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The 2023 Outbreak of Dengue in Bangladesh and The Non-identify Criteria.

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A B S T R A C T

Dengue, an incapacitating viral disease transmitted by mosquitoes, has emerged as a critical public health issue in Bangladesh. This expansion reflects the worldwide pattern of dengue's geographical distribution, with Bangladesh experiencing recurrent outbreaks since 1964. Notably, Bangladesh faced a catastrophic dengue outbreak in 2023, characterized by a substantial number of cases and associated mortalities. Between January and September 2023, Bangladesh observed a worrisome upsurge in dengue cases, prompting concerns within the public health sector. The precise figures, which are subject to ongoing updates, underscore the gravity of the situation and its immediate consequences. This outbreak has not only impacted regions with a history of dengue but has also encroached upon previously considered dengue-free areas. Adding complexity to the situation, Bangladesh is grappling with an increased genetic diversity of the dengue virus (DENV), wherein all four DENV serotypes co-circulate. This heightened diversity raises worries about the risk of severe dengue due to the antibody-dependent enhancement effect. The overarching objective of our research is to comprehensively investigate the underlying factors contributing to the prevalence of dengue in Bangladesh, while also shedding light on the limitations of our current diagnostic tests.

Keywords*: Dengue, Dengue virus, Aedes mosquito, 2023 Outbreak, Dengue cases, Bangladesh, Death, Dengue Tests.*

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I. Introduction

Though Bangladesh is a small country it is facing many kinds of problems and dengue is one of them. Dengue is a mosquito-borne viral illness that can cause a variety of symptoms, including fever, headache, body aches, and nausea. Approximately 75% of global dengue cases are concentrated in Asia, specifically in the Philippines, Indonesia, and Thailand. In nations with tropical climates such as Bangladesh, where the weather is conducive to the proliferation of Aedes mosquito vectors, effectively preventing dengue hinges predominantly on accurately recognizing and managing risk factors linked to socio-demographics and lifestyle. From 1964 to 1999, dengue virus transmission in Bangladesh was infrequent. However, during 2023, dengue outbreaks exceeded all prior instances, primarily concentrated in the capital city of Dhaka. The general consensus is that the test failed to detect dengue as the primary cause. Most people ignore their mild fever, but end up testing positive for dengue when their condition worsens. The objective of our research is to elucidate the reasons

behind the prevalence of dengue in Bangladesh and the inadequacy of our current diagnostic tests.

II. Materials and methods

Literature review

The collective pursuit of knowledge in dengue research is aimed at unraveling its multifaceted aspects in the context of Bangladesh. One pivotal study directed its focus towards the distribution of dengue cases across different age groups, scrutinizing trends among adults, and delving into severity issues like dengue hemorrhagic fever. It also assessed factors contributing to outbreaks and control measures' efficacy, illuminating dengue's epidemiology and emphasizing the need for surveillance and prevention [1]. In light of the surging dengue outbreaks, another paper spotlighted their causes, underlining the urgency for fortified prevention strategies. It championed community engagement, early detection, and addressing various factors, offering pathways to manage the rising dengue cases [2]. On maternal and neonatal fronts, an exploration of vertical transmission revealed its indicators, consequences, and the necessity of vigilant monitoring during pregnancy. The study further painted the clinical landscape in newborns, adding depth to our understanding of dengue's impact [3]. Addressing the meteorological dimension, one research delved into the weather's role, specifically temperature and humidity, in dengue transmission in Dhaka [4]. In the backdrop of increasing dengue burden, another study spotlighted the gravity of severe cases, investigating dengue's genetic diversity and serotype circulation [5]. In the north, clinical and meteorological intersections were investigated, aiming to define the link between weather and dengue cases [6]. Pushing boundaries, a paper introduced an innovative fractional model for dengue transmission, underpinned by advanced mathematical techniques [7]. Zooming out, a comprehensive review captured the evolving dengue scenario in Bangladesh, identifying contributing factors to recent outbreaks and offering insights for global dengue control [8]. Forward-looking research aimed to understand dengue's emergence, its current status, and its future susceptibilities in Bangladesh [9]. Collectively, these endeavors contribute to a comprehensive mosaic of knowledge, equipping us to better comprehend, prevent, and manage dengue's challenges in Bangladesh and beyond.

Mutation of Aedes mosque

Now a days aedes mosquito have undergone major changes in their life cycle and behaviors, according to a researcher which is done by Kabirul Bashar, a professor of zoology and an expert in vector control at Jahangirnagar University. The principal vector for dengue infections, Aedes aegypti used to be able to reproduce solely in clear water. But now it breeds in both clean and unclean water and also can breeds in various types of water, including rainwater, saltwater, drain water, and sewage water. Currently, mosquitoes are biting both during the day and at night. It used to just bite during the daylight, according to Kabirul, and he has noticed the development since 2020 [10]..

Aedes mosquito and temperature

Aedes is one of the most common mosquitoes of Bangladesh. 14 of the 123 species that have been identified in Bangladesh to far may be found in and around Dhaka. On the other hand, whereas there are 200 species of mosquitoes worldwide, only 10–12 species are found in Bangladesh. Half of the world's population is at danger from the viral virus dengue, which is spread by mosquitoes. And The Aedes mosquitoes transmit the dengue fever virus. With an estimated 50-100 million infections each year in more than 100 endemic countries, its incidence has increased 30-fold in the previous fifty years. One of the countries affected by this alarming trend is Bangladesh [11].

Because of the climate, the aedes mosquito grows so fast in Bangladesh. The temperature in Bangladesh is warm and humid, which is perfect for Aedes mosquito survival and reproduction. These mosquitoes need standing water to develop, which is frequently present in Bangladesh's monsoon-driven environment, where temperatures between 25°C and 32°C are ideal [12].

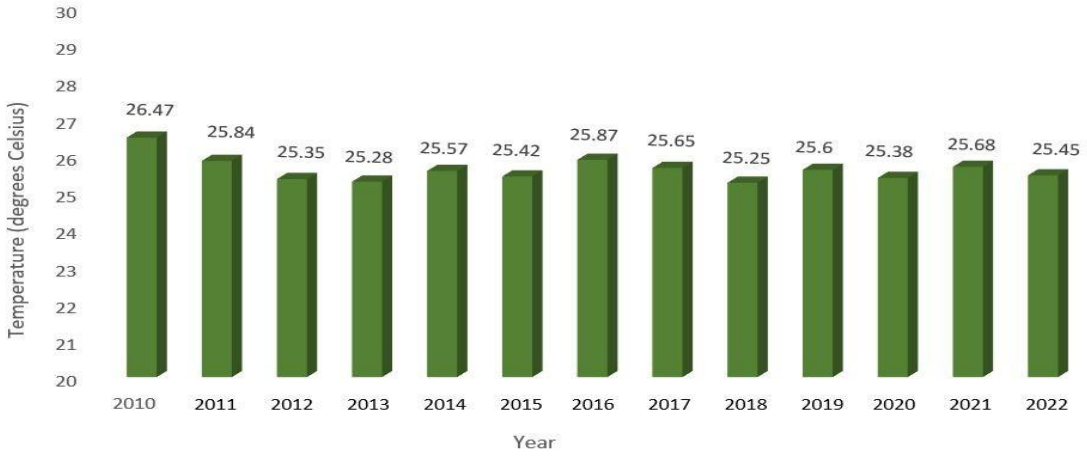

Figure 1: Average temperature Of Bangladesh from 2010 to 2022.

The bar chart shows the average temperature trends from 2010 to 2022, and it becomes evident that the average temperature remains within a consistent range during this period Which is the perfect climate for Aedes mosquito's growth.

Dengue Affected areas 2023

Dhaka, Chattogram, Sylhet, Rajshahi, Khulna, Barishal and Mymensingh are the districts which have been identified as red zones for dengue, meaning that these districts have the highest number of cases and are at the highest risk. On the other hand, the yellow color indicates the districts which are at the low risk but still there have a chance that these districts also become at high-risk area.

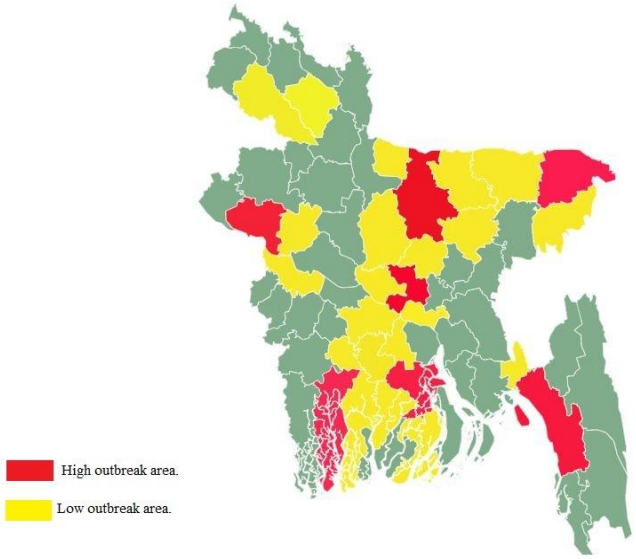

Figure 2: The dengue outbreak districts of Bangladesh of 2023.

Serotypes of Dengue fever

Dengue has become an epidemic due to our lack of awareness, and Dhaka City is counted as the most dangerous zone. In Bangladesh, dengue cases tend to peak around August and September, notwithstanding the continuous presence of infection risk throughout the year. Common symptoms of the condition may encompass elevated body temperature, explicitly reaching 40°C or 104°F, intense cephalalgia, discomfort located in the ocular region, muscular and articular distress, feelings of nausea, instances of emesis, enlarged lymph nodes, as well as the presence of a skin eruption. There are four different serotypes of the dengue virus, and they are designated as DENV-1, DENV-2, DENV-3, and DENV-4, respectively.

Primary Symptoms

In cases where Dengue Fever advances to severe dengue, a common occurrence is the manifestation of warning signs in patients, commonly observed after several days, typically within a timeframe of 3 to 7 days after the onset of early symptoms. These symptoms frequently align with decreased body temperature (below 38 degrees Celsius) and encompass intense stomach pain and accelerated respiration. Repeated infections with Dengue virus (DENV) may pose an increased risk.

Recovery process

Although a person who has previously recovered from one serotype of dengue fever is immune to that particular dengue serotype for around two to three months following their recovery, this protection gradually decreases. Consequently, individuals become vulnerable to infection by different dengue virus serotypes. Unlike other viral infections, such as COVID-19, in which memory B cells provide long-lasting immunity against multiple strains, dengue infection induces immunity specific to the serotype responsible for the initial infection. As a consequence of this, the body can maintain its immunity against that specific dengue serotype. However, it is still vulnerable to other circulating strains of the virus. The probability of a subsequent dengue infection is comparable to the initial infection due to the transmission of the virus by mosquito bites, which is characteristic of a vector-borne illness. The potential of experiencing a subsequent dengue infection is primarily contingent upon chance since it is contingent upon the occurrence of another mosquito bite. Despite this, the length of time from infection to clinical signs might be affected by the course of the disease. This phase typically ranges from 3 to 8 days, although it can occasionally be significantly shorter, varying from 1 to 3 days. As a result, symptoms may appear as soon as a day after being bitten by a mosquito and reach their climax within five days. During the primary infection, individuals generate unique antibodies specifically designed to counteract the serotype causing the infection. Nevertheless, upon encountering a distinct serotype during a subsequent infection, these pre-existing antibodies can interact with the novel virus particles, giving rise to a phenomenon called Antibody-Dependent Enhancement (ADE) [13].

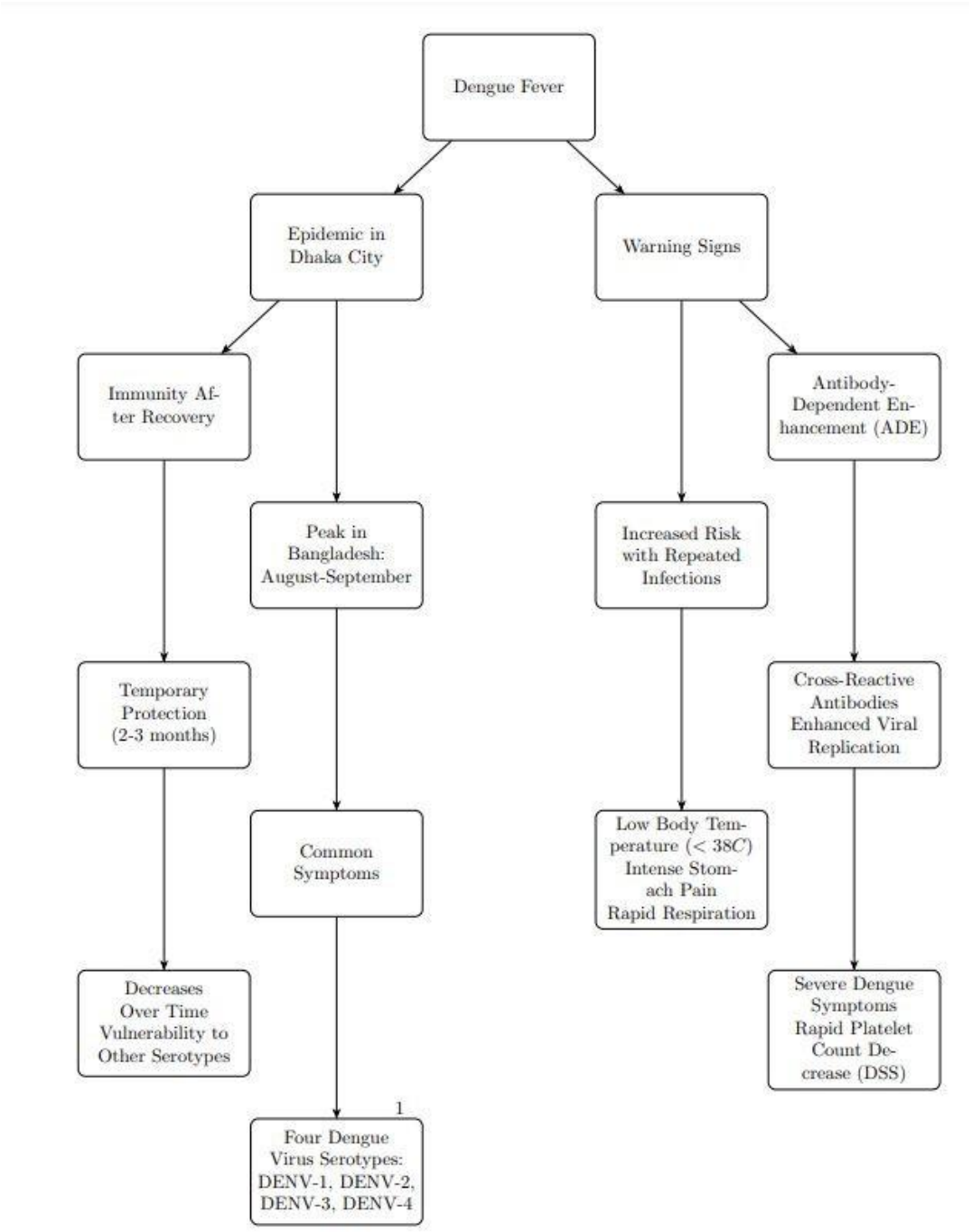

Figure 3: Dengue Fever and Antibody-Dependent Enhancement (ADE).

Cause of sure death

The antibodies generated against the initial dengue serotype attach to the new virus particles during ADE, but they cannot eliminate them properly. In contrast, the immune cells internalize the virus-antibody complexes via Fc receptors, resulting in heightened viral replication. Because of this process, the viral infection becomes more severe, which triggers a more robust immune response characterized by increased cytokine release and the activation of immune cells. As a result, the heightened immune response can manifest severe symptoms associated with dengue fever, such as bleeding, organ dysfunction, and shock. In cases where a subsequent dengue infection occurs within 12 months following the previous infection, there is a rapid decrease

in platelet count, substantially elevating the probability of experiencing a severe consequence referred to as Dengue Shock Syndrome (DSS). Multiple variables contribute to the heightened vulnerability to severe dengue in individuals who undergo a repeat infection.

Antibody-dependent enhancement, also known as ADE, is a phenomenon that can be facilitated by cross-reactive antibodies from a previous infection. These antibodies cannot stop the virus from replicating, but they make the ADE phenomenon more likely to occur.

Human error and Causes Behind

The order in which individuals are exposed to the various dengue virus serotypes can have an effect on the severity of subsequent illnesses. For instance, there is an association between a history of infections starting with DEN-2 and then exposure to DEN-3 or DEN-4 and a higher risk of developing severe dengue symptoms.

The widespread lack of understanding among individuals is an additional essential contribution to dengue epidemics. People tend to write it off as a typical disease or an infection caused by a virus, a fever that has lasted for twelve days. Nevertheless, upon undergoing a dengue test after 5-6 days, it is plausible that the test results may indicate the manifestation of dengue symptoms. This delay is caused by dengue tests typically only practical during the first four days of infection when the symptoms are most apparent.

Because there is a need for more information, many people put off seeking medical assistance until it is too late. Consequently, they may find out that they do not have dengue but that their platelet levels have dramatically decreased [14].

People will have dengue fever four times in an average lifetime, and each instance will be unique. The Nonstructural Protein 1 (NS1) and Immunochromatographic Technique (ICT) tests are the two methods that are often used in the diagnostic process while looking for dengue. The act of being bitten by a dengue mosquito elicits the production of antigens and antibodies inside the human body. Upon initiating antibody production inside the human body, namely on the fifth day, the quantity of antigen present in our system becomes entirely exhausted. In contrast, the level of antibody experiences a subsequent rise. Determining dengue infection inside an individual's body is often accomplished by assessing the quantity of antibodies present in the NS1 test. If an individual waits until the fifth day to do the NS1 test, the amount of the antigen that should be present in the body will not be there. This will result in a test report that is negative.

In general, individuals from Bangladesh tend to resist seeking medical attention while experiencing symptoms of fever, often seeing it as a commonplace ailment. Subsequently, upon.

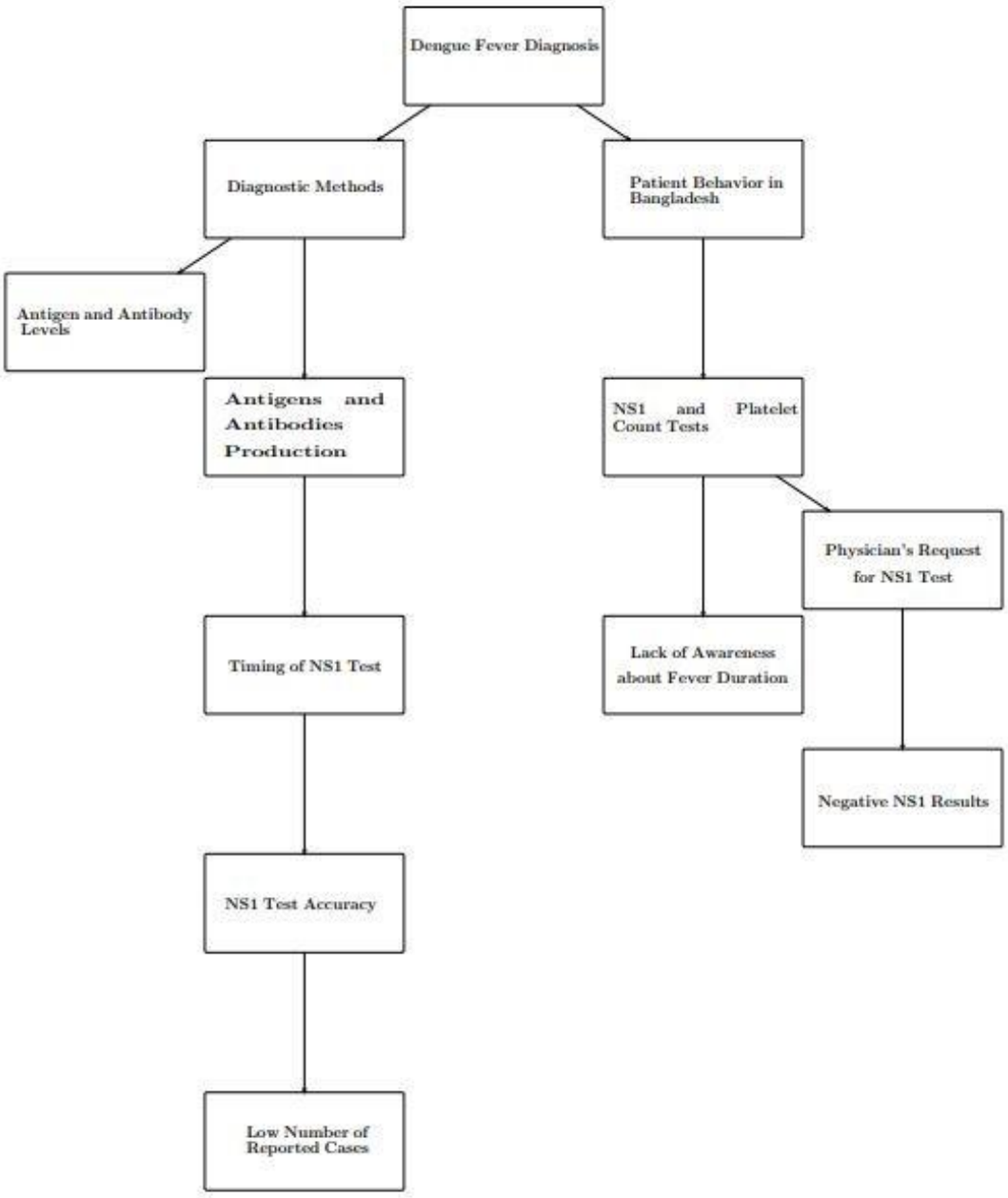

Figure 4: Dengue Fever Diagnosis and Challenges.

III. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Impact of dengue

In recent years, dengue has shown its increasing prevalence in Bangladesh, leading to periodic outbreaks and a growing public health concern.

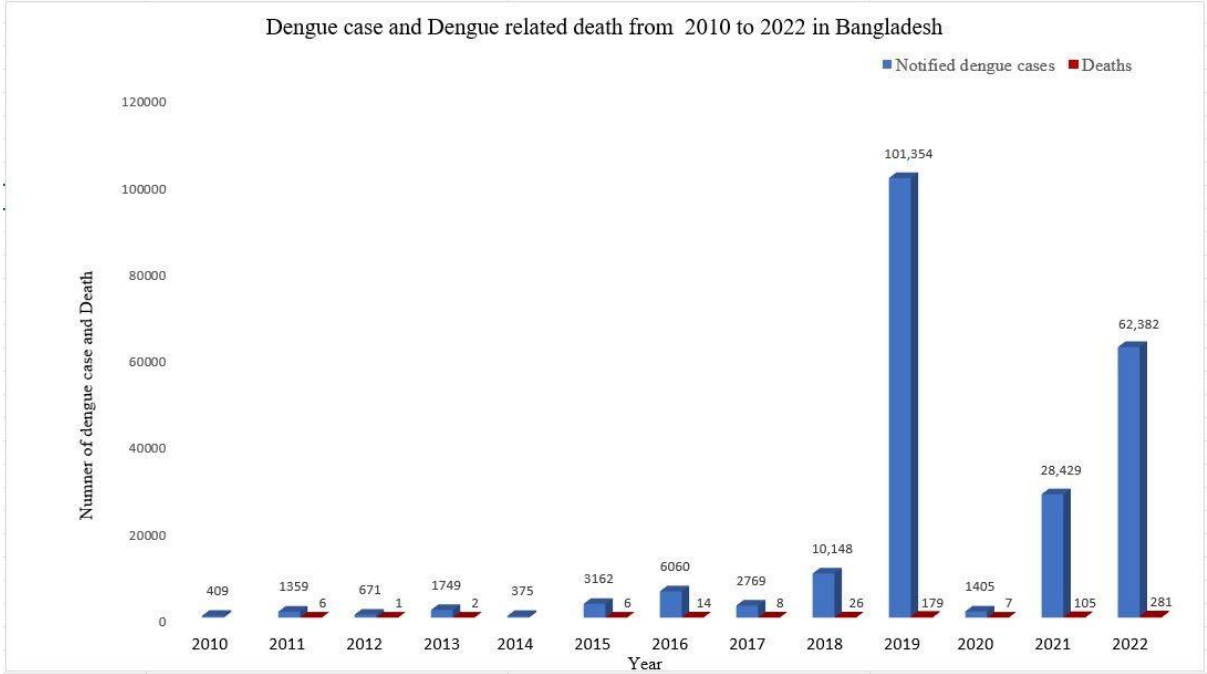

Figure 5: Number of Dengue case and Dengue related death of Bangladesh from 2010 to 2022.

The bar chart illustrates the number of dengue cases and associated deaths in Bangladesh from 2010 to 2022.The number of dengue case cross 10,000 in 2018 but it shows a significant rise in dengue cases in 2019, reaching a peak of approximately 101,354 cases, with 179 reported deaths. Subsequently, in 2021, there was a decrease in cases to around 28,429, with 105 reported deaths. However, in 2022, there was a notable resurgence in dengue cases, with 62,382 reported cases and 281 associated deaths.

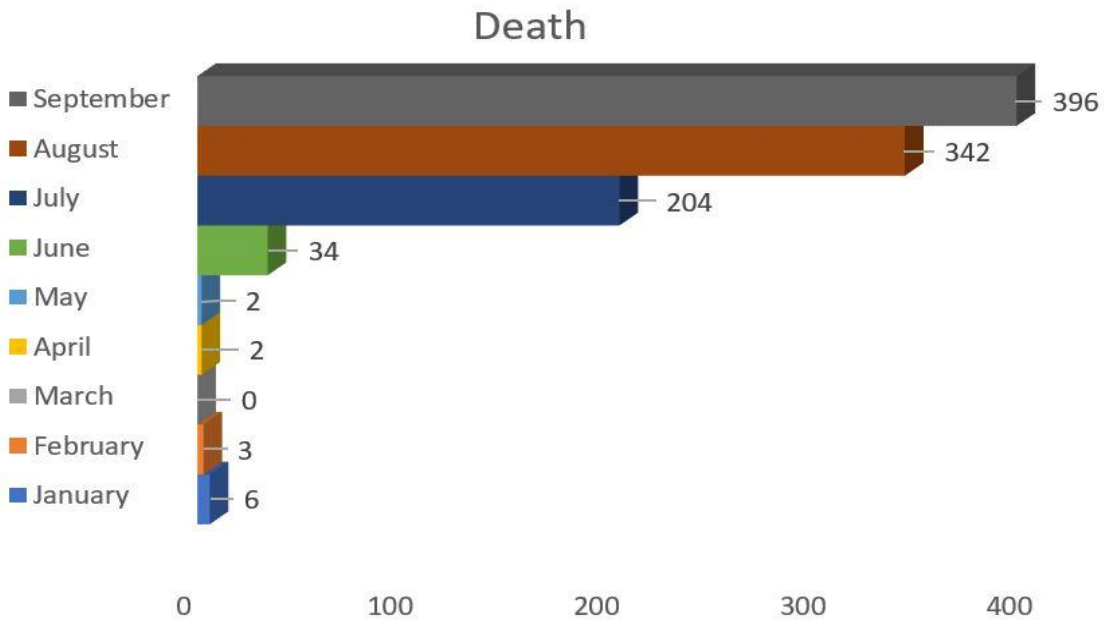

Figure 6: Number Death in 2023 till September.

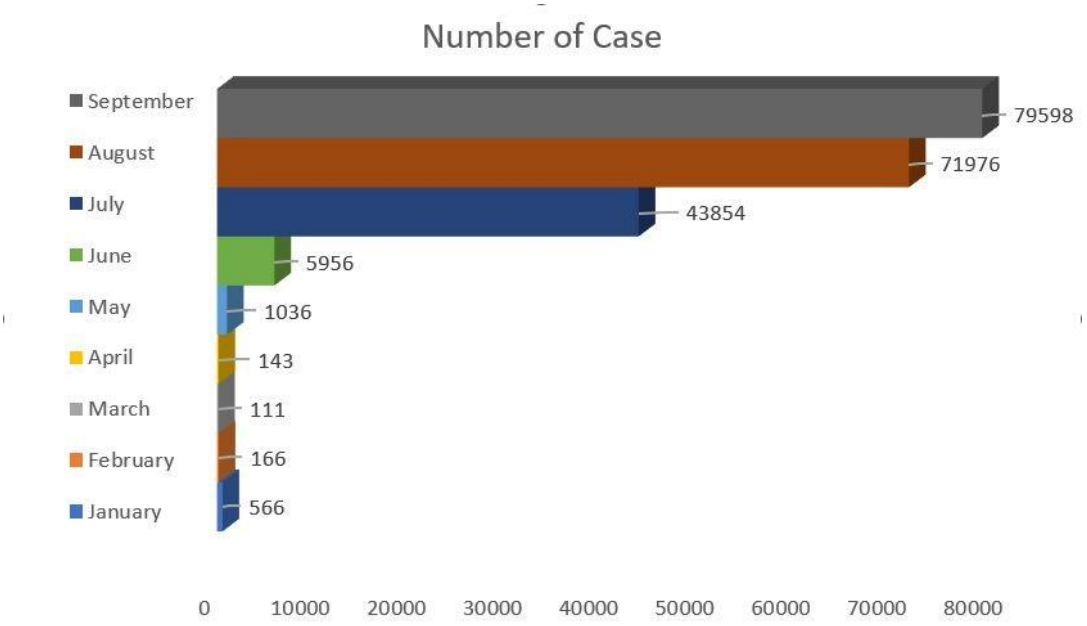

Figure 7: Number of dengue case in 2023 till September.

By analyzing the situation, several key factors contributing to the proliferation of the Aedes mosquito, the vector responsible for dengue transmission in Bangladesh, have been identified. These factors include climate conditions, temperature variations, and, notably, a lack of public awareness.

Furthermore, some misconceptions have arisen regarding dengue infection. Initially, some individuals have mistaken dengue for exhibiting variant behavior akin to COVID-19. Consequently, they may receive negative dengue test results, while concurrently experiencing a decrease in platelet count. It is important to clarify that such discrepancies are typically not due to any mutation in the dengue virus but are primarily attributed to human error in understanding the disease. Dengue virus itself has not undergone significant changes akin to those observed in the COVID-19 virus.

IV. Discussions

The findings of this study indicate a significant alteration in the behavior and life cycle of Aedes mosquitoes, which serve as the primary vector responsible for the transmission of dengue fever in Bangladesh. Aedes aegypti, historically known for breeding exclusively in clean water, has undergone an evolution in its breeding habits, now utilizing a variety of water sources, including unclean water, rainwater, saltwater, drainwater, and sewage water. Additionally, the biting behavior of Aedes mosquitoes has shifted from solely daytime biting to both daytime and nighttime biting. This transition in Aedes mosquito behavior, reported as early as 2020, raises concerns about the adaptability of this vector and its implications for the transmission of dengue fever.

The climate conditions in Bangladesh provide highly favorable circumstances for the proliferation of Aedes mosquitoes. The warm and humid climate, characterized by temperatures ranging from 25°C to 32°C, creates an ideal environment for the survival and reproduction of Aedes mosquitoes. This temperature range aligns with the requirements for the presence of standing water, which is abundant in Bangladesh, particularly during the monsoon season. The data displayed in Figure 1, which illustrates the average temperature trends from 2010 to 2022, confirms the consistent climate conditions that promote the growth of Aedes mosquitoes.

Consequently, climate remains a significant catalyst for the increased prevalence of dengue fever in Bangladesh.

The study identifies specific regions within Bangladesh that are at a heightened risk for dengue fever outbreaks. The districts of Dhaka, Chattogram, Sylhet, Rajshahi, Khulna, Barishal, and Mymensingh have been classified as red zones, signifying a higher number of reported cases and an increased likelihood of dengue transmission. These findings are crucial for prioritizing the allocation of resources and the implementation of interventions in areas with a higher prevalence of dengue fever. However, it is essential to acknowledge that the risk extends beyond these identified red zones, as indicated by the yellow areas, which represent districts at a lower risk that could potentially transition into high-risk areas. This underscores the necessity for a comprehensive nationwide approach to dengue fever prevention and control.

The presence of all four serotypes of the dengue virus in Bangladesh adds an additional layer of complexity to the situation. The co-circulation of DENV-1, DENV-2, DENV-3, and DENV-4 within the country increases the risk of severe dengue fever due to the potential effects of antibody-dependent enhancement (ADE). The symptoms of dengue fever, which typically peak in August and September, can be severe and encompass high fever, headaches, eye and joint pain, nausea, vomiting, enlarged lymph nodes, and skin rashes. Gaining an understanding of the specific serotypes in circulation is pivotal for the development of vaccines and the effective management of dengue fever cases.

The study's results reveal an elevated risk of severe dengue fever in cases of repeated infections with different serotypes of the dengue virus. Antibody-dependent enhancement (ADE) is a concerning phenomenon that occurs when pre-existing antibodies interact with a new serotype of the virus, leading to more severe symptoms. These findings underscore the intricate nature of dengue fever management and highlight the significance of distinguishing between serotypes and closely monitoring patients for the potential of severe outcomes.

The study highlights numerous challenges in the diagnosis of dengue. Misconceptions and delays in seeking medical attention are significant obstacles. A common problem is delayed testing, as depicted in Figure 4. The limited timeframe for conducting dengue tests within the first four days of infection poses a challenge, particularly since the symptoms of dengue can be mistaken for common ailments. This misunderstanding can result in delayed diagnosis and treatment, leading to decreased platelet counts and other complications.

The data presented in Figure 5 reveals a worrisome trend of increasing dengue cases in Bangladesh. In 2019, there was a remarkable surge in cases, surpassing 100,000, and in 2022, there was a resurgence in cases with a considerable number of dengue-related deaths. This illustrates the growing concern for public health and emphasizes the urgent need to comprehensively address the issue of dengue.

The findings of the study highlight the necessity for multifaceted strategies to combat dengue in Bangladesh. These strategies should encompass enhanced measures for controlling the vector, public awareness campaigns, and an improved diagnostic process. The complex nature of dengue prevention and control is underscored by factors such as the dynamic behavior of Aedes mosquitoes, the suitability of the climate, the diversity of serotypes, and the risk of ADE effects. Addressing these challenges necessitates a collaborative effort involving government agencies, healthcare providers, researchers, and the general public.

V. Conclusions

In our study, we have examined various crucial aspects pertaining to the prevalence of Dengue in Bangladesh. We have investigated the growth conditions of the Aedes mosquito, which serves as a primary vector for the transmission of Dengue. It is of utmost importance to comprehend the environmental factors, such as temperature, that facilitate the proliferation of mosquitoes in order to implement effective control measures.

Moreover, our analysis has brought to light the alarming statistics regarding Dengue cases and fatalities in Bangladesh during the year 2023, spanning from January to September. These figures emphasize the urgency of implementing robust and comprehensive strategies to combat the disease, as it continues to pose a significant threat to public health.

Additionally, we have shed light on the inadequacy of current diagnostic tests in Bangladesh. Accurate and timely diagnosis plays a crucial role in early intervention and patient care. It is imperative to address these deficiencies in diagnostic capabilities to effectively manage Dengue.

In conclusion, our findings highlight the immediate necessity for a multifaceted approach to Dengue control in Bangladesh. This approach encompasses targeted efforts to mitigate the proliferation of Aedes mosquitoes, a thorough understanding of local meteorological conditions, and the enhancement of diagnostic tools. By tackling these challenges and fostering collaborative research, we can strive towards a more comprehensive strategy to combat Dengue, reduce its impact on public health, and endeavor for a safer and healthier Bangladesh.

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Conflict of interests

The authors declare no conflict of interest.

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