



A short communication of 2022 dengue outbreak in Bangladesh: a continuous public health threat

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Abstract

Dengue virus infection, a highly prominent health concern, has caused many health complications, positive cases, and deaths in Bangladesh in previous years. However, the prevalence of this infection and fatality rates in 2022 has shattered all prior records. The dengue virus vector, mosquitoes, found a high prevalence of infection due to the weather's favorable conditions for breeding in the months of June and July. While there is presently no particular vaccination for dengue infection, awareness of its epidemiology, pathogenesis, signs, and symptoms may aid in the development of improved diagnostic and treatment strategies. The government should also improve the infrastructure of cities to make prevent mosquito breeding and the spread of dengue infection.

Keywords: 2022 dengue outbreak, Bangladesh, dengue hemorrhagic fever (DHF), dengue shock syndrome (DSS), dengue virus (DENV), dengue/ dengue Fever (DF)

Introduction

Dengue fever is an endemic disease in Bangladesh caused by dengue viruses (DENV). Bangladesh witnessed the most catastrophic DENV outbreak in 2019, involving 101354 confirmed positive cases and 164 fatalities (Fig. 1A). In 2022, dengue incidence again rose at the second-highest level, with a notable annual death rate and a case fatality rate of 0.44 percent, according to the WHO^[1-3]. In December 2022 alone, at least 27 deaths and 5024 hospitalizations were reported, which was the highest number observed since

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HIGHLIGHTS

- A global public health concern that is getting worse day by day is dengue illness.
- Bangladesh recorded the highest number of dengue deaths (281) in 2022.
- Early diagnosis and intensive hospital care can reduce fatality.
- Public awareness against dengue and Wastewater based surveillance need to boost up.
- More research-based studies need to conduct for dengue.

the beginning of the first dengue outbreak in 2000. According to WHO data, 40% of DENV-positive cases ($n=20\ 982$) were recorded among patients in the median age cohort (25 years, range: 0–89), and 60% of these patients were male. Driven by this scenario, the purpose of this study is to show the dengue epidemic in Bangladesh in 2022 by using data obtained from the Bangladesh Government open access web portal (<https://old.dghs.gov.bd/index.php/bd/home/5200-daily-Dengue-status-report>) of the Directorate of Health Service and the Ministry of Health and Family Welfare.

On 11 October 2022, the maximum number of mortality cases ($n=8$) was confirmed in a single day, and positive cases were rapidly increasing^[4]. While the incubation period after initial infection was determined to be between 4 and 10 days with three distinct stages (febrile, critical, and recovery), the patients seemed to be asymptomatic or exhibited broad clinical manifestations. Although there is currently no authorized vaccination against DENV infection, this study aims to raise public awareness by studying the viral pathogenesis, epidemiology, clinical manifestations of patients, repercussions, and potential diagnostic and therapeutic approaches.

Epidemiology of dengue

The climate and topography of Bangladesh, a South Asian nation, are conducive to the spread of Dengue^[5-7]. According to the WHO, this disease affects more than 400 million individuals each

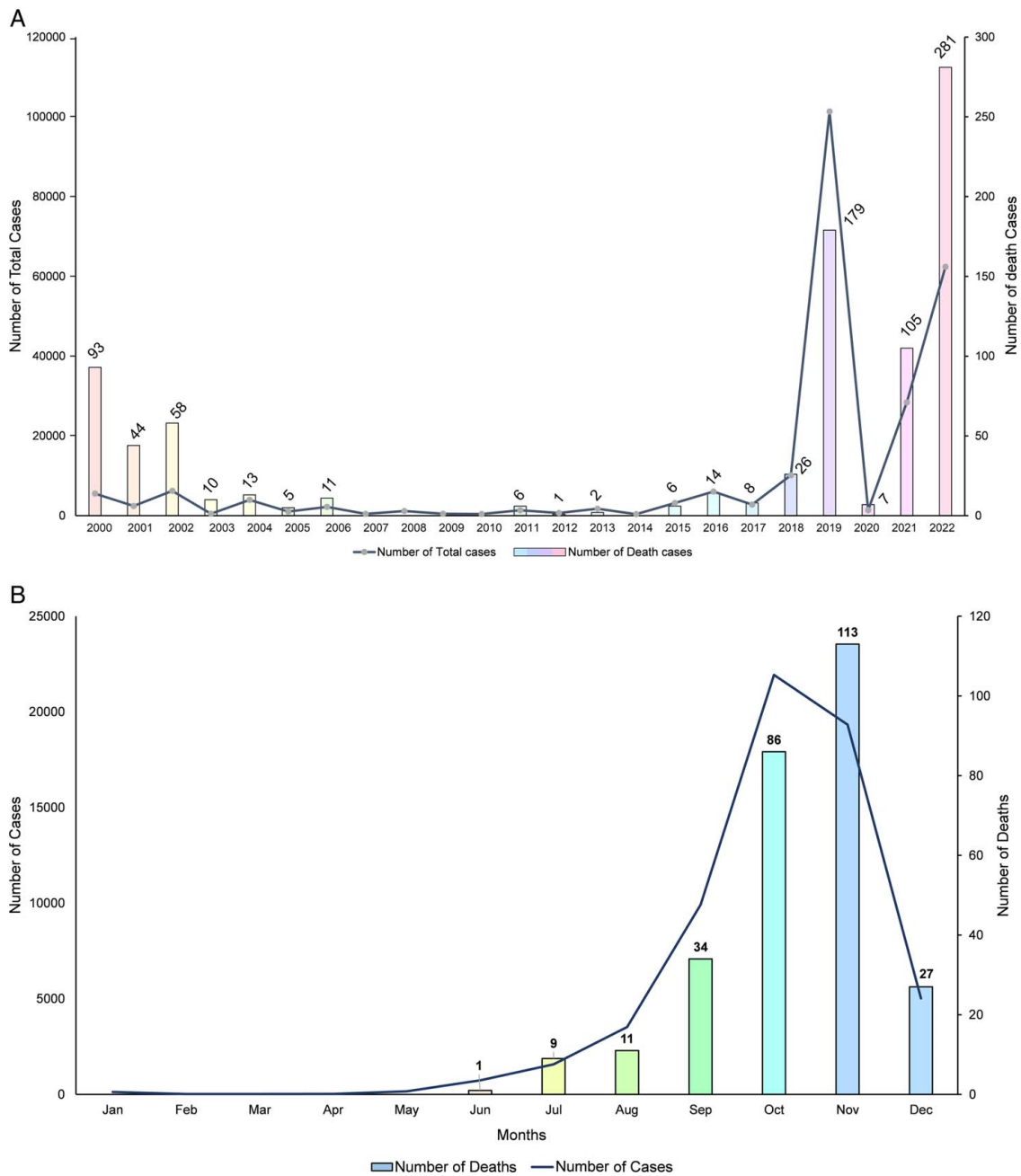


Figure 1. Status of dengue patients in Bangladesh. (A) The number of dengue confirmed positive and reported death cases from 2000 to 2022. (B) Month-by-month country wide surveillance for dengue fever in Bangladesh, 2022.

year and is on the rise, threatening over half of the world’s population^[8]. Compared to the previous 4 years (2018–2021) in which fewer cases were identified, both the number of cases and deaths climbed significantly in 2022. According to the European Center for Disease Prevention and Control, more than 376 6153 confirmed positive cases and 3582 deaths have been recorded as of 19 December 2022, with Brazil (2182229), Vietnam (325604), the Philippines (201 509), India (110473), and Indonesia (94355) accounting for the majority of confirmed DENV cases^[11]. The highest number of deaths was reported in Brazil (929), Vietnam (112), the Philippines (656), India (86), and Indonesia (853)^[11]. The

first official case of Dengue fever in 2022 was recorded in January, and it was contained until March. Since then, the number of reported dengue patients in Bangladesh has progressively increased, to a record high in September. While almost 70 persons died of dengue in the first 10 months of 2022, the highest number of fatalities was observed in September.

According to the DGSHS data for 31 December 2022, the total number of official hospitalizations included 62382 patients, with 39220 patients in the Dhaka division, 35 115 in the metropolitan city, and 4105 patients outside the Dhaka metropolitan area. The Directorate of Health Service General disclosed that 35115

hospitalized patients were from the capital, followed by Chittagong division (9109), Khulna division (3350), Barisal (3167), Rajshahi (2111), Mymensingh (1020), Rangpur (175), and Sylhet division (125). In 2022, the overall death toll by DENV infection exceeded 281, with 171 occurring in Dhaka city, one in Narayanganj district and one in Madaripur district in Dhaka division, 69 in Chattogram, and 12 in Barishal divisions, 12 in Khulna division, seven in Rajshahi, and six in Mymensingh, while no deaths was reported in Rangpur and Sylhet (Fig. 1B) (Supplementary Data-SD1, Supplemental Digital Content 1, <http://links.lww.com/MS9/A57>).

Denue virus (DENV)

Dengue virus (DENV) has a spherical shape and icosahedral symmetry, containing an 11 kb genome of +ssRNA and is a member of the Flaviviridae subfamily of the Flavivirus gen^[9,10]. It contains an open reading frame with three structural [capsid (C), premembrane or membrane, and envelope]^[11] and seven non-structural proteins (NSP) (NS1, NS2A, NS2B, NS3, NS4A, NS4B, and NS5) proteins^[12]. Dengue is caused by any of the four diverse DENV serotypes, for example, DENV1, DENV2, DENV3, and DENV4^[13]. The disease is spread primarily by *Aedes aegypti* (*Aedes aegypti*) in urban regions for a suitable breeding peri-domestic environment, with *Aedes albopictus*, the second vector, also infecting globally^[11]. This disease thrives in current global settings such as overheating, deforestation, flooding, immigration, use of pesticides, and other chemicals.

Clinical manifestation and diagnosis

Depending on the situation and the patient's state, different procedures for diagnosing DENV infection can be employed by focusing on the nonstructural protein or NSP1 antigen or by testing for immunoglobulin M or IgM antibodies. NSP1 is the most important NSP protein for diagnosis, and RT-PCR, PCR, ELISA, fast kits, and other conventional methods can be utilized for this purpose^[2]. A number of variables, including sex, age, BMI, serotypes, and host immunity (MHC Class 1, B- Lymphocytes), contribute to the development of dengue hemorrhagic fever (DHF) and its inevitable consequences in the form of organ failure, and dengue shock syndrome (DSS), resulting in notable extreme condition or death^[3]. Even though the majority of individuals are asymptomatic, leucopenia, limited platelet counts, fever, and headaches are clinical signs that resemble flu. DSS, analogous to DHF, blood coagulation, concentration, leakage, or other problems such as elevated vascular fragility, fluid loss, and multiorgan failure emerge in chronic patients. Both antibody-dependent enhancement and antibody-counteract are ambiguous immune response mechanisms against DENV^[14]. According to previous research, fever (103 to 106° Fahrenheit), backache, vomiting/nausea, abdominal pain, pain in joints and muscles, retro-orbital pain, skin rashes, melena, gum bleeding, and epistaxis, hematemesis, vertigo, weakness, sweating, and syncope are typically observed 4 to 7 days after a mosquito bite and typically last 3 to 10 days; diarrhea, sore throat, and neurological manifestations are also common^[15]. Viremia is observed 24 h after virus entry, followed by multiplication in macrophages and monocytes; bone marrow cells, and macrophages are the targets of infection. The decline in an individual's

body fluid reduces blood pressure and oxygen delivery to vital organs such as the brain^[16].

Treatment

Currently, there are no particular DENV treatments available, as well as all supportive medication is based on the patient's symptoms and condition. Anti-inflammatory drugs, NSAIDs (nonsteroidal anti-inflammatory drugs), ibuprofen, and aspirin are prescribed with Dengvaxia® (CYD-TDV), the first vaccine approved in ~20 countries produced by Sanofi Pasteur in December 2015^[15]. However, Dengvaxia is only suggested for people who have previously been infected with Dengue and is not recommended for those who have never had dengue fever. This is due to antibody-dependent enhancement of dengue (*Sanofi, 2022*). To stay hydrated, proper rest, fluid intake, and water with additional electrolytes are recommended. For severe patients, a fluid altering strategy intravenously can be used following a 0.9% solution of normal saline at 20 ml/kg/h rate initially 2 h, then 10 ml/kg/h for the next 6 h, after that, according to the patient's status up to 16 h^[17]. A laboratory follow-up study must be used to count the level of the hematocrit and platelets of patients where increasing of hematocrit with alleviating of platelet amount indicates a high risk for patient due shock^[18]. Previous studies mentioned that medical plants with sulfated polysaccharides carry antiviral molecules such as ribavirin, glycyrrhizin, and 6-azauridine, effective against DENV infection. A number of vaccines against DENV are in distinct trial phases such as chimerization by Sanofi Pasteur, combinations of specific mutations and chimeras by the NIH, and chimerization with the Dengue 2 PDK53 virus by Inviragen^[19,20]. Dengue fever is symptomatically treated during the febrile stage and paracetamol can be used to treat the fever. A child may be more susceptible to mucosal bleeding if they use salicylates or other nonsteroidal anti-inflammatory medications^[3]. For the purpose of early DHF identification in an epidemic context, primary care physicians must regularly check on all dengue fever patients (Singhi *et al.*, 2007). Severe dengue infection is linked with two main pathophysiological reactions: defective hemostasis leading to bleeding or plasma leakage resulting in hypovolemic shock. Each step of the clinical manifestations of dengue poses a different difficulty for fluid management, including the feverish, critical, and recovery stages^[21]. The goal is to cure dehydration during the first phase of the febrile phase. It can be used to treat 70% of non-shocked dengue-infected patients and the remaining 30% of these patients need intravenous fluids. As a result, all of the DSS patients require IV fluids supply to protect from DENV.

Prevention and control

According to experts, one of the leading main causes of Bangladesh's high dengue incidence rate is the evolving nature of urbanization, such as the increased building of high-rise structures^[2]. The nearly universal availability of standing water in public areas, unfinished buildings, and basements makes them the ideal habitat for *Aedes* mosquitoes to breed. In addition, construction projects for infrastructure are ongoing year-round, and mosquitoes seek refuge and breeding grounds there. Although experts frequently pinpoint the most probable locations where mosquitoes breed most heavily, authorities are

unable to launch early attempts to eradicate them. For a long time, experts have warned about this. Despite our experience fighting dengue, dengue cases typically peak in Bangladesh around June or July each year, and we are now well-versed in how to handle such spikes. The truth is that Bangladesh faced a significant number of deaths last year. This indicates that both the city corporations and the health authorities have been slow to act.

The primary step in resolving the dengue problem is to take the right measures to avoid contact with infected mosquitoes^[22]. It should be emphasized that *Aedes* mosquitoes attack during the day, therefore, it is imperative to eliminate standing water, apply insecticides to kill them, wear long-sleeved clothing or dresses, and deploy insect repellent to stay away from mosquitoes^[16]. Vaccination and drug therapy should be developed besides of taking all steps of prevention^[9]. Antipyretics (paracetamol) can be used for fever, analgesics or pain killer for joint pain. Serious patients with DHF/DSS should be hospitalized immediately, where oral rehydration therapy can follow for dehydration. Platelet transfusion is recommended when it's level 20 000 or below^[23].

Vector control should follow according to the WHO Integrated Vector Management system to minimize vector breeding areas, lessen vectors, environment managing and lessening stagnant areas of water, use larvicides, fogging and fumigation in camps, treatment of waste, and wastewater before releasing in the environment^[15]. Bangladesh also experienced the dreadful flood which started on 17 May 2022 and mostly captivated two districts of the northeastern division of Sylhet with 79 death and thousands of injuries, and enormous economic disruption described. The ongoing COVID-19 contagious disease occurred by SARS-CoV-2 has disrupted global public health, businesses, and economics due to widespread infection^[9,24–26]. It is ambiguous till now for reasons behind the increasing dengue infection while government actions, environment, season, wastewater, and the public health knowledge gap and if it is unfeasible to control immediately can turn into another outbreak^[27,28].

Conclusion and future prospects

This study will be useful in learning about the dengue outbreak in 2022 and adopting preventative measures against the dengue disease. Although this data based study clear the importance of DENV infection for Bangladesh, furthermore research-based studies need to conduct for this public health issue including increase public awareness. The flavivirus that renders dengue is primarily found in tropical and subtropical regions. The leading causes of this situation include improper education, a knowledge gap, a lack of appropriate legislative regulations, and a deficient wastewater management system. Serological-based hospital monitoring combined with wastewater-based surveillance may be used to identify hotspots and forecast patient counts. During monsoon season, all need to concern for DENV, including proper protections. Everyone should be concerned about DENV during the monsoon season and take appropriate precautions. Those who are susceptible need to be diagnosed right away and confirmed patients being admitted to the hospital with extra care. Reduced Dengue transmission, urbanization planning, environmental degradation, effective therapeutic vaccines, antiviral medications manufacturing, and correct education should all be addressed in multisectoral initiatives to prevent and manage this

illness. Surveillance might be applied with serological-based hospital surveillance to detect hotspots and predict patient.

Ethical approval

The present study includes printed and published information; therefore, formal ethical clearance not applicable for this study.

Consent

NA.

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Conflict of interests disclosure

The authors declare that there is no conflict of interest.

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References

- [1] ECDC, 2022; *Dengue worldwide overview by European Centre for Disease Prevention and Control*; Accessed 14 January 2022. <https://www.ecdc.europa.eu/en/Dengue-monthly>
- [2] Dey SK, Rahman MM, Howlader A, *et al.* Prediction of dengue incidents using hospitalized patients, metrological and socio-economic data in Bangladesh: a machine learning approach. *PLOS One* 2022;17:e0270933.
- [3] Kularatne SA, Dalugama C. Dengue infection: global importance, immunopathology and management. *Clin Med (Lond)* 2022;22:9–13.
- [4] DGSH, 2022; Accessed 14 January 2022. <https://old.dghs.gov.bd/index.php/bd/home/5200-daily-Dengue-status-report>
- [5] Ahmed F, Islam MA, Kumar M, *et al.* First detection of SARS-CoV-2 genetic material in the vicinity of COVID-19 isolation Centre in Bangladesh: variation along the sewer network. *Sci Total Environ* 2021;776:145724.
- [6] Islam MA, Marzan AA, Islam MS, *et al.* 2021. (2021). *Sex-specific epidemiological and clinical characteristics of COVID-19 patients in the southeast region of Bangladesh* 2021. *MedRxiv* <https://doi.org/10.1101/2021.07.05.21259933>. <https://doi.org/doi.org/10.1101/2021.07.05.21259933>.
- [7] Jakariya M, Ahmed F, Islam MA, *et al.* Wastewater-based epidemiological surveillance to monitor the prevalence of SARS-CoV-2 in developing countries with onsite sanitation facilities. *Envi Poll* 2022;:119679.
- [8] WHO, 2022 b; Accessed 14 January 2022. <https://www.who.int/bangladesh/news/detail/28-05-2018-Dengue-a-mosquito-borne-disease..>
- [9] Rahman FI, Ether SA, Islam MR. Upsurge of dengue prevalence during the third wave of covid-19 pandemic in bangladesh: pouring gasoline to fire. *Clin Pathol* 2022;15:2632010X2210760.
- [10] Khan J, Adil M, Wang G, *et al.* A cross-sectional study to assess the epidemiological situation and associated risk factors of dengue fever; knowledge, attitudes, and practices about dengue prevention in Khyber Pakhtunkhwa Province, Pakistan. *Front Public Health* 2022;10. <https://doi.org/10.3389/fpubh.2022.923277>
- [11] Murugesan A, Manoharan M. *Dengue Virus. Emerging and Reemerging Viral Pathogens* 2020:281–359. Elsevier. <https://doi.org/10.1016/B978-0-12-819400-3.00016-8>

- [12] Perera R, Kuhn RJ. Structural proteomics of dengue virus. *Curr Opin Microbiol* 2008;11:369–77.
- [13] Sanofi: *Dengvaxia*®, *World's First Dengue Vaccine, Approved in Mexico - Sanofi*. (n.d.).
- [14] Yong YK, Wong WF, Vignesh R, *et al*. Dengue infection – Recent advances in disease pathogenesis in the era of COVID-19. *Front Immunol* 2022;13. <https://doi.org/10.3389/fimmu.2022.889196>
- [15] Khan S, Akbar SMF, Yahiro T, *et al*. Dengue infections during COVID-19 period: reflection of reality or elusive data due to effect of pandemic. *Int J Environm Res Public Health* 2022;19:10768.
- [16] CDC, 2022; *Symptoms and Treatment | Dengue | CDC*. Accessed 14 January 2022. <https://www.cdc.gov/Dengue/symptoms/index.html>
- [17] Teixeira MG, Barreto ML. Diagnosis and management of Dengue. *BMJ* 2009;339:b4338
- [18] Hasan MN, Islam MA, Sangkham S, *et al*. Insight into vaccination and meteorological factors on daily COVID-19 cases and mortality in Bangladesh. *Groundw Sustain Dev* 2023;100932.
- [19] Thisyakorn U, Thisyakorn C. Latest developments and future directions in dengue vaccines. *Therapeutic Adv Vacc* 2014;2:3–9.
- [20] WHO. 2022 a; Accessed 14 January 2022. <https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON424>.
- [21] Hung NT. Fluid management for dengue in children. *Paediatr Int Child Health* 2012;32(suppl1):39–42.
- [22] Tayal A, Kabra SK, Lodha R. Management of dengue: an updated review. *Ind J Pediatr* 2022. <https://doi.org/10.1007/s12098-022-04394-8>
- [23] Nasir NH, Mohamad M, Lum LCS, *et al*. Effectiveness of a fluid chart in outpatient management of suspected dengue fever: a pilot study. *PLOS One* 2017;12:e0183544.
- [24] Islam MA, Haque MA, Rahman MA, *et al*. A Review on Measures to rejuvenate immune system: natural mode of protection against coronavirus infection. *Front Immunol* 2022;13.
- [25] Rakib SH, Masum S, Patwari MRI, *et al*. Design and development of a low cost ultraviolet disinfection system to reduce the cross infection of SARS-CoV-2 in ambulances. 2021 International Conference on Electronics, Communications and Information Technology (ICECIT) 2021:1–4. <https://doi.org/10.1109/ICECIT54077.2021.9641131>
- [26] Sakib MMH, Nishat AA, Islam MT, *et al*. Computational screening of 645 antiviral peptides against the receptor-binding domain of the spike protein in SARS-CoV-2. *Comput Biol Med* 2021;136:104759.
- [27] Islam MA, Shahi S, Marzan AA, *et al*. Variant-specific deleterious mutations in the SARS-CoV-2 genome reveal immune responses and potentials for prophylactic vaccine development. *Front Pharmacol* 2023;141090717.
- [28] Islam MA, Hasan MN, Tiwari A, *et al*. Correlation of dengue and meteorological factors in Bangladesh: a public health concern. *Int J Environ Res Public Health* 2023;20:5152.