

An epidemiological insight of malaria outbreak in a residential complex of a defence establishment in Gujrat state of India

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Abstract

Introduction: Kutch area in Gujrat state of India is high endemic area for BT malaria. After devastating earthquake of 26 Jan 2001 in the region, number of malaria cases increased in the region. A closed campus of defence establishment witnessed an outbreak of BT malaria in 2005 due to local transmission confirmed by epidemiological investigation.

Material and methods: On receiving the information of an abnormal rise in the number of cases a team headed by a senior epidemiologist was sent to investigate the outbreak. On submission of report the team was asked to implement control measures to prevent its further transmission.

Results: A large number of cases reported in the campus with a high slide positivity rate of 27.07 percent and API of 75.12 per thousand population in 2005. Majority of them (99.17 percent) were BT malaria cases. Family members were affected most (API 106.66) as compared to the Air Force employees (API 33.57). A spleen rate of 1.04 percent and an infant parasite rate of 10.81 percent revealed a high transmission among the children.

Discussion: Population residing in the campus had BT malaria epidemic with very high percentage of cases among younger population. The main cause of epidemic was failure of the measures for prevention and control. Local transmission of malaria was caused by *An. stephensi* which was found to breed heavily in pools, ditches, overhead tanks and static tanks. Clinical cases reported with fever and confirmed by blood smear examination were neither treated nor reported to higher authorities. Antimalarial activities were also not conducted as per the guidelines mentioned in the directives of defence services. The epidemic was controlled effectively by adopting the measures advised by the investigating team.

Key words: Post-earthquake malaria, outbreak, endemicity, epidemic investigation, API

1. Introduction:

After an earthquake hit the Kutch area of Gujrat on 26 Jan 2001 there was an abnormal rise in the number of cases with occasional outbreaks in the area. There was an alarming increase in the number of malaria cases in a closed campus of a defence establishment of the region. Command Head Quarter, the higher formation of the area on receiving information of the cases formed a team headed by a senior epidemiologist accompanied by local administrative and medical authorities. The team investigated the outbreak and implemented measures for its control. The outbreak was effectively controlled and measures suggested were also

found useful in bringing down the incidence of malaria at other similar defence establishments.

2. Material and methods:

In India, the defence establishments are located in different parts of the county having variety of climatic conditions and terrains. The measures for prevention and control of malaria and other vector borne diseases are very well defined in all three branches of defence services to implement throughout the country. These measures vary in different stations depending upon terrain, climatic conditions and endemicity of malaria. District Bhuj located in Kutchh area of the Gujrat state is the westernmost part of India with a high endemicity

of malaria. The area witnessed an earthquake on the Republic Day i.e. 26 January 2001, with vast devastating effects, leaving over 18,600 persons dead, more than 150,000 of them homeless and an economic loss of about Rs. 22,000 crores [1]. Urban locality of Bhuj is an endemic malaria zone where cases keep occurring throughout the year with peak spurts in the months between September to December due to rise in humidity and fall in temperature which favours multiplication of the vector. Earthquake effects created rise in number of water bodies and water collection in artificial pools which were dug or made to store water for construction and renovation work at most of the places. These were neither in use nor demolished after the construction work was over, hence became potential breeding places for anopheles mosquitoes. These water collections were the main cause of rise in the number of cases during post earthquake period which continued afterwards also till 2006.

There had been a sudden rise in the number of malaria cases in the year 2005 inside the campus with a report of more than 30 cases among defence employees in a short span of four months from May to July, in the year 2005. Occurrence of these cases was considered as an outbreak by the competent authorities at Command Head Quarter. A team comprising of an epidemiologist as head of the team and other members from related departments was deputed to investigate, submit the report and monitor the implementation of the suggested measures to control the disease. A preliminary report was submitted by the team in a week's time, followed by submission of final report in about four weeks. Preliminary report confirmed the rise in number of cases as an epidemic. Since the epidemic continued during the period of investigation measures suggested in preliminary report were implemented under guidance of the team for its effective control. The epidemic was controlled successfully on aggressive implementation of the antimalarial activities.

3. Results

Following are the results of the epidemiological investigation:

Table-1: Year wise malaria cases (total, BT & MT) and API in past five years

Year	BT	MT	Total	API
2000	11	1	12	5.75
2001	65	15	80	38.36
2002	13	3	16	7.67
2003	11	1	12	5.75
2004	9	1	10	4.79
2005	67	3	70	33.57
2006	15	2	17	8.15

Out of total 363 malaria cases found positive on blood slide examination, 70 were employees and rest 293 of them were family members. Out of the family members 84 wives, 107 sons, 99 daughters and 03 parents were detected to have positive blood slides. They were either living permanently in the campus or were present at the time of their sickness.

3.1 Malaria cases:

Table-1: Year wise malaria cases (total, BT & MT) and API in past five years

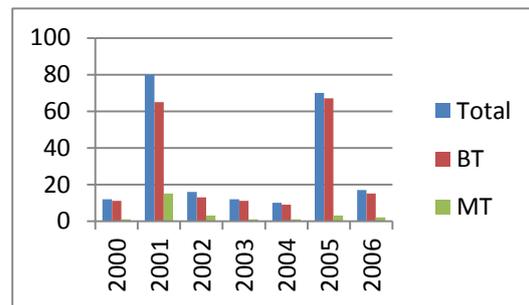


Fig-1: Year wise malaria cases (total, BT & MT) and API in past five years

a. Trend of malaria in post earthquake period: (Table-1 and Fig-1)

The area under study having witnessed the devastating effects of earthquake had a sharp rise in the number of cases all over the area in the year 2001. In the campus of defence establishment also there was a rise in the number of cases among service personnel as is evident from the Table-1 and Fig-1. Out of total 80 cases of malaria in the year 2001, there were 65 cases of benign tertian (BT) malaria and 15 cases of malignant tertian (MT) malaria. Thereafter, the number of cases came under control in subsequent years, but a second spurt was seen in the year 2005. Total number of malaria cases increased to 70, largely contributed by BT malaria, and a small contribution of 3 cases of MT malaria. Since the record is maintained in respect of service personnel only the data of their families could not be made available for previous years. However, the record of the year 2005 and 2006 in respect to families was also maintained on getting instructions from higher authorities.

b. Total number of malaria cases in the year 2005:

Table-2: Category-wise total population, age-wise malaria cases and API

Category	Total Population	Number of malaria cases								API
		Below 5 years	6-10 years	11-15 years	16-20 years	21-30 years	31-40 years	Above 40 yrs	Total	
Employees	2085	--	--		04	26	25	15	70	33.57
Wives	1023	--	--	--	--	40	42	02	84	82.11
Sons	875	32	36	20	19	--	--	--	107	122.85
Daughters	813	24	43	18	13	01	--	--	99	121.77
Parents	36	--	--	--		--	--	03	03	83.33
Total	4832	56	79	38	36	67	67	20	363	75.12

c. *Age wise distribution of malaria cases:* All age groups, including infants were detected to have blood smears positive for MP. In all 363 persons suffered from malaria out of total population of 4832 with an overall API of 75.12 per thousand population in the year 2005. 79 children in the age group of 6-10 years suffered most, followed by 56 children in the age group below 5 years. API among the women and

parents, of 82.11 and 83.33 respectively was also very high as compared to 33.57 of the service personnel.

d. *Sex-wise distribution of malaria cases:* Sex wise distribution of cases was almost equal in children, wherein 107 sons with the API of 122.85 and 99 daughters with API of 121.77 had their slides positive for MP. In the older group of women and men there was a big gap in slide positivity with 84 wives suffering with API of 82.11 while only 70 men with API of 33.57 had slide positivity.

Table – 3: Category & month-wise distribution of malaria cases in the year 2005

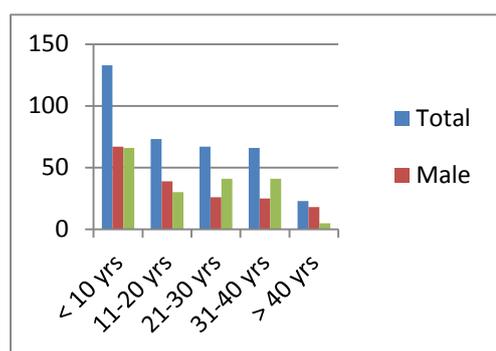
Category of the persons	Months of the year												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Employees	00	04	04	04	06	12	13	02	07	06	07	05	70
Families	07	05	04	06	29	16	46	25	59	57	10	29	293
Total	07	09	08	10	35	28	59	27	66	63	17	34	363

e. *Month-wise distribution of malaria cases:* In the year 2005 the number of cases increased gradually from 7 in January to 10 in April. Then there was a sudden increase in the number of cases to 35 in month of May followed by 28 cases in June which again increased to 59 in July followed by 27 in August and reached to 66

cases which had been the maximum number of the month in September. Number remained high in October also with 63 cases. Thereafter, the number decreased to 17 in November followed by a rise again to 34 cases in month of December.



Figures 2: Month wise distribution of the malaria cases in the year 2005



Figures 3: Age wise distribution of the malaria cases in the year 2005

3.2 Measurements of malaria :

- a. *Annual blood examination rate (ABER):* In all 1175 slides were prepared and examined for malaria parasite in the population of 4832 giving an ABER of 36.93 percent [2, 3].
- b. *Slide positivity rate (SPR):* SPR was calculated to be 27.07 percent as 434 slides out of total 1175 slides were found positive for malaria parasite[2, 3].

- c. *Annual parasite incidence (API)* is defined as number of blood smear confirmed cases per thousand population in the year 2005. It was calculated among the population of the campus as 75.12 per (363 cases in the population of 4832). In all 434 slides were found positive for MP. Out of 363 cases, 311 were found positive once, 44 were shown positive twice, 5 had their slides positive three times, while 3 cases were detected to have their four slides positive. 8 cases

were other than defence persons, hence were not reflected in counting of the cases. Out of all cases, one case had mixed infection of MT and BT, two had MT and rest 360 were BT cases. API calculated for total population was 75.12 per thousand population, for family members it was 106.66, for service personnel 33.57, for lady wives 141.63 and for children it was 122.03 per thousand population (122.87 for boys and 121.77 for girls). *Spleen rate* was evaluated out of the total 287 children of age less than 10 years, who reported to doctors in one month's period of investigation. 3 children were found to have enlarged spleen. Thus spleen rate works out to be 1.04 percent [2, 3].

- d. *Infant parasite rate*: Out of total 37 infants, 4 were detected to have their blood smear positive for malaria parasite making an infant parasite rate of 10.81 percent [2, 3].
- e. *Spleen rate*: Out of the total 287 children who reported to medical centre for treatment and follow up all of them were examined for their spleen enlargement. Only three of them were found to have spleen enlargement of 2-5 cm. The spleen rate is worked out to be 1.04 percent [2, 3].

Table-4: Malaria cases in the area under study and outside the campus

Locality	Approximate population	Malaria cases					
		2003		2004		2005	
		Cases	API	Cases	API	Cases	API
Area under study	2,085	12	5.75	10	4.79	70	33.57
Other similar areas*	28,500	150	5.26	141	4.94	167	5.85
Civil area (urban)	1,35,000	339	2.51	437	3.23	294	2.18
Civil area (rural)	2,25,000	2802	12.45	2342	10.41	1147	5.1

3.3 Malaria cases registered at other medical establishments in past 3 years:

Malaria cases outside the campus: Being high malaria endemic area the cases keep occurring between API of 2-10. In urban areas the incidence range was between 2.18-3.23 while it is very high 5.10-12.45 per thousand population per year in rural areas. Malaria is a perpetual problem of the area. In civil localities the incidence was registered as 2.18 and 5.10 per thousand population per year in urban and rural localities respectively. In another nearby defence establishment the incidence was calculated to be 18.97 per thousand population per year.

3.4 Review of the anti-malaria activities of the campus:

On reviewing the anti-malarial activities from existing records of the establishment under study following reasons were identified as the responsible factors of the outbreak.

- a. *Survey of the breeding places*: On conducting survey of the area to look for breeding of the mosquitoes several pockets of fresh water collection were found inside and in surrounding areas of the campus showing presence of larvae. Two of the static tanks in vicinity of residential area were found to have very heavy breeding of anopheles. Static tanks are open underground concrete tanks to keep reserve water for use mostly at the time of fire fighting. On making an aerial survey of the area it was found that about 20 percent of the overhead tanks were lying open due to missing covers. On examination of 50 such OHTs, seven were found to have breeding. These tanks were having stagnant water due to its non-use as the persons were out of the station for more than a week. A joint survey on the request of

the authorities of the station was conducted separately by the District Malaria Officer in the area with his team who concluded with the remark of local breeding of *Anopheles stephensi* in the area.

- b. *Anti-larval activities* [4]: As per the defence directive, all houses and buildings are required to be sprayed twice in a year with malathion or Baygon. To carry out spraying and antilarval work the local authorities were required to appoint and provide 17 workers to the medical establishment who are named Antimalaria lascars (AMLs). In place of 17 of them, only five were employed to carry out this work. As a result regular spraying activities were not conducted as per directive. In addition, many times there was non availability of transport to carry out these activities in distant parts of the station. Shortage of the hygiene chemicals {Malathion, Baygon (propoxur), Baytex (phenthion) and Abate (temphos)} also played key role in increase in the number of mosquitoes.
- c. *Personal protective measures*: In warm and humid climate of the area residents are not in practice of using the mosquito nets in spite of repeated instructions and health education given by the authorities. However, for service personnel it is compulsory to use deltamethrine impregnated nets regularly. This has been the reason of low API among the employees living separately as compared to the family members and the employees living with their families.

4.1 *Epidemic of Benign Tertian Malaria*: From the results shown in table 1, 2, 3 and 4 above, it is evident that the

4. Discussion

rise in number of cases was far more than the normal expectancy in the year 2005 and thus was declared as an epidemic of Benign Tertian (vivax) malaria predominantly transmitted by An. stephensi. The month-wise distribution of the cases shows that rise in the number of cases began in the first quarter of the year but it was abnormally high in the month of May 2005 and continued to be high till end of the year with peak in September and a marked fall in months of August and November in between.

4.2 Rise in the number of cases in surrounding localities:

Local area is under high endemic zone where the trend in past four years had been on the declining side. The reporting system in civil localities is not reliable as most of the serious cases report to the private practitioners for treatment and are not registered with the reporting medical authorities [5]. This leads the under reporting of the cases. On the other hand in defence establishments all the service personnel are compulsorily required to take treatment from the defence medical establishments, therefore there is hundred percent reporting of the cases. Out of the reported cases in civil localities rise in the cases was not significant and could not be attributed to the rise in the area under study. Although there had been, rise in number of cases who were treated at similar defence establishment, the number was comparatively very high in the area of study. The API at these establishments was 18.97 and 33.57 per thousand population respectively (Table-4)

4.3 Measurements of malaria outbreak:

As is evident from Table-1, the number of cases of malaria among the employees of the defence establishment under study was comparatively very high in the year 2001 which was the post earthquake period. Thereafter, in subsequent years the number was within normal range till 2005, when number of cases increased to 70 with API 33.57 per thousand population. The rise in cases and API is found to be markedly high on comparing it with API of previous five years except year of 2001 which was post earthquake period. Since data could be made available of only for the service personnel for previous years, it could not become possible to calculate API for the families. Entire community of the closed campus was affected by the epidemic including both sexes and all the age groups. Children, lady wives and young adults suffered more than adult males due to strict use of impregnated mosquito nets as personal protective measure. It is evident from Table-2 that lady wives (83) outclassed the number as malaria cases as compared to their male counterparts. This is probably due to indoor transmission taking place in residential complexes. Cases were more among the children of 6-10 years of age (78 cases) as compared to other age groups. This may be attributed to their outdoor activity of common exposure in park where all children go to play in the evening hours.

4.4 Transmission of malaria: Most of the population living in campus belongs to distant places of the country who keep visiting their native places at least once in a year. Barring a few imported cases, most of the cases contracted infection locally at the station. In the beginning months of epidemic, these might have contracted infection from outside but large number of

cases in month of May 2005 is indicative of beginning of transmission inside the campus. Presence of breeding places of anopheles, lacking anti-malarial activities and half hearted efforts in early detection and prompt treatment were the main causes of local transmission of the disease. Presence of MP in infants (an incidence of 10.81 percent) is a definite indication of local transmission and high number of cases among children and house wives indicates excessive transmission in residential complex. A comparatively very high incidence among lady wives could not be justified; however this can be attributed to excessive local indoor transmission. On looking at seasonal variation months from April to November were affected most. However, months from July to November are considered as of malaria season.

5. Conclusion

Kutch area of Gujrat in post earthquake period was observed a high endemic zone of malaria with an average range of API between 2-10 per thousand population per year, with a higher incidence in rural areas. A closed defence campus of the region had an epidemic of BT malaria with an overall very high API of 75.12 per thousand population in the year 2005. The API worked out for different categories was 33.57 for service personnel, 82.11 for women and 122.03 for the children. Category of children was worst affected. Months from May to December were affected more by the epidemic with its peak in September. Main reasons of outbreak was the local transmission of the disease in the residential area of the campus due to uncontrolled breeding of mosquitoes in fresh water collection pools, static tanks and stagnant overhead tanks. This was added by lack of early detection and prompt of treatment strategy, failure of implementing anti-malarial activities and ignoring of personal protective measures. On implementing the control measures strictly with proper vigilance and multidiscipline approach, the epidemic was brought under control in a period of about 4 months.

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