

4. Epidemiology

4.01 Interaction between malaria and HIV in sub-Saharan Africa

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Malaria and HIV are each responsible for a high public health burden in the tropics, particularly in sub-Saharan Africa. Although driven by very different transmission mechanisms and dynamics, wide geographical overlap and high prevalence of both infections mean that even modest interactions lead to substantial impact in populations. The effects of HIV on malaria are now well-documented in pregnant and non-pregnant adults, although many gaps in knowledge remain. Malaria infection and fever rates are increased approximately 2 fold in areas of stable transmission, especially for those with low CD4 counts or high viral loads. In areas of unstable transmission, HIV is associated with more severe disease and malaria associated deaths. Antimalarial therapy appears to be less effective in HIV-infected individuals. In pregnant women HIV is associated with more episodes of malaria, more fever and more adverse birth outcomes. In areas like southern Africa with HIV-1 prevalence approaching 30%, population attributable fraction estimates suggest that the increased risk of malaria attributable to HIV could have profound public health implications. In the other direction, malaria up-regulates HIV transcription transiently during acute episodes. The effect of placental malaria on MTCT of HIV-1 or the effect of malaria on HIV-1 disease progression in infants and non-pregnant adults are unclear. There is a clear need to strengthen the combined deployment of malaria and HIV prevention and intervention measures in areas with high malaria and HIV prevalence. HIV-infected individuals in Africa need to be protected from malaria by use of insecticide treated bednets and antimalarial chemoprophylaxis.

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4.02 Natural infections of humans with *Plasmodium knowlesi*

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Plasmodium knowlesi is a malaria parasite normally found in nature in long-tailed and pig-tailed macaque monkeys. It was first isolated in India in 1931 from a long-tailed macaque monkey imported from Singapore and was shown to be infectious to humans by blood passage. Natural infections of humans with *P. knowlesi* were thought to be rare as there had been only one confirmed report of such an infection, acquired in Peninsular Malaysia in 1965. However, in a recent study conducted in the Kapit Division of Sarawak in Malaysian Borneo from 2000-2003 with a newly developed nested PCR assay, we found that over half of 208 malaria patients were infected with *P. knowlesi*. The infections had been mainly diagnosed by microscopy *P. malariae* since these parasites are morphologically indistinguishable from *P. knowlesi*. We have expanded our study area and examined 1,334 malaria blood samples, including 331 diagnosed as *P. malariae* by microscopy, from 19 locations in Malaysian Borneo. With the exception of two imported cases in Sarawak and 6 local cases in Sabah, none of these human malaria infections was identified as *P. malariae* by PCR. In contrast, 347 were either single *P. knowlesi* infections or co-infections of *P. knowlesi* with other *Plasmodium* species, strongly suggesting that there is no local transmission of *P. malariae* in Sarawak while *P. knowlesi* infections are widespread. Blood samples from 25 monkeys in Sarawak have also been examined and two long-tailed macaques were *P. knowlesi*-positive. The small subunit ribosomal RNA and circumsporozoite genes of *P. knowlesi* from these two monkeys were phylogenetically indistinguishable from 8 causing human infections. Clinical and epidemiological data of human infections with *P. knowlesi* will be discussed together with studies being planned to determine whether human *P. knowlesi* infections are acquired from monkeys or whether a parasite host switch has occurred, supporting transmission from man-to-man.

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4.03 Malaria problem in Africa: New challenges, New interventions

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Malaria, the most pernicious parasitic disease of humans, is responsible for at least a million deaths each year with Africa bearing the brunt of the disease accounting for more than 90 percent of the whole cases. Thus, it is a prime etiologic factor of slowed economic growth in Africa as a result of lost productivity or income associated with illness or death. The ugly burden of malaria is intensified by the demise of certain antimalarial therapeutic drugs and is responsible for a recent increase in malaria-related mortality. Antimalarial drug resistance is now generally acknowledged to be one of the greatest threats on our ability to "Roll Back Malaria" and this accounts for the ban of chloroquine in first-line malaria treatment in many African countries. It is more alarming to acknowledge that alternative malaria treatment therapies may also be rendered obsolete by drug resistance. Hence, there is likelihood of pernicious untreatable malaria. Predicting the emergence and spread of resistance to current antimalarials is necessary for planning malaria control and instituting strategies that might delay the emergence of resistance. It is therefore, inevitable to understand some of the behavioural underpinnings in the emergence of malaria drug resistance. Poor drug use in terms of inappropriate dosing provide increase opportunities for parasites to be exposed to sub-optimal blood levels of the drug and hence the development of drug resistance. Peoples' perception of illness and their subsequent reaction to illness, such as their treatment seeking behaviour, and their adherence to recommended drug regimen, have a tremendous effects on the use of any antimalarial drug and play an important role in controlling resistance. The paper examines some of the drugs use patterns inducing antimalarial drug resistance and submits that interventions should be made in the realm of human perception of malaria and its management.

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4.04 Tribal malaria in Orissa, India

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Malaria has reemerged as a major public health problem in India during the past few years. Resurgence and increasing incidence of death due to malaria has been creating an alarming situation. Under varied geo-ecological conditions, the occurrence, distribution and behavioural pattern of malaria vectors and the parasite are different. Forested Tribal dominated areas contribute 30% of the total malaria cases in the country which include 60% of the *Plasmodium falciparum* cases and 50% of the deaths in the country. Orissa, a tribal dominated state deserves special attention as the state contributes about 22% of the total malaria cases, 50% deaths due to malaria and 40% *P. falciparum* malaria in India. The state comprises of 30 districts among which 14 districts are tribal dominated and 16 districts are non-tribal.

The analysis of recent data (for the year 2004) reveals the slide positivity rate (SPR) of tribal dominated districts ranges from 5.19% to 34.49% with a mean of 12.43 %, while the range of the same in non-tribal districts is from 0.4% to 14.78% with a mean of 5.94%. The average *P. falciparum* % in tribal and non-tribal districts are 90.31% and 58.06% respectively. Among total 283 numbers of death cases tribal and non-tribal districts contributed 213 and 70 respectively.

The above data indicates slide positivity rate, percentage of *P. falciparum* cases and malaria deaths are significantly higher in tribal districts and lower in non-tribal districts, which may be due to resistance of the parasite to the drugs as well as the vector to the insecticides, difficult terrains, favourable climatic conditions for mosquito breeding, high man-vector contact and low socio-economic status of the tribal population.

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4.05 Feasibility of using sea surface temperature for early warning of malaria

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The phenomenon of El Nino Southern Oscillation which is based on the record of Sea Surface Temperature (SST) in Pacific Ocean has been found related with malaria outbreaks in some part of world including India. In most of the studies, the analysis is based on the relationship between dry/ wet years vis-à-vis annual malaria cases. Classical malaria outbreaks occur in unstable malarious areas vulnerable to change in meteorological conditions with characteristics of seasonality. It has been observed that the phenomenon of seasonality in occurrence of malaria cases is lost if the data is analyzed annually and may lead to misleading relationship.

Therefore, monthly analysis of malaria cases during transmission season, vis-a-vis monthly SST values available from NOAA website, with time lag of 1 to 3 months were correlated with monthly *Plasmodium falciparum* cases in respect of some epidemic prone sites in India. It was found that with 3 month lag there was no significant correlation. For Rajasthan site, Correlation coefficient (r) between *P. falciparum* cases and SST values with 2 month time lag were - 0.70 and - 0.97 for the epidemic years 1992 and 1994 respectively while for Gujarat negative correlation was found only in the year 1994 with 2 month and 1 month lag (value of r = -0.73 and - 0.88 respectively). At Karnataka site negative Correlation was found only for the year 1994 in both the transmission seasons with 2 month and 1 month lag (r -0.99, -0.70 and -0.53, -0.94 respectively) indicating significance of SST values in early warning of malaria for some years.

Overall findings indicate that SST values may be of significance in early warning of malaria in some situations. By excluding the role of non-climatic factors, the outcome would be better.

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4.06 The effect of insecticide-treated bed nets on morbidity of Boarding School children

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Insecticide treatment of bed nets ("mosquito nets") may be a cheap and acceptable method of reducing the morbidity and mortality caused by malaria. Orissa is an endemic home for malaria. In Orissa KBK (Kalahandi, Bolangir and Koraput) districts are highly malaria endemic area. In a rural area of Kalhandi district, bed nets were supplied to a boarding school (Navodaya Vidyalaya at Narla) were treated with Deltamethrine at the beginning of the malaria transmission season on August 2002. About 99% of students in school slept under insecticide-treated bed nets. Additionally, students residing in the school were randomized to receive malaria treatment throughout the malaria transmission season when they suffer. We measured morbidity in students in School before and after the interventions described. The epidemiological reports as available from school dispensary reveals that the average slide positive rate (SPR) before net was supplied was 12.2 which came down to 8.7 after the net was supplied. After intervention, the overall morbidity due to malaria came down to schoolchildren supplied with net was 28%. The malaria incidence were elevated after the vacation as the students come from their respective villages carrying malaria infection with them, as they do not use the bed net in their houses. It was seen from the treatment register of school dispensary that before the net was distributed, the students suffering from malaria were treated with Sulphadoxine and Pyremethamine (S.P.) drug as first line of treatment. After the distribution of bed net the students were given Chloroquine as presumptive treatment for malaria. From this study it can be concluded that use of impregnated bed net helps in blocking malaria transmission and also the drug resistance strain cannot spread.

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4.07 Malaria Disease Burden Estimation in India: Some prickly issues, challenges and opportunities

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India is a vast country with multiethnic society of 1.2 billion living in diverse geo-ecological paradigms and ecotypes of malaria. India is the only example in the world, where 3 Plasmodial species viz., *P. vivax*, *P. falciparum* and *P. malariae* are transmitted by 9 Anopheline vectors. India contributes to 77% of malaria in South East Asia. Annually, the primary health care system reports around 2 million malaria cases and about 1000 deaths from 29 states and 7 union territories. According to WHO, SEARO however, this figure could be 20 million cases with 15000-20000 deaths annually. Various longitudinal studies suggest that the gap between reported and estimated incidence is from 68-95%. Over the last 5 decades the Pf trend has been on the rise continuously and in the recent years its overall proportion is around 50% and many pockets of *P. falciparum* resistant to commonly used antimalarials have emerged. In the stable malaria zones, the asymptomatic malaria could be up to 28%. While we draw inferences from the available morbidity and mortality data on incidence gap and identify problem areas, our own estimation of DALYs lost on account of malaria based on current incidence are 1.8 million years annually as against 5,77,000 years estimated in the Global Burden of Disease study. Contrary to the African scenario, where much of the malaria mortality burden is borne by the Infants and children, in India, it is the middle productive ages in both genders that suffer the most. We have launched a major research initiative to come up with estimation of true burden of malaria in the Jharkhand state having a population of 27 million. In this process, the challenges and opportunities that exist are discussed.

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4.08 Secular trends of Malaria in Goa: 1991-2004

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Malaria accounts for more than a million cases each year and threatens to derail the economic development in India. But the risk of contracting the disease is unevenly distributed throughout the country due to its complex epidemiology. The estimate of the burden of disease over a specified time period in small state like Goa is required for targeting of control operations. The research paper attempts to study trends of Malaria in Goa from 1991 to 2004.

The study was based on surveillance data from 1991 to 2004 available with Directorate of Health Services, Goa. Data has been analyzed using time series techniques.

The emerging picture is characterized by Annual Parasite Incidence hovering around 10 in the preceding 3 years, being 12.7 in 2002, 8.6 in 2003 and 5.9 in 2004. The corresponding Slide Positivity Rate for these years was 6.15%, 4.1% and 3.2% in 2004. The above indices in Goa are significantly higher than the national average. Four urban areas viz., Panaji, Candolim, Aldona and Margao contributed to 80% cases of malaria reported from the entire state of Goa in 2003 to 2004.

The peak incidence coincides with both increases in construction activity and importation of migrant labour from adjoining State of Karnataka. The number of malaria cases corresponds proportionately to number of incoming migrant workers in the state. Areas with construction activity have a higher cases reporting, 75% of which occurs in migrant workers. Almost 80% strains of *Plasmodium falciparum* are chloroquine resistant. There is a fairly constant species distribution of malaria throughout the year. Since 1995, mortality averages 0.4% of *Plasmodium falciparum* cases. In order to combat malaria, there is a need to restructure the existing programme encouraging Intersectoral co-ordination.

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4.09 Control of vector borne diseases in Surat city, Gujarat

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The city of Surat located in southern Gujarat on the bank of river Tapti is an industrial hub for textile, diamond and silk attracting a large number of migrant workers from all over the country. Surat is endemic to malaria, filaria and dengue has emerged recently. A national filaria control unit was established in Surat in 1952. Antimalaria programme was commenced in 1988. In 2004, 8,227 cases of malaria (33.9% *P. falciparum*; 66.1% *P. vivax*) were reported. There were 274 microfilarae cases in 48,729 fever slides. Sixteen out of 48 samples were found dengue positive. The current strategies to control vector borne diseases in Surat include early detection and prompt treatment through active and passive surveillance, entomological surveillance, integration with private health providers/institutions for diagnosis, treatment and malaria data management, bio-environmental management (filling ditches, pits, low lying areas, weeding and channeling, desilting, water disposal and sanitation) and extensive introduction of larvivorous fish in ponds and pools, checking up and elimination of mosquito breeding in domestic containers, and selective use of temephos, MLO, fenthion and biolarvicide. Anti-adult methods include selective spraying in flood affected areas with pyrethroids, fogging in/ around houses with new Pf cases, strict use of legislative measures, promotion of use of insecticide treated nets with NGO support. For capacity building, the supervisory and primary health staffs are given re-orientation training. Inter-sectoral and community participation is promoted through IEC campaign. These measures have led to a marked reduction in the disease incidence in the city and detailed data will be discussed.

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4.10 An appraisal on the control of riverine malaria in south India

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After reemergence of malaria in mid-seventies, Thenpennai riverine tract in Tamil Nadu state remained endemic for malaria. Though indoor residual spray (IRS) with malathion had brought down the incidence of cases but have failed to interrupt transmission completely. *Plasmodium vivax* was the dominant species of parasite and transmission was perennial, peaked in March-April and October-November, respectively. Malaria vector, *Anopheles culicifacies* s.l. was extensively breeding and found mainly responsible for both domiciliary and extra-ordinary malaria transmission. Although *An. culicifacies* s.l. was susceptible to malathion, relatively high vector densities could be detected after residual spraying in unsprayed structures and in unsprayed niches in sprayed structures. The large numbers of human-fed and sporozoite positive female mosquitoes resting indoors were mainly responsible for continued transmission of malaria, while outdoor resting vectors also play a role in transmission.

Two operational problems, high proportions of refusals to permit residual spraying and extended transmission season throughout the year due to high vectorial capacity (2.194 for *P. vivax* and 2.594 for *P. falciparum*) were identified and recommended that IRS with malathion could be supplemented by strengthening anti-larval measures, and by peri-domestic ground thermal fogging using technical malathion. In this report, we have briefed the successful control of riverine malaria with the recommended revised vector control strategy.

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4.11 Importance of surveillance in Malaria, a simple tool to recognize unusual outcomes

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Surveillance is a watchful, vigilant approach to information gathering, that serves to improve or maintain the health of population. An active surveillance system is essential for defining problems and taking timely action. In the absence of effective surveillance system, malaria spread unrecognized by the responsible health care or public health agency. In National Program, Malaria has a well established surveillance system, both active and passive even though epidemics are reported because of not given this surveillance system a prime concern. We have retrospectively observed a SC data where epidemic had occurred and found out some important finding like trend of disease in last three year. We have also analysed data of whole district Taluka and found same picture. This study is retrospective study based on Malaria register which is kept at PHC level and monthly report of District Malaria Office of district Kheda, Gujarat. Data is in form of tabular and graphical form monthwise, PHC wise, Talukawise and SPR wise.

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4.12 Malaria in canal-irrigated Thar Desert, Northwestern India

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The Thar Desert in northwestern India is world's one of the most populous and recently formed arid regions characterized by a mélange of unique ecology and anthropogenic activities particularly associated with the IGNP related irrigated agriculture. In yore the Thar has been traditionally regarded a low malaria endemicity area, with potential for occasional outbreaks. However, during the last seven decades, a major part of the Thar Desert has undergone vast physiographic and climatic changes, resulting in the formation of extensive mosquitogenic conditions of varied nature, high vector densities and intrusion of new malaria mosquitoes earlier unknown for the region. Consequently, scenario of the disease epidemiology in the desert, with several cyclic epidemics reported in the last 12 years, has changed a great deal, with *Plasmodium falciparum* emerging more strongly now. It is evident from the data (1961-2000) that not only has increased the slide positivity rate in the desert region but also *P. falciparum* incidence increased, particularly during the 1994 (the worst epidemic year so far) when it shot up by 3.5-fold. Along with *Anopheles stephensi*, the traditional malaria vector in the xeric environment, another significant vector namely *An. culicifacies* has also established itself in the areas extensively irrigated through canals. Both these vectors have been incriminated in the irrigated parts of the Thar Desert, while only *An. stephensi* is incriminated in typical xeric environment. A careful review of malaria scenario in the Thar Desert (Rajasthan State) suggests that the region has been largely transformed into a hyperendemic area, at least in certain parts extensively irrigated and needs urgent attention to bring the situation under control.

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4.13 Role of population movement in transmission of malaria in desert part of Rajasthan, India

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Role of population movement in transmission of malaria in desert part of Rajasthan was studied. Majority of the desert dwellers earn their livelihood through monsoon based single crop pattern of agriculture and rearing of animals. Frequent drought occurring is a common phenomenon in this region. During the drought period major proportion of population move from one place to another for survival of themselves and their animals. They return back depending on good monsoon for the food and fodder both. Governmental efforts are being made to improve the quality of life by carrying out developmental activities in this region. People come from different states of the country to Rajasthan for the better job opportunities in construction of Indira Gandhi Canal, mining, industry and agricultural work in command area. Local residents and people who come from malaria endemic states and having fever were examined for malaria. In both the groups determinants of malaria transmission were also studied and compared. Responsible malaria transmitting vector was also studied. *Plasmodium falciparum* positive cases were found among people of both the groups. This may endanger the possible introduction of chloroquine resistant parasite in the desert. Other unexposed population is also at risk of malaria transmission. Such population movements being a continuous and regular feature are significant and capable of affecting the outcome of operational programme.

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4.14 Prevalence of malaria in Vijayawada city, Andhra Pradesh

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P. vivax and *P. falciparum* infection during 2003 and 2004, 95.87%, 97.8% and 4.13%, 2.2% were recorded in Vijayawada city respectively. Peak transmission of malaria with highest slide positive rate was recorded 6.19% in September 2003 and 5.9% in August 2004. Studies of Anti Vector measures were conducted to facilitate the control of malaria in Vijayawada city. Results are discussed.

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4.15 Epidemiology of malaria in Iranshahr County, Sistan and Baluchestan province, southeastern of Iran, April 2004 to March 2005

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Malaria remains an important public health problem and is endemic in more than 100 countries in the world. It has a great variety in epidemiology and clinical manifestation in different parts of the world. Iranshahr is a malarious area located in Sistan and Baluchestan province, southeast of Iran. For considering the epidemiology of malaria in the area a retrospective study has conducted from Apr., 2004 to Mar., 2005 (solar year 1383). Total reported cases were 472 including 32, 440 cases of *Plasmodium falciparum* and *P. vivax* respectively. About 23.3% of the cases were imported and nearly 20% of total cases were found in Afghan refugees and Pakistani immigrants. About 62.2% of total cases were between male and rest 37.7% in female. API, ABER and SPR calculated as 1.81 per thousand, 27.76 percent and 0.65 percent respectively. Number of recorded cases had a peak in late summer and early autumn. About 62.2% of total cases were found between male and the rest 37.8% in female. It seems that some complicated epidemiological factors such as existence of six species of vectors (most of them are exophile), high illiteracy rate, poor performance of health service delivery systems, high socialization with Pakistan and Afghanistan neighbours and so on cause failure in complete control of malaria in this country.

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4.16 Epidemiological study on malaria in an endemic area of West Bengal state, India

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The malaria scenario is diverse in different parts of the state of West Bengal, India, especially in the northern part. Siliguri is situated in the foothills of the Himalaya in the district of Darjeeling. Neighbouring countries like Bhutan, Bangladesh and Nepal are not far away from Siliguri Municipal Corporation (SMC) area and are malaria-endemic. Rapid and unplanned urbanization coupled with population migration in this economically important area for the last couple of decades has contributed new mosquito-genic and malariogenic situations. Keeping in view the above perspectives, an attempt has been made to study the transmission pattern of malaria in this area. This study proposes to analyse the incidence of malaria registered in SMC between 2000 and 2004. Altogether 31742 blood slides from clinically suspected cases were examined for the detection of malaria parasite, if any. 2340 (7.37%) cases were found to be positive for malaria. Amongst them falciparum malaria has contributed 86.32% and the remaining is vivax malaria. *Plasmodium falciparum* cases varied from 65(2000) to 648(2003), indicating nearly 10 fold rise of falciparum malaria within three years. Clinical manifestations of the infections were observed in all the years encompassing all the three distinct seasons with a pronounced peak in the rainy season. These observations suggest that malaria transmission has been going on perennially. Significantly more males were affected than the females. Paediatric age groups were less affected in comparison to the total case incidence. Malaria vectors viz. *Anopheles culicifacies*, *An. annularis* and *An. maculatus* have been found in this area. This study would be helpful in formulating strategies in the containment of the disease.

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4.17 Filariasis in the shadow of malaria

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Filariasis and malaria both are mosquito borne diseases and coexist mainly in tropical climates. While the former produces a morbid condition the latter can be fatal. This is the reason governments, companies, research community, public all are attentive to malaria but show lesser concern for filariasis. Individual with filarial lymphedema is subjected to tremendous personal agony, pain and social boycott. If we compare the total global budget allocation for malaria, funds for filariasis is meagre.

A study conducted at Panna district, Madhya Pradesh showed that people's knowledge about the disease significantly varies between filariasis and malaria. Only 33% individuals could relate mosquito bite with filariasis while all the individuals could relate it to malaria. Advertisements shown in TV and other mass media regarding mosquito cidal/repellent products spend lots of money depicting or associating mosquito with malaria but ignores to show a link between filariasis and mosquito despite the fact that 120 million people are at risk of infection with filariasis.

A study conducted recently at Khajuraho, Madhya Pradesh showed about 18% microfilaraemia in the study population. The present Global Program to Eliminate Lymphatic Filariasis (GPELF) is run mainly in the shoulder of malaria control machineries. Though logistically it provides a readymade platform for running the program, it cannot take up this activity for long because of malaria work. To achieve the goal of filariasis elimination program people has to work round the year to make a platform for the MDA to be successful. Though MDA is a one-day affair for the endemic masses, it should be everyday affair for the program people.

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4.18 Malaria among the Jarawas, a primitive and vanishing tribe of Andaman and Nicobar islands of India

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Andaman and Nicobar islands Union territory of India were inhabited by 14 aboriginal tribes. Some of these tribal populations have already become extinct, and the numbers of the existing ones are also dwindling. At present there are only six tribal population. The Jarawas, are the primitive Negrito tribe inhabit the jungle area of south and middle Andaman of Andaman Islands. The members of this tribe have been geographically and socially isolated from other inhabitants of the islands. No malaria had ever been reported in the tribe. Until 2001, when an outbreak of febrile illness was reported. This group of islands being highly endemic for malaria, which triggered a malariological survey among Jarawas. Malaria parasite, all identified microscopically as *Plasmodium falciparum*, were detected in the blood smear of 30 of the 179 Jarawas investigated, only *P.falciparum* was detected when blood samples from 26 of the subjects were investigated in PCR based assays. Genetic diversity studies, based on the msp1 and msp2 polymorphic markers, also revealed a low level of polymorphism in *P.falciparum* parasite infecting the Jarawas, compared with other areas of India. It seems possible that malaria parasite have recently reached the Jarawas.

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4.19 Rainfall and malaria transmission in lower Assam, Northeastern India

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A retrospective analysis of malaria incidences and rainfall for the period from 1986 - 2003 for data based in malaria endemic area of the state of Assam revealed that there was a significant association between seasonality of prevalent parasite species and months of heavy rainfall. The incidence rate was significantly lower for *P. falciparum* species (relative risk = 0.71; 95% CI = 0.63 - 0.81; P <0.0001) in the dry season as compared to wet season. In contrast for *P. vivax* species, the incidence rate was significantly higher (relative risk = 1.35; 95% CI = 1.26 - 1.45; P <0.0001) in the dry season as compared to wet season. However, the correlation of absolute rainfall and the annual number of confirmed cases of malaria/1000 population ($r = -0.317$; $df = 16$; $P = 1$), and that of annual number of rainy days and malaria cases ($r = -0.27$, $df = 11$, $P = 0.17$) were too far weak to be statistically significant. It is concluded that the long-term malaria control strategy should rely on generation of increased awareness on disease and its prevention, health-care access, and national commitment for increased prosperity particularly in resource-poor settings.

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4.20 Malariometric indices in Baiga Primitive tribe

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Malariometric indices are one of the important measures in epidemiological surveillance and in planning the control strategy for malaria. The classical malariometric measures are spleen rate, average spleen size, parasite rate etc. The importance of malaria transmission in tribal areas lead to increasing morbidity and mortality. The research has shown change in climate, lack of prompt recognition and treatment are reasons for transmission of this devastating parasitic disease. The aboriginal communities show an increasing interest in the use of traditional treatment (guniya) as a first-line for the disease. The malariometric indices provide needed information about the trend of the disease. The present study was carried out in 17 Baiga villages spread over three community blocks in 'Baigachak' area district Dindori of Madhya Pradesh. The study period is from October, 1999 to April, 2000. Populations of 1275 were clinically examined for spleen enlargement and 361, blood smear examination done for the cases of fever based on probable diagnosis. The results shows: proportionate case rate-30.7, spleen rate-32.2, average spleen size, Gr.I 9.5, Gr.II 90.0, Gr.III 0.5, Parasite Rate-17.0, Infant parasite rate-40.0, slide positivity rate-22.2, slide falciparum rate-16.7, Pf percentage-55.0, asymptomatic carrier-25.7. On conclusion the area is mesoendemic based on parasite rate and spleen rate.

4. Epidemiology

4.21 Situation analysis of malaria transmission in Bhubaneswar

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Bhubaneswar, the capital of Orissa is an upcoming city since 1960's. A lot of ecological changes have taken place due to various developmental activities and rapid industrialisation in the capital. This has resulted in the migration of labourers from different malaria endemic areas of Orissa to the city and mushrooming of the urban slums, which has facilitated the development of mosquito-genic condition. The situation analysis study indicated that malaria is prevalent throughout the year with slide positive rate (SPR) 11.8 % and Pf % (62 %). There is no difference in -malaria incidence between slum (SPR 11.7 %) and non-slum area (SPR 11.9 %) of Bhubaneswar. Three known malaria vectors namely, *An. annularis*, *An. culicifacies* and *An. stephensi* were prevalent in the city. There was to and fro population movement between Bhubaneswar and known high malaria endemic areas. There is no surveillance mechanism to assess the infection load in migratory population. Our data reveals that 85% of the confirmed malaria positive cases had contracted malaria from endemic areas as per the correlation of the incubation period and their sojourn in the endemic area. The rest 15% of the positive cases acquired the infection locally. Therefore, the possibility of indigenous local transmission cannot be ruled out. Malaria infection in Bhubaneswar city occurred throughout the year due to migratory population from endemic malaria areas and a few indigenous cases of malaria transmission occurred twice in a year viz; one in January and February and other in July. Hence, these findings necessitates further indepth study with appropriate regular active surveillance round the year with prompt detection and treatment facility in order to control urban malaria situation effectively.

4. Epidemiology

4.22 Three decades trend of malaria from Sangli of Maharashtra, India

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Sangli district of Maharashtra has rainfall range from 500 to 900 mm and temperature 14°C to 38°C. Therefore, mosquito biodiversity is rich in this region and resulted several outbreaks of malaria during the three and half decades 1971 to 2004. In first decade (1971 to 1980) malaria positive incidence was highest (average 5642), while Pf% was lowest (average 8.83%). In second decade (1981 - 1990) malaria positives decreased (average 1184) with increased Pf% (average 12.45%), while in third decade (1991 - 2000) malaria positives have increased (average 1645.2) with increased Pf% (average 29.59) indicating that Pf% is increasing alarmly even in current decade (2001-2004, average 21.79). During the year 1994-1999 and 2000-2005 the shifting of positives from problematic to non-problematic area have been observed. In the district, malaria complexity was influenced by human activities and natural calamities like excessive rainfall, flood, and drought etc, played an important role in increasing the malaria cases. The increasing trend of Pf% and death due to malaria in third and recent decade have been discussed with respect to geographical and climatic factors in the paper.

4. Epidemiology

4.23 Trends of *P. vivax* and *P. falciparum* in Aligarh

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Present study is based on the malaria cases enrolled in J.N. Medical Collage and a few other clinics and hospitals of Aligarh, during the years 2001, 2002 and 2003. Blood smears were prepared from suspected malaria patients. Thick and thin blood smears stained with J.S.B. and Giemsa stains and examined microscopically under an oil immersion lens to see the positivity of malaria infection. From malaria positive cases monthly *P. vivax* and *P. falciparum* infections and Slide positivity rates (SPR) and Slide falciparum rates (SFR) were worked out for the year 2001, 2002 and 2003.

During 2001 out of 1473 slides examined, 487 were found positive for malaria of which 275 belonged to *P. vivax* and 212 to *P. falciparum*. In 2002 a total of 1369 slides were examined, out of which 498 were found positive for malaria of which 292 belonged to *P. vivax* and 206 to *P. falciparum*. In 2003 a total of 1428 slides examined for malaria infection, out of which 580 found positive, slides showing positivity for *P. vivax* and *P. falciparum* were 298 and 282, respectively. During the 2001, 2002 and 2003 overall percentage of *P. vivax* and *P. falciparum* were 56.46, 58.63, 51.37 and 43.55, 41.36 and 48.62, respectively. *P. vivax* and *P. falciparum* showed almost similar transmission pattern during the years 2001, 2002 and 2003 having mean SPR 27.7, 28.5 and 30.3, respectively. A considerable degree of fluctuation was observed during peak transmission season (i.e. September and October) when SPR was comparatively high and ranged 54.25 to 57.7%.

4. Epidemiology

4.24 Application of satellite data as a diagnostic tool for large-area detection and monitoring malaria epidemics

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Landscape epidemiology emphasizes that climate and landscape circumscribes the distribution of mosquito-borne diseases, while weather affects the timing, duration, and intensity of outbreaks. Mosquitoes are sensitive to temperature, rainfall and humidity as well as to plant growth. Warm surfaces, rainfall, high humidity and healthy vegetation are excellent conditions and habitat for mosquito's activities and for carrying the disease to people. The indicated characteristics can be provided by operational weather satellites, pinpointing public health officials where the deadly microbes or vectors transmitting the diseases might dwell. This presentation will show potential for using new satellite-based Vegetation health indices (VHI) as proxy for early detection of large-area malaria epidemics and monitoring malaria outbreaks. The VHI, developed from radiances measured by the Advanced Very High Resolution Radiometers (AVHRR) flown on NOAA operational polar orbiting satellites, evaluate greenness, vigor and hotness of the canopy. They are indirect measures of mosquito habitat. The AVHRR-based VHI are available since 1981 to present. They were collected on a weekly basis from six NOAA afternoon polar-orbiting satellites for every 16*16 km land surface. A few examples will show potential and modeling approach.

4. Epidemiology

4.25 Malaria is endemic in Orissa but not in Kerala where as the ecological environment is more favorable for malaria in Kerala

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In India, malaria is very common in many states like Orissa, Bihar, Assam, Madhya Pradesh and recently in Rajasthan. Always blame goes to the environmental and ecological factors. The environmental and ecological conditions are more favorable in Kerala than in any other malaria endemic states in the country. Kerala is a tropical area with a lot of humidity, dense forests, hills, rivers and a large number of water reservoirs because of rain throughout the year. Most of the population resides in area surrounded by dense trees and water reservoirs but in spite of these favorable conditions, Kerala has minimum number of malaria cases in India in comparison to other states. The incidence of disease is increasing dramatically in many states. The re-emergence of malaria is blamed on various factors like human complacency, technical failures, emergence of drug resistance in the parasite and insecticidal resistance in the mosquito, administrative shortcomings and environmental factors like global warming, urbanization, movement of human population etc. but Kerala is out of the grip of malaria where as most of these factors are same for this state also. This is because, Kerala is head in India in all aspect of health; public health sector is very strong in the states. Education level is very high including high female education. There is no discrimination against females, women are empowered and have high decision-making power which enforce them about awareness of their health and higher utilization of health services. Kerala government also spares largest part of its revenue on health and education. People are more aware about their rights and because of decentralization in the health system there is more population involvement in health activities and health awareness programmes at grass root level. In public health system also, there is more accountability, responsibility and transparency at various levels.

4. Epidemiology

4.26 Trend of Malaria in Orissa

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Orissa is one of the highly malaria endemic state in India, with 3.7% of India's population. Orissa contributes 16 to 28.6 % of the total malaria cases, 35 to 50 % of *P. falciparum* cases and 12.9 to 50 % of total malaria death of the country. Malaria has been known in Orissa from time of immemorial. A study of malaria trends in Orissa reveals that initially DDT spray and vital effort from National Malaria Control programme (NMCP) wiped out the diseases, cases declined and API and SPR in Orissa was 0.3 and 1.42 respectively and no death till 1971. These were the days of highest achievement under NMEP. In sixties when NMEP was heading towards malaria eradication, a resurgence of malaria occurred in Orissa, a major problem faced by NMEP was DDT shortage (Sharma, 1999). In the eighties, malaria problem further aggravated and in 1981 malaria related cases in Orissa reported 29.8 million positive cases and 51 reported death due to malaria. The incidence of malaria in Orissa from 1961 to 2005 shows there is five fold increase in ABER from 1961 to 1981 i.e. 2.62 to 10.42 and subsequently there is no change in ABER. *P. falciparum* percentage increases profusely from 13 to 85%. There is ten fold increase in SPR rate. The API was very low less than 0.5 in 1961 but increases ten fold during the year 1981 and subsequently it remain stable above 10 till 2004. The API, SPR and ABER almost remain on same range from 1981 to 2004. There is no rapid increase i.e. 10.42 to 12.76, 8.61 to 11.04 and 11.41 to 13.35 in ABER, SPR & API respectively from 1981 to 2004. The state of Orissa is divided into four distinct geo-physiographical regions i.e. Easternghat, Coastal track, Central table land & Northern plateau. Out of four geo-physiographical region of Orissa, only the Coastal tract show low SPR ranges from 3 to 5 & API ranges from 3 to 6 and rest of three regions show higher value i.e. SPR ranges from 10 to 16 and API ranges from 9 to 31. The pf cases also remain higher in all the three regions except only the northern plateau.

4. Epidemiology

4.27 Malaria in Iran

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Malaria is one of the most important infectious diseases in developing countries of the world. Worldwide, over 40% of the population lives in malaria transmission areas (i.e., Africa, Asia, the Middle East, Central and South America, and...). It is estimated that 300-500 million cases of malaria occur each year resulting in 750,000-2 a social losses. About 1000 years ago, the Iranian physicians such as Avicenna (979-1037) were acquainted to the clinical feature of the disease. Iran categorized as Epidemiological Category Group 3 (Countries with moderate endemicity and relatively well established control programmes. it was found hyperendemic in some littoral parts of Caspian sea in the north and Persian Gulf in the south and hypo- or meso-endemic in the central parts of the country. We report epidemiologic Distribution of Malaria and it's major vectors in Iran's provinces in recent years.

4. Epidemiology

4.28 A hospital based screening for Japanese encephalitis, malaria, and enteric fever in adult patients of acute febrile encephalopathy

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The alteration of consciousness due to diffuse cerebral dysfunction in association with acute illness and fever is an important clinical problem seen in clinical practice all across the country, and also in other tropical environments. In hospital mortality and subsequent residual disabilities in patients presenting this syndrome due to various infectious diseases, range from 2.5% to 40%. An important proportion of this adverse outcome results from delay in starting specific therapy in some of these patients, as is true for all other serious infectious diseases. The study had been done to document the proportion positive for *P. falciparum*, Japanese encephalitis virus, and Typhoid infections in patients admitted with a diagnosis of 'Acute Febrile Encephalopathy' (AFE) in the Department of Medicine, KGMU, Lucknow, and to document the percentage of patients of acute febrile encephalopathy responding to empirical antimalarial and/or antibiotic therapy and their concordance with the positive result of investigations used for diagnosing malaria, JE and typhoid fever.

4. Epidemiology

4.29 An epidemiological study on the pattern of malaria cases admitted to a tertiary level health care centre in Orissa

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Out of a total of 2617 bed head tickets examined during January-31st March, 2005, 573 (21.89%) were confirmed cases of malaria of which 397(69.3%) were males and 176(30.7%) females. People from rural areas constituted 70.1% (n=399) and from urban areas 29.9% (170). The mean duration of stay in hospital was 5.10 days (SD±2.97 days, range 1-23 days). 459 persons (80.2%) were cured, 85 (14.9%) died and 28 LAMA. Largest number of cases (76.2%) and deaths (n=61, 85.9%) was contributed by *P.falciparum*.

4. Epidemiology

4.30 Climatic variables and malaria incidence in Dehra Dun, Uttaranchal

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In the Dehra Dun Valley, the main mosquito vectors are *Anopheles stephensi* (Singh *et al.*, 1994) and *An. fluviatilis* (Mahesh & Jauhari, 2001). For the last couple of years, vector-borne diseases are becoming the most dreaded health problems in the state of Uttaranchal because of developmental activities in one or the other ways. Although many campaigns against it have been conducted, malaria and dengue fever are still the major health problems in some of the districts of Uttaranchal particularly, Dehra Dun, Haridwar, Udham Singh Nagar and Bageshwar. It has been found that climate is a major parameter in all ecosystems and has always been a fundamental factor in human settlement, economy and culture. Although there have been few studies on the relationship between climatic variables and malaria rates in India, many studies have addressed the ways that other factors like urbanization, irrigation, deforestation and agricultural practices have affected malaria rates. Since there are no studies being done on climatic variables and malaria incidence in the Dehra Dun Valley, henceforth it has been decided to explore empirical relationship of primary climatic factors with the malaria incidence using Pearson's correlation analysis. The main aim of this analysis is not only to find the effect of climatic factors on malaria incidences but also to find influence of factors in quantitative terms. The exact location sites selected for the present study are in the vicinity of the Doon Valley. These are town area of the Valley, Sahaspur, Doiwala and Kalsi. The pattern of year wise malaria incidence is based upon epidemiological data for the year 1999 to 2002, obtained from the District Malaria Office, Dehra Dun. The climatic variables have been treated as independent variables while monthly incidence of malaria as dependent variables. During the study period statistically higher positive correlation of association was found between MPI and climatic variables. However, highest significant correlation was found between rainfall and malaria incidence when the data was staggered to allow a lag of 1-month.

4. Epidemiology

4.31 Malaria epidemics early detection in Brazil: an automation proposal

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In Brazil, 99% of the cases of malaria are registered in the Amazon Region. However, an automated system has still not been defined to detect epidemics that occur in this area. To propose appropriate statistical method for early detection of malaria epidemics in the Brazilian Amazonian Region. Three municipal districts were selected: Amarante do Maranhão (low risk), Manaus (medium risk) and Machadinho D'Oeste (high risk). Five statistical graphics were investigated: average \pm 1.96 standards deviation (Cullen method); inter-quartile range (Albuquerque method); 3rd quartile method; Cusum-tabular method and smoothing of baselines (Stern & Lightfoot method). In the graphics construction, monthly registrations of cases among seven year-old were used, excluding two epidemic years. The surveillance year was 2003.

The true alarm rate detected by the five methods was 100% in Manaus. In Machadinho D'Oeste was 100% for the 3rd quartile method, 25% for the Cullen and Stern & Lightfoot methods and 0% for the other methods. In municipal district of Amarante do Maranhão there was not epidemic month and no alarm was discharge by the five methods, corresponding to 100% of success. The 3rd quartile method is the most appropriate method for early detection of malaria epidemics in the municipal districts of the Amazonian Region of Brazil, and is recommended for implantation in routine malaria surveillance.

4. Epidemiology

4.32 Situation Analysis of malaria in Shankargarh PHC of district Allahabad

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Present paper deals with the epidemiological consequences of labour movement pattern and its magnitude, in transmitting malaria and causing periodical outbreaks in stone quarry areas of PHC Shankargarh. Shankargarh is characterized by the presence of stone/silica sand quarries with constant labour migration from adjoining district and bordering state of MP resulting in introduction of different *Plasmodium falciparum* strains which serves as a fluid reservoir of parasites for the Local population. Shankargarh is an epidemic prone and unstable malaria area. Every five to seven years the area encounters tidal wave of outbreak of malaria, resulting in some mortality and high degree of morbidity. The data of malaria clinic shows that the last outbreak of malaria occurred during 1991-92 which was followed by a downtrend up to the year 2003. In the year 2004 there was a sudden outbreak of malaria. The number of malaria cases went up from 1049 to 6458 in 2004 resulting in almost six fold increase. This increasing trend is still continuing in 2005 with 4786 cases already reported till August 2005. Studies conducted on drug resistance status in the area show that there is a high degree of chloroquine resistance. Out of 57 cases taken up for the study, 23 cases were found resistant to Chloroquine, out of which early parasitic failure was reported in nine cases, while rest 14 cases showed late parasitic failure.

4. Epidemiology

4.33 Indepth study on entomological and parasitological factors responsible for transmission of malaria in fringe forest villages of Bhabar region, district Nainital, Uttaranchal

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At Malaria Clinic 40 to 60 percent malaria cases were reported from fringe forest villages of Bhabar since 1997 to 2001. Therefore, an in depth study was conducted to know entomological and parasitological factors responsible for transmission of malaria in 5 villages i.e. Lakhan mandi, Pachaunia , Forest compound, Dubel bera and Khola bazar villages of district Nainital, Uttaranchal from Apr., 2002 to Dec., 2004. The results revealed prevalence of 9 anophelines including two malaria vectors i.e. *An. culicifacies* and *An. fluviatilis*. The per man hour densities varied in *An. culicifacies* from 0.0 to 139.0 and in *An. fluviatilis* from 0.0 to 69.0. Incrimination study revealed 0.24% sporozoite rate in *An. culicifacies*. Sibling species investigation revealed prevalence of species B (53.8%) and C(46.2%) of *An. culicifacies* and species T(100%) of *An. fluviatilis*. A total of 785 blood smears were examined during passive case study which showed 50.4 and 28.3 percent SPR and SFR, respectively revealing high malaria incidence. The infant parasite rate (IPR) was 42.9%. Spleen survey among children revealed 25.95% spleen rate showing high malaria endemicity in the above area. Thus, in fringe forest area active transmission of malaria occurred due to high vectors densities, parasitic load in the community and favourable environmental conditions and ecological niches.

4. Epidemiology

4.34 Situation analysis of malaria in and around Chilka Lake area

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Chilka lake in Orissa state is the largest brackish water lagoon in India, connected to the Bay of Bengal. Malaria has declined around Chilka lake in Orissa from hyperendemicity in 1930s to hypoendemicity during the recent decade. A situation analysis of malaria in PHCs around Chilika lake was done by taking malarial incidence as stratum. Malaria prevalence was detected in four Primary Health Centre (PHC) around Chilika lake area viz., Balugaon, Tangi, Banpur and Khalikotte in 2004. As per the epidemiological data during the last three years collected from state govt., it was observed that Banpur PHC had maximum number of malaria cases during 2002 to 2004, the SPR in 2002, 2003 and 2004 being 8.79, 5.53 and 7.49 respectively. The second highest incidence of malaria occurs in Khalikotte PHC followed by Balugaon and Tangi. The SPR in 2004 was 5.37, 2.56 and 1.9 in Khalikotte, Balugaon and Tangi respectively. The percentage of *Plasmodium falciparum* shows a declining trend i.e., 65.7% in 2002 to 31% in 2004 in Banpur PHC where as it shows an increasing trend i.e., 71% in 2002 to 80% in 2004 in Khalikotte PHC and also in Tangi PHC where the pf% was 20%, 45.7% and 89.5% in 2002, 2003 and 2004 respectively.

4. Epidemiology

4.35 Epidemiological record of malaria in Dibrugarh district of Assam and traditional approaches for its treatment

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The north eastern region of India often considered as one of the malaria prone areas. This paper deals with the epidemiological record of malaria in Dibrugarh district of Assam from 2001 to 2005 (up to May) and the prevailing traditional treatment procedures among the local people. There were only 24 cases of malaria reported in the district during 2004 as compared to the figure of 84 in 2001 which indicates a significant decline in the epidemiological pattern of malaria in this area. The number of malaria cases recorded was high during the period from the end of summer to the end of monsoon season (from May to September) ranging from 83% to 91% of the total cases of the year. Approximately 70% to 80% of the cases are due to the *Plasmodium falciparum* while remaining 20% to 30% cases are the result of infection due to *Plasmodium vivax*. There is no record of incidences of malaria due to other human malaria parasites. No report of death due to malaria is recorded from 2002 while the number of deaths in 2001 was 6.

Traditional treatment procedures utilizing natural resources of this region are reported to be effective for curing malaria some of which are related to the traditional culture of the ethnic people of the district. The present communication reports some traditional formulations used in the treatment of malaria involving some indigenous plant species and other components of natural origin, along with the method of preparation and mode of application. Some remedial measures mentioned in the books written in local language (Assamese) have also been cited in the paper.

4. Epidemiology

4.36 Recent Trends of Malaria in Kolkata, West Bengal, India

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Malaria has been recognized in India as the most debilitating disease for aeons. Though the disease has been found mostly restricted to the rural areas, the intensity of its occurrence has been on the rise in the urban areas in recent years. The disease has been known to cause large-scale deaths in Bengal for centuries. These have been depicted in various literatures available. Sir Ronald Ross conducted the greatest discoveries on the transmission pattern of malarial parasites in the city of Kolkata over a century ago.

The city of Kolkata has been found to record almost 40-50% of the total malaria cases reported from the state of West Bengal. Deaths due to malaria is also on the rise. Number of *Plasmodium falciparum* cases recorded from the city is also quite alarming. The vector *Anopheles stephensi* have been reported to have acquired resistance to DDT, BHC, Propoxure and Melathion. *P. falciparum* too have shown resistance to Chloroquine at RII and RIII level. Moreover, large number of malaria cases goes unrecorded since they are mostly treated in private hospitals/nursing homes/private practitioners.

The rapid rate of urbanization in recent years have brought in major topographical changes in the erstwhile-established ecosystem. Therefore, in view of the alarming situation of malaria incidence in Kolkata vis-à-vis the state of West Bengal, the urgent need for its containment with various available tools will be discussed.

4. Epidemiology

4.37 Role of Asymptomatic Carriers in the Transmission of Malaria

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Malaria is one of the major health problem in India. In 30 districts of Orissa which are endemic for malaria, *P. falciparum* constitute 80%. The phenomenon of asymptomatic carriers has been reported from the state of Orissa but their role in transmission of malaria has not been defined. We had undertaken a study in Two PHC's of Sundergarh district (Orissa) by covering two thousand Population.

Parastiological surveys for the detection of asymptomatic carriers of malaria were conducted in District Sundergarh of Orissa. Surveys were carried out in March, June and September 2001. Asymptomatic carriers constituted 40-50% of the total examined in different study areas. Gametocyte density was more in symptomatic cases as compared to that of in asymptomatic carriers. Blood samples drawn from asymptomatic gametocyte carriers were fed to *An. stephensi* in different batches. Two out of 20 samples from asymptomatic carriers showed development of malaria parasites in the vector. On the other hand out of 11 samples from symptomatic cases, three showed development of parasites in the mosquitoes. The results showed that the role of asymptomatic gametocyte carriers has to be established in the transmission of malaria. There is an urgent need to develop a test which is simple and could screen large number of samples within a short time. Hence, a peptide for detection of gametocyte antibodies had tried but it had not worked. Still a search of good peptide is required.



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