Review Article

Review of Malaria Situation in Assam with Special Reference to Security Forces

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Abstract

Assam, alone, with 2.6% of the country’s population, contributes > 5% of the total malaria cases in the country. Keeping in view the importance of malaria in the North East and its special significance to the Armed Forces the present study was undertaken to review the malaria situation in Assam.

Data on commonly used parameters of malaria surveillance including drug resistance from 2000 to 2008 were collected. Subsequently the extensive data was compiled in the form of Malaria Atlas Of Assam with choroplath maps at district and PHC level. The number of hospital admissions due to malaria in various service hospitals post 2009 have been taken as an index to measure the success of focused interventions.

District wise mean API of Assam is depicted in Table 1 whereas District wise pattern of reported chloroquine resistance is presented in Figure 1 [4] Total number of admissions due to malaria (both P Vivax and P falciparum species) in service hospitals in the state of Assam for the period 2000 to 2008 is depicted in Table 2. Month wise distribution of cases of malaria in a particular Army field formation (where the revised focused intervention strategy was first implemented) for the year 2009 along with type of infection is given in Table 3.

The service personnel deployed in NE region are especially vulnerable as they share the same anthropoecosystem as that of local population but at the same time lack the partial immunity to malaria enjoyed by local population[1].

The data collated by us has shown that the patterns of malaria incidence are not uniform across the state and varies considerably even within the same District. Having API based choroplath maps upto PHC level is of great value for malaria risk assessment for the security forces.

Keywords: Malaria, Malaria in Assam, Choroplath Maps, API, Security Forces, Malaria Surveillance, Chloroquine Resistance

Introduction

Malaria has been a major public health illness in the North East. The seven sister states contribute 10 to 12% of total malaria cases; and 14% of the total malaria morbidity in the country. Assam alone, with 2.6% of the country’s population,
contributes >5% of the total malaria cases in the country. The state of Assam (24°44’ to 27°45’ N latitude ; 89°41’ to 96°02’ E longitude) is the second largest state in the Northeast region (78,523 km²) and contributes over 50% of all malaria cases from the North East and over 5% of the total reported cases in the country. 

*P. falciparum* is the predominant parasite species. The region is highly receptive to malaria transmission due to topography, vegetation (40% area is forest), excessive and prolonged rainfall (2 to 3 m) which promote vector breeding. High humidity (60 to 90%) and warmer climate for most of the year ensures longevity of the vectors. Difficult terrain and poor communication are the other highlights of this state. Because of the presence of distinct physiographic units (Brahmaputra Valley in the North, Barak Valley in the South and hill regions between valleys), sharing of interstate/international borders by 21 districts out of total 23 districts of the state, and a large tribal population of varying ethnicity all major epidemiological types of malaria like forest-related malaria, tribal malaria, border malaria, rural and urban malaria, etc., are encountered.

It was keeping in view the importance of malaria in the North East and its special significance to the armed forces and other such security forces which remain deployed throughout the state owing to various threats and continue to have malaria cases despite routine chemoprophylaxis with weekly chloroquine, the present study was undertaken to review the malaria situation in Assam.

### Materials and Methods

Data on commonly used parameters of malaria surveillance including drug resistance from 2000 to 2008 was collected by personal liaison from different District Malaria Offices. Besides, personal visits were paid to Malaria Research Centre, Sonapur, and ICMR Institute at Dibrugarh, to obtain additional data particularly on vector species prevalent in the state of Assam. Data was cross validated by means of field surveys in endemic areas. The ABER (annual blood examination rate), API (annual parasite incidence) and SPR (slide positivity rate) data was further analyzed for mean and 95% CI. This extensive data base enabled drawing of choropleth maps of malaria for the entire state, first at district level and then up to PHC level and compiling them as an atlas titled *Malaria Atlas of Assam*. This atlas helped in identification of areas of intense transmission and/or areas of chloroquine resistance down up to PHC level. Subsequently, a focused strategy was prepared for prevention of malaria infection among armed forces personnel operating in such areas emphasizing on personal protection, chemo-suppression with an appropriate drug regimen in chloroquine-resistant areas and extensive health education. The same was implemented in an army field formation in upper Assam as a test case under the personal supervision of authors after convincing the commanders of its necessity. The documented incidence of malaria in this particular army field formation in 2009 was taken as an indicator of the success of the strategy followed by its dissemination and roll out on a larger scale. The number of hospital admissions due to malaria in various service hospitals post 2009 has been taken as an index to measure the success of such focused interventions on prevention of malaria infections among vulnerable armed forces personnel.

### Results

District-wise mean API of Assam is depicted in Table 1 whereas district-wise pattern of reported chloroquine resistance is presented in Fig. 1. Districts were further classified on the basis of API. The number of districts showing a particular API during the study period is presented in Fig. 2. District-wise API from 2000 to 2008 is shown in Fig. 3. Total number of admissions due to malaria (both *P. vivax* and *P. falciparum* species) in service hospitals in the state of Assam for the period 2000 to 2008 is depicted in Table 2. Month-wise distribution of cases of malaria in a particular army field formation (where the revised focused intervention strategy was first implemented) for the year 2009 along with type of infection is given in Table 3. The incidence of malaria in the state of Assam from 2009 to 2013 along with total number of malaria cases admitted in the previously referred five service hospitals in the state of Assam is given in Table 4.
Table 1. District-Wise Mean ABER, Mean API and Mean Pf %: 2000–2008

| S. No. | District             | Mean ABER | Mean API (95% CI) | Mean Pf % (Range)          |
|--------|----------------------|-----------|-------------------|-----------------------------|
| 1.     | Barpeta              | 6.03      | 1.31 (0.82 to 1.81) | 53.04 (39.58 to 69.89)     |
| 2.     | Bongaigaon           | 9.01      | 3.33 (2.30 to 4.36) | 93.08 (88.55 to 94.16)     |
| 3.     | Cachar               | 6.11      | 2.40 (1.98 to 2.82) | 99.33 (97.35 to 99.82)     |
| 4.     | Darrang              | 7.56      | 8.30 (6.20 to 10.40) | 15.97 (8.52 to 25.43)      |
| 5.     | Dhemaji              | 5.66      | 1.98 (0.67 to 3.29) | 38.89 (2.06 to 100)        |
| 6.     | Dhubri               | 7.29      | 1.10 (0.85 to 1.35) | 89.84 (85.89 to 93.53)     |
| 7.     | Dibrugarh            | 6.94      | 0.04 (0.02 to 0.06) | 78.70 (72.73 to 88.76)     |
| 8.     | Goalpara             | 9.09      | 5.33 (4.12 to 6.53) | 84.19 (74.06 to 90.98)     |
| 9.     | Golaghat             | 8.89      | 0.69 (0.14 to 1.24) | 53.22 (22.80 to 93.56)     |
| 10.    | Hailakandi           | 9.95      | 7.74 (5.97 to 9.51) | 98.92 (98.00 to 99.69)     |
| 11.    | Jorhat               | 7.24      | 0.18 (0.08 to 0.29) | 62.04 (14.02 to 95.24)     |
| 12.    | Kamrup               | 7.30      | 2.39 (1.70 to 3.08) | 80.81 (76.30 to 89.77)     |
| 13.    | Karbi Anglong        | 21.41     | 18.69 (16.45 to 20.92) | 86.04 (82.94 to 88.17)     |
| 14.    | Karimganj            | 5.03      | 0.52 (0.33 to 0.71) | 90.21 (83.98 to 95.13)     |
| 15.    | Kokrajhar            | 9.68      | 6.88 (5.27 to 8.49) | 76.67 (66.51 to 82.08)     |
| 16.    | Lakhimpur            | 8.16      | 3.68 (1.16 to 6.20) | 12.72 (0.21 to 42.13)      |
| 17.    | Mongaon              | 6.11      | 1.02 (0.23 to 1.81) | 60.79 (43.24 to 64.20)     |
| 18.    | Nagaon               | 10.40     | 2.45 (2.01 to 2.89) | 60.62 (24.4 to 78.41)      |
| 19.    | Nalbari              | 6.21      | 1.72 (0.94 to 2.49) | 79.60 (68.32 to 86.15)     |
| 20.    | North Cachar Hills   | 13.27     | 14.51 (12.76 to 16.26) | 74.82 (64.81 to 82.28)     |
| 21.    | Sibsagar             | 5.67      | 0.05 (0.02 to 0.08) | 82.58 (70.21 to 90.91)     |
| 22.    | Sonitpur             | 8.93      | 3.14 (2.02 to 4.26) | 38.33 (24.04 to 59.23)     |
| 23.    | Tinsukia             | 6.18      | 1.26 (0.79 to 1.74) | 29.78 (18.22 to 49.59)     |

**DISTRICT WISE PATTERN OF REPORTED CHLOROQUINE RESISTANCE**

![Map of Chloroquine Resistance Pattern in Various Districts of Assam](image1.png)

Figure 1
From Fig. 2, it is observed that there was an epidemic in the year 2006. The number of districts showing an API of 0–2 was 7 as compared to 10 to 15 in the other years of the study period. However, it is also observed from Fig. 3 that this epidemic was contributed to a large extent by five districts, viz., Darrang, Goalpara, Golaghat, Kokrajhar and Sonitpur.

Discussion

Malaria is endemic in most Northeastern states of India with predominance of \( P. falciparum \) infections.\(^{1,6} \) Outbreaks in civil and even in service population are a regular event.\(^{1,7,8} \) Transmission of the malaria pathogen is persistent and is maintained mostly by Anopheles minimus; other vectors are Anopheles dirus and Anopheles fluvitalis.\(^{1,9-11} \) The service personnel deployed in NE region are especially vulnerable as they share the same anthropo-ecosystem as that of local population due to their extensive deployment in counter-insurgency operations and border management but at the same time lack the partial immunity to malaria enjoyed by locals due to their regular turnover.\(^1 \)

The data collated by us has shown that the patterns of malaria incidence are not uniform across the state and varies considerably even within the same district. Having

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Table 2. Total Number of Admissions due to Malaria (both \( P. vivax \) and \( P. falciparum \) Species) in Six Service Hospitals in the State of Assam for the Period 2000 to 2008

| S. No. | Name of Hospital | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | Total |
|--------|-----------------|------|------|------|------|------|------|------|------|------|-------|
| 01.    | 151 BH          | 105  | 129  | 78   | 89   | 107  | 75   | 98   | 66   | 61   | 808   |
| 02.    | 155 BH          | 126  | 144  | 75   | 94   | 124  | 93   | 103  | 78   | 68   | 908   |
| 03.    | 160 MH          | 31   | 61   | 26   | 78   | 48   | 19   | 11   | 02   | 02   | 278   |
| 04.    | 162 MH          | 29   | 56   | 22   | 69   | 45   | 17   | 07   | 01   | 01   | 247   |
| 05.    | 180 MH          | 03   | 05   | 03   | 06   | 04   | 22   | 02   | 05   | 06   | 056   |
| 06.    | 5 AFH           | 108  | 114  | 66   | 78   | 102  | 81   | 90   | 63   | 57   | 759   |
| Total  |                 | 402  | 509  | 270  | 414  | 430  | 307  | 311  | 215  | 195  | 3053  |

Table 3. Month-Wise Distribution of Cases of Malaria in an Army Field Formation for the Year 2009 along with Type of Infection (Post Targeted Intervention)

| Month  | Total No of Hospital Admissions due to Malaria (All Types) in Six Service Hospitals of Assam |
|--------|-------------------------------------------------------------------------------------------|
| Jan 2009 | 01                                                                                     |
| Feb 2009 | 00                                                                                     |
| Mar 2009 | 00                                                                                     |
| Apr 2009 | 00                                                                                     |
| May 2009 | 00                                                                                     |
| Jun 2009 | 02                                                                                     |
| Jul 2009 | 05                                                                                     |
| Aug 2009 | 03                                                                                     |
| Sep 2009 | 01                                                                                     |
| Oct 2009 | 00                                                                                     |
| Nov 2009 | 02                                                                                     |
| Dec 2009 | 00                                                                                     |
| Total   | 14                                                                                     |

Table 4. Malaria in Assam, North-East India, 2009–2013

| Year   | Population (millions) | No. of Cases | API | \( P. falciparum \) % | Deaths | Total No of Hospital Admissions due to Malaria (All Types) in Six Service Hospitals of Assam |
|--------|-----------------------|--------------|-----|----------------------|--------|-------------------------------------------------------------------------------------------|
| 2009   | 31.27                 | 91413        | 2.92| 73                   | 63     | 190                                                                                       |
| 2010   | 31.35                 | 66716        | 2.13| 72                   | 36     | 141                                                                                       |
| 2011   | 32.03                 | 47397        | 1.48| 73                   | 45     | 113                                                                                       |
| 2012   | 32.45                 | 29999        | 0.92| 69                   | 13     | 101                                                                                       |
| 2013   | 32.91                 | 19542        | 0.59| 77                   | 07     | 102                                                                                       |
API-based choroplath maps up to PHC level is of great value for malaria risk assessment for the security forces operating in that area as it facilitates planning of focused interventions with greater and better compliance instead of general advisories. Such data is also a valuable input for commanders planning short-term operations against insurgents, etc.

**Conflict of Interest:** None

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