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Review Article

Dengue outbreak in state of Uttar Pradesh, North India: lessons learnt and way forwards

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ABSTRACT

Dengue, a vector borne viral disease, is endemic in most areas of India and sometimes causes epidemics annually. Each of the dengue outbreaks causes higher number of mortality and morbidity, which has a significant socioeconomic impact. Northern India is most severely impacted by each of the dengue outbreaks. India had clocked 289235 and 233519 dengue cases with 485 and 297 deaths in the year 2023 and 2024 respectively, as per the information provided by the national centre for vector borne diseases control (NCVBDC), a record highest in last five years. In Uttar Pradesh, the most populous state of India, there have been more than 35,402 and 15868 confirmed cases of dengue and 36 and 9 deaths were reported in 2023 and 2024 respectively, which is one of the most severe in last decade. Patients were reported from urban as well as semi-urban, and rural areas. It is necessary to properly monitor the dengue cases through both active and passive disease surveillance in order to ensure prompt case management along with containment measures if dengue outbreak control is to be achieved in future.

Keywords: Dengue, Outbreak, Uttar Pradesh, India, Cases, Deaths, 2023

INTRODUCTION

Dengue, a viral illness caused by the dengue virus (DENV), is transmitted to humans through the bite of infected *Aedes* mosquitoes-primarily *Aedes aegypti* and to a lesser extent *Aedes albopictus*.[1] The disease poses a major global health challenge, particularly in tropical and subtropical regions, with an estimated 100-400 million infections annually.[1,2] Notably, about 70% of the global burden falls on Asia.[2] Dengue is found in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas.[1]

Over the past two centuries, dengue has expanded significantly, becoming endemic in over 120 countries, with the last three decades witnessing a sharp rise in its global distribution.[3] In India, the earliest virologically confirmed dengue outbreak was reported along the eastern coast, including Kolkata (formerly Calcutta), during 1963-1964.[4] A significant epidemic of dengue hemorrhagic fever (DHF) occurred in 1996, affecting major urban centers like Delhi and Lucknow.[5,6]

Since then, there has been a noticeable resurgence of dengue in the northern plains of India, especially in Uttar Pradesh. Originally perceived as an urban illness, the disease has gradually spread to rural areas as well, driven by factors such as high population density, unplanned urbanization, and inadequate vector control.[7] Several large-scale dengue outbreaks have been reported from North India over the past two decades.[8]

DENGUE OUBREAK OF 2023 IN UTTAR PRADESH

The year 2023 had an unprecedented increase in vector borne diseases, primarily dengue and malaria. As per NVDCP reports, the number of dengue cases in India touched 2,89,235 in year 2023 (Data from state of West Bengal was only available till 13.09.23), of which 485 have succumbed due to it which was highest in past six years.[9] The actual situation might have been much worse as data from some of the states are not routinely reported.

Furthermore, if we talk about the dengue situation in the state of Uttar Pradesh, the largest state of India by population, more than 35,402 confirmed cases and 36 deaths were reported in 2023, a record highest in the past 6 years in the state (Figure 1 and 2) and also highest among all the states and union territories of India.[9] However, media reports reported a much higher number of deaths than the actual reported figure.[10] The outbreak was ongoing in the year 2024 as more than 15,000 confirmed cases and nine deaths were reported in 2024.[9] Patients were being reported from not just urban but also semi-urban and rural locations. State capital, Lucknow, had emerged as a dengue hot spot with the highest number of reported infections at 957. Other severely affected areas include Moradabad (944 cases), Gautam Buddha Nagar (819 cases), Kanpur Nagar (816 cases) and Ghaziabad (732 cases).[10,11]

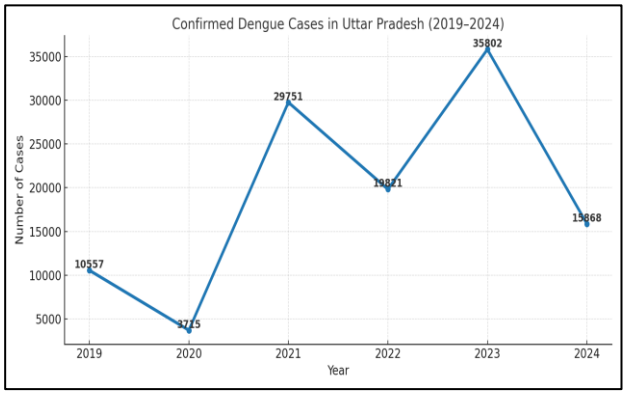

Figure 1: Trend of confirmed dengue cases in the state of Uttar Pradesh, 2019-2024.

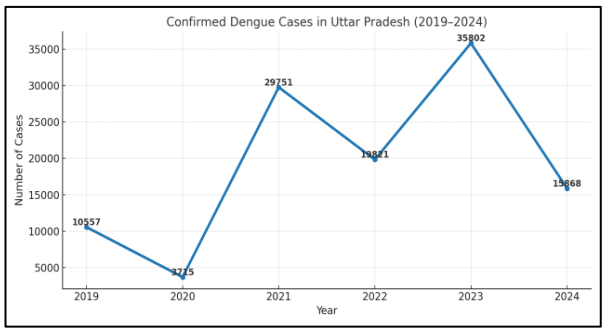

Figure 2: Trend of deaths due to dengue in the in the state of Uttar Pradesh, 2019-2024.

DENV EPIDEMIOLOGY AND SEROTYPES

Dengue is caused by a virus of the *Flaviviridae* family and there are four distinct, but closely related, serotypes of the virus that cause dengue i.e. DEN-1, DEN-2, DEN-3, and DEN-4.[12] DEN-2 is frequently associated with severe dengue (SD) infections and major epidemics globally. DEN-2 consists of six genotypes such as Asian/American, Asian I, Asian II, Cosmopolitan, American, and sylvatic. DF is not only becoming more common in recent years, but it is also expanding to new geographical areas. Local environmental conditions are known to influence mosquito vector density, which in turn influences DENV transmission.[12] The probability of DENV transmission increases with increasing temperature and absolute humidity. An increase in built-up area, a proxy for urbanization, was determined to be another predictor of increasing dengue incidence. The mosquitoes breed in very small collections of clean water. The mosquito usually becomes infective 8-12 days after biting an infective dengue patient. After being bitten by an infected mosquito, a vulnerable person develops dengue illness after an incubation period of 5-7-days. The illness occurs throughout the year with a peak during monsoon and post-monsoon season due to high vector density.

Majority of the time, the disease is mild and self-limiting, with only about 5% of people developing complications. There are three classic stages: Febrile, critical, and convalescent.[13] DHF and dengue shock syndrome (DSS), the worst types of this disease, have been observed in all regions of India. There has been a temporal change in the prevalence of certain clinical symptoms in the decade following the first epidemic. Shifting serotypes (DEN-1 to 2, 3, and 4) were thought to be responsible for the variation in clinical presentation during the outbreaks and re-infection. However, detailed serotype data for each of the outbreaks are still lacking.[14] A high fever, headache, myalgia, body aches, vomiting, joint pain, a transient rash, and minor bleeding signs such as petechiae, ecchymosis at pressure sites, and venipuncture bleeding characterize the febrile phase of DF. The patient's chance of developing to DSS is enhanced in the critical phase that follows, which is defined by plasma leakage that can lead to shock and fluid buildup (ascites or pleural effusion) with significant bleeding without breathing problems and severe organ damage.[15]

A hospital based study assessing the annual trend of DENV infection at Lucknow, North India from 2008-2010 reported a gradual increase in number of dengue fever cases with highest incidence in 2010. Serotypes circulating in years 2008, 2009 and 2010 were DV-2 and DV-3, DV-1, 2 and 3 and DV-1 and DV-2 respectively implying change in circulating serotypes over the year.[16]

A study from Eastern Uttar Pradesh and adjoining region of Bihar showed that DEN-2 was the only serotype which was prevalent in this geographical area. DEN-2 was the

only serotype amplified in serotype-specific reverse-transcription PCR from sera of 210 (65.21%) among 322 positive patients. This represent that the DEN-2 circulating strains of DENV are responsible for the most of the outbreaks in North India in recent years.[17]

NEED OF AN EFFECTIVE SURVEILLANCE SYSTEM

Dengue surveillance is essential for the detection of outbreaks and, in the longer term, to monitor disease trends in order to control.[18] Ideally, surveillance activities should include the rapid detection of human infection supported by valid clinical and laboratory diagnosis, vector surveillance and monitoring of environmental and social risk factors for dengue outbreaks to ensure that increased dengue transmission is detected early and that the response is rapid and appropriate.[19]

A study by Bannister-Tyrrell et al from Indonesia aimed to develop a modelling framework to guide planning for the potential elimination of locally acquired dengue in Yogyakarta found that a combination of hospital-based surveillance and enhanced clinic-based surveillance for dengue, an acceptable level of confidence (80% probability) in the elimination of locally acquired dengue can be reached within 2 years, emphasizing the role of surveillance in the elimination of dengue.[20]

A review conducted by Mertha et al by analysing the nine attributes of the surveillance system according to updated guidelines for evaluating public health surveillance systems by centres for disease control and prevention (CDC).[21] It was found that 67% of surveillance system implementations used sentinel surveillance and 33% used epidemiological studies globally. Surveillance system activities: 83% used active and passive surveillance, whereas 17% used only passive surveillance. The authors recommended that surveillance systems should aim to meet these nine attributes from the design to implementation stage.

Another study by Tilak et al from Maharashtra India exploring dengue dynamics from a multi-dimensional surveillance approach revealed that there were specific preferred breeding sites such as plastic discarded plates and flowerpots with more cases in particular sector.[22]

PROSPECTS OF AN EFFECTIVE VACCINE

Dengue vaccines are limited and have not yet been approved for use in India.[23,24] Since last two decades, efforts were put globally to develop safe and effective vaccines to prevent DENV infections but were faced with several challenges, mainly related to the complexity of conducting long-term studies to evaluate vaccine efficacy and safety to rule out the risk of vaccine-induced DHS/DSS, particularly in children.[23] At least seven DENV vaccines have undergone different phases of clinical trials; however, only three of them (Dengvaxia®, TV003, and TAK-003) have showed promising results. Denvaxia® is currently the only licensed vaccine, but phase III clinical trials with two other vaccines, TV-003/TV-005 and TAK-003, are currently ongoing, with promising results.[23] TAK-003, a live attenuated tetravalent dengue vaccine candidate based on a DEN-2 backbone developed by Takeda, is being tested in a long-term clinical trial in eight dengue-endemic countries. Over a 3-year period, TAK-003 was effective against symptomatic dengue. Efficacy declined over time, but it was still effective against hospitalized dengue.[25]

CONCLUSION

In conclusion, the 2023 outbreak of dengue in the state of Uttar Pradesh was the most severe in the last 6 years and was continuing in the year 2024. The recurrence of dengue outbreaks in Uttar Pradesh remains a significant public health challenge, exacerbated by factors such as urbanization, inadequate waste management, and seasonal rainfall that create favorable breeding conditions for the *Aedes Aegyptus* mosquito. Despite ongoing efforts to control the spread of dengue through vector control strategies, public awareness campaigns, and early detection measures, the state continues to experience periodic outbreaks. This highlights the need for a more integrated, multi-sectoral approach to effectively mitigate the risks.

Recommendations

To reduce the incidence of dengue in Uttar Pradesh, a multi-pronged approach is necessary, focusing on prevention, surveillance, community involvement, and public awareness. However, certain measures are required to be taken such as use of mosquito nets and repellents, larvicidal fish in water bodies, and fogging of insecticides. The ongoing dengue epidemic in the state of Uttar Pradesh should be contained sooner rather than later by strengthening and expanding the surveillance system, bolstering community capacity, and addressing sociolect-cultural causes.

An integrated prevention and control strategy, early case detection and epidemiological studies, along with, last but not the least, an effective vaccine development should be taken into the account for effective dengue control in long run. Finally, ensuring adequate cleanliness, hospitalization, and public knowledge is crucial in combating the dengue epidemic in the state of Uttar Pradesh.

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