Access this article online
Website: www.searo.who.int/publications/journals/seajph
DOI: 10.4103/2224-3151.115828
Quick Response Code:

Economic burden of malaria in India: The need for effective spending

Indrani Gupta, Samik Chowdhury

Institute of Economic Growth, New Delhi, India

Address for correspondence:
Professor Indrani Gupta, Health Policy Research Unit, Institute of Economic Growth, University Enclave, Delhi 110007, India.

Email: ig.indrani@gmail.com, indrani@iegindia.org

ABSTRACT

About 95% of India's population resides in malaria-endemic areas and, according to government sources, 80% of malaria reported in the country is confined to populations residing in tribal, hilly, difficult and inaccessible areas. Using a nationally representative sample, this study has estimated the economic burden of malaria in India by applying the cost-of-illness approach, using the information on cost of treatment, days lost and earnings foregone, from the National Sample Survey data. A sensitivity analysis was carried out, by presenting two alternative scenarios of deaths. The results indicate that the total economic burden from malaria in India could be around US$ 1940 million. The major burden comes from lost earnings (75%), while 24% comes from treatment costs. Since mortality is low, this is not a major source of economic burden of malaria. An analysis of the trend and patterns in public expenditure by the National Vector Borne Disease Control Programme shows a declining focus of the central government on vector-borne diseases. Also, allocation of financial resources among states does not reflect the burden of malaria, the major vector-borne disease in the country.

Key words: Economic burden, India, malaria, public spending

INTRODUCTION

In India, vector-borne diseases such as malaria, dengue, chikungunya, Japanese encephalitis (JE), kala-azar and lymphatic filariasis have considerable impact, in terms of morbidity and mortality. The epidemiology of these vector-borne diseases varies considerably, on account of ecology, vector bionomics, and economic, sociocultural and behavioural factors.[1] Residents of rural and tribal areas as well as urban slums are most at risk from such diseases, which impact mostly the poor and vulnerable sections of the population. Vector-borne diseases contribute to widespread disease, disability and deaths in India, especially among the poor, who have limited access to timely and effective treatment. Children and pregnant women have low immunity to vector-borne diseases like malaria, and are especially vulnerable, leading to maternal deaths, stillbirths, and low birth weight in infants.

The major burden of vector-borne disease in India comes from malaria; according to the Directorate of the National Vector Borne Disease Control Programme (NVBDCP), about 95% of the population in the country resides in malaria-endemic areas. While severe a decade ago, there has been a declining trend in the overall endemicity of malaria in the country, with a reported number of cases in 2012 of around 1.06 million (provisional).[1]

Despite the significant presence of vector-borne diseases in India, there is a paucity of studies on the economic burden on households and likely cost of these illnesses, using nationally representative data. While there continue to be debates and discussions around the prevalence, incidence and deaths from malaria, the last health round (60th round) of the National Sample Survey[2] of India (NSS) – which is a nationally representative survey – is yet to be utilized to understand the treatment burden of malaria and the profile of those affected. The NSS has the potential to independently validate the various estimates of malaria burden. While limitations exist, they exist for other surveillance data as well, and such a nationally representative sample should be used for a better understanding of the malaria situation in the country.

This paper, therefore, uses unit-level data from the NSS 60th round on health, to analyse the direct and indirect costs of malaria; specifically, the data are analysed to understand the distribution of the burden of malaria across sex, residence (rural/urban areas), education and consumption categories. Subsequently, the analysis focuses on direct and indirect costs of treatment for outpatients and hospitalizations. The NSS 60th round is useful in this context because, in addition to costs of treatment, it also seeks responses on missed days of work and earnings foregone. Alternative estimates of deaths

are used to calculate the burden from loss of earnings and years of productive lives. While the survey pertains to 2004, the estimates are used in conjunction with more recent estimates of malaria cases in India, to assess the economic burden of the disease on the country. The paper also highlights certain key issues on the patterns in public financing of the NVBDCP in general.

Malaria in India

The case-load of malaria in India has reduced and reported deaths are declining, indicating declining endemicity. However, the epidemiology of malaria remains complex, owing to the geographical and ecological diversity. In the mid-1970s, malaria re-emerged in India, with 6.4 million new cases in 1976,[3] indicating the need for constant vigilance and prevention. According to the NVBDCP,[1] of the reported 1.06 million cases in 2012, 50.01% are due to *P. falciparum*. Also, about 95% of the country's population resides in malaria-endemic areas, and 80% of malaria reported in the country is confined to regions that have more than 20% of their population residing in tribal, hilly, difficult and inaccessible areas. The most affected states are: Andhra Pradesh, Chhatisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan and West Bengal.

It is possible that the actual number of malaria cases is higher because a large number of infected individuals might be seeking treatment from private health providers, who do not report to NVBDCP.[4] Non-reporting of mortality causes a serious problem with data on the medical cause of certification of death, compounded by the lack of medical certification of deaths as well as issues with the attribution of specific cause of death.[3] Other analyses point out that it is indeed a challenge to estimate the true case burden of malaria in India.[5] A more recent article indicates that global malaria mortality may be much higher than previously estimated, especially among adults.[6] For India, a widely quoted study in *The Lancet* estimated that 205 000 deaths per year could be attributed directly to malaria, with lower and upper limits of 125 000 and 277 000, respectively.[7] These figures differed significantly from the 2008 World Health Organization (WHO) *World malaria report*,[8] which reported 15 000 deaths per year due to malaria, and also from the numbers reported by the NVBDCP. Research also confirms that the majority of deaths from malaria were not in any formal health-care facility, and therefore, would not be counted in any reporting system.[9] Finally, the analysis contended that cases due to *Plasmodium falciparum* might represent only a fraction of the total malaria disease burden in India.

Clearly, surveillance is a key area that needs further policy focus to refine estimates of cases and deaths because the economic burden of malaria is entirely driven by the case-load and mortality.

Economic impact of malaria: global evidence

A number of studies have looked at the economic impact of malaria globally. Some have estimated the impact of malaria on economic growth and there is some evidence for a belief that regions that have been able to reduce malaria have subsequently registered higher economic growth.[10] However, numerous studies have focused on the economic burden on households; for example, an early study from Malawi showed that households with a very low income bore a disproportionate share of the economic burden of malaria, with 32% of their annual household income being lost as a result of the direct and indirect costs of malaria, compared to only 4.2% for households in the low- to high-income categories.[11]

Another study from Sri Lanka indicated that, although the overall economic impact was limited, cases of malaria occurred seasonally and were concentrated in an important agricultural season. This season saw the bulk of the economic impact in terms of loss in working days and loss in school days, in addition to the usual direct costs.[12]

A study from Nigeria compared the financial and economic costs of malaria with other illness episodes for households in five malaria holoendemic rural communities. The findings showed that the costs of treatment for malaria accounted for almost half of expenditure on curative care costs incurred by the households.[13]

However, despite a significant burden of malaria in India, few studies have looked at the economic impact of malaria on households, though there are some that have looked at chikungunya[14] and lymphatic filariasis.[15] One paper examined the effects of a large-scale eradication programme that drastically reduced malaria over a short period of time. The findings indicate that malaria eradication resulted in improvements in income for males.[16]

While the consensus from such studies is that malaria imposes significant burden on households, there is as yet no study that has used a nationally representative database to assess the total economic burden of illness and deaths from malaria in India.

METHODS

The study used NSS data for the last available health round on India, which pertains to 2004. The NSS data contain information on the direct costs of treatment for both outpatient and hospitalization episodes in rural and urban areas respectively. The survey also asks about the kind of illness suffered by the respondent. While self-reported morbidities may not be accurate generally, anyone who stated malaria as his/her illness has certainly had a diagnosis. Thus, it is safe to assume that the malaria numbers from the NSS are indeed malaria, though the number could be higher due to lower treatment-seeking behaviour in general.[17]

In the absence of more recent data, current available estimates of cases and deaths are used for analysis and discussion of economic burden. For the total number of deaths, data from WHO and the more recent *Lancet* study were used for the lower and upper range of possible deaths from malaria. The direct and indirect costs for both inpatients and outpatients were calculated from NSS data. Wherever required, the weights given in the NSS data were used to estimate nationally

representative numbers. A cost-of-illness approach was used to calculate the economic burden of malaria, using the information on cost of treatment, days lost and earnings foregone, and the present value of number of years of life lost due to malaria. Since the NSS pertains to 2004, the gross domestic product (GDP) deflator was used to arrive at expenditure figures for 2012, with the assumption that relative treatment costs remain the same.

Since one component of the cost of illness is productive work days lost, the analysis was restricted to adults only.

The stepwise methodology to calculate costs of illness from malaria for adults is given next.

1. Total economic burden from malaria has three components: treatment costs due to illness, productivity loss due to foregone earnings emanating from lost days of work, and the economic value of lost earnings due to death.
2. Two inputs are important in these calculations: the total number of cases of malaria and total number of deaths due to malaria. WHO estimates that in India about 11% of the population is malaria free, 67% reside in low-transmission areas (0–1 case per 1000 population), and the remaining 22% live in high-transmission areas (greater than 1 case per 1000 population). In all therefore, 89% of the population is affected. Since the WHO estimates are ranges, (prevalence of 0–1 and greater than 1), these were assumed to be 0.5 and 1 per 1000 or 0.05% and 0.1% in low- and high-transmission areas respectively.
3. For deaths, two alternative estimates are used: WHO estimate of 15 000 per year,[18] and the upper range of deaths from the *Lancet* study (277 000). This is done to get a range within which the true economic burden might lie. Thus, two alternative estimates of economic costs are arrived at, with two different assumptions regarding total deaths from malaria, while the number of cases remains the same.
4. It is also assumed, based on the *Lancet* study, that 60% of the total deaths are of adults (age 15 years and above).[7] This number is independently validated from the NSS study, which shows that slightly more than 60% of malaria cases occurred among adults.
5. Treatment costs are calculated using the costs of outpatient treatment and hospitalization from NSS 60th round. These costs are re-estimated for 2012 by using a suitable deflator.
6. The total burden due to treatment costs is calculated by using the unit costs of treatment, in conjunction with estimated cases.
7. From NSS, the average earnings foregone are used to arrive at the potential loss of earnings, in conjunction with the total days lost due to illness and death
8. Assuming 45 years as the average age of death due to malaria among adults, and an average age of retirement as 60 years, the potential number of life-years lost can be calculated, and, using a discount rate of 5%, the present value of earnings foregone can be estimated.

RESULTS

Profile of malaria-affected individuals

The data indicate that in 2004 there were a total of 2.4 million cases of malaria (see Table 1). This is somewhat higher than the NVBDCP's reported 1.92 million cases for 2004, and more consistent with other views discussed above about the true burden of malaria in the country. Other statistics indicate that slightly more males are affected than females. The majority of malaria cases are in rural areas (78%) and about 75% of the cases occur among individuals who are illiterate or have less education. The distribution across consumption quartiles is somewhat more, even though the lowest quartile has 10% more cases than the other three quartiles. Overall, of all ailments reported, malaria comprised 2.5% and 1.9% of the cases in rural and urban areas respectively.

Table 1: Profile of malaria-affected individuals

Characteristic	Percentatge (total n = 2 396 194)
Sex, male	54
Residence, rural	78
Education	
Illiterate	48
Primary and less	27
Consumption quartile	
First	33
Second	23
Third	24
Fourth	22

Source: NSS unit level data, 60th round[2]

Table 2 presents the distribution of cases between the Empowered Action Group (EAG) of states, comprising Assam, Bihar, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand versus other major states. The EAG states are prioritized for special focus in government programmes.

Table 2: Malaria cases across EAG and non-EAG states

Residence/states	EAG	Non-EAG
Rural	39.3	38.4
Urban	8.2	14.0
Total	47.5	52.4

Source: NSS unit level data, 60th round.[2]

While slightly higher for the EAG states, the case-load between these two groups seems similar for rural India. In fact, for urban India, the cases are significantly higher for the non-EAG states. Overall, 47.5% of the total cases occurred in the EAG states. The EAG states comprise about 45% of India's population, and to that extent, the distribution seems logical. However, if the fact that these are the socioeconomically weaker states and contribute mostly to the adverse Millennium Development Goal (MDG) outcomes is taken into account, such a distribution of case burden becomes a cause for concern.

Treatment costs and loss of work days and earnings due to malaria

Table 3 presents the average expenditure on malaria for outpatient treatment and hospitalization, work days lost, and loss of earnings, by residence and consumption quartiles.

Overall, an average of 175 rupees was spent for each outpatient treatment and 75 rupees on each hospitalization for malaria in 2004. The disease required more outpatient expenditure generally, though hospitalization expenses in urban India were relatively much higher than in rural India. While the average work days lost was similar across residence, loss of earnings was higher in urban areas. There also seems to be a positive correlation between economic status and cost of treatment, with higher quintiles spending more on malaria treatment.

Economic burden of malaria in India

Table 4 presents estimates of the economic burden of malaria from treatment costs, the value of earnings foregone because of work days lost, and the current value of lives lost.

The costs of illness for outpatient treatment, hospitalization and other costs are based on the estimates given in Table 3, and calculated for 2012 by applying the appropriate GDP deflator. The relative costs have, therefore, been assumed to be the same with respect to each other. The average total cost of treatment was 475 rupees in 2012. Earnings loss per day were 213 rupees and the total work days lost is assumed to the same (10 days), derived from the NSS study.

The results indicate that the total economic burden from malaria in India could be around US$ 1940 million and varying the death rate does not make much difference. That is because the major burden comes from lost earnings (75%), while the remaining 24 % comes from treatment costs. Mortality and value of lives foregone is not a major source of economic burden of malaria. The results do not change much when varying the total number of deaths. However, if the prevalence figures were varied, the estimates would change dramatically, though this exercise is not attempted here, owing to the lack of data that might indicate the true prevalence and incidence of malaria in the country. Clearly, if the prevalence was assumed to be double, the loss of earnings would be a substantial part of the total economic burden. Overall, while malaria may not lead to many deaths, it imposes a great burden via illness and missed days of work, which in turn has implications for households' welfare, and ultimately would also play out at the macro level by impacting national productivity and income.

Public financing of vector-borne disease control in India

High economic burden warrants significant spending on prevention, control and treatment; this section attempts to understand the level and patterns of public spending on the malaria programme.

Public expenditure on malaria prevention and control forms a part of the NVBDCP of the Government of India. The NVBDCP is an umbrella programme for prevention and control of vector-borne diseases, and is, in turn, a part of the National Disease Control Programme (NDCP), which has another five components dealing with leprosy, tuberculosis, blindness, drug de-addiction and iodine deficiency. Currently, the NVBDCP has a 43% share of expenditure under the NDCP and malaria accounts for more than half of the central government expenditure on vector-borne diseases.

The two sources of financing NVBDCP expenditure are the Domestic Budgetary Support (DBS) and the Externally Aided Component (EAC). While the DBS represents the central government contribution, the EAC consists primarily of funding from the Global Fund to Fight AIDS, Tuberculosis and Malaria and the World Bank (GFATM). Figure 1 shows the trend in allocation and actual expenditure on the NVBDCP. The DBS and EAC have been supplementing each other since 1997–1998, which marked the initiation of the World Bank-assisted Enhanced Malaria Control Project (EMCP). Other than a brief period between 2005–2006 and 2008–2009, the DBS has exceeded the EAC. This jump in EAC coincides with the GFATM-assisted Intensified Malaria Control Project (IMCP) in 94 districts of 10 states, along with the introduction of rapid diagnostic test kits.[19] Actual expenditure has trailed budgetary outlay for the entire period and reached a peak

Table 3: Direct and indirect cost of illness from malaria, 2004

Categories	Treatment cost (average per capita per month), rupees				Work days lost	Loss of earnings (average per capita per day), rupees
	Outpatient care	Hospitalization	Others (Transport, lodging etc)	Total		
Sector						
Rural	191	53	28	272	10	107
Urban	119	149	19	286	9	171
Quartiles						
Poorest	167	46	28	241	11	91
Second	154	75	25	254	11	131
Third	173	58	24	256	9	119
Richest	210	135	26	370	8	158
All	175	75	26	275	10	124

Source: NSS unit level data, 60th round.[2]

Table 4: Economic burden of malaria under alternative assumptions of mortality

Parameters	Scenario I	Scenario II
Total costs of treatment (millions of rupees)	28 340	
Value of earnings foregone (millions of rupees)	87 739	
Current value of lives lost (millions of rupees)	14	115
Total economic costs due to malaria (millions of rupees)	116 093	116 194
Total economic costs due to malaria (millions of US dollars, US$ 1 = 60 rupees)	1935	1937

Note: scenarios I and II are based on alternative estimates of deaths from malaria.

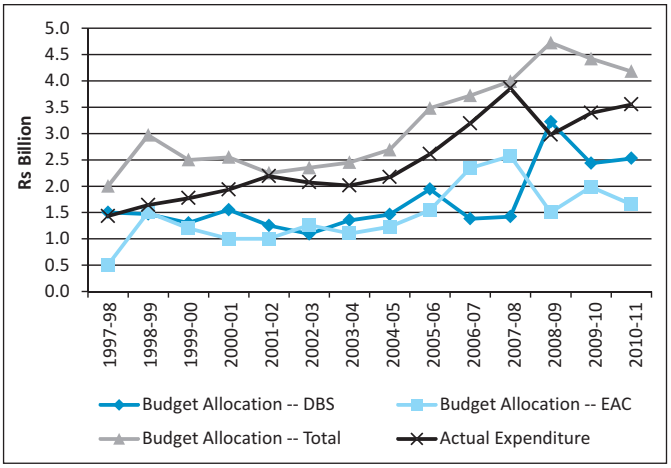

Figure 1: Budgetary allowance and expenditure under NVBDCP

DBS: Domestic Budgetary Support; EAC: Externally Aided Component.
Source: Strategic plan for malaria control in india, 2012–2017[19]

during 2008–2009, which was followed by a reduction in budgetary outlay itself, in absolute terms. Comparing the previous two plan periods (see Table 5), it is observed that the aggregate approved outlay has grown by 27% between the two plan periods, but actual expenditure has grown by only 13%.

Further, the rate of absorption – measured by the proportion of outlay actually spent – has declined by more than 25 percentage points between the two plan periods. This is important because a major chunk of the plan expenditure is in the form of direct transfer of central plan assistance to state/district-level autonomous bodies/implementing agencies. Such a low rate of utilization could be indicative of weak absorptive capacities, as well as administrative issues. Whatever the reasons, lower absorption leads to efficiency loss, and needs proper analysis.

Figure 2 shows the trends in plan expenditure on NVBDCP by the central government. It is important to note that plan expenditure comprised 96% of the total expenditure on the programme in the year 2011–2012.[21] Plan expenditure (the blue line) demonstrates a clearly increasing trend over the years, with a slight decline during 2007–2009. It has more than doubled during the 10-year period. While this is encouraging, when viewed in isolation, it says little about the significance of this programme within the central government budget for the health sector. To examine this, Fig. 2 also plots plan expenditure on NVBDCP, but as a percentage share of total plan expenditure of the Ministry of Health and Family Welfare (MOHFW; the red line). It is observed that this share steadily declines from 4% in 2002–2003 to 2.2% in 2011–2012.

When this trend is juxtaposed with the significant burden of malaria analysed in the previous section, it emerges as a cause for concern. In fact, plan expenditure on the NDCP as a share of the total plan expenditure of the MOHFW has also registered a decline from 9% in 2002–2003 to 5% in 2011–2012. This is indicative of the general decline in health spending of the government, which affects all public health programmes.[22]

Although health is constitutionally a state subject, the central government provides technical, commodity (drugs, insecticides and larvicides) and financial assistance to the states and UTs. North-eastern States (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura) have been provided 100% central assistance for programme implementation since December 1994. Additionally, in 100 districts of eight states, namely Andhra Pradesh, Chhattisgarh, Jharkhand, Gujarat, Madhya Pradesh, Maharashtra, Orissa and Rajasthan, 1045 PHCs predominantly inhabited by tribal people have been provided full support, including operational expenses under the EMCP, with World Bank assistance, since 1997. The new World Bank-supported "Malaria control and kala-azar elimination project" for a period of 5 years has also been implemented since 2008–2009. The operational costs for

Table 5. Plan financing of anti-malaria programme

Plan expenditure on NVBDCP	Xth plan (2002–2007)	XIth plan (2007–2012)	Average annual growth (%)
Approved outlay (billion rupees)	13.49	31.9	27.3
Actual expenditure (billion rupees)	11.97	19.53	12.6
Expenditure as % of outlay	88.7	61.2	

Source: Health profile of India, 2012, Central Bureau of Health Intelligence.[20]

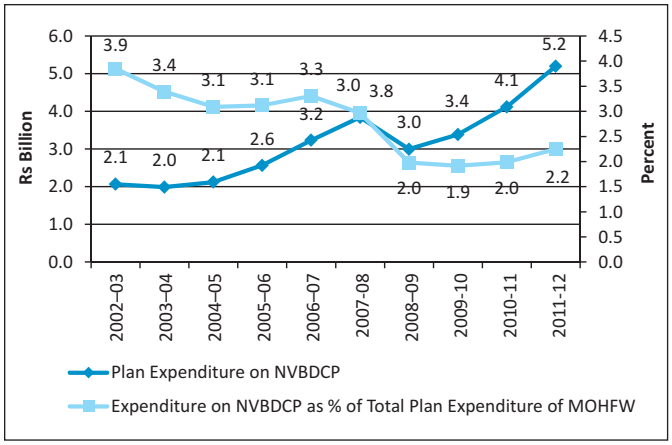

Figure 2: Trends in plan expenditure on NVBDCP

Source: Health profile of India, Central Bureau of Health Intelligence, MOHFW, Government of India,[20] and Demand for grant no 47, MOHFW, Union Budget, Ministry of Finance, Government of India.[21]

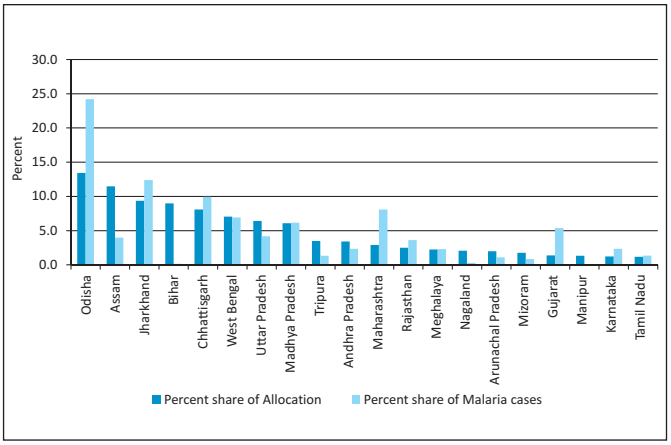

Figure 3: Share of allocation under NVBDCP and malaria cases for selected states, 2012–2011

Source: data on financial allocation from Lok Sabha unstarred question No. 5008, dated on 2 September 2011;[23] data on malaria cases from NVBDCP website.[24]

implementation of the NVBDCP and certain commodities are met from state funds. The centre also meets the requirement of states during emergency situations. Being under the umbrella of the National Rural Health Mission, the states are required to submit their project implementation plan every year, which is appraised in the MOHFW, and thereafter funds are allocated under the NVBDCP.[19]

Figure 3 shows the distribution of central allocations for NVBDCP for selected states with a share of malaria cases greater than 1%, for the year 2010–2011. The percentage share of malaria cases for the same year is also plotted alongside. The states are ordered by their share in total allocation for the NVBDCP.

States that receive the highest share of central allocation for NVBDCP are Odisha, Assam, Jharkhand, Bihar and Chattisgarh. If this is combined with the states' share of malaria cases, some interesting observations can be made. For more than half of these states, the share of allocation falls short of the share in malaria cases in the country. Especially significant are the cases of Chattisgarh, Gujarat, Jharkhand, Maharashtra and Odisha, which are also known to be the states with relatively greater burden of malaria. This analysis raises the possibility of reallocation of central resources and aligning these with disease burden across states.

Comparing with the estimated economic burden calculated from the cost-of-illness approach, in 2012, about 5410 million rupees or US$ 86 million was spent on the entire vector-borne disease programme of the country. While a major part of this will be on malaria, the amount remains much lower than the potential economic burden imposed by the disease, which is around US$ 1940 million for only adults. There are significant costs involved for treatment, as well as other social costs of morbidity and deaths of children that have not been included in the analysis.

Overall, the expenditure analysis indicates that there is a need to step up spending on malaria, which is very low compared to the potential burden it is imposing in the country, and possibly declining as a percentage of total health spending in the country. Also, the distribution across states does not seem commensurate with the disease burden, indicating the possibility of improving resource allocation for spending to be more effective.

CONCLUSIONS AND DISCUSSION

While a proper surveillance system would remain a key to assessment of the economic impact of malaria and require global cooperation and consensus regarding the methodology of estimation,[25] the analyses in this study, including the estimates of cost of illness and deaths, yield useful insights into the magnitude of the problem, and enable comparison with current disease-control expenditures. The current surveillance is clearly inadequate, since it mostly captures data from the public sector. Also, the economic burden of malaria may be much higher, especially since a significant percentage of the population does not seek care. Under these circumstances, these figures for economic burden should be treated as being on the lower side; the true impact may be much higher, being driven by cases of morbidity resulting in loss of productive days, and treatment costs, rather than mortality. In particular, the loss of work days is quite high for malaria and is likely to impose a high economic impact at the household level as well. The profile of those affected clearly indicates that such work-day losses are going to be felt more severely by the most vulnerable.

Funding will remain the most important policy concern for the control, prevention and treatment of malaria. While domestic funding for malaria is augmented by international funding from sources like the GFATM and the World Bank, analysts have

pointed out that global funding has not been adequate so far and it is unlikely that MDG goals to halve the disease burden by 2015 will be achieved without significant increases in funding.[26] The gap in funding need remains a critical global concern and it could be almost four times the funds currently available. The Roll Back Malaria Partnership has developed The Global Malaria Action Plan, which can be viewed as a document around which other partners can coordinate their efforts. For resource mobilization, a two-pronged strategy visualized by GMAP includes setting up resource-mobilization processes at country level, by developing a fully fledged country-level financing plan, and coordination with international agencies such as the World Bank and other partners.[27].

Furthermore, even at the domestic level, actual expenditure has fallen far short of approved outlay for vector-borne diseases. Priority accorded to vector-borne disease seems to have declined over the years, as evidenced by the declining share of this component in the plan expenditure of the MOHFW. There also seem to be horizontal imbalances in the distribution of these funds across states, with states with higher prevalence of malaria not necessarily receiving higher funding from the central government

In addition to scaling up effective interventions, strengthening health systems remain a cornerstone of a successful strategy of malaria control. Interventions can be effective only if there is an effective system of, for example, supply chain, human resources and monitoring and evaluation. Strengthening health systems, as well as scaling up interventions, would require funding. While international funding has been a major part of India's funding for malaria, the country has to find additional resources from its domestic sources for a sustainable programme of control and elimination of malaria.

REFERENCES

1. India, Ministry of Health and Family Welfare. Malaria: magnitude of the problem. New Delhi: National Vector Borne Disease Control Programme, Directorate General of Health Services. http://www.nvbdcp.gov.in/malaria3.html - accessed 22 March 2014.
2. India, Ministry of Statistics and Programme Implementation. Morbidity, health care and the condition of the aged: NSS 60th round (January – June 2004). New Delhi: National Sample Survey Organisation, 2004.
3. Kumar A, Valecha N, Jain T, et al. Burden of Malaria in India: retrospective and prospective view. In: Breman JG, Alilio MS, White NJ, Editors. Defining and defeating the intolerable burden of malaria III: progress and perspectives: supplement to volume 77(6) of American Journal of Tropical Medicine and Hygiene. Northbrook (IL): American Society of Tropical Medicine and Hygiene; December 2007.
4. India, Planning Commission. Report of the working group on disease burden for the 12th Five Year Plan. New Delhi, 2011. http://planningcommission.gov.in/aboutus/committee/wrkgrp12/ health/WG_3_1communicable.pdf - accessed 22 March 2014.
5. Das Aparup, Anupkumar R. Anvikar, Lauren J. Cator, Ramesh C. Dhiman, Alex Eapen, Neelima Mishra, Bhupinder N. Nagpala, Nutan Nanda, Kamaraju Raghavendraa, Andrew F. Read, Surya K. Sharma, Om P. Singh, Vineeta Singh, Photini Sinnis, Harish C. Srivastava, Steven A. Sullivan, Patrick L. Sutton, Matthew B. Thomas, Jane M. Carlton, Neena Valecha. Malaria in India: the center for the study of complex malaria in India. Acta Tropica. 2012;121(3):267-273. http://www.thereadgroup.net/wp-content/uploads/Das-et-al-India-ICEMR-2012.pdf - accessed 22 March 22 2014.
6. Murray Christopher J L, Lisa C Rosenfeld, Stephen S Lim, Kathryn G Andrews, Kyle J Foreman, Diana Haring, Nancy Fullman, Mohsen Naghavi, Rafael Lozano, Alan D Lopez. Explaining the Global malaria mortality between 1980 and 2010: a systematic analysis. The Lancet. 2012 Feb 4; 379. http://globalhealthcenter.umn.edu/documents/global-malaria-lancet0212.pdf - accessed 22 March 2014.
7. Dhingra Neeraj, Prabhat Jha, Vinod P Sharma, Alan A Cohen, Raju M Jotkar, Peter S Rodriguez, Diego G Bassani, Wilson Suraweera, Ramanan Laxminarayan, Richard Peto. For the million death study collaborators adult and child malaria mortality in India: a nationally representative mortality survey. The Lancet. 2010 Nov 20-26;376(9754):1768-1774.
8. World Health Organization. World malaria report 2008. Geneva: WHO, 2008. http://www.who. int/malaria/publications/atoz/9789241563697/en/index.html - accessed 22 March 2014.
9. Simon I Hay, Peter W Gething, Robert W Snow. India's invisible malaria burden. The Lancet. 2010 Nov 20-26;376(9754):1716-1717. http://dx.doi.org/10.1016/S0140-6736(10)61084 – accessed 22 March 2014.
10. Gallup John Luke & Effrey D. Sachs. The Economic Burden of Malaria. The intolerable burden of malaria: a new look at the numbers: Supplement to Volume 64(1) of the American Journal of Tropical Medicine and Hygiene. Breman JG, Egan A, Keusch GT, editors. Northbrook (IL): American Society of Tropical Medicine and Hygiene; January 2001. http://www.ncbi.nlm.nih.gov/books/NBK2624/ - accessed 22 March 2014.
11. Ettling M, McFarland DA, Schultz LJ, Chitsulo L. Economic impact of malaria in Malawian households, Vector Biology and Control Project, United States Agency for International Development. Arlington, VA. Tropical Medicine and Parasitology : Official Organ of Deutsche Tropenmedizinische Gesellschaft and of Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ). 1994;45(1):74-79.
12. Konradsen F, Van der Hoek W, Amerasinghe PH, Amerasinghe FP. Measuring the economic cost of malaria to households in Sri Lanka. The American Journal of Tropical Medicine and Hygiene. 1997;56(6):656-660.
13. Onwujekwe Obinna, Reginald Chima, Paul Okonkwo. Economic burden of malaria illness on households versus that of all other illness episodes: a study in five malaria holo-endemic Nigerian communities. Health Policy. 2000 Nov 17;54(2):143–159.
14. Gopalan Saji Saraswathy, Ashis Das. Household economic impact of an emerging disease in terms of catastrophic out-of-pocket health care expenditure and loss of productivity: Investigation of an outbreak of chikungunya in Odisha, India. J Vector Borne Dis. 2009 Mar;46:57–64. http://www.mrcindia.org/journal/issues/461057.pdf - accessed 22 March 2014.
15. Kapa D Ramaiah, Pradeep K Das, Edwin Michael, Helen L Guyatt, The economic burden of lymphatic filariasis in India. Parasitology Today. 2000 Jun 1;16(6):251-253. http://dx.doi.org/10.1016/S0169-4758(00)01643-4 – accessed 22 March 2014.
16. Cutler David, Winnie Fung, Michael Kremer, Monica Singhal,Tom Vogl. Early-life malaria exposure and adult outcomes: evidence from malaria eradication in India. American Economic Journal: Applied Economics. 2010 Apr:2(2):72–94. http://www.princeton.edu/~tvogl/malaria_ cfksv.pdf - accessed 22 March 2014.
17. Mukherjee Anit N, Krishanu Karmakar. Untreated morbidity and demand for healthcare in India: an analysis of national sample survey data. Economic and Political Weekly. 2008 Nov 15; XLIII(46):71-77.
18. World Health Organisation. World malaria report 2010. Geneva: WHO, 2010. http://www.who. int/malaria/world_malaria_report_2010/en/ - accessed 22 March on 2014.
19. India, Ministry of Health and Family Welfare. Strategic plan for malaria control in India, 2012-2017. New Delhi: Directorate of National Vector Borne Disease Control Programme. http://nvbdcp.gov.in/Doc/Strategic-Action-Plan-Malaria-2012-17%20.pdf - accessed 22 March on 2014.
20. India, Ministry of Health and Family Welfare. National health profile of India – 2012. New Delhi: Central Bureau of Health Intelligence, Directorate General of Health Services. http://cbhidghs. nic.in/index2.asp?slid=1256&sublinkid=1163 - accessed 22 March on 2014.

21. India, Ministry of Health and Family Welfare. Notes on demands for grants, 2013-2014. Demand No. 47. New Delhi: Department of Health and Family Welfare. http://indiabudget.nic.in/ ub2013-14/eb/sbe47.pdf - accessed 22 March on 2014.

22. Gupta Indrani, Chowdhury S. Scaling up health expenditure for universal health coverage: prospects and challenges. Delhi: Health Policy Research Unit, Institute of Economic Growth, 2013. Unpublished Mimeo.

23. Lok Sabha questions. http://164.100.47.132/LssNew/psearch/qsearch15.aspx - accessed 22 March 2014.

24. India, Ministry of Health and Family Welfare. Malaria Situation in India. New Delhi: National Vector Borne Disease Control Programme, Directorate General of Health Services, 2013. http://nvbdcp.gov.in/Doc/mal-situation-Nov13.pdf - accessed 22 March 2014.

25. Hay Simon I, Peter W Gething, Robert W Snow. India's invisible malaria burden, The Lancet. 2010 November 20-27;376(9754):1716–1717.

26. Snow Robert W, Carlos A. Guerra, Juliette J. Mutheu, Simon I. Hay. International funding for malaria control in relation to populations at risk of stable plasmodium falciparum transmission. PLoS Medicine. 2008 Jul;5(7):e142. http://www.plosmedicine.org/article/fetchObject.action?uri=info%3Adoi%2F10.1371%2Fjournal.pmed.0050142&representation=PDF - accessed 22 March 2014.

27. The Roll Back Malaria Partnership. Executive summary: the global malaria action plan. Geneva: GMAP, 2008. http://www.rollbackmalaria.org/gmap/0-5.pdf. - accessed 22 March 2014.

How to cite this article: Gupta I, Chowdhury S. Economic burden of malaria in India: the need for effective spending. WHO South-East Asia J Public Health 2014; 3(1): 95–102.

Source of Support: Nil. **Conflict of Interest:** None declared. **Contributorship:** Both authors were responsible for conceptualization, analysis and writing this paper.