



TRAINING MODULE FOR MEDICAL OFFICERS PRIMARY HEALTH CENTRE



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Directorate General of Health Services,
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SESSION – 1: INTRODUCTION AND OVERVIEW

1.1 : INTRODUCTION TO MALARIA PROBLEM IN INDIA

Distribution of malaria

- Malaria is endemic in more than 100 countries and about half the world's population live in areas of malaria transmission
- Extends up to 40° north and 40° south of equator
- Intense malaria transmission is in equatorial region
- On the fringes of its distribution malaria is usually unstable
- Incidence of malaria may vary from village to village, city to city and even in a city, from ward to ward.

Malarial Parasites in India

In India two types of plasmodia are responsible for most human malaria.–They are *Plasmodium vivax* (*P. vivax*) and *Plasmodium falciparum* (*P. falciparum*). There are two other plasmodia (*Plasmodium malariae* and *Plasmodium ovale*) that cause malaria in humans, but they are rare and of practicably no public health importance in India. *P. malariae* is responsible for less than 1 % of malaria cases in India and *P. ovale* malaria does not occur in India. *P.falciparum* is the variety which is responsible for almost all the deaths due to malaria. *P. vivax* causes debilitating illness, but vivax malaria is rarely fatal, unless accompanied by some other problem like malnutrition. In many states of India, particularly the North Eastern states, Orissa and Chhattisgarh, a very high proportion of malaria cases are due to *P. falciparum*.

Malaria estimates in Pre-control era

- It was estimated in 1947 that out of a population of 340 million in the country, annual malaria incidence was 75 million (nearly 22% of population) with 0.8 million deaths
- The morbidity and mortality rates used to increase to double in epidemic years
- Epidemics were recorded at an interval of 5 to 7 years
- Economic loss due to malaria to the nation was estimated at Rs. 7500 crores annually in 1940 (Rupee value of the reporting year)

Milestones in malaria control measures in India

1945 - DDT brought into civilian use for the first time. Systematic studies with different dosage of DDT were taken up.

1952 - A population of about 30 million was being protected with residual insecticidal spray under various projects.

1953 - National Malaria Control Programme (NMCP) launched

- 1957 - Programme expanded every year and a population of 165.57 million was effectively protected.
- 1958 - Encouraged by the success of NMCP, the Government of India changed the strategy from control to eradication and the National Malaria Eradication Programme (NMEP) was launched.
- 1961 - Epidemiological surveillance initiated.
- 1962 - Many areas entered into consolidation and maintenance phases after annual independent appraisals by international teams.
- 1966 - 50% areas of the country from where malaria was practically eradicated entered into maintenance phase on fulfilling technical criteria. The vertical organization of NMEP was withdrawn and public health services were made responsible for maintaining malaria free status.
- 1968 - Due to extensive malaria outbreaks in consolidation and maintenance phases, a population of 91 million was reverted back to attack Phase for regular spray.
- 1977 - Modified Plan of Operation implemented with change in strategy from eradication to containment. *P.falciparum* Containment Programme (PfCP) was added to NMEP.
- 1995 - Accelerated Malaria Action Programme (MAP) was taken up in high risk areas.

National Malaria Control Programme (NMCP)

Launched in April 1953

Objectives

- To bring down malaria transmission to a level where it ceases to be a major problem.
- Thereafter, transmission will be held down.

Strategy

- Residual insecticidal spray.
- Malaria control teams to survey and monitor incidence.
- No organized chemotherapy but drug made available on demand.

Achievements

Population of 165.57 million covered in 5 years from 1953 to 1958.

Reductions achieved in:

- Child spleen rate - 73%
- Child parasite rate - 79%
- Infant parasite rate - 62%

National Malaria Eradication Programme (NMEP)

The Sixth WHO Expert committee defined malaria eradication in 1956 as the ending of the transmission of malaria and the elimination of the reservoir of infective cases in a campaign limited in time and carried to such a degree of perfection that when it comes to an end there is no resumption of transmission. Encouraged by the stupendous achievements of the National Malaria Control Programme (NMCP) in India, the programme was converted to National Malaria Eradication Programme (NMEP) in 1958.

Phases

1. Preparatory phase
 - Limited survey
 - Planning of project
 - Preliminary operations
2. Attack phase
 - Residual insecticidal spray
 - Introduction of surveillance
3. Consolidation phase
 - Surveillance operations
 - Focal spray
 - Epidemiological investigations
4. Maintenance phase
 - Area handed over to General Health Services.

Modified Plan of Operation (MPO)

Implementation from April 1977

Objectives

- Prevention of deaths due to malaria
- Reduction of morbidity due to malaria
- Maintenance of industrial and green revolutions due to freedom from malaria, as well as retention of achievements gained so far.

Important changes

- State malariologists made overall in charge of the programme
- Zonal teams created with entomological component
- District Malaria Officer's post created with direct responsibility for spray
- Spray staff provided on the basis of size of population
- MO-PHC made responsible for malaria work in PHC and MPW for surveillance
- Phasing of programme abolished
- Areas with 2 API and above to receive regular rounds of spray; other areas to receive focal spray
- DDCs/FTDs introduced

Table 1.1: Malaria problem in India: Pre-eradication and thereafter

Year	Population (in Million)	No. of Malaria Cases (in Million)	Per cent reduction in cases since 1947	Percentage of Population with Malaria	Number of Deaths
1947 (estimate)	344.1	75.0	-	21.80	8,00,000
1965	466.0	0.1	99.9	0.02	Nil
1976	575.0	6.4	91.5	1.11	59
1984	710.0	2.18	97.0	0.30	247
1994	879.0	2.38	96.8	0.27	1208*
2006	1089.8	1.48	98.0	0.14	1708*

*Due to epidemics in different states.

Malaria in the 1990s, presented new features which were not commonly seen before, namely, vector resistance to insecticides; pronounced exophilic behaviour of vectors; extensive breeding sites created by development projects, urbanization and industrialization; change in parasite equation in favour of *P. falciparum* and resistance of *P. falciparum* to chloroquine and other antimalarial drugs. Since 1994, focal outbreaks have been reported from different parts of the country.

At present, every year around 90 to 110 million patients with fever are screened for malaria through blood slides, of which around 1.5 to 2.0 million are positive for malaria parasite. Around 50% of these cases are *Plasmodium falciparum* which is known to cause complications and deaths.

Though the average national API had come down, it varies from one state to another. Additional inputs are being provided by the National Vector Borne Diseases Control Programme (NVBDCP) to high endemic districts of malaria. The seven north-eastern states are supported by 100% central assistance for malaria control activities. In addition, the Enhanced Malaria Control Project (EMCP) with World Bank assistance was implemented during 1997-2005 in 100 districts of eight states, which had a high malaria incidence and at least 25% tribal population. The Intensified Malaria Control Programme (IMCP) funded by Global Fund for the Fight against HIV/AIDS, Tuberculosis and Malaria (GFATM) is in operation since 2006 in 10 states and 106 districts. A World Bank assisted National Vector Borne Diseases Control Project is being implemented in 93 districts during the period 2009-14.

Presently malaria situation remains a major problem in certain states and geographical pockets. Majority of malaria cases and deaths are being reported from Orissa, the seven North Eastern states, Jharkhand, Chattisgarh, Madhya Pradesh and Rajasthan. It must be stressed here that while malaria has been brought under control in many parts of the country, ecological and geographical conditions favorable for spread of malaria however remain. Therefore it is important not to lower the guard against malaria in these areas and control activities must continue in these areas.

1.2 : JOB RESPONSIBILITIES OF MO- PHC TOWARDS MALARIA CONTROL

The MO-PHC should be well trained and take keen interest in malaria control activities. To fulfill the duties under the primary health care system, he should carry out the following activities:

Early diagnosis and complete, prompt and effective treatment

- To select FTDs for the PHC area in consultation with District Malaria Officer and the community.
- To make a fortnightly calendar for house-to-house visit of MPW (Male) in consultation with DMO.
- To refer all fever cases to malaria laboratory for blood smear collection and examination before giving final prescription/medicines.
- He will ensure that the laboratory technicians maintain lab registers and also other charts and graphs showing subcentre-wise and passive agency-wise blood smear collection, examination and positive cases.
- To ensure/supervise that all positive cases get treatment as per drug policy within 24 hours of examination.
- To ensure sufficient stocks of RDTs and antimalarials in PHC and periphery.
- To analyze data for action and prediction of outbreak and also assist in epidemiological investigation based on weekly fever surveillance report.
- To provide referral services to severe cases of malaria to district hospital / other referral hospitals and to arrange for their transportation.
- To monitor drug failure in malaria cases (failure of response to chloroquine) and inform the District and State Headquarters immediately.
- To ensure that records of clinically diagnosed cases are maintained.
- To undertake trainings of HS/ MPW/ ASHA in the PHC area.

Integrated vector control

- To ensure that the spray operations are conducted as per schedule and in case of any delay, he will find out the reasons and reschedule the programme.
- To assist the DMO/ DVBDSCO in preparation of supervisory plan for the PHC area.
- To solve and bottlenecks in spray operations in his area such as turnover of seasonal spray men (field workers), insecticide supplies, shifting of camps, etc.
- To ensure that reports are sent in time.
- To contact DMO immediately in case of delay/suspension of spray programme and solve the problems.
- To inspect spray operations, during field visits, at least once a week.

Supportive Supervision

- Visit all PHCs and microscopy centres in the area of Block PHC once a month and monitor sentinel sites once a month. He should try to visit all Subcentres once in 2-3 months. During visit to subcentres, he should visit remote villages and interview ASHA and 2 patients treated by every ASHA in the last one month (checked from her records)

- During supervision of all Malaria Clinics and PHC laboratory in his area, see the quality of blood smear collection, staining, efficiency of microscopic examination and check whether the stain is filtered daily, look into the condition of microscope and other equipment, stains, glass slides, etc..
- While on tour, to verify that MPW (Male), MPW (Female) and ASHA carry out malaria case detection as laid down in the policy.

IEC/ BCC

- To plan for anti-malaria month with DMO/ DVBDSCO.
- To plan for IEC in the PHC area before spray operations, to improve their acceptance.

Recording & Reporting

- To ensure that records of all fever cases examined and found positive are maintained in the laboratory.
- To ensure that all MPWs submit the monthly subcentre report by 5th of the following month and that the monthly PHC report is submitted to the District by 7th of the following month.

SESSION – 2: MALARIOLOGY

2.1: EPIDEMIOLOGY OF MALARIA

Epidemiological factors

Agent factors (Parasite – *Plasmodium*)

- Three species prevalent in India
- *P.vivax* is the predominant species in India : 50 - 55%
- *P.falciparum* contributes about 40 - 45% of malaria cases
- *P.malariae* contributes less than 1% of malaria cases in India
- Sporogony longest in *P.malariae* and shortest in *P.vivax*.
- No relapses in *P.falciparum* and *P.malariae*
- Different strains of *P.vivax* show different relapsing patterns

Host factors

- Age: Parasitaemia in infancy, low initially and increases as maternally acquired immunity decreases.
- Sex: No influence on susceptibility or parasite density
- Pregnancy: Primigravidae have higher parasitaemia with *P.falciparum* and are at greater risk than multiparae
- Genetic factors
 - HbF and Thalassaemia seem to protect against malaria infection
 - Sickle cell trait: Relative protection against *P. falciparum* infection
- Human immune mechanism
 - Repeated exposure leads to immunity
 - Immunity is slow to develop but continues as long as parasitaemia is present
 - Immunity declines when the parasitaemia is cleared (naturally or by therapy) and usually disappears in 2 to 3 years
 - Immunity is species and strain specific
 - Immunity restricts production of gametocytes
 - Immunity diminishes fertilization in vector
 - Children have variable experience with malaria and are likely to suffer more.

Environmental factors

- Climate influences density, longevity and behaviour of vectors and duration of sporogony
- Rainfall influences the number of breeding places and their characteristics
- Type of soil, terrain and contours determine run-off rate of rain water and percolation into sub-soil stratum
- Role of impounding reservoirs, irrigation canals and seepage of water from canals
- High temperature and humidity:
 - Lower survival of mosquitoes
 - Affect blood meal frequency
 - Affect sporogony

- 70% humidity is ideal

Factors related to gametocytes affecting transmission dynamics

- Density and viability in circulation determine disease transmission
- Higher gametocytaemia in primary attack
- Gametocytes appear simultaneously with asexual stages in *P.vivax*, and are viable for 2 ½ to 4 days.
- In *P.falciparum* gametocytes appear 7 to 8 days later or more after asexual stages and are viable for a longer period.
- Higher gametocyte density in *P.falciparum* as compared to *P.vivax* and *P.malariae* at the same level of asexual parasitaemia.

Incubation interval and seasonal variation

- Incubation interval is the total period of extrinsic and intrinsic cycles
- *P.vivax*: 22 days; *P.falciparum* : 35 days
- Seasonal variations occur in incubation interval in unstable malaria
- *P.vivax* peak appears early in transmission season.
- *P.falciparum* peak appears later transmission season may be extended.
- Higher gametocytaemia in *P.falciparum*; higher vector infectivity and more sporozoites.

Vectorial factors

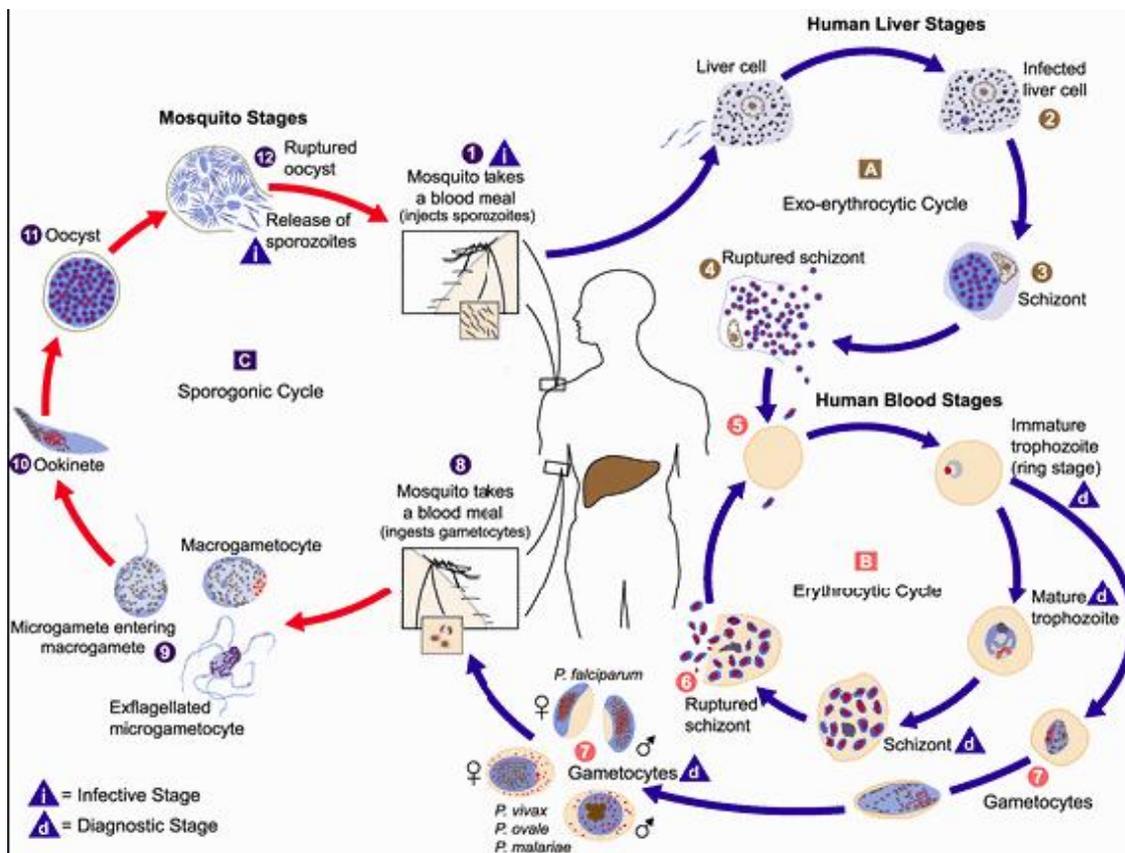
- Vector density
- Man biting rate
- Frequency of blood meal
- Time and place of man - mosquito contact
- Man - cattle ratio
- Flight range
- Vector's susceptibility to infection

2.2: MORPHOLOGY, LIFE CYCLE AND TRANSMISSION OF MALARIAL PARASITE

Life Cycle of the Malarial Parasite

The malarial parasite undergoes 2 cycles of development – the human cycle (asexual cycle) and the mosquito cycle (sexual cycle). Man is the intermediate host and mosquito the definitive host.

Figure 2.1. Life Cycle of *Plasmodium* species in man and the mosquito



Asexual cycle in human being

The asexual cycle begins when an infected anopheles mosquito bites a person and injects sporozoites. There are 3 phases in the human cycle.

Hepatic Phase

The sporozoites disappear within 60 minutes from the peripheral circulation. Many of them are destroyed by phagocytes, but some reach the liver cells. After 1-2 weeks of development (depending upon the species), they become hepatic schizonts, which eventually burst releasing a shower of merozoites. The number of merozoites produced from a single sporozoite varies – as many as 40,000 in *P. falciparum*, whereas only 200 – 15,000 in other species. In *P. falciparum*, the intrahepatic schizonts rupture almost simultaneously and there is no persistent tissue phase (exo-erythrocytic phase). In other species, the hepatic forms may remain dormant (hypnozoites) for long periods, liberating merozoites at various intervals, causing relapses of malaria.

Erythrocytic Phase

Many of the merozoites released from the liver cells are quickly destroyed, but a significant number attach themselves to specific receptor sites on the RBCs, penetrate them and pass through various stages of trophozoite and schizont. The erythrocytic phase ends with the liberation of merozoites, which infect fresh RBCs. The clinical feature of fever with chills coincides generally with the rupture of RBCs. The cycle is repeated over and over again until the condition worsens or when it may be slowed down by the immune response of the host. The duration of each erythrocytic cycle varies between species – 48 hours for *P. falciparum*, *P. vivax* and *P. ovale*; and 72 hours for *P. malariae*.

Gametogony

Some of the erythrocytic forms of plasmodia do not divide further but develop into male and female gametocytes. Not all infected persons are infectious (can infect anopheline mosquitoes). The blood of the person has to have mature male and female gametocytes and the density should be minimum 12/cumm of blood to be infective. These gametocytes take over a week to appear in the blood. Gametocytes do not cause any symptoms in humans. Most drugs like chloroquine kill the asexual forms that cause the fever but leave intact the sexual forms that are infective especially in case of *P. falciparum*. Thus an apparently normal person may harbour the disease and contribute to its spread.

- Gametogony is 2 - 6 times longer than schizogony
- Female to male gametocyte ratio is 3:5:1
- Gametocytes take 3 - 4 days for maturation
- Gametogony in *P. falciparum* in internal organs

Table 2.1: Differentiation of characteristics of *P. vivax* and *P. falciparum*

	<i>P. vivax</i>	<i>P. falciparum</i>
Exo-Erythrocytic Tissue Phase in Liver		
Pre-erythrocytic stage (days)	6-8	5 ½ -7
Pre-patent period (days)	11-13	9-10
Incubation period (days)	14 (12-17) or up to 6-12 months	12 (9-14)
Mean diameter of mature tissue schizont	45µ	60µ
No of merozoites in tissue schizont	10,000	30,000
Erythrocytic Schizogony		
Erythrocytic schizogony cycle(hours)	48	48
Parasitaemia per µl (cmm) Average	20,000	20,000 to 150,000
Parasitaemia per µl (cmm) Maximum	50,000	200,000
Primary attack	Mild to severe	Severe in non-immune
Febrile paroxysm (hours)	8-12	16-36 or longer
Period of recurrence	Variable	Short
Relapse	+	Nil
Duration of untreated infection (years)	1 ½ - 5	1 – 2
Microscopic differentiation		
<u>RBC</u>		
Size	Enlarged	Normal or small
Colour	Pale	Normal
<u>Parasite</u>		
Stages in peripheral blood	All stages	Rings and gametocytes
No. of parasites in RBC	Single; seldom more	Single or multiple
Size of Ring to Size of RBC	1/3	1/5
Stippling	Schuffner's dots	Maurer's dots
No. of merozoites per RBC	12-24	12-30
Pigment	Coarse, aggregated	Solid group granules

Spread of malaria

The plasmodia spread from person to person by the bite of mosquitoes. This process is called the transmission of the disease, and the mosquitoes are the vectors of malaria. However, not all mosquitoes can act as malaria vectors. It is only mosquitoes belonging to the genus *Anopheles* - and that too the female of the species which can carry the parasite and infect. Male *Anopheles* mosquitoes only feed on plant juices and nectar and cannot transmit malaria.

Sexual Cycle in Mosquito

The mosquito cycle (sporogony) begins when gametocytes are ingested by the vector mosquito while feeding on an infected person. The male gametocytes, after reaching the stomach of the mosquito and develop into 4-8 filaments called "microgametes". The female gametocyte undergoes maturation to become a "macrogamete". The microgametes get attracted to the macrogamete, and one of the

microgametes fertilizes the macrogamete. The resulting zygote is at first motionless, but within 18-24 hours, becomes a motile ookinete, which penetrates the stomach wall of the mosquito and develops into an oocyst on the outer surface of the stomach. The oocyst further develops into numerous sporozoites, when the oocyst ruptures and releases the sporozoites into the body cavity of the mosquito. Many of the sporozoites migrate to the salivary glands and the mosquito becomes infective to man. The period required for the development of the parasite from the gametocyte stage to sporozoite stage is about 10-20 days depending on atmospheric temperature and humidity. This period is known as the “extrinsic incubation period”. The sporozoites (the infective stage of *Plasmodium*) are injected with saliva when the mosquito next feeds.

In falciparum malaria, there may be involvement of the brain and coma in addition to life threatening complications including kidney or liver failure. With early and effective treatment, the case fatality rates in *P.falciparum* malaria can be brought down from above 5% to close to zero. Malaria cases can be classified according to the parasite species causing them and according to the severity of the disease, as either uncomplicated or severe malaria. It should be understood that severe vivax malaria is very rare.

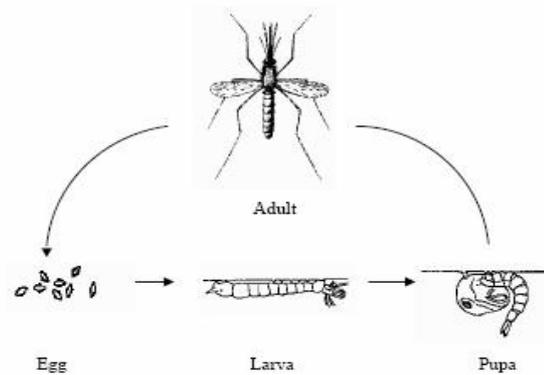
Sporogony time at 20 - 21°C

- *P.vivax* 14 - 16days (no development below 15 °C)
- *P.falciparum* 18 - 20days (no development below 17 °C)

Temperature over 32-34 °C inactivates the parasite

2.3: VECTOR MOSQUITOES AND THEIR BIONOMICS

Life cycle of anopheline mosquitoes



Eggs

The female anopheline mosquito requires a blood meal after mating for development of eggs. About 100-150 eggs are laid on the water surface during oviposition. The average lifespan of female anopheline mosquitoes is about 3-4 weeks.

Larva

The larvae hatch out from the eggs after about 1-2 days. There are four larval stages or instars. The total duration of larval stage is generally 8-10 days at normal tropical water temperatures. At lower temperatures, the aquatic stages take longer time to develop.

Pupa

The pupa is shaped like a comma and it is a non feeding stage. It stays under the surface and swims down when disturbed. The pupal stage lasts for two to three days after which the skin of the pupa splits. Then the adult mosquito emerges and rests temporarily on the water's surface until it is able to fly.

Adult

Mating takes place soon after the adult emerges from the pupa. The first batch of eggs develops after one or two blood meals, while successive batches usually require only one blood meal. After the mosquito takes a blood meal she usually rests for a short period. Mosquitoes that enter a house usually rest on a wall, under furniture or on clothes hanging in the house after they bite and are said to be endophilic. Mosquitoes that bite outside usually rest on plants, in tree holes, on the ground or in other cool dark places and are called exophilic. Mosquitoes which prefer human blood are known as anthropophilic while mosquitoes preferring animal blood are known as zoophilic. Clearly, those who prefer to take human blood are the most dangerous as they are more likely to transmit malaria from person to person.

Figure 3.1 Distinguishing features between anophelines from culicines

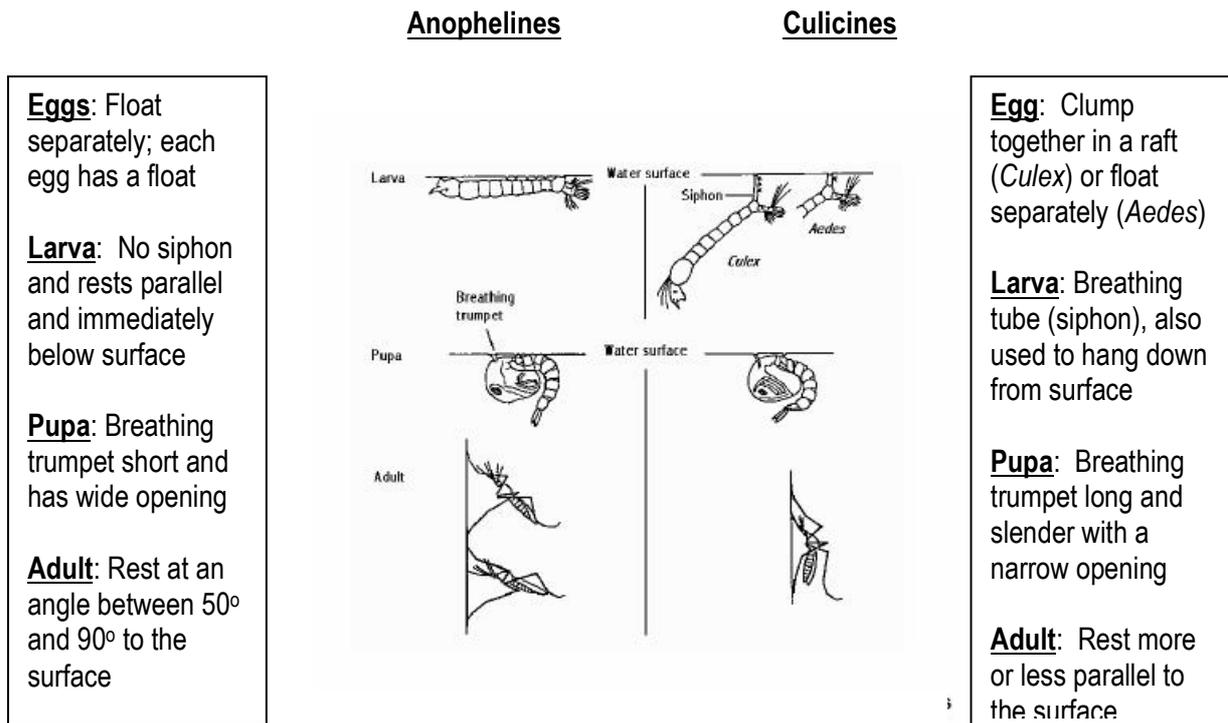
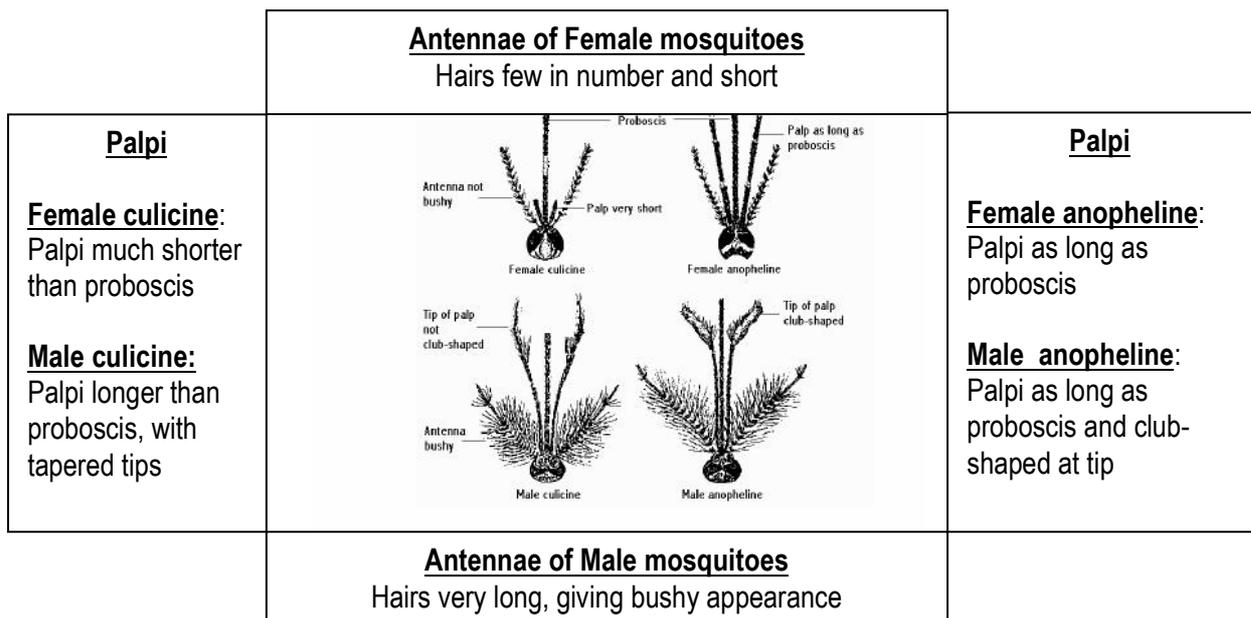


Figure 2: Distinguishing *Anopheles* females from males



Bionomics of vector species in India

Table 3.1 Bionomics of important malaria vector species in India

	<i>An.culicifacies</i>	<i>An. fluviatilis</i>
1. Distribution	J&K to Tamil Nadu, Rajasthan, Gujarat, West Bihar and West Bengal in the east, Karnataka, Goa, AP, UP, Orissa, Delhi, Haryana, MP, Maharashtra; uncommon in north-east	Southern States, Western India, Punjab, Delhi, J&K, H.P., U.P., Bihar and Orissa, A.P. Kerala, Tamil Nadu, Karnataka, W.Bengal, Gujarat, Rajasthan.
2. Larval habitat	Wide range: Usually breeds in water not rich in organic matter – Irrigation channels, river bed pools, tanks, ponds, sometimes in rice fields, irrigation wells, and even brackish water, hoof marks and cart tracks. (wheel ruts) rain water collection in borrow pits along rail canal & road, rock pools.	Clear water breeder, grassy margins of slow moving streams, seepages, irrigation channels, resorting to shallow wells in monsoon, terraced rice fields in Wynad of Kerala and contour drains.
3. Resting habitat	Predominantly indoor rester – cattle sheds and human dwellings. Prefer cool with low disturbance places. Some may rest outdoors after spray.	Human dwellings, mixed and cattle sheds in some places in Karnataka, etc. In foothills, some proportion rests outdoors
4. Biting time	1 ½ hours after dusk. Peak 10.30 pm.-12.30 am	Differs from area to area. Bombay : dusk to midnight with peak form 9-11 pm, other places : 8 pm to 2 am
5. Feeding habits	Mainly zoophilic – Indiscriminate feeder at high density	Foothills : Highly anthropophilic, plains: zoophilic

	<i>An. stephensi</i>	<i>An. sundaicus</i>	<i>An. minimus</i>
1. Distribution	Widely distributed in North West and Peninsular India and occurs in small numbers in rest of the country. Uncommon in North East	36 km South West of Calcutta, Chilka in Orissa to Visakhapatnam in A.P, Recently encountered from the mouth of Hooghly to Salt Lake in Calcutta. A & N Islands	Southern States T.N., Karnataka, Orissa , U.P., Bihar, West Bengal, Assam and Eastern States
2. Larval habitat	Urban Areas: Domestic & peridomestic water collections and underground tanks.	Brackish waters with algae. Behind embankments protecting rice fields, tanks, cleared mangroves and lagoons. Also recorded in fresh water tanks, ponds, lakes and railway borrow pits near coastal areas. Withstands heavy organic pollution. Prefers sunlight.	Clear slow moving water with grassy margins, swampy vegetation and little shade. In foothills it can breed in shallow earth wells and crab holes along the margins of the sow moving spring swamps, irrigation ditches, streams
3. Resting habitat	Differs widely. Human dwellings and cattle sheds	Often in human dwellings and less frequent in cattle sheds. Outdoor resting in vegetation near breeding places, predominantly exophilic in A&N Islands	Prefers human dwellings-lower half of walls, on floors, under cots or on the underside of the cots. Outside resting observed in Jeypore Hill tract, etc.
4. Biting time	Soon after dusk. Peak 4 am – 6 am.	Soon after dusk peak 10 pm to 12midnight. At high densities may even bite during day	Peak 12 midnight – 2 am
5. Feeding habits	Indiscriminate feeder on human and cattle	Prefers human blood	Predominantly anthropophilic, 85.7 to 92.4 per cent

Bionomics of other vectors

An. dirus. Highly anthropophilic and exophilic species with sphere of influence in North eastern states, West Bengal and Andaman and Nicobar islands. Breeds in forest pools, streams with decaying leaves, barrow pits along forest roads and trenches.

An. philippinensis. Mainly zoophilic and occasionally anthropophilic species with sphere of influence in deltaic Bengal, Assam and Meghalaya. Breeds in tanks, pools, barrow pits, drains, swamps, ditches and rice fields preferring shady collections.

An. annularis. Mainly zoophilic and occasionally anthropophilic species with sphere of influence in Orissa, North coasts of AP, Jhansi area in UP and Garo Hills in Meghalaya. Breeds indiscriminately preferring clean stagnant waters, margins of lakes and ponds, slow moving streams and rice fields.

An. varuna. Highly anthropophilic species with sphere of influence in Visakhapatnam, Singbhum hills (Bihar), Kerala, MP and Jeypore hills (Orissa). Breeds in running waters in hills and pools, tanks and ditches in plains.

2.4: EPIDEMIOLOGICAL AND ENTOMOLOGICAL SURVEILLANCE

Epidemiological Parameters

Annual Blood smear Examination Rate (ABER)

$$\text{ABER} = \frac{\text{Number of blood smears examined in a year}}{\text{Total population}} \times 100$$

ABER reflects efficiency and adequacy of case detection. Based on the estimated fever rate in India, a minimum ABER of 10% was fixed under the programme; the blood smear collection should not be less than 1% per month during the transmission period.

- ABER should be equal to fever rate in the locality.
- Fever rates in the community differ from season to season; hence different targets should be fixed for different seasons / months of the year.
- Ensure that all localities are covered regularly under surveillance, as per prescribed time schedule.
- If some villages are not covered by surveillance during the transmission season, there is a great danger of focal outbreaks.

The MO-PHC should

- Scrutinize the epidemiological data and compare village-wise and fortnight-wise targets with actual blood smear collection, positives every month, and every fortnight during pre-transmission and transmission period.
- Correlate reports of fever incidence or OPD fever attendance from these areas.
- Become concerned with the situation and take further steps in case of high fever rate or low collection of slides.
- If the blood smear collection is very high and laboratory results show low positivity rates, MO-PHC should be alert and investigate the efficiency of the laboratory and verify the microscopic diagnosis.

Monthly Blood smear Examination Rate (MBER)

$$\text{MBER} = \frac{\text{Number of blood smears examined in a month}}{\text{Total population}} \times 100$$

Instead of ABER, monthly blood examination rate should be compared with previous month's performance and same corresponding month of the previous year to analyze the trend of fever rates in the community.

Annual Parasite Index (API)

$$\text{API} = \frac{\text{Total No. of blood smears positive for malaria parasite in a year}}{\text{Total population}} \times 1000$$

- API depends upon the adequacy of ABER; in areas with low ABER, the significance of API is lost.

- If ABER is satisfactory, API becomes the most important criterion to assess the malaria prevalence in the community.
- API is also used under the MPO for decision on spray operations.

Annual Falciparum Index (Afi)

$$\text{Afi} = \frac{\text{Total number of blood smears positive for } P.\textit{falciparum} \text{ in a year}}{\text{Total population}} \times 1000$$

- It is the proportion of total positives for *P.falciparum* infection in the total population under malaria surveillance.
- Similar interpretation should be applied to Afi as for API.

Slide Positivity Rate (SPR)

$$\text{SPR} = \frac{\text{Total No. of blood smears found positive for malaria parasite}}{\text{Total no. of blood smears examined}} \times 100$$

- SPR is less dependent on ABER; it is more reliable than API even for those years when ABER fluctuates from year to year.
- Whenever the case detection mechanism is inadequate, this is a dependable parameter for determining the progress of containment measures.
- SPR assumes greater significance, if the ABER is low and gives better indication of parasite load in the community.

Slide Falciparum Rate (SfR)

$$\text{SfR} = \frac{\text{Total No. of blood smears found positive for } P.\textit{falciparum}}{\text{Total no. of blood smears examined}} \times 100$$

- SfR is also less dependent on ABER
- It pinpoints areas of *P.falciparum* preponderance for prioritizing control measures.

***P.falciparum* percentage (Pf %)**

$$\text{Pf \%} = \frac{\text{Total no. of blood smears found positive for } P.\textit{falciparum}}{\text{Total no. of blood smears positive for malaria parasite}} \times 100$$

- Pf % gives the relative proportion of *P.falciparum* infection and trends in relation to total case load.
- Any rise in *P.falciparum* percentage also indicates breakdown of malaria control activities leading to high morbidity and high mortality.

Entomological parameters

- Entomological parameters should be correlated with epidemiological parameters to get a complete picture of malaria in the area.
- The entomological data generated in one PHC of the region can be applied to the other close-by PHCs of the region, especially in respect to vector susceptibility, seasonal variation, longevity etc.

Adult vector Density

Hand Collection Method

$$\text{Man Hour Hand Captures (Per man hour density)} = \frac{\text{No. of mosquitoes collected}}{\text{No. of man hours spent in search}}$$

- High vector density indicates high potential for malaria transmission.
- Data on longitudinal studies on vector densities indicate seasonal (weekly / monthly / annual) trend of vector prevalence; its disease transmission potential; vector behaviour (resting indoors / outdoors) and impact of anti-vector measures.
- Some vectors like *An. minimus* and *An. fluviatilis* can transmit even in low densities.

Total pyrethrum spray catch density expressed as total catch per hut

- An auxiliary method for determining vector prevalence in an area.
- Useful even in situations of low indoor resting habit of vector(s) as well as where indoor habitats provide hiding places not detected through hand capture methods.

Man-Mosquito contact

- Human Bait: Per bait, per night, per unit time.
- Indicates differential man feeding propensity, man biting rate of mosquitoes, site of vector man contact and changes, if any, consequent to indoor residual insecticidal spray.

Sporozoite Rate (Per cent)

$$\text{Sporozoite Rate for each species} = \frac{\text{No. of females positive for sporozoites}}{\text{No. dissected}} \times 100$$

- It incriminates the mosquito species as malaria vector.
- It is an indicator of the efficiency of species in malaria transmission in time and space.

SESSION – 3: TECHNICAL UPDATE

3.1: CLINICAL FEATURES AND DIFFERENTIAL DIAGNOSIS OF MALARIA

Clinical Features

The primary fever in malaria is marked by paroxysms which correspond to the development of the parasites in the red blood cells. The peaks of the fever coincide with the release into the blood stream of successive broods of merozoites. The febrile paroxysms occur with definite intermittent periodicity repeating every third or fourth day depending upon the species of the parasite. The typical attack comprises of three distinct stages, i.e., the cold stage, the hot stage and the sweating stage. The classical 3 stages may not always be seen due to maturation of generations of parasites at different times. Periods of latency in malaria may last several weeks or months. The disease is characterized by enlargement of the spleen and secondary anaemia. Febrile herpes is common in malaria. *P. vivax* malaria has a tendency to relapse. In patients with *P. falciparum* infection the primary fever in its first few days is usually irregular or even continuous and then the classical 48 hour periodicity becomes established or the fever may continue to be irregular and the hot and cold stages, so typical of other malarial infections are less clearly separated from one another. In persons with poor immunity the paroxysms are associated with marked prostration. Headache, nausea and vomiting are usually more severe, and there is greater tendency towards development of delirium, haemolytic jaundice and anaemia. About 0.5% to 2% of *P. falciparum* cases may develop severe complications.

Clinical manifestations of severe malaria

- Cerebral malaria (unrousable coma or impairment of consciousness)
- Severe anaemia
- Renal failure
- Pulmonary oedema or Acute Respiratory Distress Syndrome (ARDS)
- Hypoglycaemia
- Circulatory collapse or shock
- Spontaneous bleeding from gum, nose, gastrointestinal tract etc.
- Substantial laboratory evidence of Disseminated Intravascular Coagulation (DIC)
- Repeated generalized convulsions
- Acidaemia or acidosis including hyperlactemia
- Macroscopic haemoglobinuria
- Prostration
- Hyperparasitaemia

Clinical features of Cerebral malaria

- One or several of the following neurological manifestations may be present:
 - Diffuse symmetrical encephalopathy
 - Focal or generalized convulsions
 - Muscle tone may be increased or decreased
 - Variable tendon reflexes; plantar reflex may be flexor or extensor
 - Teeth grinding and clenching may be observed
 - Motor abnormalities such as decerebrate / decorticate rigidity may be present
 - Change of behaviour such as agitation, confusion, aggression etc.
 - Mild neck stiffness may occur

- Cerebrospinal fluid (CSF) is clear with fewer than 10 WBCs per μl ; protein often slightly raised
- Dysconjugate gaze (divergent eyes) may be common
- Retinal haemorrhage indicates poor prognosis

Differential Diagnosis of Cerebral Malaria

Condition	Features
Heat stroke	Occurs during summer, on exposure to heat; absence of sweating; skin hot and dry
Meningitis	Gradual onset, neck rigidity, CSF changes
Viral encephalitis	Outbreak of many cases with similar history, neck rigidity, typical headache, post-monsoon season
Cerebrovascular episodes	Sudden onset, higher age group, CSF changes, characteristic history
Hypertensive encephalopathy	History of long standing hypertension, sudden onset
Hypo- or hyper- glycaemia	History of diabetes
Uraemic coma	History of chronic kidney disease
Hepatic coma	History of chronic liver disease
Narcotic poisoning	Circumstantial history, pupillary changes

Acute Renal Failure (ARF)

- ARF may present as oliguric or non-oliguric renal failure and even anuria in severe cases
- Urine output < 400 ml in 24 hours or 20 ml/hour (0.5 ml/kg body weight per hour for children)
- Serum creatinine exceeds 3 mg/dl in adults and 1.5 mg/dl in children

Pulmonary oedema or Acute Respiratory Distress Syndrome (ARDS)

- Increase in respiratory rate
- Bilateral basal crepitations
- Raised JVP
- Hilar congestion with bilateral diffuse infiltrations in the chest radiogram

Hypoglycaemia

- In conscious patients, classical symptoms of anxiety, palpitation, dilatation of pupils, breathlessness, alteration of consciousness, feeling of coldness, tachycardia and light-headedness
- If untreated, leads to impaired consciousness, coma, generalized convulsions, extensor posturing and shock

Shock / Circulatory collapse

- Systolic pressure in supine position: less than 80 mm Hg in adults, adolescents and children over 10 years, lower than 70 mm Hg in children aged 1 month – 10 years, lower than 60 mm Hg in neonates
- Cold, clammy and cyanotic skin, constricted peripheral veins, and rapid and feeble pulse or core skin temperature difference > 10°C

5.3 Difference between severe malaria in adults and children

Signs or symptoms	Adults	Children
Anaemia	Common	Very common
Convulsions	Common	Very common
Pre-treatment hypoglycaemia	Less common	Common
Metabolic acidosis	Less common	Common
History of cough	Uncommon	Common
Cerebral malaria	Common	Common in older children
Jaundice	Very common	Uncommon
Renal failure	Common	Less common
Pulmonary oedema, ARDS	Less common	Rare
Duration of illness before severe features	Longer (5-7 days)	Shorter (1-2 days)
Resolution of coma	Longer (2-4 days)	Shorter (1-2 days)

Errors in diagnosis

- Failure to examine blood film
- Errors in microscopic diagnosis / RDT
- Failure to take history of movement
- Failure to realize severity of the disease
- Faulty differential diagnosis

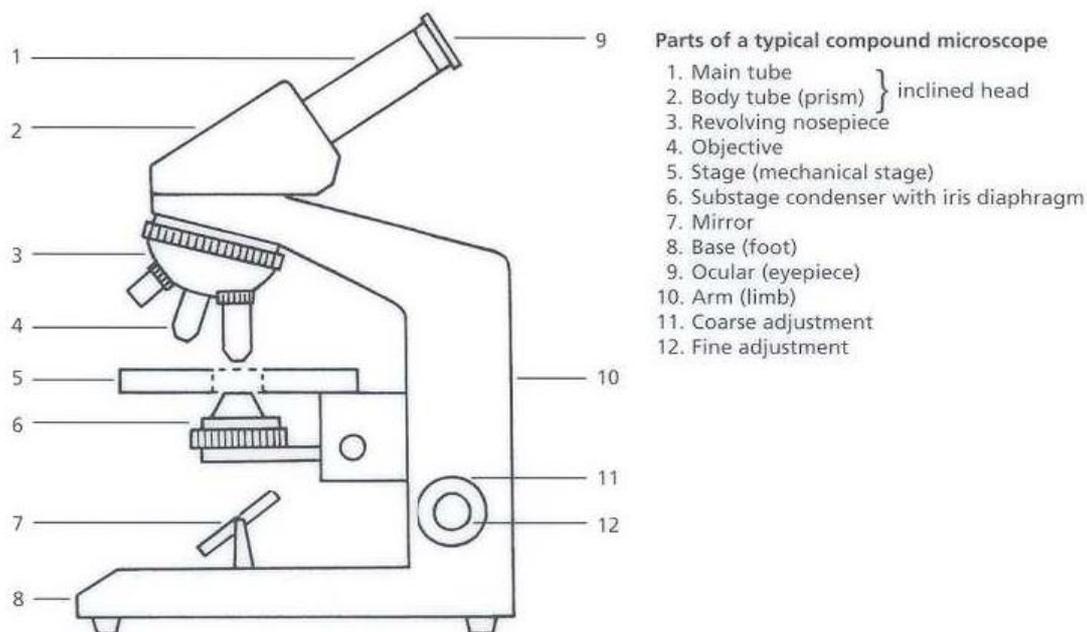
3.2: LABORATORY DIAGNOSIS OF MALARIA AND SUPERVISION OF LABORATORY SERVICES

Importance of microscopy for management of malaria cases

The whole edifice of malaria control is based on accurate and prompt diagnosis of malaria in fever cases.

- Make available diagnostic facilities and chemotherapy of malaria close to residence of all fever cases.
- Diagnosis of all fever cases suspected to be malaria must be confirmed by microscopy or RDT.
- The PHC laboratory / malaria clinic becomes the central point to maintain required levels of efficiency and accuracy of microscopic examination.
- The strategy of malaria control is influenced by parasite species and its distribution in the community.

Use of the microscope



A lens combination of a x10 eyepiece and a x100 objective, to give a total magnification of x1000, is the standard used in most microscopes currently available. Binocular microscopes are easier and less tiring to use, particularly for long periods. When a mirror is used with artificial light, the flat side should be used; when daylight is the light source, the concave side should be used without the substage condenser.

Essential aspects of microscopy

- Adequate amounts of natural as well as artificial lighting in the laboratory
- Working table with adequate space

- Revolving stool for the lab technician
- Adequate facilities for laboratory record, chemicals, cleaning of slides, staining, etc.

Condition of Microscope

- Oil-immersion lens and eye-piece free from dust, dirt or opacity
- Coarse and fine adjustments in good working condition
- Mechanical stage moving without jerks / zigzag movement

Care of the microscope

- Always keep the microscope covered with a clean plastic or cloth cover when it is not in use to protect it from dust, especially in hot dry climates
- Protect microscope from fungus growth in warm humid climate by either:
 - Storing it in a continuously air-conditioned or de-humidified room or
 - Fixing a 15- watt bulb, which is left constantly lit, in the microscope box or
 - Connecting a number of 15- or 25-watt bulbs, left constantly lit, inside a cupboard with tightly fitting doors
- Clean the immersion oil from the immersion objective every day

Cleaning and storing microscope slides

- New slides should be soaked in water with detergent for 30-60 minutes and then rinsed several times under running tap water. Dry each slide using a clean, lint-free cloth.
- Previously used slides must be soaked for at least 1 hour in hypochlorite solution before being washed and dried.
- Slides for preparation of blood films must be scrupulously clean and free from moisture, grease and scratches.

Checking random samples of blood smears

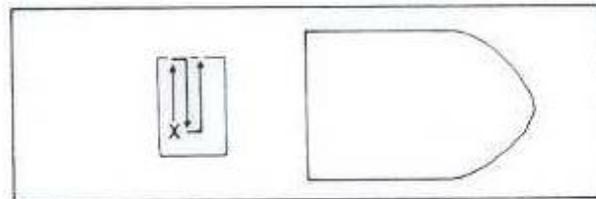
Random samples of blood smears to be picked up from slides stained over the preceding week. At least 20-25 slides to be checked for the following:

- Presence of both thick and thin smears
- Serial number of the slide: clearly legible on thin smear
- The quality of smear and staining to be judged visually
- Thick smear to have adequate blood about 1 cm in diameter and have light blue stain colour with violet iridescence
- Thin smear to be single layered and tongue shaped
- Glass slides to be free from dust, dirt, greasy spots and scratches
- Staining and artifacts to be checked from slides of each subcentre
- Random confirmation of positives for species and stages
- Re-examination of all blood smears of severe and complicated *P. falciparum* infection for species, stages and density of parasites.

Examination of blood films for malaria parasites (various blood stages of *P. falciparum* and *P. vivax* are shown in Plates 1 and 2 respectively)

Examination of thick films

Examine 100 fields, following the pattern of movement shown. To assist in examination, use a hand tally counter to count fields. Record findings on the appropriate record form. A parasite count may be included. Examine the blood film following the pattern of movement shown.

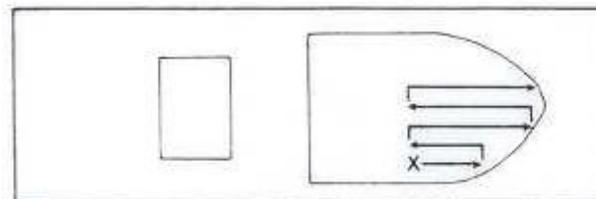


Examination of thin films

It is usually in the distal third of the blood film that cells are:

- Most evenly distributed
- In a single layer and
- Have minimum distortion

Examine the blood film following the pattern of movement shown. Examination of thin films may be necessary for confirmation of species identification or when thick films have been poorly prepared.



Methods of counting malaria parasites in thick blood films

It is often necessary to determine the density of malaria parasites in thick blood films so that the physician is aware of the severity of the infection and the parasites are responding to treatment. Two methods are employed to count the parasites in thick blood films:

- Determination of parasites / μ l of blood
- Plus system

Determination of parasites μ / ml of blood

(a) If, after counting 200 leukocytes, 10 or more parasites are found, record the results in terms of number of parasites / 200 leukocytes. Using a formula, multiplying the number of parasites by 8000

(taken as standard number of leukocytes / μl of blood) and then dividing this figure by the number of leukocytes counted, the parasites / μl of blood is determined, for example,

If 200 leukocytes are counted and 25 parasites are counted,
(25 parasites x 8000/200 leukocytes) = 1000 parasites / μl of blood

(b) If after counting 200 leukocytes, the number of parasites is 9 or fewer, continue counting until you reach 500 leukocytes and then record the number of parasites/500 leukocytes.

If 500 leukocytes are counted and 5 parasites are counted,
(5 parasites x 8000/500 leukocytes) = 80 parasites / μl of blood

Plus system

A simpler method, albeit less satisfactory, entails using a code of between one and four plus signs, as follows:

- + = 1 - 10 parasites per 100 thick film fields
- ++ = 11 - 100 parasites per 100 thick film fields
- +++ = 1 - 10 parasites per single thick film field
- ++++ = More than 10 parasites per single thick film field

Inspection of records for time lag

A sample of M - 4 forms should also be seen especially to note the time taken between:

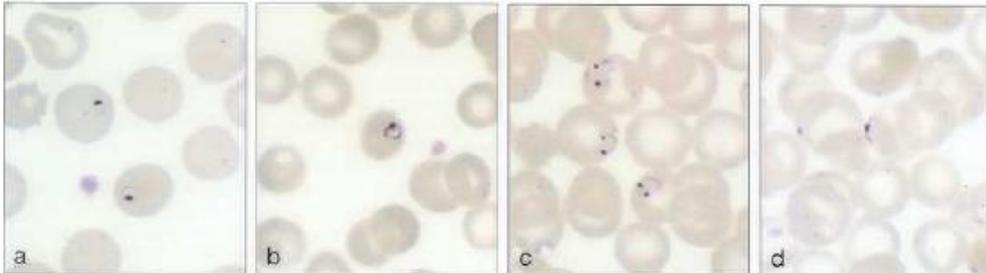
- Making of slides at periphery to receipt at the laboratory
- Period between receipt in laboratory and staining
- Period between staining and examination of slides
- Period between examination of slides and dispatch of results to the periphery for effective treatment

Necessary supervision must be exercised by MO-PHC over the lab technician and corrective action taken for minimizing time lag between slide making and receipt of report by health provider.

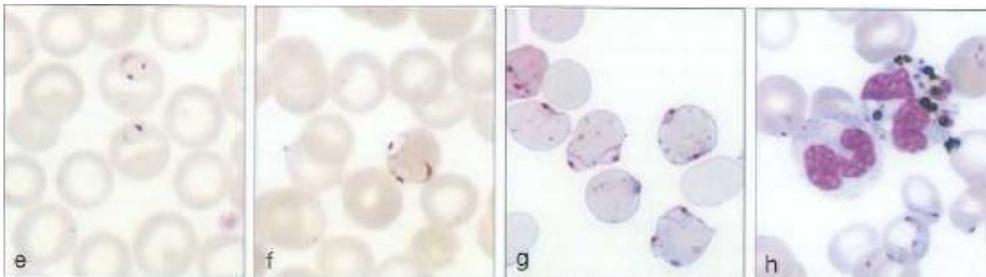
Cross checking of activities from records

- Status of active case detection and population coverage.
- Whether MPWs are visiting all villages at fortnightly interval round the year and if not, the reasons for such default
- Whether MPWs are collecting adequate number of blood smears from all the villages during their domiciliary visits
- Any fungal growth in stains and buffer water, proof of daily filtering of stains, stock register, verification of drugs and chemicals, reagents of analytical grade, distribution of drugs and microscopy slides to DDC, FTD, etc.
- Daily work load of technicians as per norms vis-à-vis backlog of blood smears.

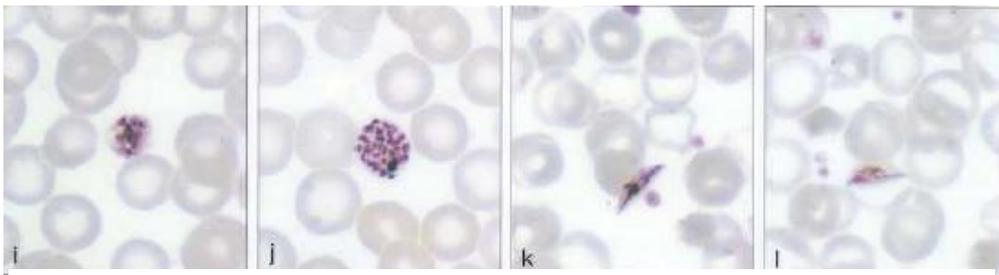
Plate 1: *Plasmodium falciparum* thin film



- a, b:** Trophozoites are small, with thin ring of cytoplasm, a vacuole and prominent chromatin dot
c: Red cells with double chromatin dots is a frequent feature.
d: Parasites at margin of red cells referred to as accolé or appliqué forms



- f, h:** Multiple invasion of erythrocytes is a frequent feature
f, g: Sometimes marginal forms displaced markedly with parasite extending beyond cell margin

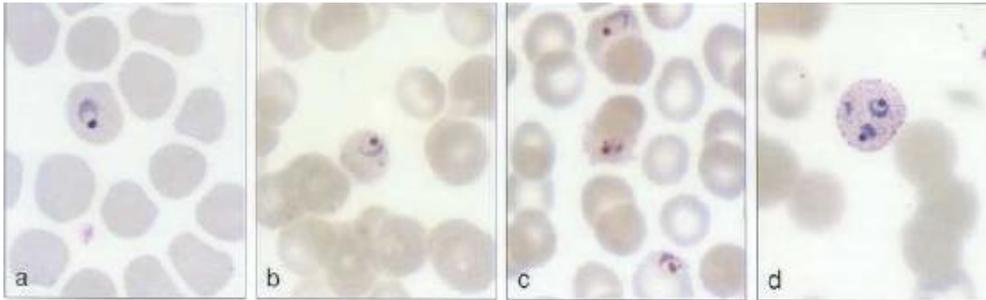


- i, j:** Mature schizonts are compact containing 16 to 24 merozoites
k, l: Gametocytes, initially spindle-shaped

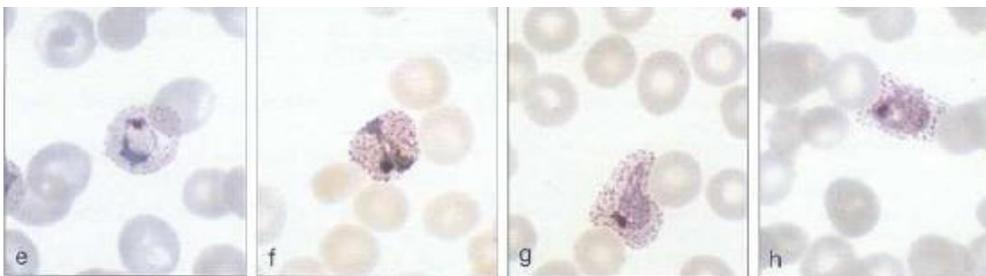


- m-o:** Develop into banana- or sausage-shaped bodies with rounded ends.
m-n: chromatin concentrated as a mass
o: pigment tends to be more scattered
p: occasionally, gametocytes assume bizarre shapes
Gametocytes are only usually seen in peripheral blood smear in *P. falciparum* infections.
Trophozoites and schizonts are seen only when infection is severe with high parasitaemia.

Plate 2: Plasmodium vivax thin film



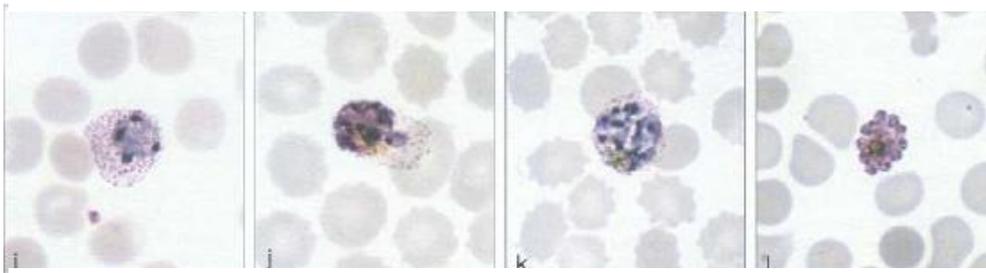
a - d: Infected RBCs become enlarged by > 50% in size. Ring form measure about one-third diameter of RBCs. Have prominent red chromatin and fine circle of blue cytoplasm



e: Young trophozoites have irregular, amoeboid appearance; Scaffer's dots seen

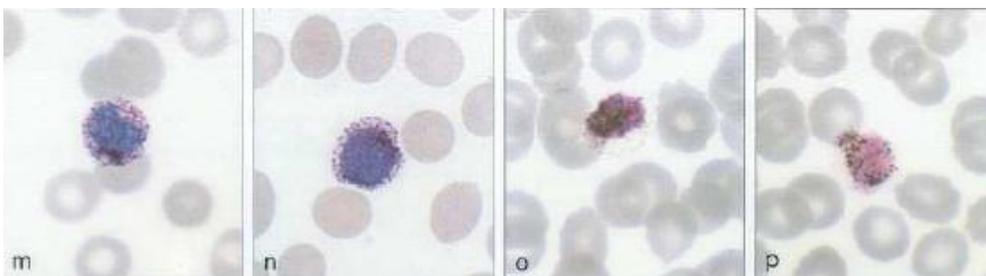
f - g: Older trophozoites become very large, markedly amoeboid and may fill RBC

h: Chromatin mass is large and compact with grains of pigment scattered throughout cytoplasm



i: The early schizont is large and amoeboid

j - l: Chromatin divides into small irregular masses ultimately forming 12-24 merozoites; mature schizont fills enlarged RBC



M - n: Macrogametocytes are large and blue and have small, eccentric compact chromatin mass; brown pigment is scattered throughout cytoplasm. Parasite nearly fills enlarged RBC.

o - p: Microgametocytes have large, diffuse mass of pink staining chromatin and light blue cytoplasm containing scattered granules of dark pigment

3.3: MALARIA CASE MANAGEMENT

Antimalarial drugs

Chloroquine

Chloroquine is a 4-aminoquinoline used extensively for treatment and prevention of malaria. Widespread resistance has now rendered it ineffective against *P. falciparum* in most parts of the world, although it still maintains considerable efficacy for treatment of other species of malaria. Chloroquine interferes with parasite haem detoxification. Resistance is related to genetic changes in transporters (PfCRT, PfMDR), which reduce the concentrations of chloroquine at its site of action, the parasite food vacuole. The principal limiting adverse effects in practice are the unpleasant taste, which may upset children, and pruritus, which may be severe in dark-skinned patients. Other less common side effects include headache, various skin eruptions and gastrointestinal disturbances, such as nausea, vomiting and diarrhea.

Amodiaquine

Amodiaquine is a 4-aminoquinoline with a mode of action similar to that of chloroquine. Its adverse effects are also similar to those of chloroquine. Amodiaquine is associated with less pruritus and is more palatable than chloroquine. It is associated with a much higher risk of agranulocytosis and, to a lesser degree, of hepatitis when used for prophylaxis.

Sulfadoxine

Sulfadoxine is a slowly eliminated sulfonamide which is a competitive inhibitor of dihydropteroate synthase, the bacterial enzyme responsible for incorporation of p-amino benzoic acid in the synthesis of folic acid. Sulfadoxine is used in a fixed-dose combination of 20 parts of sulfadoxine with 1 part of pyrimethamine. Hypersensitivity reactions can be severe because of its slow elimination and may affect different organ systems. Nausea, vomiting, anorexia and diarrhea may occur. Cutaneous manifestations can be severe and include pruritus, photosensitivity reactions, exfoliative dermatitis, erythema nodosum, toxic epidermal necrolysis and Stevens-Johnson syndrome. Treatment with sulfadoxine should be stopped in any patient developing a rash because of the risk of severe allergic reactions.

Pyrimethamine

Pyrimethamine is a diaminopyrimidine used in combination with a sulfonamide and it exerts its antimalarial activity by inhibiting plasmodial dihydrofolate reductase thus blocking the synthesis of nucleic acids in the malarial parasite. Pyrimethamine is generally very well tolerated. Administration for prolonged periods may cause depression of haematopoiesis due to interference with folic acid metabolism. Skin rashes and hypersensitivity reactions also occur.

Mefloquine

Mefloquine is a 4-methanolquinoline and is related to quinine. It is effective against all forms of malaria. Minor adverse effects are common following mefloquine treatment, most frequently nausea, vomiting, abdominal pain, anorexia, diarrhea, headache, dizziness, loss of balance, dysphoria, somnolence and sleep disorders, notably insomnia and abnormal dreams. Neuropsychiatric disturbances (seizures, encephalopathy, psychosis) are less common but are more severe.

Artemisinin and its derivatives

Artemisinin

Artemisinin, also known as qinghaosu, is a sesquiterpene lactone extracted from the leaves of *Artemisia annua* (sweet wormwood). It has been used in China for the treatment of fever for over a thousand years. It is a potent and rapidly acting blood schizonticide and is active against all *Plasmodium* species. It has an unusually broad activity against asexual parasites, killing all stages from young rings to schizonts. In *P. falciparum* malaria, artemisinin also kills the gametocytes – including the stage 4 gametocytes, which are otherwise sensitive only to primaquine. Artemisinin and its derivatives inhibit an essential calcium adenosine triphosphatase, PfATPase 6. Artemisinin has now largely given way to the more potent dihydroartemisinin and its derivatives, artemether, artemotil and artesunate. These drugs should be given as combination therapy to protect them from resistance. A wide variety of formulations for oral, parenteral and rectal use are available.

Artemisinin and its derivatives are safe and remarkably well tolerated. There have been reports of mild gastrointestinal disturbances, dizziness, tinnitus, reticulocytopenia, elevated liver enzyme values and electrocardiographic abnormalities. The only potential serious adverse effect reported is type 1 hypersensitivity reactions in approximately 1 in 3,000 patients. Artemisinin has not been evaluated in the first trimester of pregnancy so should be avoided in first trimester patients with uncomplicated malaria until more information is available.

Artemether

Artemether is the methyl ether of dihydroartemisinin. It can be given as an oil-based intramuscular injection or orally. It is also coformulated with lumefantrine for combination therapy, as tablets containing 20 mg of artemether and 120 mg of lumefantrine.

Artesunate

Artesunate is the sodium salt of the hemisuccinate ester of artemisinin. Artesunate can be given orally, rectally or by the intramuscular or intravenous routes. In India Artesunate is available under the National Vector Borne Diseases Control Programme (NVBDCP) for combination therapy with Sulfadoxine-Pyrimethamine. Artesunate-Mefloquine and Artesunate-Mefloquine are the other ACTs used which include Artesunate.

Dihydroartemisinin

Dihydroartemisinin is the main active metabolite of the artemisinin derivatives, but can also be given orally and rectally as a drug in its own right. A fixed dose formulation with piperazine is currently undergoing evaluation as a promising new ACT.

Artemotil

Artemotil, previously known as arteether, is the ethyl ether of artemisinin. It is given by intravenous injection only and is provided by the NVBDCP.

Lumefantrine

Lumefantrine belongs to the aryl aminoalcohol group of antimalarials, which also includes quinine, mefloquine and halofantrine. It is only available in an oral preparation coformulated with artemether.

This ACT is highly effective against multidrug-resistant *P. falciparum*. The drug is remarkably well tolerated.

Primaquine

Primaquine is an 8-aminoquinoline which is effective against intrahepatic forms of all types of malaria parasite. It is used to provide radical cure of *P. vivax* and *P. ovale* malaria, in combination with a blood schizonticide for the erythrocytic parasites. Primaquine is also gametocytocidal against *P. falciparum* and has significant blood stage activity against *P. vivax* (and some activity against asexual stages of *P. falciparum*). The mechanism of action is unknown. The most important adverse effects are haemolytic anaemia in patients with G6PD deficiency, other defects of the erythrocytic pentose phosphate pathway of glucose metabolism, or some types of haemoglobinopathy. Therapeutic doses may also cause abdominal pain if administered on an empty stomach. Larger doses can cause nausea and vomiting. Methaemoglobinemia may occur.

Quinine

Quinine is an alkaloid derived from the bark of the Cinchona tree. It acts principally on the mature trophozoite stage of parasite development and does not prevent sequestration or further development of circulating ring stages of *P. falciparum*. It also kills the sexual stages of *P. vivax*, *P. malariae* and *P. ovale*, but not mature gametocytes of *P. falciparum*. It does not kill the pre-erythrocytic stages of malaria parasites.

Quinine is available as quinine hydrochloride, quinine dihydrochloride, quinine sulphate and quinine bisulphate tablets. It is also available as quinine hydrochloride, quinine dihydrochloride and quinine sulfate injectable solutions.

Administration of quinine or its salts regularly causes a complex of symptoms known as cinchonism, which is characterized in its mild form by tinnitus, impaired high tone hearing, headache, nausea, dizziness and dysphoria, and sometimes disturbed vision. More severe manifestations include vomiting, abdominal pain, diarrhea and severe vertigo. Hypersensitivity reactions to quinine range from urticaria, bronchospasm, flushing of the skin and fever, through antibody-mediated thrombocytopenia and hemolytic anemia, to life-threatening haemolytic-uremic syndrome. Massive haemolysis with renal failure (black water fever) has been linked epidemiologically and historically to quinine. The most important adverse effect in the treatment of severe malaria is hyperinsulinaemic hypoglycaemia which is particularly common in pregnancy.

Factors influencing efficacy of antimalarials

- Rate of absorption on oral administration
- Duration of effective blood levels
- Binding with body proteins and its duration
- Rate of excretion
- Half life of antimalarial
- Preferential concentration in RBC and plasma
- Rapidity of action on parasite RNA and DNA or metabolic system
- Rate of conversion into active metabolites

National Drug Policy, 2008

Treatment of *Plasmodium vivax* cases

Microscopically positive *Plasmodium vivax* cases should be treated with chloroquine in full therapeutic dose of 25 mg/kg body weight divided over three days (10 + 10 + 5 mg/Kg body weight on days 1, 2 and 3 respectively). Primaquine should be given in dose of 0.25mg/kg body weight daily for 14 days to prevent relapse.

Table 7.1 Chloroquine dosage schedule for *P. vivax* cases

Age in years	Day – 1 (10mg/Kg)	Day – 2 (10mg/Kg)	Day – 3 (5 mg/Kg)
<1	½	½	¼
1 – 4	1	1	½
5 – 8	2	2	1
9 – 14	3	3	1½
15 & above	4	4	2

Table 7.2 Primaquine dosage schedule for *P. vivax* cases * - 14 Days

Age in years	Daily dose for 14 days		
	Daily dosage (in mg of base)	No. of Tablets (2.5 mg base)	No. of Tablets (7.5 mg base)
< 1	Nil	Nil	Nil
1 – 4	2.5	1	⅓
5 – 8	5.0	2	⅔
9 – 14	10.0	4	1⅓
15 & Above	15.0	6	2

* Primaquine is contraindicated in pregnant women and infants.

Treatment of *Plasmodium falciparum* cases

The National Malaria Treatment Guidelines recommend that change of drug should be considered when treatment failure proportion exceeds 10%. Artemisinin-based Combination Therapy (ACT) has replaced Chloroquine as the first line of drug for treatment of *P.falciparum* in all seven NE states and 50 high Pf endemic districts in the state of Andhra Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh and Orissa (names of districts given in appendix 'A'), other chloroquine resistant areas and identified cluster of Blocks surrounding drug resistant foci. Areas/PHCs showing a treatment failure of more than 10% (both Early and Late Treatment Failures) to Chloroquine in a minimum sample of 30 cases, should be switched over to ACT. Change of drug to second line of treatment may also be implemented in a cluster of Blocks around the resistant foci after taking into consideration the epidemiological trend of *P.falciparum* (Pf > 30%) and approval of Directorate of NVBDCP. Resistance should also be suspected if in spite of full treatment with no history of vomiting, diarrhea, patient does not respond

within 72 hours of treatment. Such individual patients should be given alternative drug i.e. ACT combination and report to concerned District Malaria / State Malaria Officer/ROHFW Pf monitoring teams for monitoring of drug sensitivity status.

ACT should be given only to confirmed *P. falciparum* cases found positive by microscopy or Rapid Diagnostic kits. The dose is 4mg/kg body weight of Artesunate (AS) daily for 3 days, combined with 25mg/ kg body weight of sulphadoxine/sulphalene + 1.25 mg per kg body weight of pyrimethamine (SP) on the first day. Artesunate tablets should not be administered as mono therapy. It should invariably be combined with sulpha pyrimethamine tablets in prescribed dosages. Strength of each Artesunate tablet: is 50 mg and each Sulpha Pyrimethamine (SP) tablet contain 500mg sulphadoxine/sulphalene and 25mg pyrimethamine

ACT Dosage Schedule for *Plasmodium falciparum* cases * - 3 Days

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 years	AS	1	1	1
	SP	1	Nil	Nil
5 - 8 years	AS	2	2	2
	SP	1 ½	Nil	Nil
9 - 14 years	AS	3	3	3
	SP	2	Nil	Nil
15 years and above	AS	4	4	4
	SP	3	Nil	Nil

AS- Artesunate

SP- Sulpha-Pyrimethamine

A single dose of Primaquine i.e. 0.75 mg/kg body weight, is recommended to be given with ACT combination as it will enhance gametocyte clearance and facilitate interruption of transmission. Primaquine should also be not used in pregnant women and infants. As per current National Policy Artemisinin derivatives are not to be used in pregnant women.

As per the current National policy, in all states not mentioned above and in areas not known to have chloroquine resistance, microscopically positive Pf cases should be treated with chloroquine in therapeutic dose of 25 mg/kg body weight divided over three days (similar to *P. vivax* cases) and a single dose of Primaquine 0.75 mg/kg body weight on the first day.

Primaquine Dosage for *Plasmodium falciparum* cases * - 1st Day only

Age in years	Dosage on Day 1 only		
	Dosage (in mg of base)	No. of Tablets (2.5 mg base)	No. of Tablets (7.5 mg base)
< 1	Nil		0
1 – 4	7.5	3	1
5 – 8	15	6	2
9 – 14	30	12	4
15 & above	45	18	6

If RDK for only Pf is used, negative cases showing signs and symptoms 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. Similarly, in situations where diagnosis by microscopy or RDK is not possible, cases showing signs and symptoms 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 area a 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 VHWs like FTDs/ASHA as well.

Severe and complicated malaria cases

Complications

Serious complications can arise in *P.falciparum* infection. They may sometimes develop suddenly over a span of time as short as 12 -24 hours and may lead to death, if not treated promptly and adequately. Severe malaria is clinically characterized by confusion or drowsiness with extreme weakness (prostration). In addition, the following may develop:

- cerebral malaria with generalized convulsions
- pulmonary oedema
- severe anaemia
- renal failure
- hypoglycaemia
- metabolic acidosis
- circulatory collapse/shock
- spontaneous bleeding and laboratory evidence of DIC
- macroscopic haemoglobinuria
- hyperthermia
- hyperparasitaemia

In children, febrile convulsions, repeated vomiting and dehydration are common if the temperature is high, therefore a diagnosis of malaria should be confirmed at the earliest.

In pregnancy, malaria, especially *P.falciparum* is a serious disease because with each bout of malaria, there is a reduction in haemoglobin and profound anemia may develop rapidly. They are also at high risk of abortions or intrauterine growth retardation because sequestration of parasites in placenta restricts oxygen and nutrients flow to the fetus.

Requirements for management of complications

For management of severe malaria, health facilities should be equipped with the following:

- Parenteral antimalarials , antibiotics, anticonvulsants, antipyretics
- Intravenous infusion equipment and fluids
- Special nursing for patients in coma
- Facilities for blood transfusion
- Well equipped laboratory
- Oxygen respirator

If these items are not available, the patient must be referred without delay to other institutions where such facilities are available. A list of all health care facilities in the district where emergency care for severe malaria is available should be kept available with private health providers.

Note: Before referring patients, please conduct RDT and take blood smear, give a parenteral dose of Quinine or artemisinin derivatives in suspected cerebral/complicated malaria cases and send case sheet, details of treatment history and blood slide with patient.

Management of severe malaria cases

Severe malaria is an emergency and treatment should be given as per severity and associated complications which can be best decided by the treating physicians. Parenteral artemisinin derivatives or quinine should be used irrespective of chloroquine resistance status of the area. However, the guidelines for specific antimalarials therapy as per the WHO recommendation are given below:

- **Quinine salt** 20 mg/kg* body weight (bw) on admission (IV infusion or divided IM injection) followed by maintenance dose of 10 mg/kg bw 8 hourly; infusion rate should not exceed 5 mg salt / kg bw per hour.

(*loading dose of Quinine salt i.e 20mg /kg bw on admission may not be given if the patient has already received quinine or if the clinician feels inappropriate).

- **Artesunate:** 2.4 mg/kg bw i.v. or i.m. given on admission (time=0), then at 12 h and 24 h, then once a day.
- **Artemether:** 3.2 mg/kg bw i.m. given on admission then 1.6 mg/kg bw per day.
- **Arteether:** 150 mg daily i.m for 3 days in adults only (not recommended for children).

Note:

- A. The parenteral treatment should be given for minimum of 48 hours and once the patient tolerates oral therapy, quinine 10 mg/kg bw three times a day with doxycycline 100 mg once a day or clindamycin in pregnant women and children under 8 years of age, should be given to complete 7 days of treatment in patients treated with parenteral quinine.
- B. Full course of ACT should be administered to patients treated with artemisinin derivatives.
- C. Use of mefloquine alone or in combination with artesunate should be avoided especially in cerebral malaria due to neuropsychiatric complications associated with it.
- D. In severe and complicated *P.falciparum* malaria cases intravenous Quinine/ parenteral Artemisinin derivatives are to be given irrespective of chloroquine resistance status. This treatment may continue till such time oral Quinine/Artemisinin derivatives become available.

Chemoprophylaxis

Chemoprophylaxis should be administered only in selective groups in high *P.falciparum* endemic areas. Use of personal protection measures including insecticide treated bed nets should be encouraged for pregnant women and other vulnerable population including travellers for longer stay. However for longer stay in high Pf endemic districts by the Military & Para-military forces, the practice of chemoprophylaxis should be followed wherever appropriate e.g. troops on night patrol duty etc and decisions of their Medical Administration Authority should be followed. For short term chemoprophylaxis (less than 6 weeks), daily doxycycline is the drug of choice (if not contraindicated). However, it is not recommended for pregnant women and children less than 8 years. Mefloquine is the drug of choice for chemoprophylaxis involving longer stay. It is contraindicated in cases with history of convulsions, neuropsychiatric problems and cardiac diseases. Hence, necessary precautions should be taken and all should undergo screening before prescription of the drug.

Chemoprophylaxis should be administered only in selective groups in high *P.falciparum* endemic areas.

For short term chemoprophylaxis (less than 6 weeks)

Doxycycline: daily in the dose of 100 mg in adults and 1.5 mg/kg for children (if not contraindicated). The drug should be started 2 days before travel and continued for 4 weeks after leaving the malarious area.

Note: It is not recommended for pregnant women and children less than 8 years.

For long term chemoprophylaxis (more than 6 weeks)

Mefloquine: 250 mg weekly and should be administered two weeks before, during and four weeks after exposure.

Note: Mefloquine is contraindicated in cases with history of convulsions, neuropsychiatric problems and cardiac conditions. Hence, necessary precautions should be taken and all should undergo screening before prescription of the drug.

Advice to the patients / caretakers

- Once a suspected case is diagnosed positive by RDT or microscopy, treatment with the first dose should be ensured in the presence of the health –care provider / worker. The blister pack with remaining tablets is given to the patient / caretaker with clear instructions to take the complete treatment. If the treatment is not completed as prescribed, the disease may manifest again with more serious features and may be more difficult to treat.
- The patient under 5 years or pregnant may be asked to wait for 15 minutes after taking the first dose. If vomiting occurs within this period, let the patient rest for 15 minutes and give the first dose again. If the patient vomits again, refer the patient immediate to the nearest Doctor/ CHC/ Hospital.
- The patient may report back immediately, if there is no improvement after 24-72 hours, if the situation gets worse or the fever comes back.
- That regular use of a mosquito net (preferably insecticide treated net) is the best way to prevent malaria.

Maintenance of records

Appropriate record should be maintained by all healthcare providers and the local authority may be informed if there is increase in number of cases.

Some Dont's in malaria case management

- Do not give anti malarials on empty stomach
- Do not use corticosteroids
- Do not give intravenous. mannitol
- Do not use heparin as anticoagulant
- Do not administer adrenaline
- Do not overhydrate

SESSION – 4: PROGRAM STRATEGY

Main strategies of Malaria control programme

- Universal access to care in each village of the high burden areas with ASHA or other community volunteer trained in the use of RDT and ACT
- Universal protection of high risk populations with IRS of insecticide treated bednets (ITN/LLIN) with scaling up of LLIN use which will become the main tool in future.

Case management strategy

- Prompt diagnosis of all *P. falciparum* cases with monovalent RDTs at present (Bivalent kits for both *P. falciparum* and *P. vivax* are likely to be introduced in future)
- All cases of *P. falciparum* in high burden areas treated with ACT (3 days) and single dose of Primaquine
- All villages will be identified as “Slide villages” or “RDT villages” as determined by expected time taken for microscopy results to be available.
- In RDT villages, slide will be sent to the laboratory only if RDT result is negative
- All slides will be sent as soon as possible after they are collected, even if a single slide has to be sent at a time
- The practice of presumptive treatment of malaria has been stopped. If a patient is a case of suspected malaria and RDT is not available and microscopy results will take more than 24 hours, a full 3 day course of chloroquine will be given, pending microscopy results.
- Trained ASHAs and other community volunteers will be the backbone of malaria case detection, treatment and referral in the peripheral areas.
- Emphasis will be given to passive case detection in fever cases reporting to health workers or volunteers; active case detection will continue to be done particularly in areas where there are no volunteers and also when outbreaks occur.
- Sentinel surveillance sites will be established in each district to monitor cases of severe malaria and their outcomes.

Vector control strategy

- Principles of Integrated Vector Management will be applied in all high burden areas, with saturation by IRS or ITNs/LLINs.

- The choice between IRS and ITN/LLIN will be determined by operational criteria (remote areas which are hard to conduct IRS)
- The choice of insecticide for IRS will be according to information on insecticide resistance; pyrethroids are best avoided as they are used in ITN/LLINs.
- Net distribution will be at the rate of one net per 2.5 persons and based on the need assessment in each family.
- It is preferable to use LLINs instead of reimpregnation of bed nets and therefore all efforts will be aimed at phasing out existing ITNs with LLINs; till the time there is complete replacement of all bed nets with LLINs, reimpregnation of ITNs will continue.

4.1: EXISTING AND ADDITIONAL HUMAN RESOURCES FOR HIGH BURDEN AREAS

Medical officer in charge of PHC

The MO-PHC, as the team leader and program manager is responsible for results. He will manage the change from current malaria program strategy to future strategy by:

- Planning and ensuring establishment of community volunteers at all areas and their supportive supervision
- Establishing supply and incentive mechanisms as per program strategy
- Stratifying all villages / habitations as “RDT” or “slide” sites
- Introducing the use of new MIS formats at all levels
- Training all staff and volunteers

He will contribute data and details from his area for development of the annual district action plan. He will also monitor the quality of laboratory results, data on disease burden and forecast outbreaks. As a clinician he will be well versed with management of malaria cases and refer cases of severe malaria to the referral centres at the earliest.

The skills expected from the MO-PHC are:

- Understanding of technical basis for malaria control and overall program strategy
- Program management skills: analyzing and utilization of data for planning and monitoring
- Interpretation of surveillance data trends
- Personnel management skills
- Communication skills
- Training skills

The job responsibilities of MO-PHC have been dealt with in detail in an earlier session.

Role of Laboratory Technician

- Ensure quick and reliable reporting of blood smears giving priority to slides coming from sites without RDTs
- Provide support mechanisms for slide transport
- Maintain lab records meticulously and support reporting from the PHC

The role of the laboratory technician presented here is only indicative and for the purpose of the full job description and scope of work, reference should be made to the respective annexure in the operational manual.

Role of Health supervisors

- Ensure that MPHs are performing their duties well in supporting case management and vector control activities
- Conduct monthly program review with the staff, particularly when the MO-PHC is not available
- Monitor data quality through field visits and perform desk reviews
- Monitor training status of staff and alert MO-PHC when required

- Deploy staff for active case detection when appropriate
- Lead preliminary outbreak investigations and support the DMO's team in detailed investigations

The role of the health supervisor presented here is only indicative and for the purpose of the full job description and scope of work, reference should be made to the respective annexure in the operational manual.

Multipurpose Health Workers (MPHW) (Male, Female)

Roles

- Support the community level providers in each village under their subcentre by appreciation, training, supply, records and incentives etc.
- Encourage people to seek care for fever from community level providers
- Provide diagnosis and treatment for malaria whenever possible, particularly in the subcentre village.
- Undertake active case detection activity
- Report and respond to outbreaks
- Plan IRS operations, prepare communities and supervise spray activity
- Plan reimpregnation and distribution of bed nets, oversee the activity and provide guidance for correct use.
- Collect and collate primary data on case management, IRS and ITN as prescribed.

Skill set required

- Supportive supervision skills
- Communication skills
- Data collation skills
- Spray supervision skills
- Bednet reimpregnation technique
- Active case detection
- Outbreak response skills

The role of the MPHWS presented here is only indicative and for the purpose of the full job description and scope of work, reference should be made to the respective annexure in the operational manual.

Accredited Social Health Activist (ASHA)

Primary role

- Diagnosis
- Treatment
- Recording data
- Referral

Skill sets required

- Safe and accurate conduct of blood tests – RDT / slide making
- Age specific dosing of drugs including ACT
- Ability to explain rationale of antimalaria drugs in simple terms to the patients

- Maintenance of primary case record (M-1)
- Detection of severe malaria for referral
- Detection of outbreaks for alerting

Secondary roles

- Support distribution and reimpregnation of ITNs
- Encourage people on correct use of ITNs
- Encourage people to accept IRS

Skill sets required

- Correct method of use of bednets, both indoor and outdoor
- Ability to explain rationale of bed nets and IRS in simple terms to the community members

Selection criteria

- Willingness to learn and do blood testing
- Willingness to attend to patients with fever who come to her
- If another volunteer is available, he or she can be recruited for the activity; there can be more than one volunteer per village and ASHA and AWW from same village can also be trained.

Incentives

The NVBDCP recommends payment of incentive @ Rs. 20/- per case tested and up to a maximum of Rs. 200/- per month. However, the state governments may modify the scheme within the allotted budget amounts.

The role of the ASHA presented here is only indicative and for the purpose of the full job description and scope of work, reference should be made to the respective annexure in the operational manual.

Malaria Technical Supervisor (MTS)

MTS will on an average cover 2-3 blocks and report to the DMO and VBDC; in case of very high burden blocks, coverage of one block may only be possible.

Primary roles

- Supportive supervision of malaria related activities of ASHA/community volunteers and MPHWS, as well as functionaries associated with IRS/ITN activities
- Contribute to program monitoring through data collection and analysis using LQAS or other methods
- Provide support to all other malaria control activities

Skill set

- Communication skills
- High mobility
- Supportive supervision
- Data handling – collection, entry, storage, analysis and interpretation
- Knowledge of technical basis of malaria control

Coordination with PHC

- Visit the PHCs, subcenters and villages to interact with everyone involved in implementation of the malaria program, viz. MO-PHC, supervisors, lab technicians, malaria inspectors, MPHWS (M, F), spray teams, ASHA/other volunteers
- Support the programme by identifying gaps and initiate action at filling them
- Attend monthly block level malaria program review meetings
- Provide feedback to PHC staff, including MO-PHC about what is working and what is not working, in relation to various activities – diagnosis, lab quality, treatment, surveillance, vector control, data quality, logistics and supply chain management, BCC etc.
- Periodically collect data through LQAS to tell whether the PHC has reached the set targets for selected indicators or not

The MTS can only supplement the supervision and monitoring carried out by the PHC staff; the prime responsibility of getting results remains with the PHC team. As the new MTSs do not have much field experience, they require the initial support of PHC staff to learn about the program activities. The MTS will be trained initially and on the job training will also be given by the DMO and VBDC for them to identify gaps in program implementation and respond to them. The PHC staff is expected to provide the MTS ready access to raw data / records / reports as well as information about deployment of ASHAs, spray teams etc.

The list of roles of MTS presented here is only indicative and for the purpose of the full job description and scope of work, reference should be made to the respective annexure in the operational manual.

District Vector Borne Diseases (VBD) Consultant

The VBD consultant will report to the DMO. He will be much more thoroughly trained than the MTS in malariology, field epidemiology, data analysis and interpretation and all technical aspects related to the interventions. As the DMO may be involved with various other responsibilities, the VBD consultant will attend to the technical aspects of the program implementation in the district. The VBD consultant will conduct frequent field visits to identify the program needs and give feedbacks to the DMO, MO-PHC and MTS.

The role of District VBD consultant presented here is only indicative and for the purpose of the full job description and scope of work, reference should be made to the respective annexure in the operational manual.

4.2: OPERATIONAL IMPLICATIONS OF CASE MANAGEMENT STRATEGIES

Suspected case of malaria

The definition of suspected malaria is “a patient with fever in endemic area during transmission season, or who has recently visited an endemic area without any other obvious cause and in the absence of a confirmed diagnosis”. For ruling out other causes of fever, the following should be looked for.

1. Cough and other signs of respiratory infection
2. Running nose and other signs of cold
3. Diarrhoea
4. Pelvic inflammation
5. Skin rash suggestive of eruptive illness
6. Burning micturition
7. Skin infections e.g. boils, abscess, infected wounds
8. Painful swelling of joints
9. Ear discharge

However, none of these symptoms exclude malaria with certainty. Only a trained clinician can come to a clinical diagnosis of malaria in the presence or absence of “other cause”. In the program, MPHWs have also been trained to rule out malaria based on these “other causes”, but it is not clearly known as to how well these definitions are practically used at the grass root level. Under the new strategy, ASHA/ community volunteer will be the primary care provider, with minimal skills. They will be initially trained to perform a blood test on every case of fever. This may result in an overuse of blood tests initially. Over a period of time, they will be taught to be more discriminating in differentiating “suspected malaria cases from “all fever cases” and the number of blood tests carried out by them is likely to reduce proportionately.

How and when to use RDT and blood smear

If a microscopy result can be made available to the provider managing the patient within 24 hours (in practice on the day, when the patient presents or the day after), only microscopy is done. Antimalarial treatment is given only on the basis of a positive slide-result.

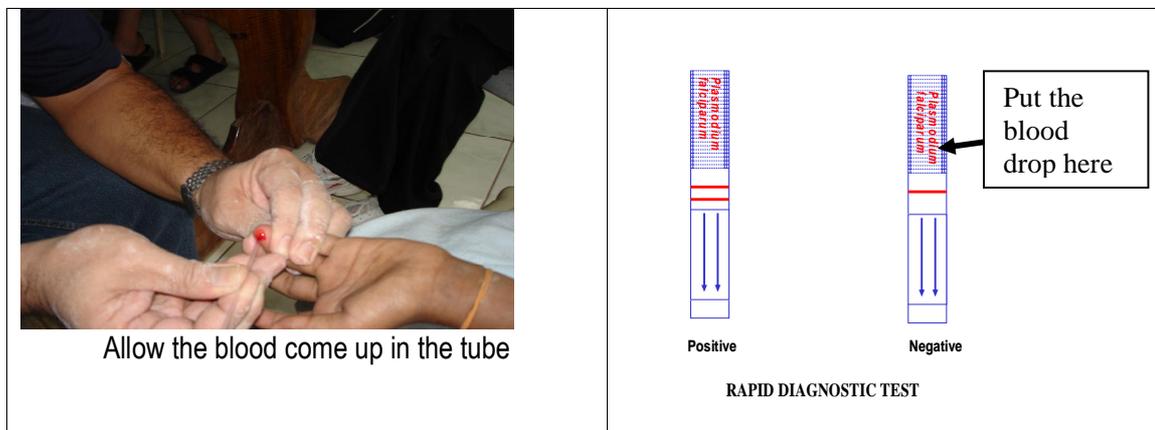
In inaccessible areas, where microscopy result cannot be made available within 24 hours, Pf RDTs are at present supplied. An RDT is done in front of the patient and a slide is also taken. If the RDT is negative, the slide is sent for microscopy. If it is positive, the patient is treated for falciparum malaria, and the slide is discarded. Mixed infection cannot be ruled out in such cases, but the risk is low. The ACT treatment for *P.falciparum* is also effective for the blood stages of *P.vivax*. If the patient should have a *P.vivax* relapse later, he or she is expected to return and then be diagnosed and treated with primaquine.

Wherever a microscopy result can be made available within 24 hours, microscopy should be used as the only routine method. RDTs should be used in PHCs and other health facilities only in emergencies in the absence of the laboratory technician.

Rapid Diagnosis Test (RDT)

The Rapid Diagnosis Test (RDT) is done with the Rapid Diagnosis Test Kit (RDK). This kit is regularly supplied by the government through the nearest Primary Health Center. The kit contains the following materials:

1. Spirit swabs - one swab for one patient
2. Lancets - one lancet for one patient
3. Small glass tube (capillary tube) - one for each patient
4. Test strips - one strip for one patient
5. One multiple-well plastic plate - common for all tests
6. Test tube – one test tube for one patient
7. Buffer solution or reagent solution - a special liquid for doing the test, in a dropper bottle, common for all tests



Procedure

- Take informed consent for conducting the test
- Arrange all equipment for RDT and taking blood slide
- Check that the test kit is within its expiry date. If not, do not use it.
- Open a foil pouch and check that the powder inside it is still blue. If not, discard the test and use another test.
- Remove the test strip and the small glass tube or loop from the foil pouch and place them on a clean dry surface.
- Take out the bottle containing the liquid and the dropper.
- Place a new test tube in the multiple-well plate.
- After drawing blood from a finger, touch the tip of the small glass tube to the blood drop on the finger and let a small amount of blood come up in the tube or the loop.
- Touch the tube or the loop to the test strip just below the arrow mark to place the blood there. If there is a paper where *Plasmodium falciparum* is written, remove it and place the blood on the strip in the place that was covered by the paper.

- Put the used small glass tube in waste box.
- Using the dropper, place 4 drops of liquid from the bottle into the new test tube that you had placed in the multiple-well plate.
- Place the test strip containing blood in this test tube with the arrow pointing down, with the tip of the strip dipped in the liquid.
- Wait for about 15 minutes. During this time, prepare the thick and thin blood smears on a slide.
- Observe the test strip after 15 minutes. You will find one of the following situations:
 - No red line appears on the test strip - this means that the test strip is not working. Discard it and repeat the test carefully with a new test strip, starting with the first step.
 - A single red line appears - this means that the patient does not have falciparum malaria. Send a slide to the laboratory to check if the patient may have the less dangerous form, *P. vivax* malaria. The patient is to be given paracetamol, pending results of microscopy.
 - Two red lines appear- this means that the patient has falciparum malaria. Treat the patient for falciparum malaria with ACT and primaquine, in dosage schedule given in the chapter on “malaria case management”. There is no need to send the blood slide to the laboratory.

After the test has been read, put the test strip and test tube into the waste box along with all used swabs and the used lancet. Since the RDK may come from different companies at different times, there may be small differences in the contents and in the manner in which the test is done.

Preidentification of “Slide villages” and “RDT villages”

Any village where reliable slide transportation and reporting mechanism is established for getting microscopy results by the next day for slides sent on a particular day can be termed a “slide village”. There is requirement of using slides and microscopy in such villages. In all villages where such a rapid mechanism cannot be established, RDTs should be made available and these villages will be termed “RDT villages”; both RDTs and slide will be used in these villages as described in preceding paragraphs.

Every health care provider (MPHW/ASHA/community volunteer) must know whether the particular village is a “RDT village” or “slide village” and act accordingly. Slides are important in “RDT villages” also, for example, if one out of 10 RDTs are positive, the other 9 cases will depend upon the slide result for diagnosis. Even in “RDT villages” slide transportation and reporting mechanisms have to be made quick and strong, as patients and providers will be waiting for slide results in order to give the necessary correct and complete treatment. In the process, the ASHA might be repeatedly harassed for the results by the patient or attendant.

Mechanisms to expedite slide transportation and reporting

As obtaining the results of the slide examination are crucial for effective treatment, all options to expedite slide transportation and reporting are required to be explored and utilized. These options may be use of local bus or any other vehicle making daily trips to the block HQ town, the postal system, daily migrant workers proceeding from the village to the town, school children from the villages etc. For obtaining the results from the laboratory, all these measures may be utilized and in addition, telephones (landline/mobile/SMS) may be used. Mechanisms have to be built in to ensure that the slides not only reach the block HQ town but also the laboratory and report reaches back.

It should also be ensured that the slide numbering system and data entry are simple enough for the ASHA/community volunteer to comprehend and act. The reporting should also be clear and unambiguous for the ASHA/community volunteer to read and interpret correctly. If any reporting is done over the phone, special attention should be paid for identification of the patient correctly. The ASHA/community volunteer must all care to ensure that the slides are protected from any damage en route.

Role of ASHA/Volunteer in handling severe malaria cases

The peripheral workers should be well conversant with the signs and symptoms of malaria and also its serious complications. When the patient without complications comes to any of the most peripheral agencies (ASHA, MPHW), they should invariably instruct the patient that if he/she does not get relief within a reasonable period of time i.e. 48 hours and / or headache / fever continues to increase, the patient should report to nearest PHC / CHC / hospital. The ASHA/volunteer will be trained to detect signs of severe malaria.

Criteria for referral as a case of severe malaria

- Persistence of fever after 48 hours of initial treatment.
- Continuous vomiting and inability to retain oral drugs.
- Headache continues to increase.
- Severe dehydration - dry, parched skin, sunken face.
- Too weak to walk in the absence of any other obvious reason.
- Change in sensorium e.g., confusion, drowsiness, blurring of vision, photophobia, disorientation.
- Convulsions or muscle twitchings.
- Bleeding and clotting disorders.
- Suspicion of severe anaemia.
- Jaundice.
- Hypothermia.

Preidentification of referral centres

Every volunteer / health worker should know as to which is the hospital to which a case of severe malaria should be referred as this is so very important to ensure that the patients do not waste time by going to the wrong places. The information is given by the MO-PHC / DMO and the choice of referral centre would be based on the quality of care available for severe malaria as well as the availability of round-the-clock emergency services. The sentinel sites which are being identified will also be the right choices to serve as the referral centres. The referral institutions may be public or private, but at least one public institution will be identified in each district where free services are available.

Essential facilities in PHC

Every PHC must provide at least adequate immediate care to all patients of severe malaria before higher referral for which the following facilities should be available at the PHC:

- Blood smear examination and parasite count.
- RDT
- Routine exam of urine and haemoglobin estimation.

- Oral antimalarial drugs including ACT
- Injectable Quinine, injectable artemisinin preparation
- Saline / glucose / dextrose for intravenous transfusion.
- Oxygen for serious and complicated cases.
- Antipyretics, anticonvulsants, diuretics, antibiotics.

Criteria for referral from PHC to referral / district hospital

Patients should be referred if they have any one or more of the complications of severe malaria, as given below, which cannot be managed:

- Cerebral malaria patients not responding to initial treatment with intravenous Quinine.
- Severe anaemia warranting blood transfusion.
- Bleeding and clotting disorder.
- Haemoglobinuria.
- Pulmonary oedema.
- Cerebral malaria complicating pregnancy.
- Oliguria not responding after correction of fluid deficit and administration of diuretics.
- Fluid electrolyte and acid base disturbance.

Patients with severe malaria who do not respond to antimalarials or those who worsen despite treatment should be referred. Referral should be more prompt in cases of pregnant women, postpartum women and children below five years with severe malaria, because they have a higher risk of complications. Safe referral transportation must be considered, e.g. patients should not be referred during shock.

Essential Facilities at referral hospital

The following facilities should be available at the referral centre to which severe malaria cases are referred:

- Specialized biochemical, radiological and microbiological tests
- Intensive care management and round-the-clock monitoring to deal with the critical illness
- Ventilatory support, particularly volume ventilator
- Blood transfusion
- Peritoneal dialysis

The PHC medical officer will send the case-sheet along with the patient, also indicating antimalarials administered, dosage and time of administration, reports of blood smears and other investigations for guidance to the second referral level. The staff in the PHC should explain to the patient's attendants the need for referral to a higher facility. There may be some patients/attendants who are reluctant for transfer. In such cases, the problems should be identified and the concerns and worries overcome. The common problems for reluctance to go to the hospital and their possible solutions are as follows:

Common problems for reluctance to go to hospital and solutions

Problems	Possible solutions
Attendant is not convinced about the seriousness of the illness	The harm that can occur if treatment is delayed must be explained. Local examples of patients with similar illness who suffered from complications or died because of delay in going to the referral centre may be cited. Some examples of those who went and got better may also be given
Attendant/patient is scared of the treatment and tests that are carried out in the hospital	The attendant/patient should be told what to expect. It should be explained clearly that the treatment is to help the patient get better. The injections, IV treatment and some of the tests do cause some pain but are helpful in the recovery of the patient
Attendant/patient does not have faith in the services provided at the referral hospital. They have heard of bad outcomes in other patients with similar illness	Local examples of the patients who have recovered fully following a timely referral may be given. It must be emphasized that the purpose of referral is to try to provide the best possible treatment that is in the best interest of the patient
The attendant/family has heard that the staff in the hospital is rude and they do not care	The attendant should be told that a referral card will be given to them. This will help the patient get prompt attention. If the staff in the hospital is known, then a telephone call can be made. Someone in the community who knows someone in the referral facility can also be useful
The attendant/family is worried about the expenses in the hospital for diagnostic tests and treatment and those incurred on transport and food	It should be explained that the charges depend on the family's capacity to pay. Poor patients can get free treatment or may be charged very nominally. The likely expenses should be estimated. It is also important to discuss how funds can be arranged. If needed, credit may be arranged. Some hardship is bound to occur but it has to be borne in the best interest of the patient
The attendant/patient is worried about who will look after the children and other members of the family if the attendant/patient were to be shifted to a hospital	The possibility of another family member or a neighbour looking after those who are left at home should be discussed. In the absence of relatives, help from neighbours or the community may be sought
The attendant/patient asks why the patient needs to be referred and why it is not possible to manage the patient in the PHC itself	The staff in the facility can treat many patients but not all of them. There are limitations like lack of facilities for blood transfusion, for doing some advanced laboratory tests and keeping a watch on the patient throughout the day and night
There are difficulties in transporting the patient	The staff in the health facility should provide assistance to the extent possible. Community support can be requested for rendering help. Transport may be provided free or on payment. The payment may be deferred if possible to reduce the hardship on the family

4.3: DISEASE SURVEILLANCE

Introduction

Programme monitoring enables continuous follow up of processes and outputs to identify problems at local level and help decision making where it is most needed. The importance of surveillance is that it provides actionable information related to disease trends. It is also important locally for the PHC team to assess the impact of malaria control activities and find prevailing gaps as well as for early detection of outbreaks. Correspondingly, at the district and higher levels, surveillance is useful in tracking disease burden over time and space and also to fine tune the planning.

Until now MPWs were involved in active case detection by house to house visit. Over the years shortage of these MPWs has lead to poor surveillance activity in the programme. The integration with NRHM and induction of Accredited Social Health Activist (ASHA), as the first point of contact with the health care delivery, has called for further modification of reporting requirements.

The above components provide data on case management, Vector control, programme management, coverage and utilization of services. The HMIS will only be discussed only in brief in this module. For further details, please refer the Operational Manual.

Recording and Reporting

Traditionally the programme has compiled epidemiological data through a system of sixteen manual reporting formats which are exhaustive in reporting. In the past few years the anti-malaria programme has undergone significant policy changes. Newer interventions including RDTs and ACT have been introduced at the peripheral level and bed nets have been distributed which will be scaled up rapidly in the coming years. It is important to closely monitor their utilization. For the purpose of routine recording and reporting the following M-1 to M-4, VC-1 to VC-12 formats and Programme Management Monitoring Report have been introduced.

1. Case Detection and Management

- M-1 : Report of Surveillance by ASHA/ MPW/ Health facility
- M-2 : Laboratory Request for Slide Examination
- M-3 : Record of slide Examination in PHC Laboratory
- M-4: Fortnightly Report of Cases From Subcentre/ PHC/ District/ State

2. Integrated vector Control

- VC-1: Primary record of IRS
- VC-1S: Wall Stencil
- VC-2: District IRS output Form
- VC-3: Primary record of bednet delivery and impregnation
- VC-4: Bednet Delivery and Impregnation form
- VC-5: District Annual Stock report on vector control supplies
- VC-6. IVM Plan - Block level

3. Programme management Monitoring Report

An overview of these records and reports is provided below. For the formats, please refer the Operational manual.

Case Detection and Management

A. Fortnightly Report of Fever Cases by ASHA/ MPW/ Health facility (M1)

This is the primary case record for all suspected malaria cases i.e it is actually a line list of all fever cases. This form is to be filled by any health facility/ worker which are directly involved in case detection and treatment. Therefore an ASHA or any other Community Volunteer, MPW and MO would maintain case record in this format. In M1, each row corresponds with one patient record. Serial No is filled in column 1 which is started fresh each month. Details of village, village code, name of fever case and Head of Family are entered in Col 2 to 5. Each village will be assigned a code for computer based data entry which is to be retained once and for all. In exceptional cases where a fever case is a visitor to the village, 991/ 992 is filled in the respective Col. Whether collection is during Active / Passive surveillance is filled as A or P in Col 6. For all purposes the ASHA/ CHV/ MO PHC will be passive agencies. Therefore in these cases the entry in Col 6 will be always P. It is only an MPW who can be involved in both types of collections. Fever cases coming to the MPW on their own will be entered as P while fever cases detected actively will be entered as A. Age is entered in Years/ months. Sex is to be entered as M for Male or F for Female. Duration of fever, date of RDT/ BSC, Slide No, sending and receipt of slides, result of examination of slides and RDTs, date of start of treatment, Nos of Tablets, referral and deaths if any are to be sequentially entered in the form.

Slide No is started fresh at the beginning of each year and continued over the subsequent months. Any positive test result is to be marked in red with a tick (✓). Entries up to Col 13 are filled for all patients at the time of first contact. If the RDT is positive, the blood slide need not be sent for examination and therefore Col 14 to 18 are to be skipped and are simply slashed (/). Treatment in such cases is started immediately for Pf. In cases where RDT is negative, blood slide is sent for examination and Col 14 to 18 are filled accordingly on receipt of results.

The lower part of the form consists of record of logistics. Opening balance at the beginning of the month, stock received, utilization and closing balance should be entered by ASHA or other service providers after physical verification of stocks. The ASHA/ CHV will fill M1 in duplicate and at the end of the fortnight, after allowing for 7 days for completion of patient records of the last few days of the reporting fortnight will forward the form to the Subcentre. In the middle of M1, the MPW will enter the summary of cases. The MPW will compile M4-SC by compiling the M1 of all ASHAs and adding his/ her own M1.

B. Laboratory Request Form for Slide Examination (M2)

Fever cases are diagnosed using RDT and/ or Blood Slide. In areas where RDTs are supplied, RDT and Blood slide are done at the same time. However, only if the RDT is negative, the blood slide is forwarded to Lab for further examination. Areas where RDTs are not supplied also rely on microscopy for diagnosis. M2 ie the Laboratory Request Form for Slide Examination, is filled in duplicate by ASHA/ DHV/ MPW whenever blood slides need to be sent to the Lab. In this form Col 1 to 7 are filled from M1

by ASHA/ CHV/ MPW. It is to be sent to PHC lab whenever required. Eg if 2 slides collected by an ASHA in a day, need to be examined, they are entered into M2 and sent to PHC Lab. The result of microscopy and feed back on smear quality are filled by the LT. All efforts should be made by LT to examine the slides on the day of receipt or the following day and send the results back to ASHA/ CHV/ MPW on the same day as examination of blood slides. The results obtained are entered into M1 by ASHA/ CHV/ MPW.

C. Record of slide Examination in PHC Laboratory (M3)

M3 is the Subcentre wise record, of slides examined in the PHC Lab. Slides reach the lab from the ASHA/ CHV/ MPW of the SC area. Slides will also be collected and examined for suspected malaria cases referred from the PHC OPD. Therefore at the beginning of each year, the M3 register is divided into sections for different subcentres as well as PHC OPD. In each subcentre section Serial Nos are started fresh at the beginning of each year. Record of slides sent along with M2 is entered serially into M3. As soon as M2 is received Col 3 to 10 are entered from M2 followed by the date of receipt. The date on which the slides are examined is entered in Col 2. The slide results are entered in Col 13, 14. The remarks column can indicate the quality of smear and other information like reasons of delay in examination.

D. Fortnightly Report of Cases (M4)

It is a village-wise/ provider-wise / subcentre wise monthly consolidation of all M1 forms belonging to a subcenter/ PHC area. The M1 is received by the MPW from ASHAs/ CHVs after 7 days of completion of the reporting fortnight. The MPW then compiles all M1s of his subcentre area into M4. During compilation the Subcentre MPW will fill out aggregates of each health care provider in Subcentre area in one row and in the last row enter the compilation of his own M1. The report is made in triplicate and 2 copies are forwarded to PHC on the 25th of the month for the 1st fortnight and 10th of the following month for the 2nd fortnight. The PHC does a Subcentre wise compilation in a similar M4 format and in the penultimate row enters the consolidation of PHC M1. The PHC forwards its M4 along with one copy of M4s submitted by Subcentres on the 28th of the month for the 1st fortnight and 13th of the following month for the 2nd fortnight, to the district. The district further compiles this data and sends a PHC wise report to the state on the 30th of the month for the 1st fortnight and 15th of the following month for the 2nd fortnight. The state will send the compiled report to the Centre on the 5th of the following month and 20th of the following month for the 2nd fortnights. The district is required to enter Subcentre wise data from M4 of PHCs into NAMMIS as soon as the reports are received to avoid delay in transmission of reports.

Integrated Vector Control

A. Primary Record of IRS (VC 1)

This record is to be maintained by the Spray supervisor/ Superior Field Worker (SFW) and is a house wise record of spray activity undertaken in the village. One such record is maintained for each Village in each round. VC 1 is submitted to MPW within one week of completion of the respective IRS round as per schedule. The details on village name, village code, date of spray, Round, Spray squad No, Spray supervisor are to be entered in the left upper corner of the format. Similarly summary of the coverage is given in the right upper corner of the format. The lower part consists of the house wise log of room coverage. As soon as IRS is completed in the village VC1 format is submitted by the Superior Field

Worker (SFW) to the PHC-MO where a village and subcentre wise compilation is done by PHC-MO with assistance from the Health Supervisor.

Wall stencil (VC 1S)

Wall stencil (VC 1S) is to be written by SFW on each house after the house has been sprayed. Date, round, insecticide and Squad No. are written as applicable. In SR/ TR the No of rooms sprayed/ Total no of rooms, is entered.

B. IRS Output Form (VC2)

The IRS Output Form (VC 2) is the IRS report to be generated by the PHC & District. It is a village/ Subcentre/ PHC wise compilation of VC1 formats received from the SFWs. As soon as the VC 1 of a village is received, the entire information is transferred into VC 2. It is to be filled in duplicate. Once the spray is completed in the PHC area all the VC1s should be entered into VC2. The PHC-MO shall submit one copy of VC 2 within 15 days of completion of spray in the PHC area to the district and the second copy is retained by the PHC. The DMO shall do a similar PHC wise compilation at the district and send the report within 15 days to the State. The state level report should reach NVBDCP within 45 days of completion of the Round.

C. Primary record of bed net delivery and impregnation (VC3)

The Primary record of bed net delivery and impregnation (VC3) is village level record of bednets available in the households and the details of house wise distribution and impregnation of nets. Prior to the onset of the transmission season the MPW (M) with assistance from ASHA/ AWW/ CHVs will undertake a survey in villages of his subcentre area to enumerate the no. of nets available at the household level. The top left corner of the form pertains to information on the dates of survey, impregnation & distribution of bed nets, village name, SC etc. The house wise details of activities are listed in the middle part. The total requirement of bednets in each household is listed in Col. 4. House wise enumeration of ITNs and LLINs available at the beginning of the current year is done in Col. 5 & 6. This information is filled based on the information available from village survey undertaken by MPW (M). Col 7 & 8 pertain to the actual no. of ITNs/ LLINs distributed in the village in the current year. The total no. of ITNs (available in Col. 5 & 7) in each house impregnated in the current year is entered in col. 9. Based on the no. of bed nets available, distributed and impregnated the no. of effective bed nets in each house hold is estimated in col. 10. The top right corner is a summary of bed net coverage in which % houses with at least two effective nets is entered. The stock status of synthetic pyrethroids is summarized in the lower part of this form.

D. Bednet Output Form (VC 4)

Bednet Output Form (VC 4) is a village/ subcentre/ PHC wise compilation of Bednet impregnation and distribution activities. The village level VC3 is submitted by MPW (M) to the PHC at the completion of bed net distribution and impregnation activities. As soon as VC3 from a village is received it is entered in VC 4. VC4 is filled in duplicate. Once the activities are completed in the entire PHC area and VC4 format has been filled it is sent to the DMO within 15 days of completion of all activity. One copy is retained at the PHC for its own record. The DMO consolidates these reports in next 15 days and sends

it to the state. The State should compile and forward the report to NVBDCP. The state report on Bednet Delivery and Impregnation should reach NVBDCP within 45 days of completion all activity in the state.

E. District Annual Stock report on Insecticides (VC 5)

The district should furnish the detailed PHC wise stock report on insecticide usage during the year in VC 5. The report corresponds with the Calendar year (1st January to 31st December). The columns are self explanatory. The report should be compiled by the district from PHC stock registers within 15 days of completion of the reporting year. The state should compile and forward the report within 30 days of completion of reporting year to NVBDCP. The Annual Stock Report on Insecticides for the year 2008 should reach NVBDCP by 31st January of 2009.

F. District LLIN Log (VC 6)

Data on annual distribution of LLINs is entered into District LLIN Log (VC6) at the end of each year from VC4. For the annual planning, the cumulated number of LLINs is calculated from VC6. For LLINs with an expected effective life of 3 years sum the numbers distributed over the last 2 years is taken. When planning for 2011, the numbers distributed in 2009 and 2010 should be used (LLINS distributed in 2008 will expire during 2011 and must be replaced). For LLINs with an expected effective life of 5 years sum of the numbers distributed over the last 4 years is taken. When planning for 2011, the number distributed in 2007-2010 are added. LLINs delivered through ANC must also be included. If LLINs with two different durations are included, use two separate forms for keeping log. Besides when planning for LLIN distribution, the village level bednet surveys undertaken to enumerate the nos existing in each village also needs to be undertaken.

Programme Management Monitoring Report (PMMR)

This report is to monitor progress made on different programme processes and other management issues. Update on Training status of the staff as well as the trainings conducted, field visits & reviews conducted and reviews undertaken as well as situation of logistics & stock outs are to be provided on a quarterly basis. The format is given in the Operational Manual. It has the following sections:

- Part A: Field visits & reviews
- Part B: Quality of service delivery
- Part C: Training Activity
- Part D: BCC Activity for Malaria Control
- Part E: Status of Logistics

A new cadre of Monitoring and Evaluation (M & E) staff in the form of Malaria Technical Supervisor (MTS) is being appointed at sub-district level. It is also envisaged to implement Lot Quality Assurance Sampling (LQAS) based system of annual/ biannual/ quarterly surveys to obtain quality data on availability of diagnosis & treatment within 24 hours, on utilization of bed-nets and quality of IRS coverage and reasons for non-acceptance.

A network of sentinel sites are being established which will provide data on trends of severe malaria and deaths due to malaria; 1-2 sentinel sites will be established in each high endemic district.

The data collected through the system of HMIS consists of volumes of information but this is of little use, unless it is converted to relevant information through the application of intelligence. Indicators are therefore derived from this data and are used as variables that indicate a particular condition or situation. These indicators point towards programme performance in different areas and help identify problem areas to enable corrective action. The monitoring indicators that are used in the programme are given in the following table.

Table: Monitoring Indicators

No	Area	Indicator	Definition	Frequency	Source
1.	Surveillance/ case finding	No of Fever cases No of Malaria cases No of Pf cases	Fever cases screened Malaria cases diagnosed Pf cases diagnosed	Fortnightly/ Monthly/ Annual	M1, M4-SC, M4-PHC
2.	Surveillance/ case finding	Monthly Blood Examination Rate (MBER) (should be more than 1%of population during the transmission season)	Number of blood smears examined & RDTs positive in a Month / Total Population X 100	Monthly	M4-SC, M4-PHC
3.	Surveillance/ case finding	Annual Blood Examination Rate (ABER) (expected to be more than 10%of population)	Number of blood smears examined & RDTs positive in a year / Total Population X 100	Annual	M1, M4-SC, M4-PHC
4.	Disease burden & impact	Annual Parasite Incidence (API)	Total No. of positive blood smears & positive RDTs for malaria Parasite in a year / Total Population X 1000	Annual	M1, M4-SC, M4-PHC
5.	Disease burden & impact	Annual Falciparum Incidence (AFI)	Total No. of blood smears & RDTs positive for Pf malaria Parasite in a year / Total Population X 1000	Annual	M1, M4-SC, M4-PHC
6.	Disease burden & impact	Test Positivity rate (TPR) (Test = Slide+RDT) Is independent of surveillance activity, therefore a better indicator for impact assessment	Total No. of positive blood smears & positive RDTs for malaria Parasite / Total No. of blood smears examined & positive RDTs X100	Monthly, Cumulative for the year	M1, M4-SC, M4-PHC
7.	Disease burden & impact	Test falciparum Rate (TfR) It is independent of surveillance and indicates Pf preponderance	Total No. of blood smears & RDTs found Positive for <i>P.falciparum</i> / Total No. of blood smears examined & positive RDTs X 100	Monthly, Cumulative for the year	M1, M4-SC, M4-PHC
8.	Disease burden & impact	Pf Percentage (Pf %) Indicates trends in proportion of cases due to Pf out of total cases	Total No. of blood smears & RDTs found Positive for <i>P.falciparum</i> / Total No. of positive blood smears & positive RDTs for	Monthly, Cumulative for the year	M1, M4-SC, M4-PHC

			malaria parasite X 100		
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There is a complete range of indicators reflecting programme areas like case finding, disease burden, programme management etc. The requirement of indicators, at each level of health care delivery, is very specific. At the lower levels like PHCs and Districts indicators are utilized for local decision making while at the National level they are more relevant for policy making and assessing the overall progress. A complete list of levels of health care delivery along with the indicators to be determined at each level is laid down in **Table 3**. Each level of health care delivery is to be encouraged to analyse data based on these recommendations on a regular basis. For details on input, process, output and outcome indicators, please refer the Operational manual.

Table: Monitoring at different tiers of Health Care Delivery

No	Health Care Level	Programme Area	Indicator (Source of Indicator)
1.	Village - ASHA/ other Community Volunteer	Surveillance/ case finding	- No of Fever cases (M1) - No of Total Malaria cases (M1) - No of Pf cases (M1) - No of RDTs used (M1) - No of slides sent to laboratory (M1) - No of ACT Blister Packs used (M1)
		Programme Management	- No of bednets impregnated - No of houses assisted in acceptance of spray operations
2.	Subcentre (MPW- Male/Female)	Surveillance/ case finding	- No of Fever cases (M4-SC) - No of Malaria cases (M4-SC) - No of Pf cases (M4-SC)
		Programme Management	- MPW in position Yes/ No - Trained MPWs Present Yes/ No - No of RDTs received & used (M4-SC) - No of ACT Blister Packs received & used (M4-SC) - No of ITNs/ LLINs distributed (VC 4) - Bednets Treated (VC 4)
		Outcome	- IRS Coverage – Population (%) (VC 2) - IRS Coverage – Rooms (%) (VC 2) - % of Eligible population Covered by ITN(VC 4)
3.	PHC	Surveillance/ case finding	- Monthly Blood Examination Rate (ABER) (M4-PHC) - Annual Blood Examination Rate (ABER) (M4-PHC)
		Disease Burden/ Impact	- No of Fever cases (M4-PHC) - No of Malaria cases (M4-PHC) - No of Pf cases (M4-PHC) - Annual Parasite Incidence (API) (M4-PHC) - Annual Falciparum Incidence (AFI) (M4-PHC) - Test Positivity rate (TPR) (M4-PHC) - Test falciparum Rate (TfR) (M4-PHC) - Pf Percentage (Pf %) (M4-PHC)
		Programme Management	- No of RDTs received & used (M4-PHC) - No of ACT Blister Packs received & used (M4-PHC) - % of MPH/ASHA/other volunteers trained for use of RDT / ACT (PMMR) - % of Diagnostic facilities functional with microscopy/RDT in the last reporting period (PMMR) - % of spray Equipment in working condition (VC 2) - Insecticide use (VC 2, VC 5) - No of ITNs/ LLINs distributed (VC 4) - No of BCC Activities (PMMR)

		Outcome	<ul style="list-style-type: none"> - IRS Coverage – Population (%) (VC 2, VC 3)) - IRS Coverage – Rooms (%) (VC 2, VC 3) - % of Eligible population Covered by ITN (VC 2, VC 3) - % of Eligible villages with more than 80 % population Coverage with ITNs-Bednets Treated (VC 4) - % of house holds in which beneficiaries reported having slept under ITNs/LLINs previous night (PMMR) - % of fever cases who were tested for malaria by microscopy/ RDT with a positive test result for RDT and were started on treatment no later than the next day with ACT (PMMR)
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Interpretation of Indicators

The main disease incidence indicators listed in Table 2 can be calculated from the data available from M4 for virtually any level, from village to national level. All suspected cases of malaria in the country (or district or village) are captured in M1 and consolidated correctly into M4, the resultant indicator values for API, TPR etc. are then calculated based on the formula described. All surveillance and disease burden indicators should be assessed for an increase or decrease from the previous year. When the current year is being considered the corresponding period of the previous year is used for comparison. API of More than 5%, TPR of more than 5%, Pf% more than 50% should always raise an alarm. These indicators are also used to identify high risk areas and identify areas to be focused on priority. Sudden increase of fever incidence in community, OPD fever rate and malaria incidence along with rise in TPR above 5% may indicate an impending outbreak. When assessing the coverage of IRS or ITN at least 80 % coverage of targeted population should be the acceptable cut off. Service delivery or utilization below this should be considered inadequate.

Data Quality

Under the programme it is important to ensure that the data collected through reports should be complete, accurate and consistent. This is possible only when records are maintained immaculately on a regular basis and a system of verification of reports exists. Therefore, the quality of data is the responsibility of the Officer Incharge/ signing authority. Whenever reports are compiled the signing authority should validate a sample of records and reports e.g. the BMO should recheck the compilation of M4 of all Subcentres into M4 at PHC each month. It is also necessary to verify data during onsite visits of villages, subcentres and districts. During field visits the supervisory staff like MTS, PHC/ District /State/ Centre level personnel should make an effort to crosscheck M1 for the individual patient records and visit patients diagnosed and treated in the previous month. Similarly a sample of reports should also be reworked from the records to check for their validity. The reports should also be tracked for timeliness and complete each time they are received. The time schedule for each report is mentioned below.

Table: Time Schedule for reports

S. No.	Report	Time Schedule
1	Fortnightly Report by ASHA/ Community Health Volunteer/ MPW/ PHC (M1)	Ist Fortnight- 21 st of the month IInd Fortnight- 7 th of following month
2	Fortnightly Report of cases (M4-SC)	Ist Fortnight- 25 th of the month IInd Fortnight- 10 th of following month
3	Fortnightly Report of cases (M4 PHC)	Ist Fortnight- 28 th of the month

		IInd Fortnight- 13 th of following month
4	Fortnightly Report of cases (District)	Ist Fortnight- 30 th of the months IInd Fortnight- 15 th of following month
5	Fortnightly Report of cases (State)	Ist Fortnight- 5 th of the months IInd Fortnight- 10 th of following month
6	IRS output (VC2) – Round wise	PHC – 15 days of completion of Spray
7	Bednet Delivery and Impregnation form (VC 4)	PHC – 15 days of completion of activity

Supportive Supervision:

Supportive supervision is a continuous process which aims to increase the knowledge, develop the skills, improve the attitude and enhance the motivation of the health care functionaries. Supportive supervision is not an instrument for fault finding but aids in identification of problems, solving them and improving performance. It provides an opportunity to the supervisor and health workers to identify and address weaknesses together, thus preventing poor practices from becoming routine. Progression from traditional to supportive supervision may require changes in attitudes, practices and perceptions on the part of supervisors.

The protocol of supervision for each level of staff is given in table below.

Table 5 : Supervisory protocol for staff under NVBDCP

Level	Staff	Frequency
Sub Centre	MPHW (F); MPHWF(F)	Visit 1 ASHA per village during their visit & 2 patients treated by her in the last one month (checked from her record) Supervise IRS rounds in their villages as per Supervisory Schedule for IRS
PHC	MPHS (F); MPHS(M)	As per their supervisory schedule visit all subcentres in the PHC During visit to subcentres, try to visit remote villages and interview ASHA and 2 patients treated by ASHA in the last one month (checked from her records) Supervise IRS rounds in their villages as per Supervisory Schedule for IRS
	MO	Visit all subcenters in the PHC once a month During visit to subcentres, try to visit remote villages and interview ASHA and 2 patients treated by ASHA in the last one month (checked from her records) Supervise IRS rounds in their villages as per Supervisory Schedule for IRS
Block PHC CHC/FRU/Sub Dist. Hosp.	MPHS (F); MPHS(M); MO	As described above
	MO	Visit all PHCs & microscopy centres in the area of Block BHC once a month Monitor sentinel sites once a month Visit all Subcentres once in 2-3 months During visit to subcentres, try to visit remote villages and interview ASHA and 2 patients treated by ASHA in the last one month (checked from her records) Supervision of IRS rounds in the area of Block PHC
	Malaria Technical	Visit all PHCs and microscopy centres in the Malaria Unit

Level	Staff	Frequency
	Supervisor (where deployed)	(MU)once a month Visit all sentinel sites in the MU once a month Visit all subcentres once in 2 months; visit all villages once in 6 months During visit to subcentres, try to visit remote villages and interview ASHA and 2 patients treated by ASHA in the last one month (checked from her records) Supervise IRS rounds in the area of MU, especially the remote and operationally difficult areas Further details are given in the Training Module of Malaria Technical Supervisor (MTS), The Checklist to be used by the MTS is given in Appendix 4

To Establish Supportive Supervision

A. Improve performance

- Use a protocol/standard operating procedure including a supervisory checklist for each type of unit supervised.
- Conduct supportive supervisory visits also within health care facilities you are in charge of.
- Provide staff with updates on policies or new recommended practices. Undertake on-the-job training see above supported by guidelines, manuals, visual aids.
- Plan supervision schedule in advance and communicate it to all those, who need to know. Lesser performing health facilities should receive extra or lengthier visits, so make sure that the initially planned schedule has slack time for this.
- Plan these visits as much as possible, when it is possible to observe the staff and interview patients. Talk to patients about the quality of services, preferably away from the health facility.
- Plan to spend sufficient time (from several hours, to a full day or more) to conduct the supervisory visit to each unit. Rushed visit with no time for dialogue are inefficient.
- Follow up on recommendations made during previous visits. Discuss progress with the health facility
- Check the stocks and the condition of equipment. Compare stocks with records. Are storage conditions correct? If not, help find solutions. Carry materials, and supplies for the health facility according to requests made or needs identified at previous visit.
- Review health facility records. and provide feedback to the staff as well as MO in charge.
- Analyse programme indicators for the health facility to make the performance objective and measurable.
- Involve the community in the evaluation process. Ask community members how they are treated when they visit the facility. Talk to community leaders during the visit to get their feedback and identify jointly, what the community can do.
- Find out, if the relationship between community and health workers is good; if not, find out what is wrong and remedy the situation.
- Discuss strengths and weaknesses, and actions to be taken (by whom and by when).
- Identify gaps and solve problems in positive ways

- Praise health workers in public for good performance and for practices that meet quality. Correct performance only through person-to-person contacts.
- Work with other health programmes to coordinate supervisory activities in a spirit of mutual support.
- Schedule a return visit before leaving the site.

B. Maintain and enhance motivation

- Give praise and recognition to health workers for what they are doing right.
- Involve health workers in planning and encourage health facility supervisors to work together with their staff.
- Take part in staff meetings if possible. Talk to staff about their work situation, needs and ambitions.
- Act on feedback from the health workers, health workers will feel valued that they have an impact. Show that you trust them (as much as you actually do)
- Establish monthly meetings with all health facilities within a district. This provides an opportunity for health workers to learn new approaches and strategies used in different health facilities and to receive continuing education. It can also be a forum to acknowledge their achievements.

C. Build sustainability

- Collect data on positive results gained from supportive supervision, such improved performance of health workers, improved coverage of IRS, better treatment etc.
- Develop a team approach to increase supportive supervision at the health facility and make it a routine procedure, with or without frequent visits from the central or district level.
- Health facility staff can develop supervision plans that fit their structures and conduct regular self-assessments to monitor their performance.

Active case detection (ACD) and passive case detection (PCD)

The new norms for case management emphasize and maximize quality care for patients. Quality care is expected to attract more patients to come early and will therefore strengthen surveillance through passive case detection (PCD).

In villages where there is no trained provider of early diagnosis and effective treatment, active case detection (ACD) must be implemented with regular, preferably weekly visits by a health worker, who provides case management. Such a service, though not ideal, can deal with many cases of suspected malaria and should also serve as a stimulus for villagers to help establish a permanent curative service.

The RDTs will contribute to the ABER, and the results will contribute to the test positivity rate. With the measures proposed, the program expects PCD to increase and ACD to decrease over time. In high-burden areas, the ABER obtained through PCD would already be well above 10%. ACD should not be used to achieve an annual blood examination rate (ABER) above 10%, but to provide coverage to underserved areas. To improve the monitoring of the malaria situation and the provision of quality services, malaria data for ACD and PCD must be distinguished at all levels.

With improved access to quality case management, the incidence of severe malaria and in-patient malaria should decline, as should malaria deaths. To capture these trends, sentinel surveillance will be established, focusing on a few facilities with indoor patient care in each district. Paradoxically, improvement of case management, by attracting more patients, could lead to a temporary increase in the annual parasite incidence (API). This should not be a cause of concern, as long as the test/slide positivity rate does not show a marked increase. In the longer term, the use of ACT should help reduce transmission and thereby lead to a reduction of the annual falciparum incidence (Afl) because of the anti-gametocyte effect of artesunate.

As before, health staff will monitor fever and suspected malaria cases to detect outbreaks early. Fever surveillance will be integrated with the weekly schedule of Integrated Disease Surveillance Project (IDSP). The emergence of early warning signs depend on local conditions and can be best obtained with the support of local staff.

Outbreak detection and response

An epidemic is defined as the occurrence of a disease of similar nature in the community clearly in excess of normal expectancy. The term 'outbreak' is usually used for a small, localized epidemic when the number of cases is not very large. ASHA/volunteers will be trained to immediately report any "unusual" increase in fever cases to the nearest subcentre (MPHW) or PHC (by phone or even by going personally

- Malaria is a seasonal disease; incidence fluctuates from year to year and in different seasons.
- Malaria incidence in different paradigms shows wide fluctuations.
- These fluctuations, usually, are not of great importance, if the appropriate control measures are regularly implemented.
- If control measures breakdown prior to or during transmission period, local epidemics/focal outbreaks occur.
- If control measures inadequate over a number of years even in low transmission areas, explosive focal outbreaks may result.
- The length of transmission period, and poor quality of control measures, parasite species, distribution and the intensity of epidemic differs from area to area and year to year.
- In areas with low transmission potential for a shorter period, epidemics are of *P.vivax*.
- In areas with high transmission potential over longer duration in early duration in early period *P.vivax* predominates, later on *P.falciparum* takes over. High morbidity & mortality in the community.
- The MO-PHC should monitor the epidemiological parameters to undertake advance action, if epidemic potential builds up.

Key factors to be monitored for prediction and early detection of malaria outbreaks

Change in parasite load

- No. of fever cases
- No. of malaria positives
- Species distribution.

Vector Dynamics

- Increase in mosquitoes density

- Vector density
- Man mosquito contact

Population Dynamics

- Influx of migrants from non-endemic to endemic areas and vice-versa
- Tropical aggregation of labour in projects
- Large labour movement to forest or for agriculture
- Population migration during floods and drought

Environmental / Climatic Conditions

- Early and heavy rainfall in pre-transmission period
- Increased humidity
- Natural disasters like
 - Floods
 - Drought causing river bed pools
 - Earth quake, etc.

Monitoring of malaria incidence

- MO-PHC should keep a watch on the incidence and trends of malaria in the community
- Malaria incidence of the current month should be compared with the incidence during the same month of preceding year(s)

Sources of information on malaria incidence

- Rise in malaria positivity rate in the laboratory examination
- Rising fever incidence reported by
 - ASHA / FTD holder / MPW
 - Medical practitioner of the area
 - NGO / CBO / FBO
 - Community leaders / members
 - Press
 - Legislature

Cross checking of laboratory results

- The high positivity rate in the laboratory should be confirmed by cross-checking of the positive slides by an independent Laboratory Technician or by MO-PHC him/herself.
- If the laboratory diagnosis is not correct, check the laboratory equipment, staining and the results of backlog slides.
- If there is low slide positivity rate as per the laboratory, but there is high fever rate as seen by number of blood slides examined, the MO-PHC should clinically find the cause of high fever rate or get the necessary investigations done.
- If high number of clinical malaria cases is observed, then MO-PHC should check the records to verify domiciliary visits
- If some villages had not been visited by MPW (Male) for a long time, a rapid fever survey should be carried out

If an epidemic is predominantly due to *P. vivax*, then it is almost certain that the first round of IRS had not been carried out or the coverage was poor. It can also be surmised that case detection and drug distribution have not been done properly for at least 2 – 3 months.

Follow up Action

- Carry out mass survey or rapid fever survey
- Two follow-up surveys: first survey 21 days of remedial measures and the second survey 21 days after the first survey
- Strengthen the case detection mechanism
- Activate all FTDs and VLWs
- Investigate cause of epidemic by an epidemiological investigation to find out:
 - Influx of migratory population which was not covered by routine control measures
 - Breakdown of regular malaria control operations
 - Unusual natural calamities such as floods, heavy rains, drought with opening up of relief camps etc.

Survey method

The MO-PHC shall make arrangements for delineation of the epidemic area and to find out the extent and severity of the epidemic and immediately inform the mobile epidemic control team.

Rapid Fever Survey

Every village in the suspected zone is covered and only cases of fever and cases with history of fever are taken up. The area of survey should be expanded centrifugally from the epicenter of the outbreak till areas with normal positivity rates are reached. It is advantageous to establish field laboratories by pooling laboratory technicians and staff from all sources. The survey should be over in 7 to 10 days.

- RDT tests for *P. falciparum* should be done immediately and those found positive will be administered the first day dose of ACT; Therapy will be continued for 3 days.
- Blood smears taken should be examined within 24 hours
- All age groups should be covered, especially children, pregnant women and migrants
- All persons whose blood smear has been taken for microscopy should be given clinical treatment with 3 day course of chloroquine; appropriate, complete treatment will be given to all those persons who test positive.

Mass Survey

As an alternative, mass survey of the entire population shall be carried out irrespective of age, sex and fever status.

Duration of Epidemic Control Measures

The entire exercise should be completed in a period of 7 to 10 days and in any case not exceeding a fortnight

Materials required for diagnosis and treatment

- 4 aminoquinolines - Population x 3 (in terms of 150 mg base tablet)
- Primaquine - Population x 18 (in terms of 2.5 mg base tab)
- Microslides - Population x 1
- No. of microscopists - $\frac{\text{Population}}{50 \times 7}$
- No. of microscopes - One per microscopist
- Cotton, Spirit/Savalon, Slide Boxes, Prickling Needles, Stationery, etc. to be procured on ad-hoc basis
- J.S.B. stain, other material for cleaning and packing of slides, etc. on ad-hoc basis

Anti-Vector Measures

Space spray

Do not wait for completion of survey in the entire area. Space survey should be started as soon as survey results of a village are available. Other villages are included as soon as their survey results are available. Every house in the epidemic villages should be covered. Indoor space spray should be carried out for 7 to 10 consecutive days or till the residual insecticidal spray in all house of the locality is completed.

- Formulation- 1 litre of 2% Pyrethrum extract diluted with 19 litres of kerosene oil (or any other formulation readily available like Finit, Hexit or Baygon etc.)
- Dosage - 15 to 30 cc to be sprayed in 30 cubic meters of space
- Equipment - Hand operated micro-discharge fogging machine/atomizers (Flit gun)
- Timing - Preferably early morning or late evening hours
- Precaution - Close all doors and windows and other openings before space spray

Residual insecticidal spray

The indoor residual insecticidal spraying operation should be started simultaneously with indoor space spray. The insecticide of choice will be the insecticide to which the local vector is amenable to control. Apply the recommended dose of insecticide chosen to all human and mixed dwellings

No. of spray squads for residual spray operations

Plain Area $\frac{\text{No. of houses in the village targeted}}{600}$ = No. of spray squads

@ 30 houses per pump per day

Hilly Area $\frac{\text{No. of HD \& MD in the villages targetted}}{\quad}$ = No. of spray squads

500

@ 20-25 houses per pump per day

- Field workers: No. of squads x 5
- Superior Field Worker: No. of squads x 1
- Stirrup Pumps: No. of squads x 2 plus one pump as reserve for 2 squads
- Bucket (3 gallon): No. of squads x 3
- Bucket (2 gallon): No. of squads x 1
- Soap, straining cloth, nozzle tips, measuring jug, rope & pump repair kit: as required

Other Measures

If the epidemic is due to predominance of vector breeding in water storage tanks or in peridomestic water collections, undertake anti-larval measures along with space spray and residual spray. Detailed entomological investigation may be carried out later to ascertain the susceptibility status of the vector(s).

Tracking malaria deaths

All deaths due to malaria and suspected malaria must be investigated by the MO-PHC. If the death due to malaria occurs in a hospital or dispensary, the DMO or MO-PHC should be informed within 48 hours by the treating physician. If the death in a village is detected by the ASHA/volunteer/MPHW, the same shall be informed immediately to MO-PHC. The MO-PHC shall investigate the death within a month after receipt of information. It is essential to elicit correct information regarding residence to take appropriate remedial measures. The history should establish the date when the first symptom of the disease was noticed either by patient or this attendants. The following three important aspects should always be looked into before filling up the death certificate:

- *P.falciparum* only is the direct cause of malaria death.
- The direct cause of death cannot be attributed to *P. vivax* or *P. malariae* infection.
- In many seriously ill patients malaria infection can be a concomitant infection.

It is necessary to fill all the sub-items in the chronological order of events. In case the postmortem was performed on the deceased, the details of postmortem must be recorded. Full details of remedial measures taken by the MO-PHC with results of surveys and details of spray carried out will also be recorded. A copy of the investigation report along with the key for filling is given in the following pages.

Annexure

INVESTIGATION REPORT ON DEATH DUE TO MALARIA

(The investigation should be carried out by the District Malaria Officer, Assistant Malaria Officer or MO-PHC only. An investigation carried out by a person below these ranks will not be valid)

1. Basic information

- 1.1 Date of Death _____
Time of Death _____
- 1.2 Name and Surname of the deceased: _____
- 1.3 Age _____
- 1.4 Sex (In adult female, indicate status of pregnancy and its complications, if any) _____

- 1.5 Address (usual place of residence)
 Head of family: _____
 House No: _____ Street: _____
 Village/Town: _____ District: _____ State: _____

1.6 Occupation of the deceased:

2. Case history of illness

- 2.1 Source of information:
 Relatives (specify relationship):
 Paramedical staff (specify by designation):
 Treating Physician (specify by qualification):
 Any other (specify):

2.2 Date and hour of onset of illness:

2.2.1 Total days of illness:

2.3 Signs and symptoms at the time of onset of the illness (Tick mark those present) – Fever (intermittent) / Fever continuous / Rigor/ Headache / Diarrhoea / Vomiting / Blood in Stools / Suppression of Urination / Abnormal behaviour/ Convulsions / Blurring of vision / Unconsciousness
 Others (specify)

2.4 Place where disease started:

2.4.(a) Usual place of residence Yes/No

2.4.(b) If no, give address:

2.5 History of movement / specify halting station(s) during preceding 3 weeks from the date of onset of illness

Date of departure from residence

Halted at _____

- during first week
- during second week
- during third week

2.6 Referred to Hospital / PHC / Dispensary (Tick mark whichever is applicable)

2.6.1 Date of reference: _____

2.6.2 Name of Medical Institution: _____

2.6.3 Date of consultation with Private Practitioner(s)

2.6.4 Name and qualification of the Private Practitioner(s).

2.6.5 Treatment / investigation / advice by Private Practitioner(s).

3. Parasitological investigation and treatment

3.1.1 Date of blood slide collection.

3.1.2 Date of treatment given.

Name of drug	Dose
--------------	------

- 1.
- 2.

3.1.3 Blood slide collected by whom and where:

FTD/MPW / Lab.Technician / Supervisor or others (specify)

3.1.4. Date of Blood slide examination:

3.1.5 Name of the Laboratory where examined: _____

Or the case had acquired infection in *P. falciparum* predominant area as ascertained by history of movement at (Name of place)

Exception – if the locality/area does not have *P.falciparum* focus as confirmed during implementation of remedial measures or *P.falciparum* infection is not encountered in contact and mass survey cases, the death should not be labeled as death due to malaria on clinical grounds alone.

4.3 Postmortem details, if undertaken:

5. Remedial measures undertaken:

Period from _____ to _____
Implemented in place where person had fallen sick or in the area where he might have contracted the infection or both.

5.1 Contact survey date

Number of blood smears collected:
Number of blood smears examined:
Number of blood smears positive:

Results species: *P. falciparum* *P. vivax* *P. malariae* Mixed

5.2 Mass survey: Date:

Number of blood smears collected:
Number of blood smears examined:
Number of blood smears positive:

Results species: *P. falciparum* *P. vivax* *P. malariae* Mixed

5.3 Focal spray (specify)

5.4 Mass drug therapy (specify) population and coverage

5.5 Any other measure (specify)

Name and Signature of Investigator:

Designation:

Date of Investigations:

Key for filling investigation report on death due to malaria

The investigation report in case of death on account of malaria infection is necessary to confirm the epidemiological factors and operational failures resulting in the death of patient due to this disease.

It may be clearly understood by the investigating officer that:

1. In case of infection with *P.vivax* and *P. malariae* death does not occur as a direct consequence of infection with malaria parasite.

2. Only in the case of *P. falciparum*, death occurs as a direct consequence of malaria infection, because of the pathological changes produced by the parasite in the human body.

3. Therefore, unless the deceased had been found positive for *P. falciparum* infection, a case should not be labeled as death due to malaria.
4. The pathological changes noticed in *P. falciparum* are preventable and reversible, if treatment with appropriate antimalarials is administered in time.
5. However, in case of epidemic with a predominance of *P. falciparum* infection in the community, if the blood smear of a death case could not be examined, the circumstantial evidence from signs and symptoms may indicate that the patient might have died due to *P. falciparum* infection, or the death has occurred because treatment with antimalarials was started too late.
6. The investigation report on death due to malaria should reach all concerned within 7 days of the completion of investigation. The investigation should be carried out by the District Malaria Officer / Assistant Malaria Officer, Medical Officer of the PHC or an officer of similar rank and qualifications. Any investigation carried out by any other officer below these ranks will not be valid.
7. Most of the items on the proforma under basic information are self-explanatory. If the illness has started at some place other than usual place of residence under item 2.4, the history of movement should start from the usual place of residence of the patient terminating at the place where the patient became sick for the first time, and three weeks prior to sickness these addresses are to be recorded against 2.4 (b) and movement traced back to usual place of residence. The history of movement is given along with halting stations. In case the patient dies at his usual home, it is still necessary to record history of movement during last three weeks to pin-point the place where infection was acquired.
8. It is necessary to indicate whether the patient has been seen by a medical practitioner as given under item 2.6.4 and 2.6.5. If death occurs in a medical institution, then date of reference to the institute under 2.6.2 is entered.
9. Under item 3.1.8 and 3.1.9, there is a mention of date of communication of result to the periphery and radical treatment, if any. Normally it is not expected that a person would die or develop serious complications after having received full antimalarial treatment along with radical treatment with primaquine. But in a very rare case, if this has occurred, it is essential to understand the sequence of events. Therefore, date of collection of blood smear, examination, presumptive treatment and radical treatment are necessary and they should be filled by the investigator after fully satisfying himself with the accuracy of information.
10. Under item 3.2.3, evaluation of clinical progress date-wise is to be given for the entire period of stay in the hospital. Usually these remarks are given in the case sheet by the physician treating the case. They should be copied verbatim in this proforma.
11. Under item 5, "remedial measures undertaken", the investigator would look into the records of the District Malaria Officer or PHC Medical Officer to find out what remedial measures were implemented in the place where the person had fallen sick, or in the area, where on the basis of epidemiological investigation, he might have contracted the malaria infection. If remedial actions were taken in both areas, details as given under item 5, should be entered in respect of both the places.

4.4: STRATEGIES FOR TRANSMISSION CONTROL

The concept and scope of integrated vector management

Integrated Vector Management (IVM) has been defined by WHO as a rational decision making process for the optimal use of resources for vector control. IVM entails the use of a range of biological, chemical and physical interventions of proven efficacy, separately or in combination, in order to implement cost-effective control and reduce reliance on any single intervention. In most high-burden areas, long-term measures targeting adult mosquitoes are more generally effective and applicable. Two such methods are available: Indoor Residual Spraying (IRS) and Insecticide Treated mosquito Nets (ITNs). As these methods are costly and based on insecticides, they are targeted to high-risk areas, which are identified according to rigorous criteria. The choice between IRS and ITNs should be based on operational factors, community acceptance and local experience. The unit of intervention is the village.

The scope of IVM is broad, and includes:

- Inter-sectoral collaboration – Development projects, agriculture, environment etc.
- Collaboration with other disease vector control programmes, e.g. malaria and dengue in urban areas.
- Community participation - peridomestic sanitation in urban areas.

Optimizing use of IVM: Microstratification

Microstratification refers to the use of surveillance and other epidemiological and program data to determine for every village, whether it is in a high risk area; the selected villages will also be microstratified for application of either IRS or bednets as the primary vector control method. Whatever the method, the coverage should be as close to 100% as possible. All members of the populations should sleep in houses, where every room has been sprayed, or they should sleep under an insecticide-treated net. The selection of villages where bednets are used should be guided by epidemiological and entomological parameters. Where IRS operations are difficult to conduct, preference will be given to bednet use. The actual choice between IRS or ITN / LLIN will also depend on the availability of ITN / LLIN. Over time, bednet use will be scaled up, and the reliance on IRS may be minimized.

The national malaria control program is currently using IRS as the primary method of vector control in rural settings, and anti-larval measures in the urban areas. Bed nets have already been introduced in the program, and the program envisages a scale up in their use as an option that addresses environmental, operational and community acceptance considerations of IRS.

Identification of high risk areas

The Technical Advisory Committee on Malaria in its meeting held in 2002 has rationalized the criteria for undertaking indoor residual spraying. These criteria are as follows:

- To spray on priority basis all areas taking sub-centre as a unit, with more than 5 API with suitable insecticides where ABER is 10% or more.
- To spray on priority basis with suitable insecticide all areas reporting more than 5% SPR (based on passive collection of blood slides), if the ABER is below 10%
- Due priority be accorded for spray if Pf proportion is more than 50%.

- To accord priority for IRS in areas with less than API 5 / SPR 5% in case of drug resistant foci, project areas with population migration and aggregation or other vulnerable factors.
- To make provision for insecticidal spraying in epidemic situations.

Operational planning for IRS and ITNs

Within the target populations for IRS and ITNs, it is necessary to identify the populations to be covered in the year under planning: the annual-plan target populations. Priority should be given to villages with highest burden of malaria (generally, highest API). The epidemiological data should be thoroughly analyzed in this process. A meeting of MO-PHCs and MPHWS supervisors (M) should be convened at district or block level for operational planning target populations and prioritization of villages.

Choice of insecticide for IRS

For IRS, the insecticides in use are DDT 50% WP, malathion 25% WP and synthetic pyrethroids (WP). The important factors that are considered in selection of insecticide for IRS include vector susceptibility, safety and residual effectiveness. Pyrethroids are preferably avoided because ITN/LLINs use them.

Role of PHC staff in IRS activities

The MO-PHC should plan for IRS activities well in advance and carry out the following:

- Contributing to district level planning by providing relevant village wise microstratified information to DMO
- Indent for insecticide in time
- Dumping stations to be identified well in advance to dump insecticide a month ahead of spray
- Spray equipment to be checked and repaired
- Spare nozzle tips, jugs, buckets, plastic sheets, etc. to be purchased
- Manpower for spray to be calculated @ 30 houses in plains or 25 houses in hilly areas per pump per day. Each squad consists of 5 FWs and 1 SFW operating two stirrup pumps.

Insecticide requirement

The insecticide requirement is calculated based on the details given in table below:

Table: Criteria used for calculation of requirement of insecticides for IRS

S. No.	Insecticide	Requirement (in MT) for 1 million population for 2 rounds	Quantity of insecticide added to 10 L water	Dosage per sq.m of active ingredient	Area (in sq.m) covered by 10 L suspension	Duration of Residual effect (in weeks)
1.	DDT 50% WP	150.00	1 kg	1 gm	500	10 - 12
2.	Malathion 25% WP	*900.00	2 kg	2 gm	250	06 - 08
3.	Deltamethrin 2.5% WP	60.00	400 g	20 mg	500	10 - 12
4.	Cyfluthrin 10%WP	18.75	125 g	25 mg	500	10 - 12
5.	Lambdacyhalothrin 10% WP	18.75	125 g	25 mg	500	10 - 12
6	Alphacypermethrin 5%WP	37.50	250 g	25 mg	500	10 - 12

The effectiveness of IRS depends on

- Adherence to the specified criteria of the insecticide
- Use of well maintained equipment
- Correct application procedure
- Public acceptance of spraying
- Adequately trained personnel
- Effective supervision.

Spray operations should take place approximately one month before the start of the potential seasonal increase in incidence. In India, the peak transmission season(s) are usually determined by rainfall.

Advance spray programme

Involvement of Panchayats is essential for successful IRS. Panchayats / village / local bodies / village heads / Block Development Officers / Mahila Mandals, religious groups etc., are to be informed about spray schedule at least a month before the spray. This advance information must be given by so as to facilitate the villagers to extend full cooperation in getting the spray inside their dwellings with the objective of full coverage of targeted population. The MPHWs/ASHA/community volunteer should inform the same to the community members 15 days in advance and remind them again 3 days before the actual spray date.

Target surfaces

Generally, all the interior walls and ceilings are treated. In addition to permanent human dwellings, field huts where people sleep during the planting or harvesting season should be sprayed. The underside of furniture, back of the doors, outside eaves and porches must be treated. Human dwellings and mixed dwellings should be sprayed, but not cattle sheds, with a view to conserve insecticide, improve coverage of human dwellings and prevent diversion of mosquitoes from cattle sheds to human dwellings.

Supervision of IRS

Supervision of spray operations is important to ensure that operations are carried out according to correct technical procedures and corrective action is taken to achieve the programme goals. Supervision will be carried out through MPHWs and health supervisors; supervision will be both concurrent and consecutive.

Concurrent supervision

The following should be checked during such inspections:

- Date of advance notification and the maintenance of time table for spray operations
- Turn out of spray crew
- Nozzle tip discharge rate
- Conditions of spray pumps
- Preparation of insecticide suspension
- Actual spraying operation including the technique, speed and coverage etc.
- Extent of refusal to accept spray and the numbers and percentage of locked houses
- Maintenance of spray records

- Consumption of insecticide as determined by the quantity issued and stock in hand
- Date and time of checking of the squad by Inspectors/ Supervisors and other supervisory personnel and their remarks, if any
- Arrangements for mopping up
- Future programme and time schedule
- Whether exterior has been sprayed

Consecutive supervision

The following is to be checked in consecutive supervision

- Evidence of insecticide deposit on sprayed surface particularly on the ceiling and wooden surfaces like windows etc.
- Dispersal of the insecticide deposits on the walls to verify uniformity of deposits
- Number of rooms in each house sprayed satisfactorily, partially and not at all
- Percentage of refusals and locked houses
- Factors responsible for not spraying any area as elicited through enquiries from the residents
- Attempts made for mopping up operation in the event of high refusal
- Extent of mud plastering on the walls, if any and other relevant matters.

Role of PHC staff in bednet related activities

Ordinary untreated mosquito nets provide limited protection against mosquito bites as the mosquitoes may still bite through the net or get inside the net following improper use. Mosquito nets treated with insecticides provide better and effective protection by keeping away mosquitoes as well as killing them. ITNs are now becoming one of the main methods for control of malaria vectors in India. Conventional ITNs must be treated once or twice a year, depending on the duration of the transmission season. LLINs are mosquito nets whose fibres have been impregnated with the insecticide, so that the insecticidal effect is maintained through about 20 washes, and up to 3 - 5 years. It is expected that LLINs will replace use of untreated and conventional ITNs in malaria control intervention in high-risk areas over the coming years.

One bednet is expected to cover on average 2.5 persons and thus, for a given village the number of bed nets required is usually equal to the total population divided by 2.5 or the number of households multiplied by 2. In a targeted village, the required number of nets should be distributed in one single operation. However, if nets are not in sufficient supply, it can be considered to distribute one net per household per year for two years. In addition to distribution to targeted high-risk villages, bed nets should be given to pregnant women in high risk areas and to special groups such as children in tribal schools and hostels.

Every effort is being made to make all fresh bednet supplies to be LLINs; however, the ITNs being issued and those already distributed should continue to be utilized, with regular impregnation. While planning for bednet distribution, the total availability of bednets, i.e. conventional ITNs plus LLINs, will be considered; reimpregnation requirements of existing bednets will also be considered.

Behaviour change communication (BCC) efforts will be required to maximize reimpregnation of conventional bednets as well as to ensure utilization of ITNs/LLINs. Health workers at health facilities

and ASHAs/community health volunteers should provide key information during one-to-one encounters – especially when treating patients with malaria and during antenatal care and immunization attendance. Health talks should be given to small groups, especially those waiting for health services; pre-recorded audio and video tapes may be used in this context and demonstrations, e.g. of the correct way to hang bed nets, can be extremely useful. Existing materials, such as flipcharts, guidelines, leaflets and flash cards, can also be used.

Involvement of local community representatives, self help groups and NGOs should be encouraged to promote transparency of operations and optimal use by the community.

How to Treat the Net – 10 Steps for Mass Retreatment

- Mass treatment is done at fixed/designated sites.
- Insecticide treatment is recommended for synthetic nets (nylon, polyester), as treatment of cotton nets is not cost-effective and effect of insecticide is not long lasting.

Step 1: The necessary equipment consists of mosquito nets, insecticide, basin, measuring container, rubber gloves and soap. Make sure the net is washed / cleaned before treatment. Preferably, nets should be treated outdoors in the shade. If treatment is to be carried out indoors, a room with open windows should be used. Use basin, gloves that are not used for any other purpose.

Step 2: Put on protective gloves before treating nets.

Step 3: The amount of water needed depends on the net material. Regardless of the size and shape of net, the amount of water required for one synthetic net (nylon, polyester) is ½ liter (if the net is very large, more water may be needed). If measuring container comes with insecticide, use it to measure water; otherwise, use any measuring container that will not be used for food, drinks, medicines etc.

Step 4: The amount of insecticide needed to treat a net depends on type of insecticide used. Follow instructions on the container, sachet or packet. Generally, 10 –15 ml of insecticide is required to treat one net. Store the leftover insecticide in its original container, in the dark and away from children.

Step 5: Mix the water and insecticide thoroughly by gloved hands in basin.

Step 6: Always treat one net at a time; Put the net in the basin containing water and insecticide. Soak the net long enough to ensure that all parts of the nets are impregnated. Take out the net and allow excess liquid to drip back. Do not wring the treated net.

Step 7: Let the net dry flat in the shade on plastic sheets. Later, the net can be hung up in the shade to complete drying.

Step 8: Following treatment of all available nets, the leftover mixture of water and insecticide, if any, may be used to treat curtains; otherwise, dispose the liquid in the toilet or a hole away from habitation, animal shelters, drinking water sources, ponds, rivers, streams. Destroy empty insecticide containers, sachets, packets and bury in a hole away from habitation, animal shelters, drinking water sources, ponds, rivers, streams.

Step 9: Wash equipments (basin, measuring container) with lots of water while wearing protective gloves. Wash gloves (if non-disposable ones are used) with soap and lots of water, or dispose with insecticide containers. Wash hands with soap and lots of water

Step 10: Washing removes insecticide from the net. So, wash the nets as seldom as possible and gently with soap and cold water and dry flat on plastic sheet in shade. Do not wash / rinse treated net in or near drinking water sources, ponds, lakes, rivers, streams. Dispose off water used for washing / rinsing in the toilet or in a hole away from habitation, animal shelters, drinking water sources, ponds, rivers, streams. The net must be re-treated again after it has been washed three times or at least once a year even if it is not washed, preferably just before the rainy season. Nets must be treated twice a year in areas that have a lot of mosquitoes all year long.

Some Useful Tips

- Use the insecticide-treated net every night, all year round, even if mosquitoes are not seen / heard.
- Insecticides used for mosquito nets are not harmful to people, if used correctly. Direct skin contact with the insecticide on a still wet net may cause a tingling sensation on the skin. This is not harmful, even for small children.
- After treatment, the net may smell of insecticide. This will go away in a few days and is not harmful to people who sleep under the net.

Other methods for malaria vector control

Generally, other physical, chemical and biological methods do not have as good an impact as IRS/ITNs in vector control. Though they may not be considered as primary methods, they should be used wherever appropriate to augment the effectiveness of the transmission control. Larval control can play an important role in some areas, either alone or as an adjunct to IRS or bed nets. Larvivorous fish can be used where breeding sources are few and well defined as in man-made breeding sites in urban and periurban areas, and freshwater bodies in rural areas.

(For further details on IVM, reference may be made to the operational manual)

4.5: COMMUNITY PARTICIPATION AND BEHAVIOUR CHANGE COMMUNICATION

Community participation

It is practically impossible to even think of controlling malaria without the active participation and ownership of the public at large, particularly of the poorer sections that bear the brunt of the disease. It is expected that public health action against malaria is a major felt need in high burden areas, and that people do have basic interest and motivation in acting against malaria in these areas.

Since there is much misinformation and misunderstanding of the disease among the public, a strong educational component is a necessity, which can complement the strong “supply-side” interventions (RDT, ACT, ITN/LLIN) that the program now offers. These three interventions have benefits tangible to everyone thus increasing the likelihood of their acceptability and utilization.

In place of microscopy which often involved more than a few days to get results due to distant laboratories, RDTs can be conducted in front of the patient by anyone with simple training, and results become available within 15 minutes. ACT is virtually 100% effective against *P. falciparum*, and has no common side effects. LLINs do not require repeated treatment with insecticide and are effective for 3 – 5 years and up to 20 washes. The main barrier for use of bednets is that people may not be used to sleeping in the confines of a net. This is particularly true of hot regions in summer season with little breeze, and those families that cannot afford fans. However, many of them may quickly find that the mosquito-free peaceful rest that a bed net affords is worth the discomfort of getting used to sleeping inside the bed net.

Each of these three interventions is likely to be appreciated and demanded by the people, once they become familiar with these interventions. The challenge is to get people to start using them. A fourth component of the program having high acceptance potential is the establishment of trained ASHAs who are providers of RDT and ACT. Other suitable volunteers where ASHAs are not available will complement the efforts of the PHC and subcentre staff in high-burden areas in the effort to ensure that all residents of such areas have ready access to diagnosis and treatment. A communications strategy that seeks to build the recognition and credibility of the ASHA and other volunteers as a provider can be crucial to the success of the programme.

Health committees at village and PHC levels serve as forums that link providers and users of services and are designed to maximize community and provider ownership of program goals and targets. The scope for community participation in the malaria control program is enumerated in the following table.

Table: Scope for Community Participation in the malaria control program

Program Component	Scope for community support	Scope for community monitoring
Bed net distribution	<ul style="list-style-type: none"> • Determining the mode of distribution in partnership with district / PHC malaria authorities • Supporting educational efforts related to consistent and correct use of bed nets, particularly among 	<ul style="list-style-type: none"> • Ensuring equitable distribution in selected habitations, as per norms • Minimizing sale of bed nets by recipients, particularly the poorer households • Alerting appropriate authorities

Program Component	Scope for community support	Scope for community monitoring
	small communities not frequented by health workers	regarding any malpractices
Bed net impregnation with insecticide	<ul style="list-style-type: none"> • Determining mutually convenient dates with the MPH or ASHA who leads the impregnation work • Providing labor for impregnation 	<ul style="list-style-type: none"> • Ensuring that assigned volunteers or health workers conduct impregnation of bed nets as scheduled • Providing feedback about perceived effectiveness of impregnated bed nets
Insecticide Residual Spray	<ul style="list-style-type: none"> • Determining dates of spraying in partnership with district / PHC • Spreading the word about dates • Informing communities about necessity of IRS • Accompanying spray teams to houses on day of spraying, convincing people about the necessity 	<ul style="list-style-type: none"> • Monitoring whether actual spray operations are conducted as per norms and plans • Providing feedback about perceived effectiveness of insecticide spray
Larval control	<ul style="list-style-type: none"> • Supporting source reduction efforts, using local labor and funds* as feasible • Spreading word about steps families can take to eliminate breeding places 	<ul style="list-style-type: none"> • Monitoring whether actual field work for source reduction has been undertaken as per norms and plans
Early diagnosis and treatment	<ul style="list-style-type: none"> • Determining the appropriate person to play the role of the local volunteer • Spreading the word about the availability of RDT and ACT with the ASHA or other local person / volunteer, and about back-up facility when this provider is absent • Spreading the word about the need to get tested early in the course of illness • Spreading the word about the reliability of RDT and ACT for falciparum • Spreading the word about the advisability to save on costs by first resorting to the local malaria care provider • Supporting the provider in record keeping, as needed • Facilitating quick transport of slides to the laboratory 	<ul style="list-style-type: none"> • Demanding and ensuring one or more trained providers within realistic access of every habitation • Alerting authorities about non-availability or non-functioning of provider • Alerting authorities about stock-outs of tests or medicines • Alerting local providers and higher authorities about outbreaks

Program Component	Scope for community support	Scope for community monitoring
Referral care	<ul style="list-style-type: none"> • Ensuring early transport of patients of severe malaria to the correct referral institution • Helping the family avail of government schemes supporting costs of transportation and treatment* 	<ul style="list-style-type: none"> • Demanding and ensuring immediate care for cases of severe malaria at institutions • Ensuring that untied funds at village and subcenter levels under NRHM are made available in a timely manner for poor families needing referral.

Behaviour Change Communication (BCC)

BCC has been defined as a process of learning that empowers people to take rational and informed decisions through appropriate knowledge; inculcates necessary skills and optimism; facilitates, stimulates pertinent action through changed mindsets, modified behavior and reinforces the same. Simplicity, brevity, do-ability and relevance are the cornerstones of effective communication for behavior change. Clear messages, communicated through different, credible channels are most likely to bring about change.

Simple mass communication before IRS and bed net distribution rounds may consist of recruitment of local folk media, NGOs and CBOs to explain the benefits and use of IRS and bed nets to communities. About 3-6 months after the roll-out, even as early as during the first transmission season, a quick but formal, independent assessment of the program interventions can be carried out in multiple locations, to identify gaps in service availability, utilization and quality. Within a year of the roll-out of interventions, and before the second transmission season, a comprehensive BCC and Community Participation plan can be put in place, and assessed again during the transmission season to iron out the remaining wrinkles. During the first year, much of the monitoring of this activity will come from supervisory visits by PHC/MO, MPHWS and MTS. Some of the assessments mentioned above can be conducted by the MTS.

Receivers of BCC

- Villagers
- Housewives
- Mahila Mandals
- School children
- Small factory workers
- Opinion leaders and non-formal leaders (Paramount importance)

Media mix

- Posters, folders, hand bills, charts, flip charts, flip booklets, stickers, book markers for school children, postal prints, etc.
- Exhibition, folk dance, puppet show, drama, bhajan, kirtan, etc.
- Video quickies, video on wheels, cable TV, etc.

Salient points to be covered in BCC

- Benefit of indoor insecticidal spray and precautions.
- Prevention of man made breeding places.
- Prevention of water storage for 7 days or more curtails mosquito breeding and malaria.
- Malaria vectors breed in clean water.
- Fever cases to contact FTD / DDC / Voluntary Link Worker for proper treatment.
- Malaria is confirmed by blood test only.
- Confirmation of malaria by tests is necessary for effective treatment
- Malaria is more harmful to children and pregnant women-the fever cases should be tested soon.
- Advance notice on spray programme – 15 days before spray.
- Advance notice on spray - again 3 days before spray.
- Involve FTD / DDC / VLW / MPW to motivate community to accept spray.
- Peripheral workers to move with spray squads to achieve $\geq 80\%$ coverage of rooms.
- Supervisory staff to motivate community to accept spray among refusals.
- Do not plaster sprayed walls within 12 weeks.

4.6: PLANNING

The two main planning responsibilities of MO-PHC are

1. Planning the roll-out of all activities according to the new strategies
2. Contributing to the annual district level plan for malaria control

Planning the roll-out of activities

The PHC staff will list out all villages and hamlets identify the community level providers, viz. ASHA, AWW or any other volunteer in each village/hamlet, keeping in mind that every person living in the PHC area should have a local health care provider within walking distance of his/her residence. This distance is generally taken as approximately 3 km, but may vary depending upon the terrain, availability of means of transportation etc. Special attention should be paid to people residing in small hamlets in remote and inaccessible areas.

Assigning the responsibility to the concerned MPHWS/ANM/MPHS to consult the community members to select the suitable community level provider is a good option. The staff should make clear to the community level provider the training needs, volunteer nature of the work and the incentive structure. ASHA, if willing, is the preferred candidate for malaria control efforts. If options are available, selection should be based on past experience, access to vulnerable sections of the community and likely availability at all times; more than one local health provider can also be selected and trained per village/hamlet.

It will be ensured that all selected volunteers complete their training with RDTs, slide making and treatment. The list of candidates along with the corresponding MPHWS who will attend the training will be sent to the DMO who will arrange for their training. All candidates, including those with past experience with RDTs will be trained. At the completion of training, the MPHWS will ensure that each volunteer receives two months' supply of RDTs, drugs and other supplies.

The trained volunteers will be taught that RDTs are not exposed to direct sunlight and high temperatures of more than 40°C and that they should not be kept directly under tin roofs in summer. The MPHWS will help them to identify the suitable cool, dry place to store RDTs in their respective houses. The drugs will also be stored under similar conditions.

As LLINs occupy large space, their storage space and distribution should be planned well in advance so that duration of storage is kept at the minimum. A team of logistic experts will guide the process at different levels.

Identification of "RDT villages" and "Slide villages" in the PHC area will be facilitated by the MO-PHC. The appropriate slide and report transportation mechanisms will also be identified for each village/hamlet. All persons involved in the mechanism such as laboratory technicians, school teachers, postmen etc. will be trained appropriately to make the mechanism work efficiently as per the local plan. The designated referral centre for each village under the PHC should be made known to all health workers and volunteers.

Contributing to district level planning

The MO-PHC is expected to provide all relevant information to the DMO including surveillance data and also propose a microstratification plan for IVM in the PHC area. The district plan is a joint responsibility of the DMO and the MOs in charge of PHCs. Once the DMO has finalized the district plan, it should be shared with the PHC staff, so that every one is geared to execute it.

The supplies required for case management are calculated based on the surveillance data and the past year's experience. Responsibilities should be assigned for the preparatory activities for IVM, BCC, reimpregnation, post bednet distribution activities, post spray activities, supervision, reporting etc. The new staff and volunteers requiring training and those requiring refresher training will be identified for the district level training.

4.7: TRAINING

The following training courses would enable the health care providers to optimally utilize the interventions and contribute effectively to malaria control activities:

- A 3-day residential course at district level for MO-PHC on program management and a 2-day course on case management would enable the MO-PHC to function effectively as a team leader and program manager to lead program to success in malaria control.
- A 2-day residential course at the district/block level for MPHS would enable the MPHSs to play their roles as supervisors of program implementation
- A 1-day non-residential course at block level for MPH (M & F) would provide them full understanding of roles to support ASHA / volunteers, and their own changing roles in the program.
- A 3-day non-residential course at block level for ASHA/AWW/volunteers along with MPH (M & F) would impart skills in them to conduct RDT and administer ACT and understand how they will contribute to malaria control

The levels of trainers and trainees are shown below:

<u>Trainers</u>		<u>Trainees</u>
Master Trainers	—————>	District VBD consultants, MTS
District level trainers	—————>	MO-PHC
Block level trainers	—————>	MPHS, MPH (M & F), ASHA/AWW/volunteers

All attempts will be made to make the initial training practical and useful, but one-time training is never sufficient to ensure results. Therefore, there is a need for constant supportive supervision by guiding the ASHA/volunteer to make sure that they work with understanding and focus. The supportive supervision is much more critical than the initial training. The MO-PHC, as the team leader and program manager, is primarily responsible for ensuring that all ASHA / volunteers / health workers get timely and adequate support to do their job correctly.

Critical elements of supportive supervision

It is the prime responsibility of the MPH (M &F) to ensure that every ASHA/volunteer is well supported in their role, but this may sometimes require the direct intervention of the MPHS or even the MO-PHC. The following elements of supportive supervision for ASHA/volunteers are crucial to malaria control:

- Encouraging the community to get treatment from them
- Soliciting the panchayats and SHGs to support them
- Guide and be with the ASHA/volunteers till they become confident of doing blood tests correctly

- Ensure that they have adequate supplies and never run out of stocks
- Ensure that they are able to fill the M-1 correctly or find someone from the neighborhood to keep records
- Ensure that they get slide reports in time
- Ensure that they get incentive in time and correct amount
- If any ASHA/volunteers are not willing to do the work any more, ensure that they are replaced promptly and the replacement is trained
- If the ASHA/volunteers are not acceptable to the community, negotiate with the community for support or get replacements promptly and get them trained
- If the ASHA/volunteers face problems from the community due to wrong diagnosis or treatment, the same is to be resolved by explaining their roles and capabilities

The following elements of supportive supervision for MPHs are important:

- Repeated emphasis is made to inform that the main role of MPHs is in strongly supporting ASHA/volunteers in passive case detection
- Enquiring whether the MPHs are facing any difficulties in fulfilling their role - capacities, supplies, records / reports – and help them find solutions and also correct problems at the PHC level
- Making MPHs understand and emphasize often that they should ensure that IVM is being carried out according to plan and that it is critical to saturate selected villages with bednets or IRS, as planned.
- Ensuring that MPHs have enough BCC support – for popularizing ASHA / volunteers, for promoting utilization of bednets and IRS
- Informing the DMO whenever more support is required

Summary of role of MO-PHCs in training

- Identify training needs in a timely manner and convey the same to the DMO. This will include new volunteers / PHC staff who have not been trained, and staff / volunteers who need more / refresher training in weak areas
- Know in detail what roles should be played by health workers and volunteers, and how they are being trained to play these roles
- Provide ongoing training and capacity building to all PHC staff and volunteers
- Some MO-PHCs will be trainers in various training programs

Category of workers to be trained

The MO-PHC may be entrusted to train the following cadre of workers.

- Health Supervisor - PHC (Male / Female)
- Laboratory Technician – PHC
- MPW (Male / Female)
- Voluntary Link Worker (Malaria)
- ASHA/AWW/volunteers/any other village worker from NGOs or government agencies

The training may be conducted at the PHC or a nearby area where training facilities are available. The participant strength for each batch of training courses may be around 25.

Essential components of training

- Duration of preliminary and reorientation training course
- Language in which teaching material is prepared and medium of instruction preferably in local language to enable the participants to understand the subject easily
- Graphics and visual illustrations to be incorporated in the course content bearing in mind the local community, customs, costumes and cultural background so that learning material becomes a familiar part of the local community
- Problem and solution exercise
- DO's and Dont's under each topic

4.8: LOGISTICS MANAGEMENT

Planning

Planning for logistics management must include planning for the following:

- Supplies and equipment:
 - Diagnostics
 - Drug Therapy
 - Insecticides and equipment for bednet treatment
 - Insecticides and equipment for IRS
 - LLINs
- Training and manpower for above
- Transport and storage needs
- Contracts with NGOs and other sub-contractors
- Timetable of activities at PHC level

RDTs and ACT

RDTs and ACT differ from the microscopy and therapy which were until recently used for malaria diagnosis and treatment in that:

- They are vulnerable to heat and humidity
- The shelf-life is relatively short, about two years for both products
- The costs are higher.
- There is a higher risk of sub-standard or counterfeit products sold in the market.

Quantification of drug requirements

For a PHC, in a given period, the number of ACT doses required would be about the average number of *P. falciparum* cases in the PHC over the three past years. The past figures should be broken down by age. Multiplying the estimated number of cases in each age group with the number of tablets per patient for that age group (as given in table below) gives the number of tablets needed by age group. This can then be summed to provide the total number of tablets.

Age group (years)	Tablets per patient	
	Aresunate	Sulfa-Pyrimethamine
0 - 1	1 ½	¼
1 - 4	3	1
5 - 8	6	1 ½
9 - 14	9	2
15 and above	12	3

Of course, when blister packs would be used for all age groups, it will be more rational to estimate the number of the different types of blister-packs. The main determinant of requirement of RDT kits will be based on the number of *P. falciparum* cases recorded and positivity rates in previous years.

It is likely that the deployment of ACTs and RDTs will lead to increased demand for antimalarial treatment from the government sector. Therefore, during the first year of implementation, it will be prudent to assume that the need will exceed the estimations based on morbidity data by about 25%. This assumption may lead to some wastage. That would be a lesser risk compared to not meeting the justified expectations of the public after demand has been created.

These simple methods of estimation may also be applied to other antimalarial medicines. For medicines, used for the management of severe malaria, estimates are currently probably best based previous consumption data. Where parenteral artemisinin formulations have been introduced recently, the consumption of quinine ampoules can be used to estimate the requirements for injectable artemisinins. This requires conversion into equivalent amounts of parenteral treatment courses for adults.

- Since malaria transmission is seasonal, data for 3- or 6-month periods should be utilized to estimate requirements for corresponding future 3- or 6- month periods.
- Estimate requirements on the basis of the number of subcentres and villages and safety stock at each level.
- Adjust the quantity to be indented according to pack size and as well as the minimal demand size

In order to convert the estimated drug and RDT requirements into potential indents to cover consumption between two cycles of demands, the amount of medicines that must be held in stock should be calculated. As it is impossible to forecast demand with complete accuracy or to be absolutely certain about the supply, a certain amount of stocks must be kept to absorb fluctuations in supply and demand and to reduce the risk for stock outs. In districts prone to epidemics of malaria, an appropriate epidemic stock must be added to the quantities to be re-ordered. Because of the short shelf-life of RDTs and ACTs, the epidemic stock must be rotated with the routine stock to avoid the risk of expiration.

ACTs may initially be distributed by a 'push' system, in which the central and State level determines the quantities of medicines to be delivered to lower levels. This is useful if peripheral staff at PHCs has limited experience in assessing needs and managing inventories.

The next step is to select an appropriate re-supply interval. Generally, deliveries are made at intervals of 1–3 months, depending on availability, capacity and transport costs, as well as order size and storage capacity at each level of the distribution system. Other factors, such as expiry dates, seasonality of malaria and the reliability of transport during the rainy season are also be taken into consideration. In remote areas that are difficult to reach, adequate supplies of ACTs must be delivered and stored at least 1 month before the start of the malaria season.

LLINs

Planning

Planning of LLIN coverage is complicated by the fact that the effect of LLINs carries over from one year to the next. It is therefore essential to maintain a log as follows:

Table 16.1 Log frame for planning LLIN coverage

Year	- 5	- 4	- 3	- 2	- 1	Planning year
LLINs distributed						
Population protected						

This format makes it easy to project how many people are estimated to be protected by LLINs that have been delivered. The length of the log depends on the effective life of the LLINs, normally 3 or 5 years. The population protected in a given year is calculated as:

Number of nets distributed and not yet expired x 2.5

If LLINs with different effective lives have been delivered, use separate rows and sum over each year. The table must be filled in for each sub-centre, which included any high-risk population; even if there will be no implementation due to operational constraints. Prepare a PHC block summary of the sub-centre tables.

Table 16.2 Characteristics of LLINs relevant to logistics

Characteristics	Multifilament polyester LLIN (deltamethrin-coated)	Monofilament polyethylene LLIN (permethrin-incorporated)
Weight per LLIN (in Kg)	0.440	0.625
No. of LLINs per bale	100	40
Weight per bale (in Kg)	42	29
Volume per bale (Cu.m)	0.1727–0.1894	0.127
LLINs per room (3 m x 3m x 3m)	10,800	6,480

MO-PHC must be able to ensure adequate storage capacity albeit for short periods of time and reliable transport at all levels, as well as precise timing. Logistic mechanisms must ensure adequate supervision and control of the operations and full accountability at every stage. It must be remembered that LLINs are saleable and their diversion could have deleterious effects on the programme in various ways.

Storage

Bales of LLINs are well and securely packed; the nets are essentially non-perishable and are usually individually wrapped in sealed plastic bags. Nevertheless, it is important to ensure that warehouses are clean and dry. Shelf-life should be ascertained from the manufacturer.

Bales are relatively easy to handle, being light enough to be moved manually. The principal concern in their storage is thus one of volume rather than weight. The very large volumes involved make it critical that there is adequate storage capacity at all levels.

The tightly packed and tied bales can be stacked several layers high (up to a height of 5 m) without any damage to the bottom layers. In theory, 5.8 bales of polyester LLINs occupy a volume of 1 m³; in practice, 4 bales/m³ is a reasonable working figure. Thus, if a warehouse room space is 3 m x 3 m x 3 m, available volume is 27 m³, which would accommodate 27 x 4 = 108 bales or a total of 10800 polyester LLINs.

Monofilament polyethylene LLINs can be stored at 6 bales/m³, so that the same warehouse volume of 27 m³ would accommodate 162 bales or 6480 LLINs of this type.

Stock management is relatively simple because LLINs are well packed and do not deteriorate physically. Bales must be carefully counted by at least two individuals during off-loading of the containers; this provides a double-check of the quantities indicated on the bills of lading.

Transport

Even though LLINs are well wrapped and bales robustly packaged, every vehicle must be equipped with a tarpaulin for protection.

As for storage, the principal consideration in the transport of LLINs is one of volume rather than weight.

Onward transport of LLINs from PHC to subcentres and villages could be done, if needed, by the vehicles normally used to carry medicines, vaccines and other supplies – most often bicycles and motorcycles.

Assumptions for carrying capacity

- One person with bicycle and vaccine carrier can carry 4 – 6 LLINs weighing 2.6 – 4.0 kg depending on various factors.
- One person with motorcycle and vaccine carrier can carry 10 LLINs weighing 6.5 kg
- One 4 x 4 light vehicle with mobile team members and vaccines and equipment can carry 150 LLINs weighing 97.5 kg.

Distribution of Bednets

Preparatory activities

It is important that preparatory work is done to ensure optimal use of mosquito nets. The following activities must be completed prior to the distribution or insecticide treatment of the mosquito nets:

- Survey of the area – number of households, number of persons in each household, number of pregnant women and children under 5 years of age, number of mosquito nets in use, knowledge, attitude and practices
- Identification and involvement of community representatives, self help groups, women's organizations and NGOs
- Preparation of the list of beneficiaries

- communication among the community for the regular and proper use of mosquito nets, with more focus on pregnant women and young children; insecticide treatment of the bed nets and proper care of the bed nets
- In case of bednet treatment, selection of site(s) and persons, training and making arrangements for necessary items

Distribution

- Organize camps for distribution of insecticide treated mosquito nets
- Keep records of mosquito net distribution
- Make arrangements for distribution to those who were unable to attend the camp(s)

Post Distribution Activities

Periodic visits to be made by health workers / volunteers to check and encourage regular net use.

4.9: PROGRAM MANAGEMENT

The various roles of MO-PHC as program manager are as follows:

- As team leader and program manager, the MO-PHC is responsible for results
- Manage change from current to future program strategy
- Execute program implementation
- Monitor disease burden and outbreaks
- Monitor laboratory quality
- Monitor data quality
- Contribute to annual district program plan for malaria control

Case management

The information from M-4 should be analyzed every fortnight by the MO-PHC and the staff and action taken accordingly:

Fever case load and the number of those tested positive for malaria

Age/sex/pregnancy/SC/ST wise break up of positive cases

Referrals / deaths among test positive cases

Time taken from dispatch of slides to receipt of report at the villages

Stock-outs of supplies reported by village level providers

Vector control

- Weekly, for IRS during spray season
- Seasonal for bednet distribution and re-impregnation

Lot Quality Assurance Sampling (LQAS)

The LQAS is a well-established survey sampling method that uses very small sample sizes to assess whether a certain target has been reached or not; it is being used for the first time at large scale in health programs in India. LQAS uses binomial statistics to give reasonably reliable results at very low cost and the results are about 92% reliable.

A sample of 19 households / fever cases will be drawn from each block (block PHC) in each survey round. The MTS will do LQAS surveys periodically along with other duties. LQAS survey involves data collection and tabulation to assess indicators mainly on early diagnosis, prompt treatment and bednet use. The results of LQAS will be available to MO-PHC and to the DMO for every PHC from several rounds of such surveys a year; these can be compared over rounds to assess progress, and to help plan ahead.

Field visits

The MO-PHC and MPHs may during their field visits make relevant observations on the following:

- Use LQAS tools for gathering information on case detection and management, bednet utilization
- IRS effectiveness
- Awareness of malaria
- Assessment of awareness and skills of ASHAs
- Examine records of ASHA / volunteers and health workers

- Examine level of stocks
- Look for unreported outbreaks

Monthly program reviews

The MO-PHC should set aside one day in every month for a detailed program review. It should be ensured that the MIS data of previous month, findings of last round of LQAS and observations from the field visits are available during the review. All relevant staff of the PHC including the store keeper and the lab technician should be present during the review.

While reviewing the data, specific questions will be asked for each problem to find out the reasons and then look for possible solutions. Once a solution has been arrived at, specific responsibilities will be assigned to the appropriate staff member for execution of the duty and a deadline set for its execution. For urgent issues, the deadline set is an earliest possible date / time, but for most other issues, the next monthly review should suffice.

In between monthly reviews, the staff should be reminded during interactions about what they are expected to do. The MTS should also be informed about the date of the next monthly review meeting, so that s/he can attend and constructively contribute.

Questions which should be asked during the monthly program reviews

- Does every village / hamlet / cluster / home have easy access to a local provider?
- Is there any local provider who has not reported during the current month?
- Is there any village / hamlet / cluster for which information is not available this month?
- Was there any outbreak reported in the last month by a local provider that was not attended in time by PHC staff?
- Was there any stock-out in RDT / ACT reported by any local provider? What was the reason? What was the mechanism responsible for ensuring continuous supply and why did this fail?
- In the “slide” villages, what proportion of slides reports reached the village later than one day after dispatch from the village? Review the reasons: has a mechanism for timely transport and reporting been established for every such village? Who are responsible for this mechanism? Which part of this mechanism is not working, why?
- How many slide reports did not reach the village level provider in time for making the monthly report? How can this number be reduced next month?
- In all villages, what proportion of fever cases were tested within a day of the start of fever? Is there a difference between MIS and last round of LQAS? What could be the reasons? Review examples of cases, and find the reasons: Are people in the village aware of the presence of the local

provider? Why do they not consult the provider on time? What additional inputs are needed to make this happen?

- Are there any problems being reported in the use of RDT? If there are a lot of RDT negative fever cases, what is the likely cause – is it not malaria, or could it be a problem with the test?
- Are RDTs being stored and used properly? Is this being supervised by MPH / MPHS?
- Have all local providers learnt to do RDT confidently? Who are the providers who need extra support? How best can such support or training be provided? Is it necessary to replace any local provider?
- Are the trends of disease indicators (fever incidence, test positivity) along expected lines? Are there any big changes since the last month, or since the same season the previous year?
- Are there cases of possible severe malaria or deaths from fever reported this month? Are all providers being encouraged to report these? Are there any barriers to reporting these?
- Have all cases of death been investigated? Did all cases of death or severe malaria receive attention in time? Were they tested in time? Referred in time? Was a dose of ACT given before referral in each case?
- Are ASHA / volunteers having problems with recording or reporting? Can they read and understand lab reports?
- In the villages planned to be covered with bednets, are there families that do not have sufficient bednets for household size? Are they poor families or affording ones? How can this gap be quickly filled? In any of these villages, is it time to re-impregnate?
- Are there any reports of resale of nets, or abuse of nets?
- What proportion of people sleep under the bednets? Is there a difference between perception of health workers and LQAS findings? What could be the reasons? What planned steps have not yet been taken to inform and advise people to use bednets?
- Has the laboratory been able to cope with the load last month? If not, why not? Are there quality issues with microscopy?
- What is the stock position in the PHC of RDT / ACT / other supplies?
- Are supplies being stored appropriately – particularly RDT (visit the store personally and observe)? What are the problems with storage? Can they be resolved locally?
- During spray season, hold brief weekly reviews and ask the appropriate questions

- During planned bednet distribution and re-impregnation campaigns, ask the appropriate questions during monthly reviews

If there are any issues that cannot be solved at the PHC level, a list of these issues should be made and sent to the DMO; if any of the issues are very urgent, the MO-PHC should speak to the DMO on the telephone and find the solutions.

4.10: PROGRAM EVALUATION

Evaluation design

Program evaluation is done through internal and external assessments. Internal assessments are conducted by central teams as well as by LQAS, periodically. Strictly speaking, LQAS is more a monitoring mechanism, rather than an evaluation tool. External assessments are done through large sample surveys every 2-3 years and are conducted by NVBDCP / NIMR.

External assessments

The purpose of external assessments is to have an independent estimate of progress of the programme over time through consecutive surveys, by collection of key process, output and outcome indicators.

The study in 10 randomly sampled high burden blocks with API > 2 or 5 can be spread out over 80 villages to include 1600 households / fever cases. Such samples are adequate to detect differences of more than 10% across two surveys. The survey data will be examined along with other sources of information, including MIS and LQAS and planning data.

Evaluation survey tools

The survey will include the following schedules:

- House-listing schedule: Information about total population, current fever cases, fever cases in last two weeks, possession of bednets, last time IRS of the house was done, deaths in last 12 months
- Deaths schedule: Details of deaths in last 12 months, including possible malaria deaths
- Current fever schedule: Details of fever cases on day of survey, including blood testing and results
- 2-week fever case schedule: Details of fever cases in last two weeks, their contact with care provider, testing and treatment, and awareness of malaria
- Household schedule: Details of use of bednets and IRS, and awareness of malaria
- ASHA interview schedule: Awareness about malaria and about her roles in malaria control
- Village schedule: Details of the profile of the village, distance from facilities, forest, etc

Main indicators

Disease burden indicators

- Prevalence of fever on the day of the survey, and how many were Pf or Pv positive among them
- Prevalence of fever in the two weeks before the survey
- Deaths from suspected malaria over one year

Case management indicators

- How many of the villages in high burden areas have a local health worker who provides diagnosis and treatment
- How many of the fever cases were seen by a health worker or ASHA within a day of start of fever
- How many of the fever cases were tested and treated within one day of start of fever

Vector control indicators

- In high burden areas, how many of the households of individuals were protected by either IRS or ITN/LLIN

- How many of the individuals actually slept under an insecticide treated net the night before the survey
- What proportion of houses and rooms were adequately sprayed in the last six months

Other indicators

- Indicators related to awareness about malaria,
- Indicators related to knowledge and skills of ASHA

Baseline survey

Baseline surveys have been completed in 4 high burden districts in Orissa, Madhya Pradesh, Chhattisgarh and Jharkhand. Baseline surveys will be carried out in some more of the high burden areas before the new malaria control interventions are launched in them.