

Malaria: A public health challenge

Malaria is one of the most important public health problems. At the time of Independence, 75 million people were estimated to suffer from the disease annually and Malaria was one of the most important impediments to progress. Control of malaria in India, no doubt triggered the Green Revolution in the 1960s.

Over the years, with the efforts of the Government of India and State Governments, the incidence of malaria has been brought down to below 2 million and deaths around 1000 in 2005 from very high levels in the past. The most affected areas are North Eastern states, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Andhra Pradesh, Maharashtra, Gujarat and Rajasthan, West Bengal and Karnataka, reporting about 80% of malaria cases and deaths. However, other states are also vulnerable and have local and focal outbreaks.

Malaria is a seasonal disease. The warm climate in the country offers congenial conditions for malaria transmission, which mostly occurs in remote and rural areas, forests, hills and developmental project sites. Control of malaria is complex because of multiple mosquito breeding places and environmental conditions such as rain, temperature, humidity etc.

Malaria: Vector borne disease

Malaria is a parasitic disease, caused by species of the protozoan genus *Plasmodium* and transmitted from man to man through the bite of the female *Anopheles* mosquito. There are four generally recognized species of malaria parasites of humans. These are *Plasmodium vivax*, *Plasmodium falciparum*, *Plasmodium malariae* and *Plasmodium ovale*. Of the four human malaria parasites, *Plasmodium falciparum* is the most dangerous on account of its tendency to cause cerebral malaria. In India, two species are commonly found, namely *Plasmodium vivax* and *Plasmodium falciparum*. *Plasmodium malariae*, once commonly reported from some states, is no longer reported.

Malaria vector *Anopheles*



Fig 1: *Anopheles* mosquito

There are several hundred species of *Anopheles* in the world, but only a few are able to transmit malaria. *Anopheles* mosquitoes are found throughout the world. They seek blood meals of humans or animals because blood contains nutrients which are needed for the maturation of their eggs. After a blood meal, the *Anopheles* mosquitoes, rest in a cool, shaded, dark place, till the eggs mature. They rest in the human and animal shelters. They lay their eggs, in clean, stagnant water. The rainy season provides a lot of breeding sites.

The life cycle of the anopheline mosquitoes comprises of four stages namely egg, larva, pupa and adult. The adult stage is terrestrial (living on the earth/pond) and the other three stages are aquatic (living in the water).

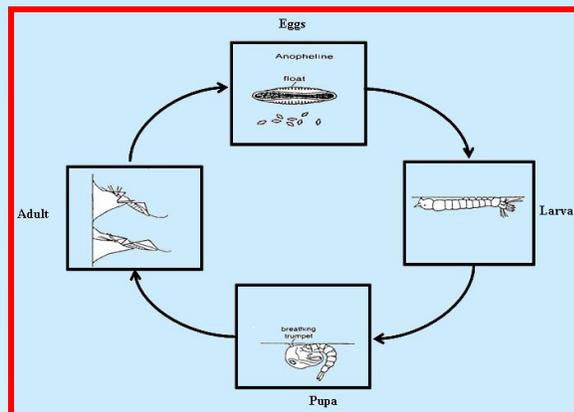


Fig 2: Life cycle of an *Anopheles mosquito*

Under optimal conditions, the egg stage lasts for 24-48 hours; the larval stages from five to seven days while pupal stage lasts for 24 to 48 hours. Thus the life cycle of anopheline mosquito may be completed within seven to ten days. The female usually mates only once and lays eggs at 2-3 days interval throughout its life.

After emergence, the adult *anopheline* mosquitoes either take shelter in the adjoining vegetations or fly away to the nearest human dwellings or cattle sheds. Most of the vectors, including *Anopheles culicifacies*, start biting soon after dusk (evening). Therefore, biting starts much earlier in winter than in summer but the peak time varies from species to species.

Only 9 species of *Anopheles* mosquitoes in India transmit malaria in different areas of the country. These are as follows –

Anopheles culicifacies - Breeds in rainwater pools and puddles, borrow-pits, river bed pools, irrigation channels, seepages, rice fields, wells. Found in whole of peninsular and north-west India and responsible for outbreaks and epidemics of malaria.

Anopheles fluviatilis - Breeds in slow running streams, seepages, irrigation channels, rice fields, shallow wells. Found in foothills throughout India.

Anopheles minimus - Breeds in shaded slow flowing streams with grassy margins, swamps, ditches, channels. Major vector in North-eastern states and North West Bengal.

Anopheles philippinensis - Breeds in tanks, swamps, ditches, rice fields, pools, inundated drains, water bodies with generally good growth of vegetation. Secondary vector in Deltaic West Bengal and North-eastern states.

Anopheles dirus - Breeds in forest pools, rain water collections in forest and forest fringes. Found in North-eastern states.

Anopheles stephensi - Breeds in stored water in wells, overhead and ground level water tanks, cisterns, rainwater collections in roof gutters, peridomestic containers, and underground water storage tanks, 'Tankas'. Found in Rajasthan desert and also urban malaria vector throughout India and the North-east. Malaria vector in towns and cities.

Anopheles annularis - Breeds in still water with abundant vegetation in a variety of water bodies: wells, moats, tanks, borrow-pits, rice fields, lakes and stream margins. Secondary vector in Orissa, Jharkhand and West Bengal.

Anopheles varuna - Breeds in rain water pools, ponds, irrigation channels, wells and slow moving streams with plenty of shade, tanks, rice fields, drains. Secondary vector in Andhra Pradesh, Jharkhand &

Orissa.

Anopheles sundaicus - Breeds in brackish (slightly salty) water pools with algae, margins of mangroves, lagoons and swamps. Malaria vector in Andaman and Nicobar islands.

Fig 3: Potential Breeding Sites for *Anopheles* mosquitoes



Transmission of Malaria

Life cycle of the malaria parasite has two phases; development and multiplication in the human host & development and multiplication in the female *Anopheles* mosquito.

Mosquito cycle (sporogony)

The mosquito becomes infected with malaria parasite when it bites a person whose blood contains the sexual forms of the parasite called gametocytes. (See Fig. below) Female gametocytes are called macro-gametocytes, and male gametocytes are called micro-gametocytes. In the mosquito midgut, the

male & female gametocytes mature into male and female gametes. Fertilisation of the female gamete by male gametes results in a motile zygote called ookinete which migrates to the gut wall and develops into a body called the oocyst. Asexual division within the oocyst yields as many as 10,000 elongated, spindle shaped motile stage called the sporozoites, which accumulate in the salivary glands of mosquito. When the infected female *Anopheles* takes its next bloodmeal from a human host, the sporozoites are inoculated into the blood stream of the human host, invading the parenchymal cells of the liver where they develop into exo-erythrocytic schizonts.

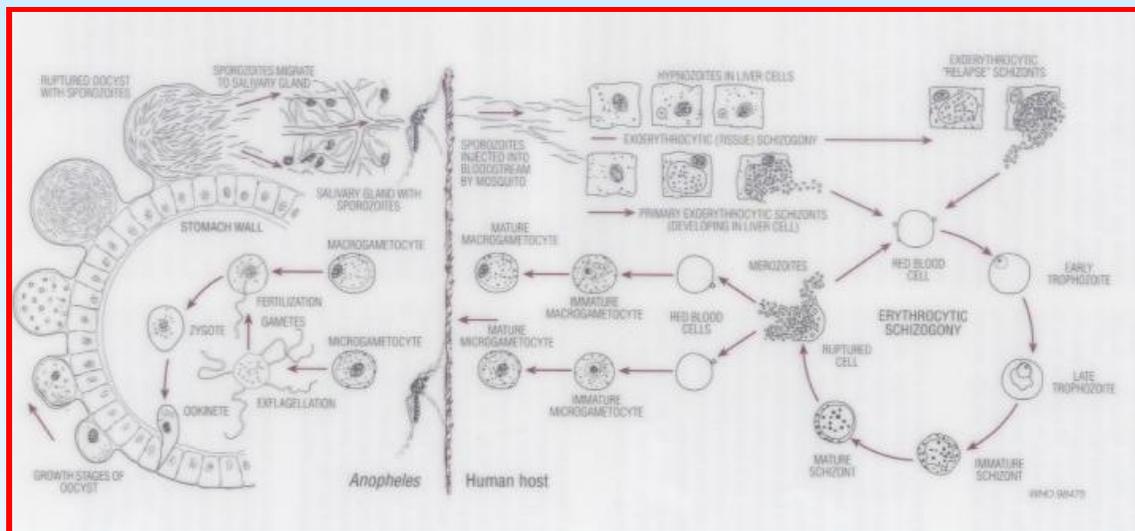


Fig 4: Transmission of Malaria

Human Cycle

A multiplication phase follows, usually lasting between 5 and 15 days depending on the species of *Plasmodium*. At the end of this time, the mature schizont bursts, releasing thousands of *merozoites*, (up to 30 000 in the case of *P.falciparum*) into the bloodstream. In *P. vivax*, however some sporozoites do not immediately develop into schizonts, they remain dormant in liver cells for months. These dormant forms are called hypnozoites. Their later development is responsible for the relapses seen in *P. vivax* infections. Since *P.falciparum* does not produce hypnozoites, they do not cause relapses.

In the bloodstream, merozoites invade the red blood cells, where haemoglobin provides nutrition for their development into trophozoites; young trophozoites are known as ring forms because of their shape. Trophozoites develop into schizonts during this erythrocytic (red blood cell) phase. Reproduction at this stage is by asexual division is called erythrocytic schizogony. After several divisions each mature schizont commonly contains 6-24 merozoites. Rupture of the infected red blood cells liberates the merozoites into the bloodstream, where they further infect red cells and begin a new erythrocytic cycle. The repetition of this cycle results in increasing parasitaemia. After several rounds of erythrocytic schizogony, some of the merozoites differentiate into micro- gametocytes and macro- gametocytes which, when ingested by the female mosquito during a bloodmeal, give rise to a fresh cycle of malaria transmission.

Factors contributing to Malaria transmission

- Human factors like expansion of areas under human habitation, particularly encroachment upon forests; population migration
- Radical changes in ecology and land use pattern caused by exploitation of natural resources
 Effect of climatic changes like excess rainfall creating mosquito breeding potential for considerable periods or deficient rainfall leading to water scarcity and increased water storage providing mosquito breeding grounds
- Development of drug resistance in parasite and insecticide resistance among vectors

Symptoms of Malaria

The most common symptom of malaria is fever. Malaria causes an acute febrile illness which may be characterized by periodic bouts of shivering (paroxysms), occurring every 48-72 hours.

The fever is usually accompanied with **fever spikes (sudden rise and fall in temperature), chills and rigors** followed by sweating.



Fig 5: Patient showing symptoms of malaria

Danger Signs of severe Malaria

Sometimes, the disease can become serious and the patient's life may be in danger if the following symptoms appear -

- High fever, change in behaviour (convulsion (fits); unconsciousness; drowsiness; confusion; inability to walk, sit, speak or recognize people's identity.
- Repeated vomiting, inability to take oral medication, eat or drink.
- Passage of small quantity of urine or no urine or black urine.
- Severe diarrhoea and dehydration (sudden weight loss, loose skin, sunken eyes and dry mouth).
- Easy fatigue-ability due to anaemia (pale eyes & skin), fits/convulsions and loss of consciousness (as the parasite infects and destroys red blood cells).
- Unexplained heavy bleeding from nose, gums or other sites.
- Parasites are carried by blood to the brain (which causes cerebral malaria) and to other vital organs.

If the patient shows any of the above signs, the patient must be rushed to a hospital or the nearest clinic.

ASHA should educate the community for early recognition of the signs and symptoms of Malaria in order to receive prompt treatment



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Diagnosis of Malaria

The National Vector Borne Disease Control Programme promotes diagnosis based treatment. The diagnosis of malaria can be made by two methods – Microscopy and Rapid Diagnostic Test. All fever cases in the village should preferably be investigated for malaria by Microscopy or Rapid Diagnostic Test.

- **Blood smear examination/Microscopy** – Malaria parasite can be detected by the examination of a blood smear collected from the person suffering from fever. Under malaria microscopy, blood slide taken from a patient suffering from fever is examined under a microscope for presence of malaria parasite. This procedure is followed in areas where laboratory facilities are available.
- **Rapid Diagnostic Test (RDK)** – This is a simple test to detect malaria. This test is used in areas where laboratory facilities are not available. The results of the test are available instantly. Early diagnosis of malaria means that correct and complete treatment could be provided to the patients. As a public health measure, early and complete treatment helps in reducing the transmission of malaria. This test can be done by ASHA after receiving training from health workers.

Management of malaria case

- Clinical diagnosis of malaria on the basis of signs and symptoms
- Confirmation of malaria by Laboratory diagnosis/RDK;
- Referral to secondary/tertiary level of care, if necessary;
- Education of patient or family on :
 - (i) administration of the drugs
 - (ii) when to report to health facility
 - (iii) danger symptoms
 - (iv) prevention of malaria
- Dispensing the correct drugs of assured quality,
- Patient compliance as per instructions

Treatment of Malaria

Malaria is completely curable if correct treatment is started in time. The Directorate of National Vector Borne Disease Control Programme has recommended guidelines to be followed for malaria treatment. The first line of treatment is Chloroquine and the second line is ACT (Artesunate+Sulpha Pyrimethamine) combination.

Microscopically positive Pf cases should be treated with chloroquine in therapeutic dose of 25 mg/kg body weight over three days and single dose of Primaquine 0.75 mg/kg bw on the first day. This practice is to be followed at all levels including VHWs like FTDs/ASHA as well.

Microscopically positive Pv cases should be treated with chloroquine in full therapeutic dose of 25 mg/kg body weight over three days. This practice is to be followed at all levels including VHWs like FTDs/ASHA etc. Primaquine can be given in dose of 0.25mg/kg bw daily for 14 days under medical supervision only to prevent relapse.

PRIMAQUINE SHOULD NOT BE GIVEN TO INFANTS AND PREGNANT WOMEN

Do not neglect Malaria fever – it may be fatal



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Table: Chloroquine drug dosage chart

Chloroquine base	Day 1	10mg/kg (600 mg adult)
Chloroquine base	Day 2	10mg/kg (600 mg adult)
Chloroquine base	Day 3	5mg/kg (300 mg adult)

Dosage as per age groups

Age in years	Day 1	Day 2	Day -3
	Tab. Chloroquine	Tab. Chloroquine	Tab. Chloroquine
<1	1/2	1/2	1/4
1-4	1	1	1/2
5-8	2	2	1
8-14	3	3	1 1/2
>14	4	4	2

The Primaquine tablets are available in two strengths, 7.5 mg and 2.5 mg. The age-wise dosages are prescribed below accordingly.

Table: Primaquine drug dosage chart

Dosage as per age groups

(a) *P. falciparum*

Age in years	Day 1 Primaquine (7.5 mg base)	
	mg base	No. of Tablets
<1	Nil	0
1-4	7.5	1
5-8	15	2
8-14	30	4
>14	45	6

(b) *P. vivax*

Age in year	Primaquine 2.5 mg base	
	Daily dose for 14 days*	
	mg base	No. of Tablets
< 1	Nil	Nil
1-4	2.5	1
5-8	5.0	2
9-14	10.0	4
15 & Above	15.0	6

Primaquine for 14 days should be given under medical supervision only

In case of fever, get test done for Malaria...



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Fever cases positive by RDK should be treated according to the diagnosed species as described above. However, if RDK is used for Pf only, negative cases showing sign and symptom of malaria without any other obvious causes should be considered as ‘clinical malaria’ and treated with chloroquine in full therapeutic dose of 25 mg/kg body weight over three days.

In situations where diagnosis by microscopy or RDK is not possible, cases showing sign and symptom of malaria without any other obvious causes should be considered as ‘clinical malaria’ and treated with chloroquine in full therapeutic dose of 25 mg/kg body weight over three days in low risk area while in high risk areas (Pf predominant areas) single dose of Primaquine 0.75 mg/kg bw should also be given on the first day. This practice is to be followed at all levels including VHVs like FTDs/ASHA as well.

Chloroquine resistant areas

As per the Drug Policy, Chloroquine is the first line of treatment for malaria. So far, 262 PHCs in 20 States/UTs have been identified as Chloroquine resistant areas, where the Government of India has introduced new drug combination Artemisinin plus Sulfadoxine-Pyremethamine for treating Chloroquine resistant cases. The health worker of the area would be informing ASHA the drug of choice in a particular area.

ACT is the first line of antimalarial drug for treatment of *P.falciparum* in chloroquine resistant areas. The dose is 4mg/kg bw of artesunate daily for 3 days + 25mg/ kg bw of sulfadoxine/Sulfalene + 1.25 mg per kg bw of pyrimethamine on the first day. ACT should be given only to confirmed *P. falciparum* cases found positive by microscopy or Rapid Diagnostic kits. Compliance and full intake is to be ensured.

Table: Artesunate + Sulfa-pyremethamine (ACT) drug dosage chart

Age wise Dose Schedule for AS+SP

Age		1 st Day (number of tabs)* †	2 nd Day (number of tabs)	3 rd Day (numbers of tabs)
<1 Year	AS	½	½	½
	SP	¼	Nil	Nil
1-4 Yeas	AS	1	1	1
	SP	1	Nil	Nil
5-8 Year	AS	2	2	2
	SP	1 ½	Nil	Nil
9-14 Year	AS	3	3	3
	SP	2	Nil	Nil
15 and above	AS	4	4	4
	SP	3	Nil	Nil

* Tablet strength : Artesunate : 50 mg; SP : Sulfa 500mg; Pyremethamine : 25mg

Artesunate and SP Combination treatment is not recommended in pregnancy

Prompt treatment of Malaria saves lives



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Complete Treatment

- ASHA should ensure that if a patient is diagnosed positive for malaria, he/she takes full course of treatment.
- The anti-malarial drugs are not to be taken on an empty stomach.
- She must advise the community that diagnosis and treatment is available free of cost in the village.
- She must also advise individuals against taking self prescribed medicines for malaria.
- ASHA must encourage the community to avail the services of Fever Treatment Depots (FTDs) who provide anti-malarial drugs to the community at the village level, thereby increasing access and coverage.

Severe and complicated malaria cases

In a small number of patients suffering from malaria, complications can develop, which sometimes prove to be life threatening. Complications in *falciparum* malaria are particularly to be taken care of. This type of malaria may affect the brain. Treatment is effective if it is started early. If the patients show any of the signs as described above, ASHA must ensure prompt identification and referral so that while undertaking field visits if she comes across such a case, she can refer it quickly to an appropriate health facility/hospital.

In order to prevent complications and deaths due to malaria it is important that ASHA also provides education to the community for recognition of these signs and symptoms of severe malaria so that timely referral could be made and precious lives saved.

**ASHA should educate the community
that prompt treatment of malaria
reduces the duration of disease
and its harmful effects on the human body**

Role of Accredited Social Health Activist (ASHA)

ASHA would be a service cum information kiosk for the people living in rural areas.

ASHA, the service provider -

Conducting fever surveillance and timely reporting – Malaria is a disease associated with high fever, chills with rigors, headache, vomiting and other flu like symptoms. ASHA would conduct door-to-door fever surveillance activity on a weekly basis and report any occurrence of fever to the ANM/ health workers as well as the Medical Officer, Sector PHC.

While malaria control activities require to be undertaken round the year, owing to the seasonality in incidence of malaria, special emphasis should be given during the high

Ensure complete treatment of Malaria

transmission season. In most parts of the country, the high transmission of malaria peaks coinciding with the onset of rains. Thus, ASHA would undertake community based fever alert surveillance and record fever cases in the village in the register provided. ASHA should also report any unusual increase in fever cases to the ANM/ health workers as well as the Medical Officer, Sector PHC.

Conducting Rapid Diagnostic Test for diagnosis of malaria – ASHA would be trained in the use of Rapid Diagnostic Test kits for malaria, a blood test on the person suffering from malaria symptoms to determine the presence of malaria.

Acting as Fever Treatment Depot – If the Rapid Diagnostic Test for malaria is positive, ASHA would make treatment available at the village level as a Fever Treatment Depot so that people get treatment at the earliest to prevent any complication and death. The worker will be imparted adequate training before assigning her the responsibility of a Fever Treatment Depot. ASHA must provide supervised treatment, if possible.

Motivating and encouraging Fever Treatment Depots - ASHA must encourage the community to avail the services of Fever Treatment Depots (FTDs) who provide anti-malarial drugs to the community at the village level, thereby increasing access and coverage.



She must also motivate people from the community; such as school teacher, hostel warden & functionaries of mobile dispensary/hospital to serve as FTDs.

Fig 6: NVBDCP signage displayed by a Fever Treatment Depot

She must explain to the Fever Treatment Depots (FTDs) about their roles and responsibilities, which would include preparing a blood slide, collection of slides by health workers of the areas and sending slides to the nearest PHC for slide examination by Laboratory Technician and initiation of treatment if the slides are positive, conducting Rapid Diagnostic Test for diagnosis of malaria and provision of anti-malarial treatment.

Referral of severe malaria cases to hospitals – If the disease becomes serious, and the patient suffers from symptoms of severe malaria as high fever with convulsions (fits), anaemia, severe dehydration, inability to stand or sit, ASHA would refer the patient to a hospital. Treatment is effective if it is started early.

Malaria outbreak situation – The role of ASHA in a malaria outbreak situation may be described as under –

- Provide paracetamol tablets to all fever cases in the following dosage –

Age	Paracetamol Drug Dosage
1-2 years	60-120 mg
3-6 years	120 mg
7-12 years	240 mg
Adult	500 mg

Table: Paracetamol Drug Dosage Chart

Fever Treatment Depots provide anti-malarial drugs

- Informing the health workers of sub-centre about the upsurge in fever cases. ASHA must make telephonic calls in order to inform the ANM/ health workers as well as the Medical Officer, Sector PHC for taking appropriate action.
- Advising tepid water sponging for high fever, so that the temperature does not shoot up 39° Celsius or above. Advising not to use cold water as it causes shivers and keeping windows open.
- Advising the patient to take plenty of fluids/ fruit juice. The patient must be given enough water to drink. Soft meals like khichdi, daal-rice, curds, dalia are soft and easily digested are recommended for patients.
- ASHA should conduct Rapid Diagnostic Tests for detection of Pf malaria and provide appropriate treatment.

ASHA as an Information Kiosk -

Promotion of use of Insecticide Treated Nets (ITNs) - ASHA would be involved in identification of people living below the poverty line for distribution of free ITNs. ASHA would also be trained for retreatment of community owned ITNs and would educate the community to do the same. In particular, ASHA would also encourage pregnant mothers and children under five to use ITNs.



Fig 7: Pregnant mother and child using Insecticide treated net while sleeping

Malaria mosquitoes usually bite from sunset to sunrise. ITNs are especially effective for protecting pregnant women and young children as these are the vulnerable groups for complications of malaria. Malaria is particularly dangerous for young children and pregnant women. Mosquito nets provide much better protection if they are treated with insecticide. This insecticide is not harmful to people if used correctly, but it kills mosquitoes and keeps them away from the house. Treated nets also kill bed bugs and other insects.

ASHA should motivate the community to treat their bed nets with insecticides. She must also explain that since a single bite of an infected mosquito can lead to malaria, it is important that bed nets are used regularly. She must also monitor the regular use of bed nets by the community.

Indoor Residual Spraying (IRS) – To stop the transmission of malaria, it is very essential to control the mosquito populations. IRS is an important method for bringing down the mosquito population particularly prior to the high transmission season. Most malaria causing mosquitoes rest indoors after biting. When the mosquito comes in contact with the insecticide sprayed on the wall, it gets killed. Thus IRS involves spraying the inside of houses in selected areas with an appropriate insecticide in such a manner that the spray leaves a coating of insecticide on the walls of the room.



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depend on the area) on the walls and roofs of houses are conducted. ASHA would be engaged in increasing community acceptance of indoor residual spraying. ASHA must point out to the community that only the inside walls of the rooms should be sprayed and not the outside walls or places like the cattle shed, which would actually drive the mosquitoes inside the house and thereby cause more harm. She should inform the community that mud plastering after spray operations should not be done as it will mask the effect of DDT on mosquitoes.

Awareness Generation and Dissemination of information- ASHA would be providing information to the community pertaining to prevention and control of Malaria like elimination of breeding sites and the importance of early detection and complete treatment through Inter-personal communication.

**ASHA should encourage the community
to use
Insecticide treated nets while sleeping**

Use Insecticide treated nets while sleeping