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**Original Research Article**

# Chikungunya - an outbreak investigation report from Nagpur, Maharashtra 2024

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## ABSTRACT

**Background:** Chikungunya is important re-emerging viral threat in developing and developed countries. It is characterized by high fever, headache, skin rash, incapacitating arthralgia, prominent polyarthralgia, and myalgia that can last weeks to months even years in some individuals resulting in negative social and economic impact. After 2006 epidemic, infection was in quiescent state and there were sporadic cases in Vidharbha region of Maharashtra. Chikungunya outbreak has currently affected Mangalwari zone no.10 and neighboring areas.
**Methods:** After surveying the affected area of Nagpur, four types of investigations were done for data collection like epidemiological, clinical, entomological and behaviour related investigation. Serum samples were collected from suspected cases and subjected to chikungunya IgM MAC capture ELISA.
**Results:** A total of 130 suspects were tested for chikungunya IgM ELISA, of which 54 samples were positive. The attack rate was calculated as 41.53%. Outbreak occurred in hot months of June. Fever survey and entomological survey has revealed that situation was under control due to strict government actions but cases increased as monsoon arrived. High larval indices revealed that there is high Aedes mosquito density and further risk of outbreaks.
**Conclusions:** Public awareness and community participation for mosquito population control is crucial for prevention of further outbreaks.

**Keywords:** Aedes, Chikungunya, Outbreak, Larval indices, Multi-disciplinary team

## INTRODUCTION

Chikungunya virus also known as Buggy Creek virus is acute viral infection transmitted by adult female Aedes mosquito.[1] The name Chikungunya in Makonde language of Africa means 'that which bend up' refer to the stooped posture of the disease due to arthritic symptoms of disease.[1] It is single stranded RNA virus that belongs to genus Alphavirus in the Togavridea family. Chikungunya is characterized by sudden onset of fever, severe joint pains with or without swellings, maculopapular rash, nausea, vomiting, lower backache and myalgia.[2]

The virus was first reported in Tanzania in 1952 and spread to South Asia and other tropical countries.[3] The first outbreak in Asia was reported from Bangkok in 1958 followed by a number of outbreaks in Cambodia, Vietnam, Malaysia, Taiwan.[4] First outbreak in India was reported in 1963 in Calcutta.[5] In 1964 in India , outbreaks were reported from Pondicherry, Vellore, Chennai and other regions of South India.[2,5] After this, cases started declining in India until 1973 when localized outbreak was reported from Barsi, Solapur district in Maharashtra. Chikungunya virus was in quiescent state for about three decades from 1973 to 2005.[2] The re- emergence of virus in Indian Ocean lineage was due to the mutation in envelope protein E1 protein with the substitution of

alanine with valine (E1: A 226 V) in the Reunion CHIK isolates. This mutation led to less dependency of virus on cholesterol to infect mosquito host, thus enhancing the fitness survival.[5] This resulted in major epidemic of CHIK virus in 2008 in Indian ocean region which led to shift of vector from Aedes aegypti to Aedes albopictus.[6] After 2008 sporadic cases were reported in Maharashtra.

A Chikungunya fever-induced arthritis has negative impact on the quality of life of individuals with chronic disease and results in economic losses.[7]

### *Objectives*

To access the situation of chikungunya outbreak fever in Nagpur. To determine the cause and source of current outbreak. To conduct Fever and entomological survey in affected areas. To encourage public to adopt mosquito control measures to prevent future outbreaks of chikungunya, dengue and malaria.

### *District profile*

Nagpur is winter capital of Maharashtra, in Vidharbha region of Central India. Nagpur district spreads over 9,892sq kilometer area and has population of 3.1 crores, of which 2.4 crores is urban population with density of 470 people per square kilometer. The government health facilities in Nagpur includes 3 government teaching hospitals, 51 urban PHCs. The district is divided in 10 zones by Nagpur Municipal Corporation (NMC). Figure 1 shows Nagpur district zone wise map and positive cases.

Summers are extremely hot in Nagpur lasting from March to June, followed by moderate rainfall in monsoons. This makes the use of water coolers very common in every house hold. In some areas the proper water supply is not available so people depend on water storage systems mainly in plastic tanks.

## METHODS

This outbreak investigation was carried out by Viral Research and Diagnostic Laboratory (VRDL), IGGMC, Nagpur in association with District Malaria Office, Nagpur from 9th June to 8th August 2024. Patients presenting with Acute Febrile Illness (AFI) typically with acute onset of fever (>38.5 degree Celsius), severe arthralgia or arthritis not explained by other medical conditions and residing or visited epidemic area were included in this study. Other cases with chronic arthritis were excluded from the study.

### *Ethical approval*

The outbreak investigation including sample collection was exempted from review of Institutional Ethics Committee since it was an emergency response investigation.

### *Outbreak investigation setting and teams*

The outbreak investigation was performed between 9th - 10th June 2024 in Barde layout, Bhopesh Nagar and Patel Nagar in Mangalwari zone (NMC Zone -10), Nagpur by a multidisciplinary team including clinical epidemiologist, microbiologist, entomologist, social workers and urban health services team (Medical officer, Nurses and health care worker). The area is densely populated located in Northwest Nagpur with the population of 45,892 and area of 0.53 sq km. The canal flows through the area with slums area and close housing society and open drainage system.

### *Data collection*

Four types of investigations were done for data collection like epidemiological, clinical, entomological and behavior related investigation.

#### *Epidemiological investigations*

The District Malaria Office (DMO) was consulted upon arrival in Mangalwari zone. They provided data on first case, initial alerts, the spread and number of clinical suspects. Notification of clinical suspects was encouraged by first case. They recommended the clinical case definition of suspected chikungunya case as: a patient presenting with sudden onset of fever, severe joint pains, with or without transient skin rash. The DMO surveillance team continued to share the available weekly chikungunya clinical suspect notification data to outbreak investigation team. Discussion with team about background information of affected areas, causes of outbreak, investigations and control measures carried out so far. Visits to affected areas was done and surveys in these areas was done regarding fever rate and entomological indices. team also carried Rapid fever survey by house-to-house visits with health care workers. Water storage practices both in and outside houses were examined and samples were collected for mosquito larvae.

#### *Clinical and laboratory investigations*

The investigating teams identifies two high incidence areas (Bhopesh nagar and Patel nagar) where chikungunya camps were organized targeting persons with recent onset of fever and/or arthralgia. These chikungunya camps operated with urban health care services for consultations, treatment and blood sample collection for confirmation of chikungunya infection.

In parallel, ASHA workers and health workers were sensitized to collect data for fever surveillance by house-to-house survey and spread awareness about chikungunya and its control measures. They also informed people about camps.

Individual patient data was collected using VRDL case report form which contains socio-demographic variables, clinical sign and symptoms and epidemiological details. The blood samples were immediately stored at 4 degrees Celsius and transported VRDL, IGGMC, Nagpur. The IgM antibodies for chikungunya virus were detected using enzyme linked immunosorbent assay (MAC capture ELISA) kit provided by National Institute of Virology, Pune.

*Entomological investigations*

The adult and larvae of mosquitoes were sampled in areas with suspected cases of CHIKV cases. Adult mosquitoes were trapped using suction tubes from vegetation's of surrounding houses, walls, hidden gaps, parking areas in morning hours (7am-9am). The mosquitoes were collected in test tubes and carried to District Malaria office for morphological identification in afternoon. Water holding containers like coolers, plant pots, pets feeding pots, water storage cans and tanks, drainage were inspected for larvae. Three larval indices (container index, house index, Breteau index) were calculated to estimate the level of larval infestation in this area.

*Qualitative data about perception and behaviors related to outbreak*

To understand the community perceptions regarding the causes of outbreak and to observe community behaviour associated with chikungunya, we conducted semi structured interviews with adult patients whose samples were sent to lab in association with mobile clinics set by NMC in Bhopesh nagar, Mangalwari zone. Medical officers, nurses, healthcare workers, ASHA workers from concerned PHCs were interviewed focusing on patient care, sample transportation and preventive measures for mosquito population control.

***Data analysis***

The epidemiological data of Mangalwari zone were used to construct an epidemic curve displaying the duration and extent of outbreak. Based on the clinical data and samples collected during the field investigations, number of patients with acute chikungunya infection were calculated, socio-demographic characters and clinical features were summarized.

## RESULTS

In Mangalwari zone, clinical suspects were notified to NMC from 6th June 2024 to 8th August.

On 6th June, first suspected case went to private clinician with the complains of joint pain and fever where she was given painkillers. After that she observed that there were similar cases in her locality. She went to public health services where she was tested positive for chikungunya. Many people fell ill with same complaints with few people requiring hospitalization at private hospitals.

On 7th June, Public health services started an investigation to assess the extent of outbreak, identify the origin and vector of transmission and initiate appropriate control methods. On enquiring about past history of index cases, it was observed she had travel history after which she developed symptoms. While she was out of city the water in cooer tanks has bred larvae. The same history was given by neighboring 5 houses in this area who have developed the same complaints.

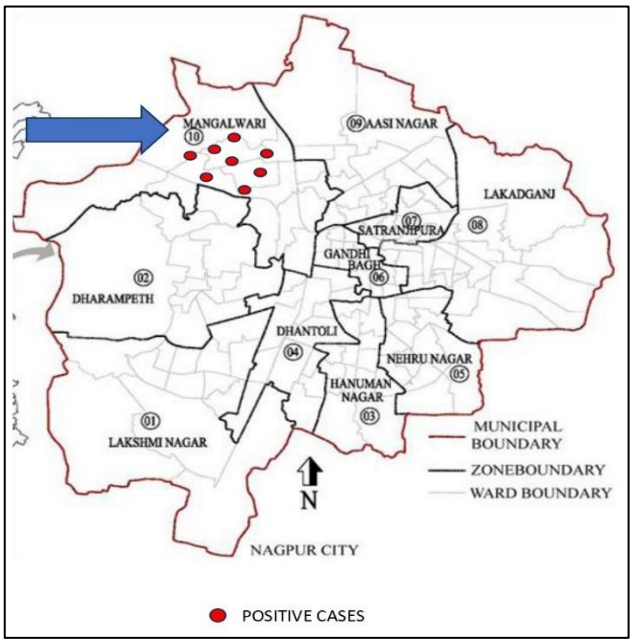


**Figure 1: Distribution of positive cases in Nagpur zone no.10.**

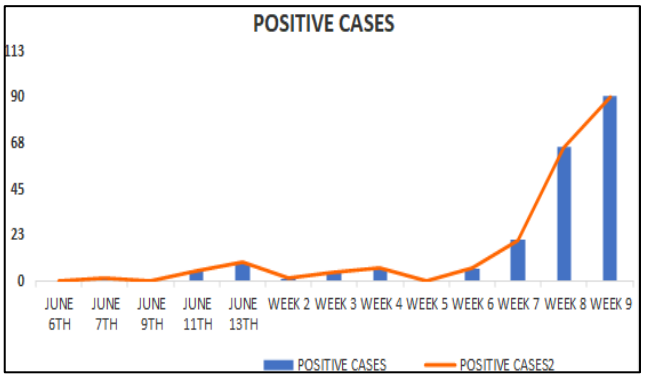


**Figure 2: Epidemic curve based on weekly notification data of chikungunya fever suspected cases in Mangalwari zone and adjacent areas, June 2024.**

A review of fever data from previous decade revealed that there was marked rise in chikungunya cases in 2024. After 2006 chikungunya outbreak there has been no marked increased in cases. It should be noted that the

baseline reported cases till 2023 has remained low. In June 2024 cases have steadily increased.

The cause of sudden rise in fever cases can be largely attributed to warmer climate and poor water storage practices. Due to warmer climate water coolers are used in every household which are excellent breeding grounds for mosquitoes. Also in summers, people tend to store water indoors and outdoors. There were many uncovered waters filled tanks, utensils and storage cans, flower pots, tires, pet feeding bowls. Also, the area has a canal that flows near slum and residential areas where people discard their household waste and sewage water is drained in same canal. All the organic waste was stagnated and decaying next to residential area. The public were not aware of cause and source of illness, water storage practices and mosquito control measures due to lack of awareness and public health education.

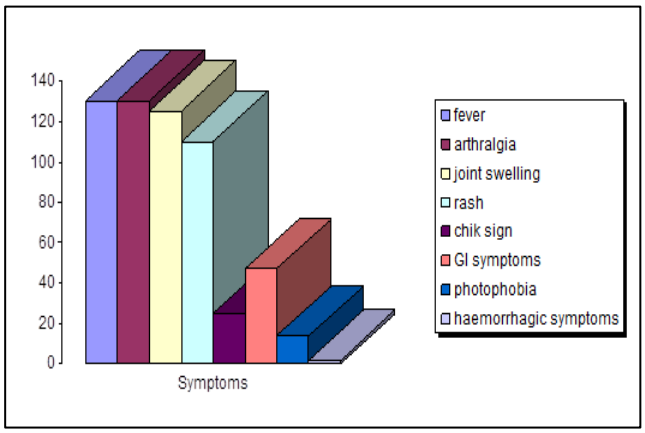


**Figure 3: Clinical presentation of suspected case.**

Fever survey covered the population of Mangalwari zone and 130 patients fitted for the case definition of chikungunya case. The samples of these suspected samples were sent to IGGMC, Nagpur for serological testing. Of 130 samples 60 (46.15%) were males and 70 (53.84%) were females. 26/60 (43.3%) males were positive and 28/70 (40%) females were positive. The P value was insignificant.

**Table 1: Age distribution of positive chikungunya cases from investigated area (n=130).**

| Age (in years) | Total | Positive | Positive % |
|---|---|---|---|
| **0-15** | 11 | 4 | 3.07 |
| **16-30** | 29 | 14 | 10.76 |
| **31-45** | 39 | 13 | 10.00 |
| **46-60** | 28 | 10 | 7.69 |
| **>60** | 23 | 13 | 10.00 |
| **Total** | 130 | 54 | 41.53 |

House to house entomological survey was carried out by district Malaria department. All the indoor and outdoor surroundings were searched for Aedes mosquito. All the adult captures showed 95% Aedes aegypti and 90% of larvae showed A. aegypti.

Larvae indices were calculated to estimate the level of infestation in affected areas.

1. House index (HI) - The percentage of houses infected with *Aedes aegypti* larvae.

$$HI = \frac{\text{Number of houses infested}}{\text{Total number of houses inspected}} \times 100$$

2. Container index (CI)- The percentage of containers infected with *Aedes aegypti* larvae.

$$CI = \frac{\text{Number of containers infested}}{\text{Total number of containers inspected}} \times 100$$

3. Breteau index (BI)-The percentage of positive containers per 100 houses inspected.

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

The adult mosquitoes (15-20) were collected from water coolers, shrubs and creeks of walls which were brought to Malaria office for speciation. The mosquitoes were examined at Malaria laboratory after proper dissection were found to be Aedes aegypti species.

**Table 2: Different larval indices.**

| Name of area | Number of houses | | | Number of containers | | | BI |
|---|---|---|---|---|---|---|---|
| | Surveyed | Infested | HI | Surveyed | Infested | HI | |
| **Bhopesh Nagar** | 94 | 20 | 21.2 | 158 | 25 | 15.8 | 26.59 |
| **Patel Nagar** | 330 | 51 | 15.45 | 893 | 130 | 14.55 | 39.39 |

Perception and behavior related investigation revealed that cause of outbreak and its misleading theories were circulating in this less literate community. Many people thought that chikungunya infection is caused by “chicken consumption”. So, some families stopped consuming poultry products.

## DISCUSSION

A total of 130 suspects were tested for chikungunya IgM ELISA, of which 54 samples were positive. The attack rate was calculated as 41.53%. After first positive case reported on 7th June cases steadily increased till 13th June

and then started decreasing till 5th week (5th to 11th July) due to strict controlling measures. From 6th week (12th - 18th July) cases again started increasing with increasing rainfall.

This investigation included 60 males and 70 females. Most affected age group was 16-30 years followed by 31-45 years and elderly population of >60 years. Dumphala et al also reported most common age group affected by chikungunya was 21-30 years while as Jain et al reported most common age group affected as 15-45years.[2,8]

All the suspected cases presented with complains of fever and joint pain. Other common symptoms were joint swelling and maculo-papular rash. Knee, ankle and metacarpal joints were most commonly involved. Rash appeared all over body with fever as initial symptom and disappeared gradually over the period of 4-5 days. Photophobia and hemorrhagic manifestations were least common. No death was recorded. According to Jain et al 81.4% patients had joint swelling and only 14.8% had rash.[2] Dumpha et al reported fever with chills and joint pain as most common symptom. 12% had eye symptoms while as rash was present in 5.6% of cases.[8]

This chikungunya outbreak started in hot month of June and cases increased as monsoon arrived. This sudden increase of cases in pre-monsoon can be attributed to several causes.

***Trans-ovarian transmission***

This was major reason anticipated for this outbreak. Each female lay 250-300 eggs on surface of water filled containers which hatches into infected larvae (container breeders). They are day feeders. Infected eggs can live in dormant conditions up to several months. This has helped them to potentially maintain viral persistence in absence of human host.[9] Studies have shown that Aedes aegypti that survived 7th generation, transovarian dengue virus was still detected.[9]

***Poor water storage system***

Nagpur experience highest temperatures in month of May and June. People use water coolers in warm weather which is excellent breeding Zones for mosquitoes. Utensils, open overhead water tanks, tyres are other sources. Jain S .et al said that water stored in containers have decreased buffering capacity due to lack of contact with ground which alters pH of water and makes it excellent breeding zones.[2]

***Hot climate***

Warmer temperature increases vector population due to increased water conservation practices. increase in biodegradable wastes in hot humid climate is another aggravating factor.

***Poor planning of area***

Congested houses, open sewage system, and open canal (where household waste is thrown) flowing through this area play important role in mosquito breeding throughout the year.

***Public awareness***

This slum area population comprises mainly of labour class. Lower education rates in this class and misbelief about disease has affected the disease understanding and prevention protocols.

The larval indices for both the Bhopesh Nagar and Patel Nagar areas were found above critical level (HI> 1, CI>1 and BI>5) predicting high risk of outbreak.[10] Generally, 10% and 5% are taken as critical level for HI and BI. BI of 5-50% is considered as moderate risk while as above 50% is considered as very high risk.[10] A study by Jesha et al in Kerala calculated HI=25.15, CI=10.36 and BI=73.05 suggesting urgent need of vector control measures in these areas.

***Control measures taken by municipal corporation***

For better coordination between rural and urban hospitals and PHCs, district level meetings were taken by DMO, where time to time case load and feedback was taken from medical officers of various areas.

Instruction regarding clinical suspicion of chikungunya, sample collection and transport were given to medical personals of all the health care facilities.

House to house fever survey was carried out by teams of UPHCs along with ASHA workers.

Medical camps were organized in high incidence areas where patients were provided with diagnostic test and basic pain-relieving mediations.

People were informed about cause of disease, educated about clean water storage practices and basic awareness about sign and symptoms of the disease. Rallies, skits and short dramas were performed in these areas to spread awareness.

Measures for A.aegypti population reduction were taken like using temphos, anti-larval spray and abolishing of mosquito breeding site. All the people in affected areas were instructed to follow “dry day”, where people were told to scrub their water storage utensils and dry them for one day to break the transmission chain. Dry day was observed once in week.

Limitations of our study was that we could not perform RT-PCR due to resource limited setting. But we used chikungunya IgM MAC ELISA kits provided by NIV,

Pune which has fairly good sensitivity and specificity for diagnostic purpose.

## CONCLUSION

Our outbreak investigation in this area of city revealed that outbreak occurred due to poor water storage in cooler tanks. Further lack of awareness among public along with poor living conditions has aggravated the situation. Clinical suspicion and early diagnosis are necessary to prevent further outbreaks. This outbreak has highlighted the need of strengthening the surveillance system, development of point of care test for CHIKV along with long with appropriate clinical care vaccine trails. This outbreak has raised the question about public awareness and its participation along with health care system responsibilities.

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