

Health Impact Assessment

Health Impact Assessment of Indira Sagar Dam and Resettlement and Rehabilitation Colonies in SSP Reservoir Impoundment Areas in Narmada Valley in Madhya Pradesh

During this period three surveys, i.e. in May 2004, July 2004 and October–November 2004 were carried out in the command area (villages of District Dhar and Jhabua) and in villages likely to go in submergence (totally, partially and rehabilitated villages of District Khandwa). Both entomological and epidemiological surveys were carried out in these villages.

In the month of May 2004, 231 slides from Dhar district were collected, of which 13 were found positive (all were *Pv*). Age-wise analysis revealed that none of the infants was found positive. In District Jhabua 328 slides were collected, of which 17 were found positive (7 *Pv* and 10 *Pf*). Two positive cases were detected in infants indicating active transmission. The vector species (both as adult and immatures) collected from both the districts were *An. culicifacies* and *An. stephensi* (malaria), *Ae. aegypti* (dengue) and *Cx. quinquefasciatus* (filariasis). The major breeding sites were cement tanks, river-bed pools, streams, etc. No *Culex vishnui* group and sand-flies were collected during the survey.

Second survey was carried out in the month of July



2004 in nine partially submerged and new rehabilitated villages of District Khandwa. Out of 205 slides examined none was found positive for malaria. The vector species collected from the district were *An. culicifacies*, *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus*. During the survey the baseline information about the dam site, command area and rehabilitation centres was also collected.

During the survey of October–November 2004 it was found that the villages close to reservoir which had no mosquito/malaria problem are now facing a threat. Data on whole night/day biting collection, parity rate, gonotrophic cycle, per man hour and room density of vectors of all the four diseases were collected. Besides this, susceptibility test for *An. culicifacies* was carried out against various insecticides as per WHO technique. The species was found resistant to DDT and mortality after 20 minutes was observed in deltamethrin and cyfluthrin. Larvae of all disease vectors were collected from various breeding habitats such as storage tanks, river-bed pools, canals, drains, etc. *Ae. aegypti* mosquitoes (127) would be sent to National Institute of Virology, Pune for dengue virus testing. In all the villages cross-sectional survey was carried out for malaria and



◆ Entomological and epidemiological studies were carried out in command area of SSP reservoir and remedial measures were suggested

filaria during day and night time. A total of 609 blood slides for malaria and 334 blood samples on filter paper for filariasis were collected.

Village-wise maps of the dam sites, command areas and rehabilitation centres has been procured and digitisation of canal network, land use, village location, forest area, etc. is in progress to develop a disease information system and map receptive areas



for various diseases. Data from various agencies was collected and it was found that no case of dengue, filaria, JE and Kala-azar is reported.

A meeting was held with the Vice Chairman, Narmada Valley Development Authority and state health authorities. The following points were highlighted — (i) the site selection for a few rehabilitation centres was not suitable; (ii) the site selection of labour colony was not suitable, these are close to drain under construction; (iii) there was a heavy vector breeding in the half finished canal which need immediate attention; and (iv) curing tanks at the rehabilitation centre, left unattended after construction, were supporting breeding of dengue and malaria vectors.

Situation Analysis of Malaria in Gadchiroli (Maharashtra) from the Viewpoint of Persistence of Malaria

In order to find out the reasons of persistence of malaria in Gadchiroli district, fieldwork comprising of entomological and parasitological survey was conducted in Dhanaura, Etapalli and Aheri Blocks of

❖ Situation analysis in Gadchiroli district revealed that the intervention measures are still not effective in controlling malaria

the district in November 2004, the peak transmission season of malaria. Data on socioeconomic conditions were generated through questionnaires. The parasitological and entomological findings revealed (gametocyte rate ranging from 14.2 to 31.2% and high density of *An. culicifacies*) that the intervention measures were still not effective in controlling transmission. Stratification of areas revealed that the breeding habitats and hilly areas within 1.5 km proximity of human settlements were highly malarious. Density of vector species was quite high in almost all the villages. Of 297 *An. culicifacies* exposed to ELISA test for detection of sporozoites, none was found positive.

Evaluation of the Pilot Programme for the Insecticide Treatment of Community Owned Bednets

A survey was undertaken in Karbi Anglong district of Assam and West Garo Hills (Meghalaya) in April 2004 to assess preparatory activities including surveys and measures for the involvement of PRIs, NGOs, SHGs; training and IEC activities; to document awareness in the community about insecticide treated mosquito nets and their keenness for getting the nets treated at the camps organised by the health department and NGOs; the willingness of the community to pay for the insecticide; operational details of the camps organised for the treatment of the nets; action taken for the procurement of the insecticide for treatment of the nets; to document coverage level achieved; the involvement of PRIs/NGOs and others; and budget available, expenditure statement and funds collected from the community. The information was elicited through questionnaires by contacting households in selected villages of two PHCs in each district. The observations indicate that the process indicators of the project are on. Efforts have been made to plan the programme, train the staff at various levels and create awareness in the community through newspapers, media, etc. Overall 3.2% of community owned bednets were treated by charging the community @ Rs. 12.50 for per 10 ml deltamethrin

❖ Rainfall and canal irrigation were responsible for malaria transmission in southern and northern Karnataka

flow in Karbi Anglong district while in West Garo Hills, 5.5% of community owned bednets were treated. A lot more is required to be done to achieve the target. Though there are many NGOs in the community but nobody came forward to help in the programme. Most of the persons could not afford to pay for the cost of insecticides.

Climate and Malaria

Impact of Climatic Factors on Malaria in Karnataka

To find out the relationship between malaria incidence and meteorological parameters for early warning of malaria, epidemiological data of malaria in respect of problematic districts of Karnataka and Rajasthan were procured from concerned state governments. Data on temperature, relative humidity and rainfall was collected from IITM, Pune. A field visit was made in February 2005 to Raichur district of Karnataka to find out the topographical conditions in canal-irrigated area. Monthly epidemiological data on *P. vivax* and *P. falciparum* in respect of Chitradurga, Raichur, Bijapur and Udupi districts of Karnataka were procured from the state government. Meteorological data on monthly minimum-maximum temperature, relative humidity and rainfall were procured for the period 1985–2000. Monthly data on total malaria cases in all the districts of Karnataka from 1994 to 2003 were also procured. Analysis of data revealed that in southern part of Karnataka (Chitradurga), transmission window of malaria is from April to November with peak of *P. vivax* in May/June, while for *P. falciparum* in October/November. On the other hand in northern Karnataka (Raichur and Bijapur), the peak of *P. vivax* is from August to October, while *Pf* reaches to peak in October/November. The analysis of results revealed that the local conditions of rainfall in southern Karnataka and canal irrigation in northern Karnataka were responsible for variation in malaria transmission windows.

Therapeutic Efficacy Studies

Operational Activity for the Assessment of Therapeutic Efficacy of Chloroquine and Sulphadoxine-Pyrimethamine in Uncomplicated *P. falciparum* Malaria

It is evident that although foci of resistance to chloroquine are present in the entire country, the

problem is more pronounced in areas with intense *Pf* transmission like Northeastern states and Orissa; in areas where there is intermixing of population like project areas including construction sites, in big metros and along international borders. Overall, the early treatment failure to chloroquine or RII & RIII level resistance is still not widespread in the country but the low level resistance and recrudescence observed in many parts of the country favours continued morbidity and transmission of resistant strains. This is confirmed by increasing proportion of *Pf* cases in the country. Therefore, the studies were conducted in high transmission area of Orissa, tourist area in Goa and one low transmission area in Rajasthan. The studies in Orissa were completed in 2003 and the results of other two sites are reported here.

Malaria transmission in Goa is high due to increased construction and developmental activities which attracted labour population from surrounding states, being tourist place with natural beauty attracts tourists throughout the year and good rainfall coupled with favourable temperature (Max. 28–37°C; Min. 18–24°C) and relative humidity (75–95%) which are conducive for mosquito proliferation.

Udaipur district in Rajasthan shares its borders with seven other districts of Rajasthan. Aravali ranges from north to south enrich the district. There are two important passes in the Aravali range— Desuri Nal and Sadri which serve as link between Udaipur and Jodhpur districts. Udaipur has, on the whole, moderate and healthy climate without significant variation. The temperature ranges from 36.7°C in May and June to 16.08°C in January. PHC Rishabdev in this district was selected as study site (Fig. 21).

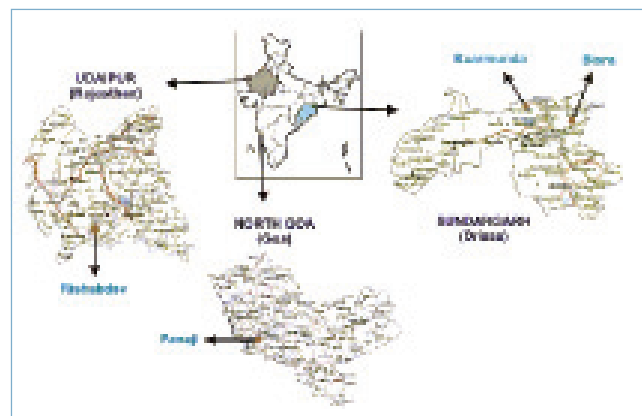


Fig. 21. Study sites: Study sites

All patients reporting to local clinic with complaint of fever were examined for prevalence of parasites in blood smear. Clinicians, taking special care to detect febrile disease other than malaria, evaluated those meeting basic enrolment criteria. The temperature, body weight and other demographic information was recorded. Peripheral smear was examined and those positive for *P. falciparum* were enrolled. Informed consent was obtained and case record form (CRF) was completed for each patient. WHO protocol was followed for inclusion/exclusion and results were analysed using WHO software.

In Udaipur (Rajasthan) 59 patients were enrolled for the present trial, 11 were lost to follow-up or withdrawn and 48 patients completed the study. The baseline characteristics are given in Table 7. The classification of therapeutic response is shown in Table 8 and Fig. 22.

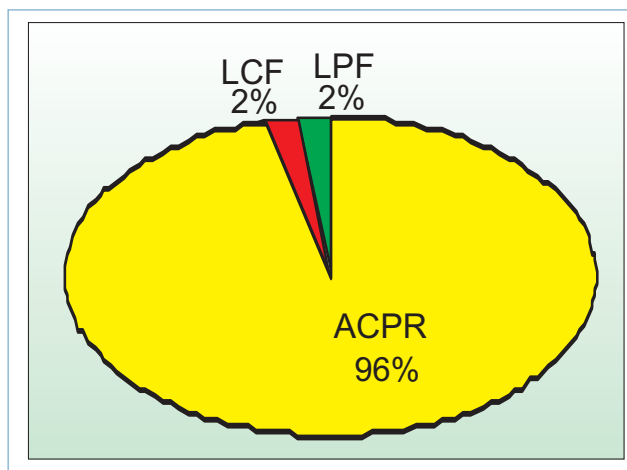


Fig. 22. Classification of therapeutic response in Udaipur

Table 7. Baseline characteristics of patients	
Drug: Chloroquine (Dose 25 mg/kg over 3 days)	Udaipur (Rajasthan)
No. of cases	59
M/F	33/26
Age in years (Range)	3–51 yr
Parasitaemia/ μ l on D0 (Range)	1000–10000



Table 8. Summary of classification of therapeutic response		
Response	Number	Prevalence
Early treatment failure (ETF)	0	0
Late clinical failure (LCF)	1	0.021
Late parasitological failure (LPF)	1	0.021
Adequate clinical and parasitological response (ACPR)	45	0.957
Total analysis	47	
Withdrawal (With)	3	
Loss to follow-up (Loss)	9	0.203
Total	59	

Table 9. Baseline characteristics of patients	
Drug: Chloroquine (Dose 25 mg/kg over 3 days)	Panaji (Goa)
No. of cases	63
M/F	55/8
Age in years (Range)	9–55 yr
Parasitaemia/ μ l on D 0 (Range)	1040–98400

Table 10. Summary of classification of therapeutic response		
Response	Number	Prevalence
Early treatment failure (ETF)	12	0.235
Late clinical failure (LCF)	7	0.137
Late parasitological failure (LPF)	24	0.471
Adequate clinical and parasitological response (ACPR)	8	0.157
Total analysis	51	
Withdrawal (With)	2	
Loss to follow-up (Loss)	10	0.2
Total	63	

❖ **Therapeutic efficacy studies of chloroquine revealed early treatment failure in Goa in contrast to late treatment failure in other parts of the country**

Sixty-three patients were enrolled in Goa. High percentages of patients were visiting Goa from neighbouring states especially Karnataka, Maharashtra and Kerala. However, 95% of the enrolled patients were present at the study site for more than one month prior to diagnosis. This indicates that the infection was most probably acquired in the study area. The baseline data of the cases enrolled are shown in Table 9 and results are shown in Table 10 and Fig. 23.

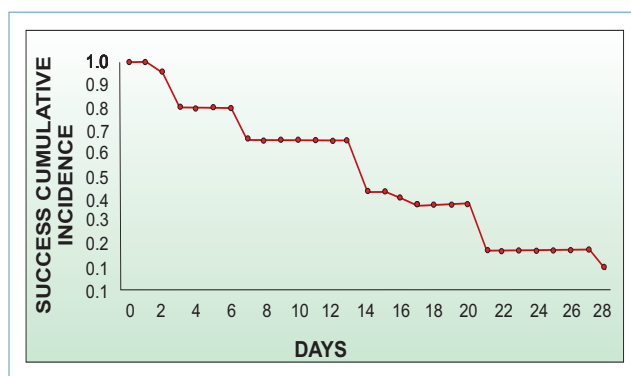


Fig. 23. Classification of therapeutic response in Panaji (Goa)

The data indicate high percentage of early treatment failures in this region in contrast to observations of late treatment failures in other parts of the country. This necessitates early intervention to limit the problem of chloroquine resistance in this state.

During 28-day follow-up reinfections can occur. To differentiate reinfections and recrudescence molecular markers (MSP-1, MSP-2 and GLURP) were used and correction factor was applied for classification of failure. The PCR corrected classification for Goa is given in Table 11.

Table 11. Summary of classification of therapeutic response

Response	Number	Prevalence
Early treatment failure (ETF)	12	0.245
Late clinical failure (LCF)	7	0.143
Late parasitological failure (LPF)	22	0.449
Adequate clinical and parasitological response (ACPR)	8	0.163
Total analysis	49	
Withdrawal (With)	4	
Loss to follow-up (Loss)	10	0.2
Total	63	



Vaccine Trial

Development of a Site for Malaria Vaccine Trial at Sundargarh District, Orissa

This is a collaborative project with International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi and is being funded by the Department of Biotechnology (DBT), Govt. of India under Jai Vigyan Mission. The studies are being carried out to understand the epidemiology of malaria in Sundargarh district, Orissa that will facilitate the field trials for *P. falciparum* malaria vaccines through collection of clinical, entomological and molecular epidemiological/immunological indicators from the study site. The longitudinal epidemiological studies were continued in two sets of villages in the forest and plain areas characterised by hyper and mesoendemic malaria situations respectively. Now there are 35 villages, 23 forest and 12 plain with a total population of 15,525. Longitudinal parasitological surveys were conducted in all the villages of phase-I study area. Weekly surveillance with the help of village volunteers was organised to measure malaria incidence. The annual parasite index (API) in the forest and plain areas was 241.8 and 14.1 respectively. Malaria is persistent throughout the year in both the areas but peak transmission was observed during post-monsoon months — September, October and November. The

◆ **Highest API (1106.5) is recorded in 1–5 years age group in forest area in contrast to plain area where all the age groups were equally affected**

proportion of different *Plasmodium* species in the forest area was 85.5, 13.7 and 0.8 for *P. falciparum*, *P. vivax* and *P. malariae* respectively, whereas it was 84.8, 15.2 and 0 respectively in the plain area.

In the forest area, the highest malaria incidence (API-1106.5) was recorded in the 1–5 years age group, whereas in the plain area, all the age groups were equally affected and API was ranging from 5.2 to 29.2. The infant parasite rate (IPR) and child parasite rate (CPR) in the forest area were high throughout the year with a yearly average of 62.3 and 49.3 respectively. The average IPR and CPR in the plain area were 0 and 2.8 respectively. The highest attack rate due to *P. falciparum* (number of episodes per person per year) in the forest area was recorded in 1–5 years age group (0.91 episodes per child per year). The average attack rate in the total population was found to be 0.21 and 0.01 in the forest and plain areas respectively.

Malaria prevalence in the study population during different transmission seasons was measured through cross-sectional point prevalence surveys in all the 35 study villages during March, June and November characterised by moderate, low and high transmission seasons respectively. About 40% of the houses were selected through computerised random numbers and all occupants of these houses were examined for malaria parasite irrespective of clinical symptoms. The parasite rate in the forest area during these surveys was found to be 10.1, 14.9 and 12.4 in March, June and November respectively, whereas it was 1.4, 1.7 and 0.5 respectively in the plain area. The highest parasite rate in the forest area during these surveys was found in 1–5 years age group with a gradual decline in the progressive age groups, whereas in plain area parasite rate was low and all the age groups were equally affected. The spleen rate in children and adults in the forest area was 79.7 and 16.2 respectively in March, June and November, whereas in the plain area it was 17.9 and 0.83 respectively. The average enlarged spleen (AES) in children in the forest and plain areas was 1.8 and 1.1 respectively. Studies on the parasite diversity and immune response during different transmission

seasons were carried out by MRC (HQ) for which blood samples were collected during these surveys.

Longitudinal entomological surveys were conducted in two indicator villages each from forest and plain areas. A total of 11 anopheline species from forest area and 10 species from the plain area were recorded. *An. culicifacies* was the most predominant species and accounted for 41.2 and 36.5% of the total anophelines in forest and plain areas respectively. *An. fluviatilis* was restricted to only forest area and its prevalence rate was 1.1%. The density of *An. culicifacies* in forest and plain areas was ranging from 5.3–48.5 and 5–51 respectively. The density of *An. fluviatilis* in the forest area ranged between 0 and 2–3. The landing rate of *An. culicifacies* on human baits in the forest and plain areas was 1.04 and 1.5 bites per person per night, whereas the human landing rate of *An. fluviatilis* in the forest area was 1.2 bites per person per night. Higher sporozoite rate (annual) was recorded in the forest area (3.5%) as compared to that in the plain area (0.6%). The sporozoite rate (SR) in three different transmission seasons in forest and plain areas were found 0.016 and 0.004 (high transmission season); 0.029 and 0.007 (moderate transmission season); and 0.01 and 0.004 (low transmission season) respectively. Further, the entomological inoculation rate (EIR) estimated were 0.051, 0.13 and 0.02 in the forest area; and 0.005, 0.011 and 0.005 in the plain area respectively for high, moderate and low transmission season.

Analysis of 270 *P. falciparum* positive blood spots from two ecosystems, 230 from forest (10 villages) and 40 from plains (5 villages) for MSP-1 and MSP-2 polymorphs revealed highly polymorphic nature of both markers. A significantly high proportion of multiclonal isolates (53.91%) were observed among isolates from forested area compared to plain area (16.21%). Multiplicity of infection (MOI) was also higher for both MSP-1 (1.99) and MSP-2 (2.21) in isolates of forested area. At three transmission levels, MOI increased from low to high transmission level—

◆ High sporozoite rate was recorded in the forest area (3.5%) in contrast to only 0.6% in the plain area

◆ The IgG profile against MSP-1₁₉ EBA 175 and TRAP was higher in the population of forest area than that of in plain area during both low and high transmission seasons

1.75 to 2.03 for MSP-1 and 1.89 to 2.66 for MSP-2 but was not significant. Percentage of single clone isolates for both MSP-1 and MSP-2 decreased from low to high transmission level while result was vice-versa with multiple clone isolates but was nonsignificant. MOI decreased with increasing age when analysed among four age groups. MOI in adults showed low MOI than infants and children which was found to be nonsignificant.

Finger-prick blood samples were collected from different age groups by repeated cross-sectional surveys at two sites each of forest and plain areas during low and high transmission seasons. Indirect ELISA was done to measure the antibody levels against *Pf* MSP-1₁₉, EBA 175 and TRAP antigens in 222 (110 from forest and 112 from plain areas) and 248 (138 from forest and 110 from plain areas) blood samples collected during low and high transmission seasons, respectively. Subsequently, 126 blood samples from 1–5 years age group of children were analysed for IgG profile against two vaccine candidate antigens MSP-1₁₉, EBA 175 during the low transmission period (June–July 2004). It was

noticed in individuals of two areas in both seasons. The mean ELISA O.D. was significantly lower in children <5 years age as compared to adults ($p < 0.001$). Proportion of high responders was more in adults than children ($p < 0.01$). However, acquisition of antibodies during the time of high transmission phase was more as compared to low transmission. Thus the results suggest that there was a boosting in antibody production against these molecules by natural infections in these individuals. The level of antibodies in study groups appeared to be related to their exposures to the parasite during high transmission phase.

Malaria Clinics

At 22, Sham Nath Marg, Delhi

A total of 137 patients attended the Malaria Clinic at MRC, 22, Sham Nath Marg or were referred from hospitals for blood examination and treatment of malaria during January to December 2004. Out of 18 patients found positive for malaria, 12 were diagnosed as *P. vivax* and six as *P. falciparum* cases.

At 2, Nanak Enclave, Delhi

A total of 2,313 patients attended the Malaria Clinic at MRC, 2, Nanak Enclave during January to December 2004, of which 292 patients were found positive for malaria infection. Among all the positive malaria cases, 275 patients were positive for *P. vivax*, 16 for *P. falciparum* and one for mixed infection. Clinical examination was done and specific symptomatic treatment was given wherever necessary. Blood samples were collected for

Table 12. Malaria cases reported at MRC clinic 2, Nanak Enclave, Delhi during the year 2004

Month	BSE	Total	<i>Pv</i>	<i>Pf</i>	Mix	SPR	SFR
Jan	53	0	0	0	0	0	0
Feb	83	0	0	0	0	0	0
Mar	155	1	1	0	0	0.65	0.65
Apr	176	3	3	0	0	1.70	0
May	118	4	4	0	0	3.39	0
Jun	153	8	8	0	0	5.23	0
Jul	195	10	10	0	0	5.13	0
Aug	359	89	88	1	0	24.79	0.28
Sep	497	139	135	3	1	27.97	0.60
Oct	281	25	20	5	0	8.9	1.78
Nov	128	8	5	3	0	6.25	2.34
Dec	115	5	1	4	0	4.35	3.48
Total	2313	292	275	16	1	12.62	0.69

observed that overall IgG profile against MSP-1₁₉, EBA 175 and TRAP in both the studies was higher in the population of forest area than that of plain area in both low and high transmission seasons. The age-dependent increase of specific antibody levels was

ongoing host-parasite interaction and genetic diversity studies. Monthly distribution of these cases and correspondingly slide positivity rate (SPR) and slide falciparum rate (SFR) calculated are given in Table 12.

◆ **Diagnostic and treatment services were provided to > 2400 patients**

Bangalore (Karnataka)

A project on “Development of strategy for integrated control of vectors of malaria, Japanese encephalitis (JE) and dengue” was accomplished in seven talukas comprising of 50 PHCs and 1846 villages in Mandya district of Karnataka. Based on geographical reconnaissance (GR), susceptibility of vector species, epidemiological analysis of data, control strategy for malaria, JE and dengue was suggested to the state government. Field evaluation of VectoBac against *Anopheles*, *Culex* and *Aedes* mosquitoes, in a variety of breeding habitats in Bangalore rural and urban areas was done. It was found 100% effective against anophelines for three days, for culicines up to 10 days; and against aedines up to seven days. Situation analysis of malaria was done in Bangalore (rural and urban), Kolar, Bellary, Chitradurga and Raichur districts. Trainings and workshops were organised for medical officers, entomologists and health workers, etc.

Car Nicobar (Andaman & Nicobar Islands)

The study on duffy blood group in the primitive tribe of Andaman and Nicobar Islands has brought forward that out of four primitive tribes found in Andaman & Nicobar Islands, Jarawas are duffy negative whereas Great Andamanese, Onges and Nicobarese are duffy positive. Study on diurnally sub-periodic filarial forms revealed that the infection was among the Nicobarese (tribal) and the nocturnally periodic form was observed among the settlers and migratory labourers. The field unit was devastated by Tsunami on 26 December 2004. The staff is being utilised by periodic visits to Andamans for situation analysis of malaria.

Chennai (Tamil Nadu)

During the year, study on bio-ecology of *An. stephensi* and its probable role in disease transmission in Chennai was completed. A report on the assessment of therapeutic efficacy of chloroquine for the treatment of vivax and falciparum malaria in Rameswaram, Ramanathapuram districts (Tamil

Nadu) indicating adequate clinical and parasitological response (ACPR) in *P. vivax* and late treatment failure in *P. falciparum* has been handed over to the officials of the Directorate of Public Health and Preventive Medicine, Govt. of Tamil Nadu. Evaluation of VectoBac tablet formulation (*Bacillus thuringiensis* var *israelensis*) and Temeguard (Temephos 50% EC) as larvicides was carried out. Other activities included technical support to various centres/institutes and collaborative research/scientific work. Health education and training programmes were undertaken as routine activities. Malaria clinic continued to function, catering to the health needs of the general public by providing prompt diagnosis and treatment.

Haldwani (Uttaranchal)

Work on the project “In-depth study of entomological and parasitological factors responsible for malaria transmission in some areas of Bhabar region, District Nainital, Uttaranchal” was continued and completed. Reverse pattern of prevalence of *An. culicifacies* and *An. fluviatilis* (peak of *An. culicifacies* in July and *An. fluviatilis* in March). About 0.37% sporozoite rate (1/270) was found in *An. culicifacies*. In OPD, a total of 1489 blood slides were prepared and examined. Out of that 581 (417 Pv, 161 Pf & 3 mixed) were found positive for malaria showing 39 and 11% SPR and SFR, respectively. IEC activities were kept continued.

Hardwar (Uttaranchal)

Steam distillate fraction from plant code MRCHAR/03/05 showed excellent activity against *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus* mosquitoes with their KDT_{50} values of 13, 12 and 18 min respectively on 2% impregnated test papers. Four plants coded as NBDB022, NBDB041, NBDB048 and NBDB056 have been short-listed to develop as novel bio-insecticides against mosquitoes. Fraction code MRCHAR/04/04/S possessed good adulticide activity against *Cx. quinquefasciatus* with LC_{50} and LC_{90} values of 0.5 and 0.97 mg cm^{-1} . Fractions MRCHAR/03/04/1 and

MRCHAR/03/04/4 of plant code MRCHAR/03/04 showed good antiplasmodial activity with their IC_{50} values of 0.62 and 1.5 $\mu\text{g/ml}$ respectively. A total of 265 samples of soil, sediment, water, human blood and human milk collected from Garhwal region were processed for determination of organochlorine residues.

Jabalpur (Madhya Pradesh)

Laboratory bioassays were performed on field collected *An. culicifacies* to determine the efficacy of Olyset® nets after repeated washings with detergent. Support was provided to the programme by undertaking epidemic investigation in Jhabua district, situation analysis of malaria in Sidhi, Seoni and Betul districts and additionally, evaluated the pilot programme of NVBDCP for the insecticide treatment of community-owned mosquito nets in Districts Chandrapur (Maharashtra) and Mandla (Madhya Pradesh). Organised WHO sponsored international training workshop on "Rapid assessment tools for malaria in pregnancy for southeast Asia". Also organised an Indo-US workshop on "Cerebral malaria associated neurological disorders in central India", project funded by Fogarty International Centre. MRC clinic at Medicine Department in Medical College Hospital continued to provide diagnostic and treatment services to malaria patients

Nadiad (Gujarat)

Health impact assessment of Sardar Sarovar water resources development project during the pre-irrigation phase made a significant progress. Disease prevalence assessment and entomological surveillance were the main activities. A collaborative study titled, 'Randomised village-scale evaluation to compare the efficacy of lambda-cyhalothrin CS with lambda-cyhalothrin WP used in indoor residual spraying for malaria vector control' was initiated with support of WHO Pesticide Evaluation Scheme. New larvicide formulations (pyriproxyfen and VectoBac WDG) were evaluated in the field for mosquito larval control. Therapeutic efficacy study detected high level of chloroquine resistance in *P. falciparum* in malaria epidemic affected areas in Kheda and Anand districts. Technical support was given to the NVBDCP in epidemiological investigations of malaria, whereas work of malaria epidemic containment in various districts in Gujarat was also undertaken. Observation

of antimalaria month and setting up new hatcheries for mass breeding of larvivorous fish were also undertaken. Scientists also participated in major meetings to plan or review the activities of the malaria programme on the request of the Gujarat government. Organised several training programmes for state health personnel.

Panaji (Goa)

Susceptibility status of Panaji and Candolim strains of malaria vector *An. stephensi* to DDT, malathion and deltamethrin revealed that both the strains are susceptible to deltamethrin but highly resistant to both DDT and malathion. GR of breeding habitats was done in the entire city of Panaji to assess the mosquitogenic potential of the breeding sites preferred by anophelines, culicines and aedines. Spot intervention measures were instituted by the NVBDCP, Goa team. The stratification of the city is being done to prioritise malaria control on the basis of situation analysis. Therapeutic efficacy of chloroquine in uncomplicated malaria revealed that ACPR was 15.7%, while failure rate was high (84.3%). The national programme has withdrawn chloroquine from Panaji and introduced SP in that area. Malaria clinic continued to provide EDPT to general public and private practitioners. Work is underway to estimate malaria burden in Jharkhand state. Training programmes were organised for students and professionals.

Rourkela (Orissa)

The work on development of a site for malaria vaccine trials was continued in Sundargarh district. Evaluation of Olyset® nets impregnated with permethrin revealed that even after 20 washes the efficacy of Olyset® nets was 80-95% against *An. culicifacies* and 100% against *An. fluviatilis*. Evaluation of bio-efficacy, persistence and impact of mosquito nets treated with tablet formulation of deltamethrin (K-O Tab) on malaria transmission was done. Independent assessment of the operational feasibility of the introduction of rapid diagnostic kits and blister combi packs for strengthening the early diagnosis and prompt treatment (EDPT) under EMCP in Sundargarh district, Orissa was done. Also concurrent evaluation of the pilot programme for the insecticide treatment of community-owned mosquito nets in Districts Nayagarh and Keonjhar (Orissa), Purulia (West Bengal) and Visakhapatnam (Andhra Pradesh) was carried out.

Shahjahanpur (Uttar Pradesh)

Field trials of pyriproxifen (0.5G) was carried out in various mosquito breeding habitats of district Shahjahanpur. The compound was applied in three dosages 2 g/m³, 4 g/m³ and 10 g/m³ of water capacity of breeding sites. The compound was tested against mosquito immatures of *Cx. quinquefasciatus* and *An. culicifacies*. Successful inhibition of adult emergence was obtained with all three doses in various mosquito breeding sites. The effect was more pronounced on the larva to pupal metamorphosis. Analysis of malaria in Shahjahanpur district to identify transmission risk factors and GR for planning vector control was also studied. Situation analysis of malaria was undertaken in Jharkhand. IEC activities were also undertaken.

Shankargarh (Uttar Pradesh)

Malaria clinic continued to serve as a source of sentinel site for monitoring of trend of malaria in Shankargarh PHC and surrounding areas. In the year 2003, the SPR showed a rising trend (22.1%) and in 2004, the SPR has gone up to 45.4%. Malariogenic stratification of Allahabad district is being attempted

based on physiography, vector distribution and parasite load.

Sonapur (Assam)

The major thrust areas of research included: (i) the situation analysis of malaria endemic districts of Assam to recommend situation-specific intervention strategies to contain the spread of drug resistant malaria; (ii) to ascertain the treatment seeking behaviour and health care access in ethnic communities of Assam; (iii) to ascertain the therapeutic efficacy of sulphadoxine-pyrimethamine (SP) as primary treatment in districts under alternate therapy replacing chloroquine; (iv) to characterise the malaria parasite strains prevalent in the region for genetic diversity; and (v) to ascertain the therapeutic efficacy of alpha-beta arteether in pediatric malaria for treatment of *P. falciparum* malaria. Other activities included health education and capacity building measures, observation of antimalaria month, and mass propagation and distribution of larvivorous fishes (Guppy) in town areas of Assam. Technical support to the malaria control programme is being provided through World Bank assistance for transfer of technology (TOT) on ITNs to the northeastern states of India.