> 14 years	1200mg	Six 200-mg suppositories

ANNEC H. ARTEMETHER IM TREATMENT SCHEDULE:

Artemether IM is an alternative treatment for malaria pre-referral therapy or alternate severe malaria treatment.

Artemether dose 3.2 mg/kg loading dose on the first day followed by 1.6 mg/kg daily for two days.

	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

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 I. PRIMAQUINE TREATMENT SCHEDULE

Primaquine is used for radical *P. vivax* cure.

Primaquine phosphate dose: 0.25 mg base per kg daily for 14 days

Weight (kg)	Age (years)	Number of tablets per day for 14 days	
		7.5 mg tablet	15 mg tablet
19 – 24	5 – 7	3/4	-
25 – 35	8 – 10	1	1/2
36 – 50	11 – 13	1 1/2	3/4
50+	14+	2	1

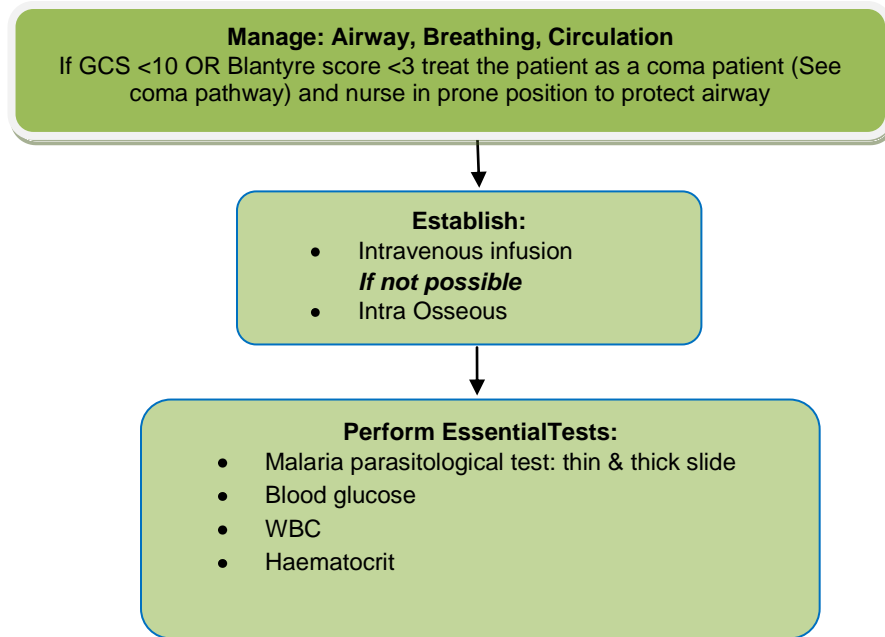
Side effects:

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.

Contraindications:

- ❖ Pregnancy
- ❖ Lactation
- ❖ Children under five years
- ❖ Any condition that predisposes to granulocytopenia, such as active rheumatoid arthritis & systemic lupus erythematosus.

ANNEX J. SEVERE MALARIA MANAGEMENT PATHWAY



ANNEX K. QUININE (IM/IV)

Quinine dihydrochloride is an alternate drug for the treatment of severe and complicated malaria, and may be used when the preferred drug, intravenous artesunate, and the alternate drug IM artemether, is unavailable. Quinine is safe in pregnancy and in anemic patients, if the doses are carefully calculated by body weight. The loading dose is given as 20mg/kg quinine salt in up to 500ml (5-10 ml/kg) of isotonic saline or 5% dextrose saline over 4 hours (at a rate of no more than 5 mg/kg quinine salt per hour). The maintenance dose should be given 12 hours after the loading dose and then 8 hourly; the maintenance dose is 10 mg quinine salt /kg diluted in up to 500ml (5-10ml/kg) of isotonic saline solution or 5% dextrose saline every 8 hours. Continue IM or IV therapy until the condition of the patient improves, and the patient can take oral medication and there is no vomiting. (10 mg of quinine dihydrochloride salt = 8.3 mg of quinine base). Do not exceed a rate of no more than 5 mg/kg quinine salt per hour.

If the preferred IV administration is not possible, give quinine by intramuscular (IM) injection diluted with sterile normal saline to a concentration of 60mg/ml at dosages listed below.

	Loading dose over 4 hours	Rest for next 8 hours	Maintenance dose over 4 hours (given 12 hours after start of loading dose)	Rest for 4 hours	Maintenance dose over 4 hours
Quinine IV Infusion	20 mg salt/kg body weight in 5% dextrose saline or isotonic saline (not to exceed 5mg salt/kg per hour)	Give N/Saline or ringers lactate to keep vein open and maintain fluid balance	10mg salt/kg body weight in 5% dextrose saline	Give N/Saline or ringers lactate to keep vein open and maintain fluid balance	10mg salt/kg body weight in 5% dextrose saline

	Loading dose	Rest for next 4 hours	Maintenance dose IM every 8 hours
Quinine IM	20 mg salt/kg body weight divided into 2 sites (one in each thigh)		10 mg salt/kg body weight IM into thigh

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.

Contra- indications:

- Hemoglobinuria
- Optic Neuritis

Annex L ARTESUNATE IV OR IM TREATMENT SCHEDULE

Artesunate IV or IM treatment for severe malaria.

Artesunate dosing is 2.4 mg/kg BW IV or IM given on admission (time = 0), then at 12h and 24h, then daily for up to five days; From 60mg vials, artesunate must be reconstituted in two steps: initially with sodium bicarbonate solution, then with either normal saline or glucose(D5W) solution. Full reconstitution results in either 6ml (intravenous concentration 10mg/ml) or 3ml (for intramuscular injection concentration 20mg/ml) of injectable artesunate dosed by weight.

Weight (kg) (approximate)	IV 10 mg/ml	IM 20 mg/ml
0-8	1 ml	0.5 ml
9 to 12	2 ml	1 ml
13-16	3 ml	1.5 ml
17-18	4 ml	2 ml
19-21	5 ml	2.5 ml
22-25	6 ml	3 ml
26-29*	7 ml	3.5 ml
30-33*	8 ml	4 ml
34-37*	9 ml	4.5 ml
38-41*	10 ml	5 ml
42-46*	11 ml	5.5 ml
47+*	12 ml	6 ml

The injectable artesunate (Guilin Pharmaceutical Co, Guanxi, China) contains 60 mg powder within a 7 ml glass vial that 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 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; adults over 50 kg weight need two full reconstituted and diluted vials at each dose, whether preparing for IV or IM injections. Complete doses are up to 360-480 mg artesunate over as many as five days for adults. * Note that for persons weighing more than 25 kg, a second artesunate vial must be completely reconstituted as above for each dose, and then each dose administered determined by the chart. Each artesunate dose is 2.4 mg/kg BW IV or IM.

ANNEX M. TREATMENT / PROGRESS / OBSERVATION CHART

Date of admission:/...../..... Time (hour/min):/..... Name of patient:

DATE: DAY

Record No. Age: Sex: M F Weight Drugs given before admission including OPD	Hours	1	4	8	12	16	20	24		
	Real time (Hours/min)									
→	QUININE diHcl	2	0 _m	k	g	1	0 _m	k	g	10
Investigations done on admission Parasite count	Temperature (2x/day)									
	Pulse (2x/day)									
	Respiratory rate (2x/day)									
	Blood pressure (2x/day)									
Haemotocrit / Hb	Blantyre coma scale (3x/day)	□		□		□				
Blood Sugar	Convulsions (Y/N)									
Urine analysis	Able to drink (Y/N)									
CSF	Able to sit (Y/N)									
Grouping of blood	Parasite count									
	Haemotocrit / Hb									
	Blood sugar									
	IV quinine in mg									
	IV fluids - dextrose saline									
	Other drugs e.g. IV									
	Diazepam / antibiotics									
	Urine volume									
	Blood transfusion									

ANNEX N. 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 O. GLASGOW COMA SCALE

The Glasgow coma scale for adults and older children	
	Score
Eyes open: <ul style="list-style-type: none"> • Spontaneously • To speech • To pain • Never 	4 3 2 1
Best verbal response: <ul style="list-style-type: none"> • Orientated • Confused, disoriented • Inappropriate words • Incomprehensible sounds • None 	5 4 3 2 1
Best motor response: <ul style="list-style-type: none"> • 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 P. BLANTYRE COMA SCALE

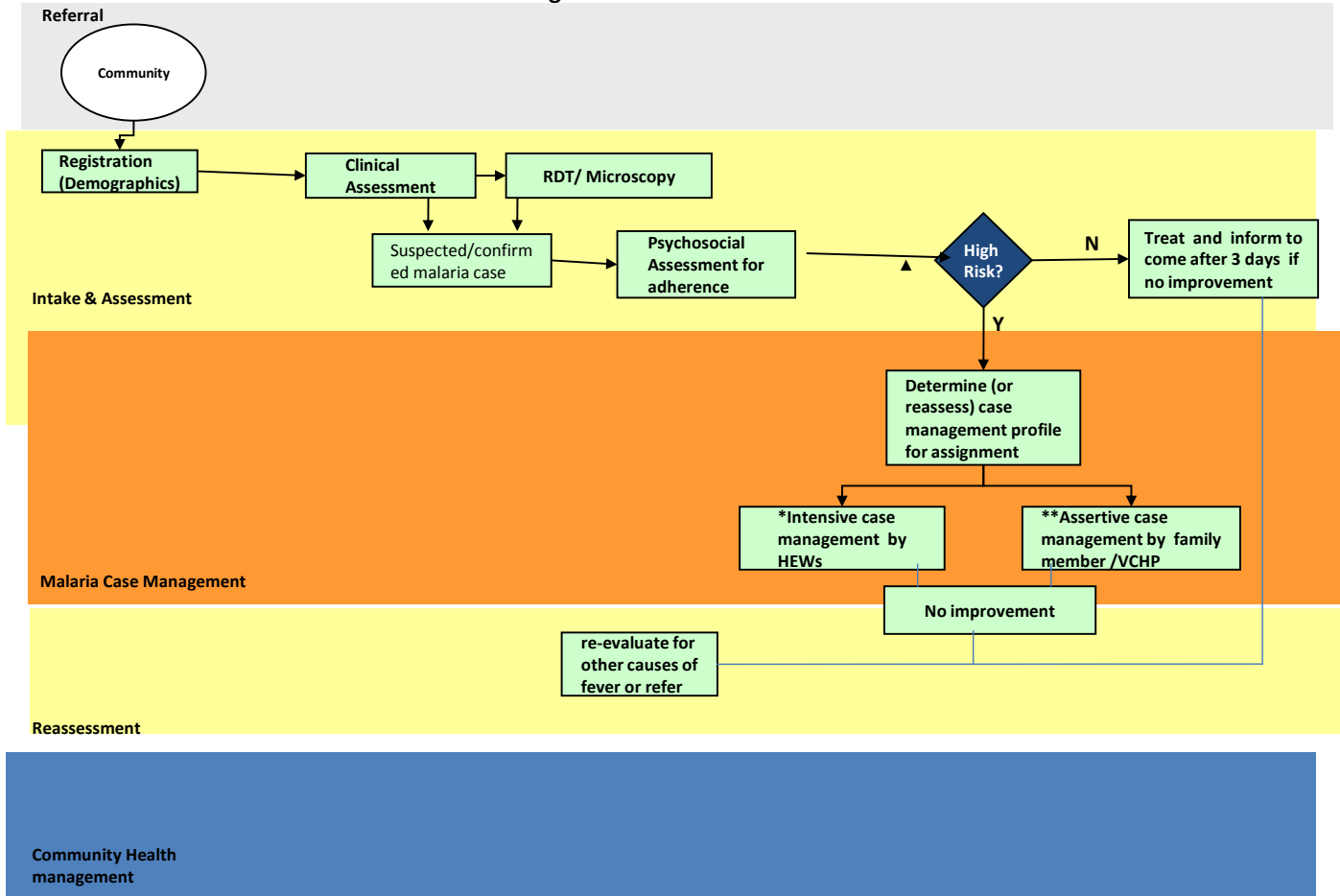
Blantyre coma scale for young children who are preverbal	
	Score
Eye movements: <ul style="list-style-type: none"> • Directed (followed mother/caretakers face) • Not directed 	 1 0
Verbal response: <ul style="list-style-type: none"> • Appropriate for age (cry) • Moan or inappropriate for age (cry) • Gasp/none 	 2 1 0
Best motor response: <ul style="list-style-type: none"> • 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 Q. MALARIA CASE MANAGEMENT PROCESS FLOW (ADHERENCE)

Malaria Case Management Process Flow



ANNEX R. 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

b. 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 S. 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		Indication (Reason for drug use)
					Started	Stopped	
Adverse Drug Reaction Description (Including Laboratory test results):						Date of onset of Reaction: D/M/Y	
_____ _____ _____ _____ _____ _____ _____ _____ _____							
Reaction necessitated: Discontinuation of drug/s/ <input type="checkbox"/> Yes <input type="checkbox"/> No Prolonged Hospitalization <input type="checkbox"/> Yes <input type="checkbox"/> No				Reaction subside after D/C of Suspected Drug <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA Reaction reappear after Restart of Suspected Drug <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> NA			
Treatment of reaction:							
Outcome: <input type="checkbox"/> Died due to adverse reaction <input type="checkbox"/> Died, drug may be contributory <input type="checkbox"/> Not yet recovered <input type="checkbox"/> Recovered with out sequelae <input type="checkbox"/> Recovered with sequelae <input type="checkbox"/> 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			

Product Quality Problem (Colour change, Separating of components, Powdering / crumbling, Caking, Moulding, Change of odour, Incomplete pack, Suspected contamination, Poor packaging /poor labeling, Receiving expired medicines,etc)

Trade Name (Drug)	Batch No.	Registration No.	Dosage form and strength	Expiry date	Size/ Type of container

For office use only

Received On:	Registration No.
--------------	------------------

Key: D|M|Y Date |Month |Year; D/C Discontinue Treatment; Y Yes; N No; NA Not available

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What to report

- All suspected reactions to drugs
- Unknown or unexpected ADRs
- Serious adverse drug reactions
- Unexpected therapeutic effects
- All suspected drug interactions
- Product Quality Problem
- Treatment failure

NB. Drugs includes

- Conventional drugs
- Herbal drugs
- Traditional medicines
- Biologicals
- Medical supplies
- Medicated cosmetics

This ADR reporting form was prepared by DACA in collaboration with MSH-SPS and the financial support from USAID.

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Business Reply Service Licence No. HQ2

From

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**Postage
Prepaid**



Drug Administration and Control Authority
Regulatory Information Development and
Dissemination Team
P. O. Box 5681 - Tel. 0115-52 41 22/23
Addis Ababa, Ethiopia

ANNEX T 2011-2015 WHO WEEK NUMBERS FOR HEALTH POSTS

2011 WHO week numbers

Week No	Ethiopian Calendar Starts (MM/DD/YY)	Ethiopian Calendar Ends (MM/DD/YY)	Gregorian Calendar Starts (MM/DD/YY)	Gregorian Calendar Ends (MM/DD/YY)
1	04/25/03	5/1/03	01/03/11	01/09/11
2	05/02/03	5/8/03	01/10/11	01/16/11
3	05/09/03	5/15/03	01/17/11	01/23/11
4	05/16/03	5/22/03	01/24/11	01/30/11
5	05/23/03	5/29/03	01/31/11	02/06/11
6	05/30/03	6/5/03	02/07/11	02/13/11
7	06/06/03	6/12/03	02/14/11	02/20/11
8	06/13/03	6/19/03	02/21/11	02/27/11
9	06/20/03	6/26/03	02/28/11	03/06/11
10	06/27/03	7/3/03	03/07/11	03/13/11
11	07/04/03	7/10/03	03/14/11	03/20/11
12	07/11/03	7/17/03	03/21/11	03/27/11
13	07/18/03	7/24/03	03/28/11	04/03/11
14	07/25/03	7/31/03	04/04/11	04/10/11
15	08/01/03	8/7/03	04/11/11	04/17/11
16	08/08/03	8/14/03	04/18/11	04/24/11
17	08/15/03	8/21/03	04/25/11	05/01/11
18	08/22/03	8/28/03	05/02/11	05/08/11
19	08/29/03	9/4/03	05/09/11	05/15/11
20	09/05/03	9/11/03	05/16/11	05/22/11
21	09/12/03	9/18/03	05/23/11	05/29/11
22	09/19/03	9/25/03	05/30/11	06/05/11
23	09/26/03	10/2/03	06/06/11	06/12/11
24	10/03/03	10/9/03	06/13/11	06/19/11
25	10/10/03	10/16/03	06/20/11	06/26/11
26	10/17/03	10/23/03	06/27/11	07/03/11
27	10/24/03	10/30/03	07/04/11	07/10/11
28	10/31/03	11/6/03	07/11/11	07/17/11
29	11/07/03	11/13/03	07/18/11	07/24/11
30	11/14/03	11/20/03	07/25/11	07/31/11
31	11/21/03	11/27/03	08/01/11	08/07/11
32	11/28/03	12/4/03	08/08/11	08/14/11
33	12/05/03	12/11/03	08/15/11	08/21/11
34	12/12/03	12/18/03	08/22/11	08/28/11
35	12/19/03	12/25/03	08/29/11	09/04/11
36	12/26/03	1/1/04	09/05/11	09/11/11
37	01/02/04	1/8/04	09/12/11	09/18/11
38	01/09/04	1/15/04	09/19/11	09/25/11
39	01/16/04	1/22/04	09/26/11	10/02/11
40	01/23/04	1/29/04	10/03/11	10/09/11
41	01/30/04	2/5/04	10/10/11	10/16/11
42	02/06/04	2/12/04	10/17/11	10/23/11
43	02/13/04	2/19/04	10/24/11	10/30/11

44	02/20/04	2/26/04	10/31/11	11/06/11
45	02/27/04	3/4/04	11/07/11	11/13/11
46	03/05/04	3/11/04	11/14/11	11/20/11
47	03/12/04	3/18/04	11/21/11	11/27/11
48	03/19/04	3/25/04	11/28/11	12/04/11
49	03/26/04	4/1/04	12/05/11	12/11/11
50	04/02/04	4/8/04	12/12/11	12/18/11
51	04/09/04	4/15/04	12/19/11	12/25/11
52	04/16/04	4/22/04	12/26/11	01/01/12

2012 WHO week numbers

Week No	Ethiopian calendar Starts (MM/DD/YY)	Ethiopian calendar ends (MM/DD/YY)	Gregorian calendar Starts (MM/DD/YY)	Gregorian calendar ends (MM/DD/YY)
1	04/23/04	04/29/04	01/02/12	01/08/12
2	04/30/04	05/06/04	01/09/12	01/15/12
3	05/07/04	05/13/04	01/16/12	01/22/12
4	05/14/04	05/20/04	01/23/12	01/29/12
5	05/21/04	05/27/04	01/30/12	02/05/12
6	05/28/04	06/03/04	02/06/12	02/12/12
7	06/04/04	06/10/04	02/13/12	02/19/12
8	06/11/04	06/17/04	02/20/12	02/26/12
9	06/18/04	06/24/04	02/27/12	03/04/12
10	06/25/04	07/01/04	03/05/12	03/11/12
11	07/02/04	07/08/04	03/12/12	03/18/12
12	07/09/04	07/15/04	03/19/12	03/25/12
13	07/16/04	07/22/04	03/26/12	04/01/12
14	07/23/04	07/29/04	04/02/12	04/08/12
15	07/30/04	08/05/04	04/09/12	04/15/12
16	08/06/04	08/12/04	04/16/12	04/22/12
17	08/13/04	08/19/04	04/23/12	04/29/12
18	08/20/04	08/26/04	04/30/12	05/06/12
19	08/27/04	09/02/04	05/07/12	05/13/12
20	09/03/04	09/09/04	05/14/12	05/20/12
21	09/10/04	09/16/04	05/21/12	05/27/12
22	09/17/04	09/23/04	05/28/12	06/03/12
23	09/24/04	09/30/04	06/04/12	06/10/12
24	10/01/04	10/07/04	06/11/12	06/17/12
25	10/08/04	10/14/04	06/18/12	06/24/12
26	10/15/04	10/21/04	06/25/12	07/01/12
27	10/22/04	10/28/04	07/02/12	07/08/12
28	10/29/04	11/04/04	07/09/12	07/15/12
29	11/05/04	11/11/04	07/16/12	07/22/12
30	11/12/04	11/18/04	07/23/12	07/29/12
31	11/19/04	11/25/04	07/30/12	08/05/12
32	11/26/04	12/02/04	08/06/12	08/12/12
33	12/03/04	12/09/04	08/13/12	08/19/12
34	12/10/04	12/16/04	08/20/12	08/26/12
35	12/17/04	12/23/04	08/27/12	09/02/12
36	12/24/04	12/30/04	09/03/12	09/09/12
37	12/31/04	01/06/05	09/10/12	09/16/12
38	01/07/05	01/13/05	09/17/12	09/23/12
39	01/14/05	01/20/05	09/24/12	09/30/12
40	01/21/05	01/27/05	10/01/12	10/07/12
41	01/28/05	02/03/05	10/08/12	10/14/12
42	02/04/05	02/10/05	10/15/12	10/21/12
43	02/11/05	02/17/05	10/22/12	10/28/12
44	02/18/05	02/24/05	10/29/12	11/04/12
45	02/25/05	03/03/05	11/05/12	11/11/12

46	03/04/05	03/10/05	11/12/12	11/18/12
47	03/11/05	03/17/05	11/19/12	11/25/12
48	03/18/05	03/24/05	11/26/12	12/02/12
49	03/25/05	03/31/05	12/03/12	12/09/12
50	04/01/05	04/07/05	12/10/12	12/16/12
51	04/08/05	04/14/05	12/17/12	12/23/12
52	04/15/05	04/21/05	12/24/12	12/30/12
53	04/22/05	04/28/05	12/31/12	01/06/13

2013 WHO week numbers

Week No	Ethiopian calendar Starts (MM/DD/YY)	Ethiopian calendar ends (MM/DD/YY)	Gregorian calendar Starts (MM/DD/YY)	Gregorian calendar ends (MM/DD/YY)
1	04/29/05	05/05/05	01/07/13	01/13/13
2	05/06/05	05/12/05	01/14/13	01/20/13
3	05/13/05	05/19/05	01/21/13	01/27/13
4	05/20/05	05/26/05	01/28/13	02/03/13
5	05/27/05	06/02/05	02/04/13	02/10/13
6	06/03/05	06/09/05	02/11/13	02/17/13
7	06/10/05	06/16/05	02/18/13	02/24/13
8	06/17/05	06/23/05	02/25/13	03/03/13
9	06/24/05	06/30/05	03/04/13	03/10/13
10	07/01/05	07/07/05	03/11/13	03/17/13
11	07/08/05	07/14/05	03/18/13	03/24/13
12	07/15/05	07/21/05	03/25/13	03/31/13
13	07/22/05	07/28/05	04/01/13	04/07/13
14	07/29/05	08/04/05	04/08/13	04/14/13
15	08/05/05	08/11/05	04/15/13	04/21/13
16	08/12/05	08/18/05	04/22/13	04/28/13
17	08/19/05	08/25/05	04/29/13	05/05/13
18	08/26/05	09/01/05	05/06/13	05/12/13
19	09/02/05	09/08/05	05/13/13	05/19/13
20	09/09/05	09/15/05	05/20/13	05/26/13
21	09/16/05	09/22/05	05/27/13	06/02/13
22	09/23/05	09/29/05	06/03/13	06/09/13
23	09/30/05	10/06/05	06/10/13	06/16/13
24	10/07/05	10/13/05	06/17/13	06/23/13
25	10/14/05	10/20/05	06/24/13	06/30/13
26	10/21/05	10/27/05	07/01/13	07/07/13
27	10/28/05	11/03/05	07/08/13	07/14/13
28	11/04/05	11/10/05	07/15/13	07/21/13
29	11/11/05	11/17/05	07/22/13	07/28/13
30	11/18/05	11/24/05	07/29/13	08/04/13
31	11/25/05	12/01/05	08/05/13	08/11/13
32	12/02/05	12/08/05	08/12/13	08/18/13
33	12/09/05	12/15/05	08/19/13	08/25/13
34	12/16/05	12/22/05	08/26/13	09/01/13
35	12/23/05	12/29/05	09/02/13	09/08/13
36	12/30/05	01/05/06	09/09/13	09/15/13
37	01/06/06	01/12/06	09/16/13	09/22/13
38	01/13/06	01/19/06	09/23/13	09/29/13
39	01/20/06	01/26/06	09/30/13	10/06/13
40	01/27/06	02/02/06	10/07/13	10/13/13
41	02/03/06	02/09/06	10/14/13	10/20/13
42	02/10/06	02/16/06	10/21/13	10/27/13
43	02/17/06	02/23/06	10/28/13	11/03/13
44	02/24/06	03/02/06	11/04/13	11/10/13
45	03/03/06	03/09/06	11/11/13	11/17/13

46	03/10/06	03/16/06	11/18/13	11/24/13
47	03/17/06	03/23/06	11/25/13	12/01/13
48	03/24/06	03/30/06	12/02/13	12/08/13
49	03/31/06	04/06/06	12/09/13	12/15/13
50	04/07/06	04/13/06	12/16/13	12/22/13
51	04/14/06	04/20/06	12/23/13	12/29/13
52	04/21/06	04/27/06	12/30/13	01/05/14

2014 WHO week numbers

Week No	Ethiopian calendar Starts (MM/DD/YY)	Ethiopian calendar ends (MM/DD/YY)	Gregorian calendar Starts (MM/DD/YY)	Gregorian calendar ends (MM/DD/YY)
1	04/28/06	05/04/06	01/06/14	01/12/14
2	05/05/06	05/11/06	01/13/14	01/19/14
3	05/12/06	05/18/06	01/20/14	01/26/14
4	05/19/06	05/25/06	01/27/14	02/02/14
5	05/26/06	06/01/06	02/03/14	02/09/14
6	06/02/06	06/08/06	02/10/14	02/16/14
7	06/09/06	06/15/06	02/17/14	02/23/14
8	06/16/06	06/22/06	02/24/14	03/02/14
9	06/23/06	06/29/06	03/03/14	03/09/14
10	06/30/06	07/06/06	03/10/14	03/16/14
11	07/07/06	07/13/06	03/17/14	03/23/14
12	07/14/06	07/20/06	03/24/14	03/30/14
13	07/21/06	07/27/06	03/31/14	04/06/14
14	07/28/06	08/03/06	04/07/14	04/13/14
15	08/04/06	08/10/06	04/14/14	04/20/14
16	08/11/06	08/17/06	04/21/14	04/27/14
17	08/18/06	08/24/06	04/28/14	05/04/14
18	08/25/06	08/31/06	05/05/14	05/11/14
19	09/01/06	09/07/06	05/12/14	05/18/14
20	09/08/06	09/14/06	05/19/14	05/25/14
21	09/15/06	09/21/06	05/26/14	06/01/14
22	09/22/06	09/28/06	06/02/14	06/08/14
23	09/29/06	10/05/06	06/09/14	06/15/14
24	10/06/06	10/12/06	06/16/14	06/22/14
25	10/13/06	10/19/06	06/23/14	06/29/14
26	10/20/06	10/26/06	06/30/14	07/06/14
27	10/27/06	11/02/06	07/07/14	07/13/14
28	11/03/06	11/09/06	07/14/14	07/20/14
29	11/10/06	11/16/06	07/21/14	07/27/14
30	11/17/06	11/23/06	07/28/14	08/03/14
31	11/24/06	11/30/06	08/04/14	08/10/14
32	12/01/06	12/07/06	08/11/14	08/17/14
33	12/08/06	12/14/06	08/18/14	08/24/14
34	12/15/06	12/21/06	08/25/14	08/31/14
35	12/22/06	12/28/06	09/01/14	09/07/14
36	12/29/06	01/04/07	09/08/14	09/14/14
37	01/05/07	01/11/07	09/15/14	09/21/14
38	01/12/07	01/18/07	09/22/14	09/28/14
39	01/19/07	01/25/07	09/29/14	10/05/14
40	01/26/07	02/01/07	10/06/14	10/12/14
41	02/02/07	02/08/07	10/13/14	10/19/14
42	02/09/07	02/15/07	10/20/14	10/26/14
43	02/16/07	02/22/07	10/27/14	11/02/14
44	02/23/07	03/01/07	11/03/14	11/09/14
45	03/02/07	03/08/07	11/10/14	11/16/14

46	03/09/07	03/15/07	11/17/14	11/23/14
47	03/16/07	03/22/07	11/24/14	11/30/14
48	03/23/07	03/29/07	12/01/14	12/07/14
49	03/30/07	04/05/07	12/08/14	12/14/14
50	04/06/07	04/12/07	12/15/14	12/21/14
51	04/13/07	04/19/07	12/22/14	12/28/14
52	04/20/07	04/26/07	12/29/14	01/04/15

2015 WHO week numbers

Week No	Ethiopian calendar Starts (MM/DD/YY)	Ethiopian calendar ends (MM/DD/YY)	Gregorian calendar Starts (MM/DD/YY)	Gregorian calendar ends (MM/DD/YY)
1	04/27/07	05/03/07	01/05/15	01/11/15
2	05/04/07	05/10/07	01/12/15	01/18/15
3	05/11/07	05/17/07	01/19/15	01/25/15
4	05/18/07	05/24/07	01/26/15	02/01/15
5	05/25/07	05/31/07	02/02/15	02/08/15
6	06/01/07	06/07/07	02/09/15	02/15/15
7	06/08/07	06/14/07	02/16/15	02/22/15
8	06/15/07	06/21/07	02/23/15	03/01/15
9	06/22/07	06/28/07	03/02/15	03/08/15
10	06/29/07	07/05/07	03/09/15	03/15/15
11	07/06/07	07/12/07	03/16/15	03/22/15
12	07/13/07	07/19/07	03/23/15	03/29/15
13	07/20/07	07/26/07	03/30/15	04/05/15
14	07/27/07	08/02/07	04/06/15	04/12/15
15	08/03/07	08/09/07	04/13/15	04/19/15
16	08/10/07	08/16/07	04/20/15	04/26/15
17	08/17/07	08/23/07	04/27/15	05/03/15
18	08/24/07	08/30/07	05/04/15	05/10/15
19	08/31/07	09/06/07	05/11/15	05/17/15
20	09/07/07	09/13/07	05/18/15	05/24/15
21	09/14/07	09/20/07	05/25/15	05/31/15
22	09/21/07	09/27/07	06/01/15	06/07/15
23	09/28/07	10/04/07	06/08/15	06/14/15
24	10/05/07	10/11/07	06/15/15	06/21/15
25	10/12/07	10/18/07	06/22/15	06/28/15
26	10/19/07	10/25/07	06/29/15	07/05/15
27	10/26/07	11/01/07	07/06/15	07/12/15
28	11/02/07	11/08/07	07/13/15	07/19/15
29	11/09/07	11/15/07	07/20/15	07/26/15
30	11/16/07	11/22/07	07/27/15	08/02/15
31	11/23/07	11/29/07	08/03/15	08/09/15
32	11/30/07	12/06/07	08/10/15	08/16/15
33	12/07/07	12/13/07	08/17/15	08/23/15
34	12/14/07	12/20/07	08/24/15	08/30/15
35	12/21/07	12/27/07	08/31/15	09/06/15
36	12/28/07	01/03/08	09/07/15	09/13/15
37	01/04/08	01/10/08	09/14/15	09/20/15
38	01/11/08	01/17/08	09/21/15	09/27/15
39	01/18/08	01/24/08	09/28/15	10/04/15
40	01/25/08	01/31/08	10/05/15	10/11/15
41	02/01/08	02/07/08	10/12/15	10/18/15
42	02/08/08	02/14/08	10/19/15	10/25/15
43	02/15/08	02/21/08	10/26/15	11/01/15
44	02/22/08	02/28/08	11/02/15	11/08/15
45	02/29/08	03/06/08	11/09/15	11/15/15

46	03/07/08	03/13/08	11/16/15	11/22/15
47	03/14/08	03/20/08	11/23/15	11/29/15
48	03/21/08	03/27/08	11/30/15	12/06/15
49	03/28/08	04/03/08	12/07/15	12/13/15
50	04/04/08	04/10/08	12/14/15	12/20/15
51	04/11/08	04/17/08	12/21/15	12/27/15
52	04/18/08	04/24/08	12/28/15	01/03/16

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 (<i>antigens</i>). 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 <i>Plasmodium falciparum</i> 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 <i>radical cure</i> and <i>suppressive cure/treatment</i> .
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. Endophilism facilitates the blocking of malaria transmission through the application of residual insecticides to walls.
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. Residual insecticides in buildings are less effective at controlling exophilic mosquitoes.
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 <i>Plasmodium falciparum</i> are typically banana or crescent-shaped (from the Latin <i>falcis</i> = sickle).
Hypnozoite	Dormant form of malaria parasites found in liver cells. Hypnozoites occur only with <i>Plasmodium vivax</i> and <i>P. ovale</i> . 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 malariatherapy).
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, <i>a parasitemia of 2 percent</i>).
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: <i>Plasmodium falciparum</i> , <i>Plasmodium vivax</i> , <i>Plasmodium ovale</i> , and <i>Plasmodium malariae</i> .
Presumptive treatment	Treatment of clinically suspected cases without, or prior to, results from confirmatory laboratory tests.
Prophylaxis	See <i>chemoprophylaxis</i> .
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 <i>Plasmodium vivax</i> and <i>P. ovale</i> .
Recrudescence	A repeated attack of malaria (short-term relapse or delayed), due to the survival of malaria parasites in red blood cells. <i>Radical treatment</i> : see <i>radical cure</i> .
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 <i>Plasmodium vivax</i> and <i>P. ovale</i> .
Residual insecticide spraying	SS praying insecticides that have residual efficacy (that continue to affect mosquitoes for several months) 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 exo-erythrocytic 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 <i>rings</i> or <i>ring stage parasites</i>); 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.

References

- Abose T, Ye-ebiyo Y, Olana D, Alamirew D, Beyene Y, Regassa L** (1998) Re-orientation and definition of the role of malaria vector control in Ethiopia, WHO/MAL/98.1085 World Health Organization.
- Ameneshewa B, Service MW** (1996), Resting habits of *Anopheles arabiensis* in the Awash River valley of Ethiopia. *Ann Trop Med Parasitol* 90:515-521.
- Anonymous.** Intravenous artesunate document:
<http://www.penjing.com/~axu/trihealth2000/productInfo/Artesunate%20for%20Injection.htm>
- Anonymous.** Rectal artesunate document:
[http://www.mepha.com/Documents/Products/plasmotrim-factsheet060913%20rev%20%20July%2008%20\(2\).pdf](http://www.mepha.com/Documents/Products/plasmotrim-factsheet060913%20rev%20%20July%2008%20(2).pdf)
- Centers for Disease Control.** Traveler's health, yellow book available at www.cdc.gov.
- Clarke SE, Bøgh C, Brown RC, Walraven GEL, Thomas CJ, Lindsay SW** (2002) Risk of malaria attacks in Gambian children is greater away from malaria vector breeding sites. *Trans R Soc Trop Med Hyg* 96: 499–506.
- Costantini C, Li SG, DellaTorre A, Sagnon N, Coluzzi M, Taylor CE** (1996) Density, survival and dispersal of *Anopheles gambiae* complex mosquitoes in a West African Sudan savannah village. *Med Vet Entomol* 10: 203–219.
- Federal Democratic Republic of Ethiopia Ministry of Health** (1999) Guidelines for malaria epidemic prevention and control in Ethiopia.
- Federal Democratic Republic of Ethiopia Ministry of Health** (2004) Insecticide treated nets: National Strategic Plan for Going to Scale with Coverage and Utilization in Ethiopia 2004 - 2007.
- Federal Democratic Republic of Ethiopia Ministry of Health** (2004) Malaria Prevention and Control Extension Package.
- Federal Democratic Republic of Ethiopia Ministry of Health** (2004) Malaria diagnosis and treatment guidelines for health workers in Ethiopia. Second. Edition.
- Federal Democratic Republic of Ethiopia Ministry of Health** (2007) Entomological profile of malaria in Ethiopia.
- Federal Democratic Republic of Ethiopia Ministry of Health** (2007) Guideline for Indoor Residual House Spraying.
- Federal Democratic Republic of Ethiopia Ministry of Health** (2008) Ethiopia National Malaria Indicator Survey 2007.
- Fontaine ER, Abdallah NE, Prince SJ** (1961) The 1958 malaria epidemic in Ethiopia, *Am. Journal of Trop. Med and Hyg.* 10: 795-803.
- Killeen GF, Knols B, Gu W** (2003) Taking malaria transmission out of the bottle: implications of mosquito dispersal for vector control interventions *Lancet Infect Dis* 3: 297–303.
- Ghebreyesus TA, Mitiku H, Written KH, Getachew A, Mekonnen Y, Lindsay SW, Byass P** (2000), Household risk factors for malaria among children in the Ethiopian highlands. *Trans R Soc Trop Med Hyg.* 94:17-21.
- Gimnig J, Ombok M, Kamau L, Hawley W** (2001) Characteristics of larval anopheline (Diptera: Culicidae) habitats in Western Kenya. *J. Med. Entomol.* 38: 282-288.
- Gish O** (1992) Malarial Eradication and the selective approach to health care: some lessons from Ethiopia. *Int J Hlth Services* 22: 179-192.
- Grillet ME** (2010) Mosquito-borne pathogen transmission exhibits spatial-temporal variability caused at different scales. *Am. J. Trop. Med. Hyg.* 82: 194-201.

-
- Karch S, Manzambi ZA, Salaun JJ** (1991) Field trials with Vectolex (*Bacillus sphaericus*) and Vectobac (*Bacillus thuringiensis* (H-14)) against *Anopheles gambiae* and *Culex quinquefasciatus* breeding in Zaire. *J Am Mosq Control Assoc.* 7:176-9.
- Lulu M, Nigatu W, Gezahegn T, Tilahun D** (1991). Inversion Polymorphisms in *Anopheles arabiensis* (patton) in five selected localities from east south and Southwest Ethiopia, *Insect Sc. Applic.* 12: 375-378.
- Manga L, Fondjo E, Carnevale P, Robert V** (1993) Importance of low dispersion of *Anopheles gambiae* (Diptera: Culicidae) on malaria transmission in hilly towns in south Cameroon. *J Med Entomol.* 30:936-8.
- Midega JT** (2007) Estimating Dispersal and Survival of *Anopheles gambiae* and *Anopheles funestus* Along the Kenyan Coast by Using Mark–Release–Recapture Methods. *J Med Entomol.* 44: 923-929.
- Mutuku FM, Alaii JA, Bayoh MN, Gimnig JE, Vulule JM, Walker ED, Kabiru E, Hawley WA** (2006) Distribution, description, and local knowledge of larval habitats of *Anopheles gambiae* s.l. in a village in western Kenya. *Am J Trop Med Hyg.* 74: 44-53.
- Muturi, J., Mwangangi, J., Shililu, J., Jacob, Benjamin, Mbogo, C., Githure, J., Novak, R** (2008) Environmental factors associated with the distribution of *Anopheles arabiensis* and *Culex quinquefasciatus* in a rice agro-ecosystem in Mwea, Kenya. *J Vector Ecol* 33: 56 -63.
- Odiere M, Bayoh MN, Gimnig J, Vulule J, Irungu L, Walker E** (2007) Sampling outdoor, resting *Anopheles gambiae* and other mosquitoes (Diptera: Culicidae) in western Kenya with clay pots. *J Med Entomol.* 44:14-22.
- Peterson I, Borrell LN, El-Sadr W, Teklehaimanot A** (2009) Individual and household level factors associated with malaria incidence in a highland region of Ethiopia: a multilevel analysis. *Am J Trop Med Hyg.* 80: 103-11.
- Peterson I, Borrell LN, El-Sadr W, Teklehaimanot A** (2009) A temporal-spatial analysis of malaria transmission in Adama, Ethiopia. *Am J Trop Med Hyg.* 81:944-9.
- Service MW** (1997). Mosquito (Diptera: Culicidae) dispersal—the long and short of it. *J Med Entomol* 34: 579–588.
- Shililu J, Tewolde S, Fessahaye S, Mengistu H, Fekadu Z, Mehari G, Asmelash D, Sintasath G, Bretas C, Mbogo J, Githure E, Brantly E, Novak R, Beier J** (2003) Larval habitat diversity and ecology of anopheline larvae in Eritrea. *J. Med. Entomol.* 40: 921-929.
- Solomon T, Yeshambel B, Teklu T, Mengesha T, Petros B** (2011) Malaria prevalence pattern observed in the highland fringe of Butajira, Southern Ethiopia: a longitudinal study from parasitological and entomological survey *Malaria J* 10:153
- Thomson MC, Connor SJ, Quinones ML, Jawara M, Todd J, Greenwood BM** (1995) Movement of *Anopheles gambiae* s.l. malaria vectors between villages in The Gambia. *Med Vet Entomol* 9: 413–419.
- Tirados I, Costantini C, Gibson G, Torr SJ** (2006) Blood-feeding behavior of the malaria mosquito *Anopheles arabiensis*: implications for vector control. *Med Vet Entomol* 20: 425-437.
- Trape JF, Zoulani A** (1987) Malaria and urbanization in central Africa: the example of Brazzaville. Part III: Relationships between urbanization and the intensity of malaria transmission. *Trans R Soc Trop Med Hyg.* 81 (Suppl 2):19-25.
- Warell D, Gilles H.** Essential malariology. Fourth Edition.
- World Health Organization** (2007) Implementation of indoor residual spraying of insecticides for malaria control in the WHO Afro region report, WHO Africa.
- World Health Organization** (2010) Guidelines for treatment of malaria, second edition. http://whqlibdoc.who.int/publications/2010/9789241547925_eng.pdf available at <http://www.who.int/malaria/en/>

World Health Organization (2002) Diagnosis and management of severe falciparum malaria, learner's guide.