Hospital-Based Prevalence of Malaria and Dengue in Febrile Patients in Bangladesh

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Abstract. We conducted a nationwide study at six tertiary hospitals from December 2008 through November 2009 to investigate etiologies of febrile illnesses in Bangladesh. Febrile patients meeting a clinical case definition were enrolled from inpatient and outpatient medicine and pediatric units. We assessed 720 febrile patients over 12 months; 69 (9.6%) were positive for IgM antibodies against dengue virus by enzyme-linked immunosorbent assay, and four malaria patients (0.56%) were confirmed with immuno-chromatography and microscopic slide tests. We identified dengue cases throughout the year from rural (49%) and urban areas (51%). We followed-up 55 accessible dengue-infected patients two months after their initial enrollment: 45 (82%) patients had fully recovered, 9 (16%) reported ongoing jaundice, fever and/or joint pain, and one died. Dengue infection is widespread across Bangladesh, but malaria is sufficiently uncommon that it should not be assumed as the cause of fever without laboratory confirmation.

INTRODUCTION

Fever is a common symptom in patients coming to hospitals with a variety of diseases.¹ Two common communicable diseases causing febrile illness in Bangladesh are dengue and malaria.² Thousands of persons have been affected by dengue fever on an annual basis, and there have been recent outbreaks in 2000, 2001, and 2002.^{3,4} Most dengue cases have been reported during outbreaks in the metropolitan cities of Dhaka, Chittagong, Khulna, and Rajshahi.⁴ A serological study conducted in 1999 collected samples from inpatient and outpatient departments of four medical college hospitals in these cities. A total of 35 serologically confirmed dengue patients were identified among a sample of 200 patients over a period of two months by using a case definition of any patient with high fever and clinical diagnosis of viral infection with exclusion of bacterial infections and other clinical diagnosis through routine laboratory tests and enzyme-linked immunosorbent assay (ELISA) for IgM antibodies against dengue virus.⁵ Aside from these data, we know little about how widespread dengue is, especially in rural areas, where 76% of the population of Bangladesh resides.⁶

Malaria is also considered a threat to public health.⁷ The Government of Bangladesh, along with several non-government organizations, including BRAC, was awarded US\$ 40 million from the Global Fund to Fight AIDS, TB and Malaria (GFATM). The project, which was started in 2007 and will continue until 2012, includes activities aiming to reduce the malaria incidence among 11 million people in 13 malaria-endemic districts and 70 sub-districts, with a focus on communication, prevention, and diagnosis.^{8,9} However, beyond this targeted area, we have limited information about malaria transmission and prevalence (Figure 1).

Because of limited use of laboratory diagnosis among the large low-income population in Bangladesh, presumptive treatment is the norm and causes of illnesses are generally not confirmed. This research is part of a larger study to investigate various causes of febrile illness in patients coming to tertiary-

level hospitals in Bangladesh. This report focuses on the prevalence of illness caused by dengue and malaria.

METHODS

Study sites. The study was conducted in six tertiary-level referral teaching hospitals, one from each of the six political divisions of Bangladesh. These hospitals included three private and three public institutions, with a range of 250 to 750 beds and average daily admission of 129 patients. These institutions provide a variety of health care services through inpatient and outpatient departments under the units of medicine, surgery, gynecology, and other medical sub-specialties (e.g., pediatrics, obstetrics, microbiology). These hospitals were selected from 12 hospitals that were participating in the Government of Bangladesh, International Center for Diarrheal Disease Research, Bangladesh (ICDDR,B) and United States Centers for Disease Control and Prevention collaborative influenza surveillance network.¹⁰

Study population. We designated two consecutive days in each month for specimen collection from each hospital. Throughout the study, we varied the specimen collection days at each hospital every month to avoid any bias related to hospital admissions/health-seeking behavior. The study physician and field assistant collected data on the total number of admitted patients and the total number of febrile patients per day in the inpatient departments of the medicine and pediatric units of the study hospitals. On the days designated for specimen collection, they first visited the inpatient department to identify those clinical cases according to the case definition and criteria. When there was an insufficient number of inpatients to meet the targeted enrollment, the study team enrolled remaining patients from the outpatient department. We included hospital inpatients to capture some of the most severely affected febrile patients.

The case definition for a febrile study patient was, 'a patient who came to either the inpatient or outpatient department and to either the medicine or pediatric unit at the participating hospital with fever > 38°C, or who reported a history of fever with onset within the preceding 10 days'. The study team excluded presumed nosocomial cases as any patient who developed a new onset of fever > 38°C after 72 hours of hospitalization, and patients with symptoms of a focused infection,

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FIGURE 1. Map of Bangladesh showing distribution of dengue and malaria cases. GFATM = Global Fund to Fight AIDS, Tuberculosis and Malaria. Surveillance hospitals: Rajshahi Medical College Hospital; Khulna Medical College Hospital; Barisal Sher-e-Bangla Medical College Hospital; Kishoreganj Jahurul Islam Medical College Hospital; Chittagong Bangabandhu Memorial Hospital; and Sylhet Jalalabad Ragib-Rabeya Medical College Hospital.

including cough with productive sputum; urgency, frequency, hesitancy during micturition; and cellulitis, abscess, boil, or local skin infection. The study team also excluded any patient with a confirmed laboratory diagnosis of other diseases not included in our study, such as enteric fever. They excluded the febrile patients consulted or admitted in the surgery and obstetrics and gynecology units.

We assumed that if the real prevalence of infection with malaria or dengue was 0.75% at these hospitals in which 200,000 people seek care for febrile illnesses per year, then a sample of 675 would identify period prevalence between 0.1% and 1.4% with 95% confidence level. We targeted collecting 10 specimens from each hospital each month for a total 720 specimens in a year.

Data collection. The study physicians obtained the clinical history regarding febrile illness and examined the participants. They completed a structured assessment form, including clinical symptoms and signs, admission diagnosis, laboratory investigations, prescribed medications and discharge diagnosis.

Sample collection and laboratory analysis. Laboratory technicians from ICDDR,B visited the selected hospitals on designated days and worked with the study physicians and field

assistants to collect blood samples from the study participants. They centrifuged collected blood to obtain serum for dengue serologic tests. Serum specimens were taken to molecular and serodiagnostic laboratories at ICDDR,B and tested for IgM antibodies against dengue virus by capture ELISA.

To identify malaria, laboratory technicians used one drop of whole blood to perform a rapid test for malaria (Falcivax™; Zephyr Biomedicals, Goa, India). This test kit applied the principle of immuno-chromatography in the form of two-site sandwich immunoassay. The Falcivax™ test detected *Plasmodium falciparum*-specific antigen, *P. falciparum*-specific histidine-rich protein-2, *P. vivax*-specific antigen, and *P. vivax*-specific pan-lactate dehydrogenase from the blood samples and differentiated *P. vivax* from *P. falciparum*. The World Health Organization recommends using rapid test kits in malaria-endemic countries¹¹ and Falcivax™ had both sensitivity and specificity of more than 92%.¹² The test kit was highly sensitive for *P. falciparum* at high and low parasite densities of 200–5,000 parasites/μL and for *P. vivax* at higher densities of 2,000–5,000 parasites/μL.¹³ Results for rapid test kits were available in 15 minutes. Study physicians then signed test reports and handed them to the participants. In addition, technicians at the ICDDR,B parasitology laboratory microscopically examined all the thick and thin blood film slides prepared in the field to confirm specific malaria parasite species.

Follow-up. The study team attempted follow-up of all patients two months after enrollment in the study by contacting them on cell phone numbers which patients had provided during initial sample collection. We administered a short questionnaire to identify outcomes related to febrile illnesses, such as recovery date, specification of any residual illness and related medical treatment. We also queried some specific clinical manifestation with onset dates relevant to the illness caused by the pathogen of interest.

Data analysis. We categorized the study population as urban (city corporation area and district municipality area), peri-urban (sub district municipality area), and rural (any other area) residents. When we compared the dengue prevalence in rural and urban areas, we adjusted the odds ratio and confidence intervals (CIs) for the clustered design of sample collection from the six hospitals. We applied the clustered sandwich estimator for cluster adjustment by using the variance estimator options of logistic regression in STATA version 10 (StataCorp LP, College Station, TX).

We compared the hospital-based prevalence for dengue and malaria in terms of the number of positive samples compared with all inpatient admissions and all febrile cases attended in the medicine and pediatrics units. We calculated the prevalence of dengue and malaria by using the formula $E_D = D \times C/S$, where E_D = estimated number of disease (either dengue or malaria) positive cases, C = patients meeting the case definition, D = dengue or malaria positive cases, and S = total number of samples collected. Prevalence in terms of inpatient admissions was calculated by using the formula $E_D \times 1,000/I$, where I = total inpatient admissions. Prevalence in terms of total febrile cases was calculated by using the formula $E_D \times 1,000/F$, where F = total febrile cases.

Human subject protection. Before collecting any data or samples, study physicians obtained informed written consent from all adult participants or assent from participants

7–18 years of age and obtained permission from their guardians. We also secured parental permission exclusively for children less than seven years old. The study protocol was reviewed and approved by the Ethical Review Committee of ICDDR,B.

RESULTS

From December 2008 through November 2009, we enrolled 720 patients. Among these patients, 462 (64%) were from the inpatient department and 147 of these inpatients (32%) were female. From the outpatient department, we enrolled 258 (36%) patients; 121 (47%) of the outpatients were female. Of the total enrolled, at the time of recruitment 176 (24%) were less than five years of age, and 392 (54%) were less than 18 years of age. On average, patients came to the participating hospitals five days after fever onset.

Of 720 inpatients and outpatients in all six hospitals, 69 (9.6%) had IgM antibodies against dengue virus. The prevalence of patients with antibodies against dengue virus was 31 of 360 (8.6%) in government hospitals and 38 of 360 (11%) in private hospitals. The median age of patients with dengue was 12 years (interquartile range = 4–28 years), and the male:female ratio was 2.3:1 (Table 1). Among all febrile patients, 268 female patients had febrile illness and 21 (8%) of them were dengue positive. The rate of dengue positivity for 452 male febrile patients was 11% ($n = 48$).

Dengue cases were detected throughout six divisions of Bangladesh (Figure 1). Seven (10%) dengue-infected patients had a history of travel in the preceding 14 days. Four dengue-infected patients crossed divisional boundaries during their travel; they traveled approximately 250–360 km from their home town. The other three patients had traveled to other districts within the division in which they lived. Dengue prevalence among rural residents ($n = 25$, 8.8%) and among urban residents ($n = 26$, 9.4%) who sought care were similar (adjusted odds ratio = 0.93, 95% CI = 0.56–1.56).

Dengue was present throughout the year, but the number of detected cases varied (Figure 2). In the post-monsoon season during September–October, we identified 13 (19%) dengue-positive cases. A similar proportion of patients who came to hospitals within the first four days of symptom onset had dengue ($n = 30$, 9.4%) compared with those who came to the hospitals 5–10 days after onset of illness ($n = 39$, 9.7%).

The hospital-based prevalence of dengue cases during the study period was 4 per 1,000 patients admitted in the medicine and pediatric inpatient departments of the six hospitals. The highest prevalence of dengue was 21 per 1,000 for inpatient admissions in Kishoreganj. Prevalence was 15 per 1,000 in Chittagong and 7 per 1,000 in Barisal. The lowest prevalence was in Rajshahi where less than 1 per 1,000 dengue patients were admitted. Conversely, when we compared prevalence in terms of overall febrile illnesses and excluded other causes of admissions, dengue prevalence increased to 60 per 1,000

TABLE 1
Demographic and clinical presentations of study participants, Bangladesh*

Characteristic	Febrile patients ($n = 720$)	Dengue cases ($n = 69$)	Malaria cases ($n = 4$)
Demographic			
Mean age, years (range)	19.8 (0.08–85)	19.2 (0.08–65)	26.3 (4–63)
0–10	318 (44.2)	31 (44.9)	2 (50)
11–20	121 (16.8)	13 (18.8)	0
21–30	117 (16.3)	12 (17.4)	1 (25)
31–40	62 (8.6)	4 (5.8)	0
> 40	102 (14.2)	9 (13.0)	1 (25)
Male	452 (62.8)	48 (69.6)	3 (75)
Hospital departments			
Medicine inpatients	232 (32.2)	22 (31.9)	2 (50)
Pediatrics inpatients	230 (31.9)	24 (34.8)	1 (25)
Medicine outpatients	132 (18.3)	9 (13.0)	0
Pediatrics outpatients	126 (17.5)	14 (20.3)	1 (25)
Clinical presentation			
Fever	720 (100.0)	69 (100.0)	4 (100)
Headache	364 (50.6)	33 (47.8)	3 (75)
Body ache	263 (36.5)	16 (23.2)	1 (25)
Muscle pain	86 (11.9)	2 (2.9)	1 (25)
Joint pain	99 (13.8)	5 (7.2)	0
Rash	4 (0.6)	1 (1.4)	0
Bleeding	10 (1.4)	0	0
Retro-orbital pain	32 (4.4)	1 (1.4)	0
Eye redness	15 (2.1)	1 (1.4)	0
Jaundice	21 (2.9)	2 (2.9)	2 (50)
Neck stiffness	11 (1.5)	0	0
Mean physical examination result (range)			
Pulse per minute	97 (44–180)	94 (62–160)	92 (88–100)
Respiratory rate per minute	25 (12–90)	26 (12–77)	26 (20–35)
Systolic blood pressure (mm Hg)	106 (60–230)	107 (80–145)	100 (90–110)
Diastolic blood pressure (mm Hg)	68 (20–120)	68 (40–90)	73 (60–80)
Temperature (°F)	100.3 (95.9–106.0)	100.4 (98–106)	100.3 (99–101)
Mean laboratory investigation result (range)			
Neutrophils, %	65 (18–91)	66 (50–90)	83 (78–88)
Platelet count/ μ L	245,519 (15,000–600,000)	257,667 (150,000–600,000)	200,000 (200,000–200,000)
ESR (mm in first hour)	48 (5–180)	43 (10–105)	23 (5–40)

*Values are no. (%) unless otherwise indicated. ESR = erythrocyte sedimentation rate.

FIGURE 2. Monthly distribution of malaria and dengue cases, Bangladesh.

febrile case-patients admitted to the inpatient medicine and pediatric departments of these six hospitals (Table 2).

The overall response rate for phone follow-up two months after initial enrollment was 77% ($n = 557$). Because of mobile number unavailability, inaccessibility, or refusal to respond, 163 (23%) patients were lost to follow-up. We followed-up 55 (80%) dengue-positive patients for a median of 66 days and a range of 56–88 days after blood collection or for a median of 70 (range = 60–98) days after disease onset. Of these patients, 45 (82%) recovered without any residual illnesses, and nine (16%) mentioned continuing symptoms of fever, headache, joint pain, or jaundice (Table 3). During the follow-up period, we identified one death, a 60-year-old female inpatient, she had a history of intermittent fever (41°C on consultation) associated with chills and sweating that subsided when she took an antipyretic. She also had cough, anemia, and edema. She died two days after admission to a hospital.

Of the 720 febrile inpatients and outpatients in all six hospitals, four (0.56%) were positive for malaria by rapid test kit result and microscopy. All rapid test results were consistent with thick and thin blood film slides when observed by microscopy. One patient was positive for *P. vivax* and three patients were positive for *P. falciparum*. The *P. vivax* case was a four-year-old boy who came to the pediatric outpatient department in Chittagong district, a malaria-endemic area targeted by GFATM interventions. Of the three *P. falciparum*-positive cases, one was a 63-year-old man from the Chittagong area. The other two *P. falciparum*-positive cases were identified in Rajshahi Division, a non-endemic and non-GFATM funded area. One of these patients was a 28-year-old man who had

traveled from a malaria-endemic area two days before the onset of illness. The other patient was a 10-year-old girl who had a history of blood transfusion.

The hospital-based prevalence of malaria during the study period was 18 (95% CI = 11–28) per 100,000 patients admitted in the medicine and pediatric inpatient departments of the six hospitals. When we considered prevalence in terms of overall febrile illnesses and excluded other causes of admissions, the malaria prevalence was 26 (95% CI = 17–38) per 10,000 febrile case-patients admitted to the inpatient medicine and pediatric departments of the study hospitals.

We could only follow-up two of the four malaria-positive case-patients. Both of them recovered and did not report any residual illnesses.

There was one co-infection of dengue and *P. vivax* malaria in a case-patient at Chittagong Hospital. This patient was a four-year-old boy residing in Chittagong who came to the outpatient department of the hospital with a history of fever for eight days.

DISCUSSION

Dengue fever is emerging as a threat to public health in Bangladesh. It was prevalent among febrile patients who came to the six tertiary hospitals in our study and was equally prevalent in rural and urban residents irrespective of travel history. In comparison, only four malaria cases were detected at the study sites.

A previous hospital-based study of dengue infections in Bangladesh was conducted in September–October 1999 during the peak post-monsoon season in four of the same metropolitan cities.⁵ Eighteen percent of 200 patients had IgM antibodies against dengue virus identified by an ELISA dot technique. The data from our study, which were collected nationwide over a period of one year, confirms the importance of dengue as a cause of febrile illness in Bangladesh throughout the year (Figure 2).

Dengue was previously assumed to be an urban disease because most cases have been reported from large cities.^{14–17} Our study found that dengue was equally prevalent among urban and rural residents. This finding supports results of other published studies on this trend.^{18–22} The spread of dengue in cities might be caused by unplanned urbanization, which produces environments that support increased vector reproduction, exposure to susceptible populations, and virus

TABLE 2
Percentage of inpatient total admissions, febrile cases and detected illnesses, Bangladesh

Characteristic	Kishoreganj	Rajshahi	Chittagong	Khulna	Sylhet	Barisal	Total
Total admission (no.)	6,552	51,633	4,328	15,401	10,984	26,420	115,318
Fever cases, no. (%)	1,405 (21)	1,683 (3)	781 (18)	805 (5)	1,293 (12)	1,930 (7)	7,897 (7)
Met case definition,* no. (%)	933 (14)	686 (1)	516 (12)	498 (3)	778 (7)	1,326 (5)	4,737 (4)
Sample collected, no. (%)	60 (0.9)	67 (0.1)	80 (2)	73 (0.5)	84 (0.8)	98 (0.4)	462 (0.4)
Dengue,† no. (%)	9 (0.14)	2 (0.004)	10 (0.23)	8 (0.052)	4 (0.036)	13 (0.049)	46 (0.04)
Malaria, no. (%)	0	1 (0.002)	1 (0.02)	0	0	0	2 (0.002)
Dengue prevalence‡	100/1,000	12/1,000	83/1,000	68/1,000	29/1,000	91/1,000	60/1,000
Malaria prevalence§	0	6/1,000	8/1,000	0	0	0	2.6/1,000

* Case definition for medicine and pediatrics inpatients and outpatients: patients who had a complaint of fever more than $> 38^{\circ}\text{C}$ with onset within the preceding 10 days along with the exclusion of nosocomial cases, symptoms of fever for more than 10 days; cough with productive sputum; urgency, frequency, hesitancy during micturition and cellulitis, abscess, boil, and local skin infection in the body and any patient with confirmed laboratory diagnosis of other diseases rather than the study organisms.

† We identified 69 dengue-positive cases in 720 enrollments from the inpatient and outpatient departments of participating hospitals. We report 46 dengue-positive cases in 462 enrollments from the inpatient departments of the hospitals.

‡ Dengue prevalence in terms of overall febrile illnesses excluding other causes of admissions.

§ Malaria prevalence in terms of overall febrile illnesses excluding other causes of admissions.

TABLE 3

Associated outcomes and possible risk factors for malaria and dengue in febrile patients in Bangladesh*

Characteristic	Dengue cases (n = 55), no. (%)	Malaria cases (n = 2), no. (%)
Mean duration of illness in days (range)	19 (2–54)	23 (13–33)
Recovery after two months	45 (82)	2 (100)
Any residual illness	9 (16)	0
Fever	3	0
Joint pain	3	0
Jaundice	2	0
Headache	2	0
Chest pain	1	0
Vomiting	1	0
Diarrhea	1	0
Death	1 (2)	0
Necessity of medication	13 (24)	0
Affected family members	5 (9)	0
Risk factors: travel history		
From another district within division	3 (5)	1 (50)
From another district from another division	4 (7)	1 (50)
Outside country	0	0

* For follow-up of 69 dengue-positive patients after 2 months of enrollment, there were 55 respondents. For follow-up of malaria, there were 2 respondents of four positive patients.

propagation.^{16,23–29} In the past several decades, dengue cases have been detected in rural areas in Thailand, Indonesia, India, Malaysia, Peru, Brazil and Cameroon.^{30–33} The vector for dengue transmission and dengue virus antigen in mosquitoes has also been detected in these regions.^{34–37} Technological advancement in villages leading to changes in rural ecology may also be a factor in dengue transmission among rural residents.³⁸

Most dengue patients identified during this study were male (70%), but male patients were also more likely to be enrolled in the study (63%). This difference likely resulted from different health care utilization among male and female patients which is typical in South Asia.¹⁸ The proportion of female febrile patients who were positive for dengue (8%) was similar to that of male febrile patients (11%), and the difference was not statistically significant ($P > 0.2$). Similarly in a study conducted during September 1996–June 1997 in Chittagong Medical College Hospital in southern Bangladesh, the proportion of female patients who were positive for dengue was 10% compared with 16% among males, a difference that was not statistically significant ($P > 0.16$).³⁹ During the 2000 dengue hemorrhagic fever outbreak in Bangladesh, a study conducted in Khulna Medical College Hospital in southern Bangladesh found no significant sex difference among the enrolled pediatric dengue patients: 62 boys (53.9%) compared with 53 girls (46.1%).⁴⁰ Additionally, there was no significant sex difference either in a study in Thailand with male and female infants (male:female ratio = 1.3:1), or in studies in Brazil and Peru with older patients.^{41–43}

Dengue fever has a reported case-fatality rate of approximately 1%, and the clinical consequences can be a serious issue for populations in Bangladesh.^{44,45} In this study, there was one death, and most (82%) patients recovered without any residual illness.

Malaria was not a major cause of febrile illness in this study population. We found few patients with malaria who came to the six tertiary study hospitals. This finding may have been caused by community malaria detection, treatment, and control initiatives implemented by BRAC and other non-government organizations through the Government of Bangladesh/GFATM.^{11,46} It could also be because we had

study sites in only two of the designated malaria-endemic areas.⁸ We detected two malaria cases in a malaria-endemic area and an additional case who had traveled to a malaria-endemic area. Another explanation for the low case reporting could be that our study might have systematically enrolled patients who had failed anti-malarial therapy. Rural residents of Bangladesh generally visit pharmacies first, which commonly dispense anti-malarial drugs for treatment of illnesses.^{47,48} Patients who visit the hospitals would be expected to be biased towards those who failed to respond to the anti-malarial therapies in the community.

This study had several limitations. First, infections from malaria and dengue can have annual variations.^{49–52} Our study collected data for only one year, and so this could have been an unusually high or low year for either infection. However, the proportion of identified patients with dengue is consistent with the results from the study performed in metropolitan areas in 1999.⁵

A second limitation is the relatively small sample size used to assess the prevalence of rare diseases among febrile patients who came to the tertiary-level hospitals throughout the country. The small number of cases makes overall and especially regional-based estimates of prevalence imprecise. However, we do have data from six hospitals over the course of the year that provides strong evidence that malaria was not a leading cause of febrile illness among these patient populations during this time.

Third, we did not collect dengue convalescent-phase serum samples. We collected samples during 1–10 days of symptom onset. Among the 319 patients enrolled in the first four days of illness, some may have been infected with dengue, but had not yet developed antibodies against dengue infection.^{53,54} Therefore, our data may have underestimated the overall prevalence. However, this is likely a minor effect because the prevalence of IgM antibodies against dengue was similar among patients who came to a hospital within the first four days of symptom onset (9.4%) compared with patients who came to a hospital within 5–10 days of symptom onset (9.7%). Moreover, the sensitivity of the assay was high, ranging from 83.5% to 96.8%, as reported in several studies,^{55–58} irrespective of the sample collection period from the onset of illness.

Fourth, because antibodies to other pathogens including other flavivirus infections such as yellow fever and Japanese encephalitis and non-flavivirus infections such as leptospirosis can cross react with the dengue ELISA,⁵⁹ it is possible that some of the dengue IgM antibody positive results are false-positives. Therefore, we may have overestimated the proportion of febrile illness caused by dengue virus. However, the high specificity (99%) of the PanBio (Windsor, Queensland, Australia) IgM ELISA reported in several studies suggests that few of our cases were misclassified.^{56,57,60}

In Bangladesh, dengue is a year-round threat in urban and rural areas. As vaccine trials continue,^{61,62} a community-based dengue vaccination campaign could be piloted and evaluated as a possible prevention strategy. Physicians and health workers in rural areas should be trained to effectively manage dengue patients with adequate rehydration, follow-up and judicious use of antibiotics. The World Health Organization has recently recommended universal parasitological diagnosis for malaria irrespective of age groups and transmission settings.⁶³ Thus, healthcare providers in Bangladesh should consistently use malaria diagnostics to ensure accurate diagnosis of febrile

illness and to reduce inappropriate use of anti-malarial drugs. When laboratory diagnosis is unavailable, decisions about empiric use of anti-malarial drugs should take into account local malaria prevalence and any potential recent exposures to malaria during travel.

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