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Outbreak Investigation of Suspected Chandipura virus-associated acute encephalitis among Children in Udaipur and Dungarpur, Rajasthan, India, 2024: A One Health Investigation

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Abstract

A sandfly-borne pathogen, Chandipura Virus (CHPV), causes sporadic Acute Encephalitis Syndrome (AES) outbreaks with high mortality among children in India. In response to AES cases in July 2024 in Udaipur and Dungarpur districts of Rajasthan, we conducted an outbreak investigation to characterize the outbreak and assess potential animal and vector links. We defined a case as the presentation of acute fever with new-onset seizures or change in mental status during the period 01 June–14 August 2024, among residents aged <16 years in these districts. We conducted a stimulated passive case search in all hospitals, interviewed all suspect cases, and collected sandfly samples from cases' homes and neighbourhoods for species identification. We collected blood samples from cases and cattle, as well as from neighbourhood houses, for CHPV testing. We identified 58 suspect cases (Dungarpur: 15; Udaipur: 43), including 13 (22%) deaths. We collected 247 sandflies; identified species were *Phlebotomus papatasi and Sergentomiya punjabensis.* We collected 10 human blood samples; one tested positive. Of 129 cattle blood samples, 12% (7/60) in Udaipur and 26% (18/69) in Dungarpur tested positive for CHPV. The detection of Chandipura virus in cattle, combined with sandfly presence near animals and human cases, is consistent with possible zoonotic and sandfly-mediated transmission, but the transmission chain was not fully established.

Introduction

Chandipura virus (CHPV) infection is a vector-borne disease caused by the genus of Vesiculovirus, family Rhabdoviridae. It was discovered in 1965 during an outbreak investigation of dengue-chikungunya-like illness in Maharashtra, India.[1, 2] Sandflies (genus *Phlebotomus* & *Sergentomiya Spp*) are the vectors for this virus, while antibodies against this have been detected in a wide range of vertebrate animals.[3, 4] The CHPV is a fast replicator and has been shown to replicate in both vertebrate and invertebrate cells within 24–48 hours of infection.[1] In humans, infection appears as a serious condition characterised by an acute onset of fever and vomiting and a sudden onset of inflammation in the brain, which leads to a range of neurological symptoms like altered sensorium, generalised convulsion, and decerebrate postures, leading to grade four coma, acute encephalitis-encephalopathy, and death within a few to 48 hours of hospitalisation.[1] The disease is predominant in the lower-income strata of the population, and the affected age group ranges from 2.5 months–15 years old.[5] The CHPV is known to cause symptoms mostly in children and has been known to cause sporadic outbreaks. Young age and underlying adverse health conditions can also increase the risk of infection and morbidity. The severity of encephalitis can vary significantly, and in many cases, it can be fatal, with case fatality ranging from 25 to more than 70%.[1, 6–10]

Various outbreaks have been reported in central and western India, including Gujarat, Andhra Pradesh, and Maharashtra.[10–13] Domestic animals can act as reservoirs for the virus; hence, animal-human interactions can also increase the risk of disease and outbreaks.[14–16]

In July 2024, health authorities from the state of Gujarat notified the health authorities in Rajasthan of three suspected paediatric CHPV cases (three infections, one resulting in death). The patients were residents of the Udaipur and Dungarpur districts of Rajasthan but were admitted to hospitals in the neighbouring state of Gujarat, a region with an ongoing CHPV outbreak at that time. On 16th July 2024, the state surveillance unit of Rajasthan initiated an outbreak investigation. Two India Epidemic Intelligence Service (EIS) Officers from the National Centre for Disease Control supported this investigation. The objective of this investigation was to describe the extent of the outbreak and understand the potential spillover of infection from animals to humans.

Methods

Case definition and case finding

An individual was defined as a suspect case if there was acute fever with new-onset seizures or a recent change in mental status (confusion, disorientation, coma, or inability to talk) during the period 01 June – 14 August 2024, in a resident of < 16 years of age in Dungarpur or Udaipur district of Rajasthan, while a confirmed case was a suspect who tested positive for Chandipura Virus through RT-PCR.

We established enhanced passive surveillance and conducted active surveillance in all health facilities, including paediatric hospitals and medical colleges of both districts, and obtained data from the national disease surveillance programme for acute encephalitis syndrome-like symptoms.

After obtaining informed consent, we conducted in-depth interviews with suspects and their parents using a semi-structured questionnaire. Information on demographic details, clinical presentation, treatment, potential risk factors, anthropometric details, clinical outcome, and environmental factors related to vector existence in and around the houses was collected.

Entomological field investigation and Sandfly collection: An entomological survey was conducted in the houses of suspect cases after obtaining the owner's verbal consent to inspect their domestic and peri-domestic areas for sandfly collection in Udaipur. Due to the unavailability of an entomologist, sandfly samples could not be collected from Dungarpur. We collected the primary vector, adult sandflies, from their resting sites, including human dwellings (bedroom and courtyard) and cattle sheds near the house. Sandfly collections were conducted for 12 hours, from 06:00 pm–06:00 am, using hand-held mouth aspirators, light traps, and sticky traps.[17, 18] Per-hour density for sandflies was calculated. Sandfly morphology was identified at the species level under a dissecting microscope, and sandfly samples were also sent for detection of the Chandipura virus by molecular technique, i.e., Real-time PCR (RT-PCR).

Laboratory Investigation

We collected blood samples from suspect cases upon their arrival at the hospital for laboratory confirmation of the Chandipura virus. These samples were sent, maintaining the cold chain, to the National Institute of Virology in Pune for Reverse Transcription-Polymerase Chain Reaction (RT-PCR)

testing for Chandipura Virus. Officials from the Animal Husbandry Department collected blood samples from the cattle of households involved in suspect cases and from surrounding households to test for Chandipura.

Ethical Considerations

The investigation was conducted as part of the public health emergency response to this outbreak. Ethical protocols of the National Centre for Disease Control (NCDC) were followed, and verbal informed consent was obtained from all interviewees or their parents.

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

All procedures contributing to this work comply with the ethical standards set forth in the relevant national and institutional guidelines for the care and use of laboratory animals.

Results

We identified 58 suspect cases in both districts (Dungarpur: 15; Udaipur: 43), including 1 lab-confirmed case in Dungarpur. All 58 suspect cases were hospitalised, of which13 died (Udaipur = 6, Dungarpur = 7) with a Case Fatality rate (CFR) of 22%. Suspect cases were distributed in seven out of ten blocks of Dungarpur and nine out of twelve blocks of Udaipur (Fig. 1); and were reported over a period of three months (Fig. 2). The index case was reported from Civil Hospital, Gujarat, on July 16, 2024. During the course of the investigation, we found another case that reported with similar symptoms and fitted the suspect case definition, which was reported on June 2nd. We considered this the primary case, which began showing symptoms on June 2 and was admitted to Rabindranath Tagore Medical College on the same day. The first death occurred on June 17, followed by five more deaths in June and July 2024.

Table 1
Descriptive Epidemiology of the Cases in the Suspected Chandipura Outbreak, Dungarpur and Udaipur, July 2024 (N = 58)

Variables	Value (%)
Age (Years)	
< 5	50 (86)
6–10	4 (7)
11–15	4 (7)
Gender	
Male	33 (57)
Female	25 (43)
Family Occupation	
Farmer	44 (76)
Other	14 (24)
Symptoms	
Vomiting	40 (69)
Altered Sensorium	26 (45)
Loss of Consciousness	20 (37)
Diarrhoea	19 (32)
Respiratory Distress	10 (17)
Headache	9 (16)

Of all the suspect cases, 86% (n = 50) were less than 5 years old, 57% (n = 33) were male, and 76% (n = 44) were from farming families. Vomiting was seen in 69% (n = 40) of the cases, altered sensorium in 45% (n = 26), loss of consciousness in 37% (n = 20), diarrhoea in 32% (n = 19), respiratory distress in 17% (n = 10), and headache in 16% (n = 9). (Table 1)

Table 2
Descriptive epidemiology of possible exposures amongst cases in the suspected Chandipura outbreak, Dungarpur and Udaipur, July 2024 (N = 58)

Risk factors	Count (%)
Type of House	
Mud and Bricks (Mixed)	33 (57)
Mud House (Kaccha)	25 (43)
Household surroundings	
Cattle in Household	42 (72)
Forest Area	41 (71)
Firewood stack	36 (62)
Bushes	33 (57)
Hilly Area	26 (45)
Sandfly nuisance	15 (26)

All suspect cases were living in houses made of wattle, daub and mud “kaccha houses”. Also, more than 70% (n = 42) of the suspect cases had cattle in the household or lived in a forest area. Firewood stacks and bushes were present near or inside the house in more than half of the cases. (Table 2)

During the period 1 June–14 August 2024, we collected a total of 247 sandflies from the houses of the suspect cases, the deceased, and their neighbourhood and cattle sheds. The sandflies were tested for species identification and were found to be *Phlebotomus papatasi* and *Sergentomiya punjabensis*. These sandfly samples tested negative for CHPV RNA by RT-PCR.

We were able to collect blood samples from only 10 cases, as they were the only cases that were admitted to the hospital at the time of the investigation. One of them (10%, 1/10) tested positive for CHPV. In addition, 129 blood samples were collected from cattle (Udaipur = 60, Dungarpur = 69). A total of 12% (7/60) in Udaipur and 26% (18/69) in Dungarpur tested positive for CHPV, with an overall positivity of 19% (25/129).

Discussion

Based on our investigation, available data, and a literature review, we believe that the outbreak of acute encephalitis in children in Udaipur and Dungarpur was likely associated with Chandipura virus. This was supported by the typical clinical picture (sudden high fever, vomiting, altered sensorium, seizures, rapid progression to coma) and the age profile (predominantly under 5 years). [1, 19] This clinical and

epidemiological pattern matches previous CHPV outbreaks in Andhra Pradesh, Gujarat, and Maharashtra, where CHPV was the dominant cause of severe pediatric encephalitis with high case fatality[10, 12, 20–23]. A high CFR, which is a hallmark of Chandipura viral infection, was observed in the present investigation. [10, 12, 22, 24]

The cases were scattered across blocks in both districts, without a clear focal point, consistent with sandfly-mediated transmission and with previous CHPV outbreaks in Andhra Pradesh, Gujarat, and Maharashtra. Previous outbreaks also identified widespread sandfly activity in rural and tribal areas. We observed common exposures like cattle in households, mud houses and forest areas nearby the houses of the cases. These environmental conditions act as a breeding ground for sandflies which are a vector for CHPV[13, 25, 25–27], increasing human–vector contact and the risk of CHPV transmission, especially during the monsoon season.

Investigation of Chandipura outbreaks in the past has relied largely on samples collected from human suspect cases, thereby failing to complete the epidemiological triad. [12, 13, 20–22, 28] In the present investigation, a ‘One Health’ approach was adopted. While the reservoirs of Chandipura are not entirely clear, domestic animals may serve as reservoirs or amplifying hosts from which sandflies become infected, subsequently transmitting infection to human hosts during a blood meal. [12, 24–26] In our investigation, nearly one-fifth of the cattle tested from households and neighbours of cases tested positive for CHPV, suggesting that domestic livestock may serve as potential amplifying hosts or reservoirs via sandfly blood meals. This possible zoonotic link underscores the interdependence of humans, animals, and the environment, unlike prior investigations that focused solely on humans.

This, along with the presence of sandflies in the vicinity, increases the risk of disease and outbreaks in the human population. Apart from this, environmental and household factors, such as the presence of mud houses, forest areas near the house, wood stacks in the houses, and shrubs and bushes, are known to be active breeding grounds for sandflies.[29–31] The presence of all these factors in our investigation points to an agent-host environment conducive to the propagation of sandflies and the consequent infection of cattle and humans. In past studies, serosurveys in endemic areas have detected antibodies to Chandipura virus in several domestic animals, including pigs, cattle, buffaloes, goats and sheep, indicating past exposure.[10, 32] The sandfly species identified in the present outbreak were *Phlebotomus papatasi* and *Sergentomiya punjabensis*, which are known to be the vectors of CHPV.[13, 33–35] The absence of CHPV RNA in the fly sample may be due to delayed or faulty transportation and to the decay of single-stranded RNA during this period, as reported in some previous studies.[13, 36]

The present investigation highlights a significant point: human and animal health are closely intertwined, and zoonotic infection can spill over from cattle and other domestic animals to humans. A “One Health” approach is now accepted as a scientific principle that recognises the interdependence of various sectors, such as human, animal, and plant.[37] The ecosystem and environment are so intricately intertwined that outbreak investigations of suspected zoonotic or vector-borne disease may benefit from

this approach.[38, 39] In the present outbreak investigation, we took a One Health approach and found that the cattle in the vicinity of suspect cases harboured CHPV in their blood. In addition, there was an abundance of vector sandflies in the houses of cases, suggesting a favourable habitat for the vector in the area.[13, 33]

These findings support strengthening integrated surveillance, decentralizing diagnostics, improving early clinical recognition, and building preparedness in endemic districts to reduce mortality. Inter-sectoral One Health approaches may help prepare for future outbreaks of pediatric encephalitis in similar settings.

We identified the agent (Chandipura virus), host (sandflies and cattle), and environmental factors conducive to transmission in the affected area. However, we were unable to fully establish the chain of transmission due to certain limitations. The lack of an adequate number of human blood samples limited confirmatory testing, requiring reliance on indirect evidence, such as sandfly presence, cattle blood samples positive for Chandipura virus, clinical symptomatology, and spatiotemporal disease distribution, to classify this as a Chandipura outbreak. Another limitation was that Sandfly samples lacked clear evidence of Chandipura virus positivity, and we had no quantitative data on human-sandfly interaction levels in the area. We also relied on a case definition to identify cases in the area through stimulated passive surveillance at hospitals treating such cases. There is a risk that subclinical cases were missed, leading to an overestimation of our case fatality rate. However, subclinical cases mostly present only with fever, making it difficult to obtain a true estimate of the burden of suspect cases. Based on the available resources, mortality reduction was one of the objectives of the investigation; hence, we focused only on clinical cases, as they had a higher risk of mortality compared to subclinical cases.

Despite these constraints, the detection of Chandipura virus in cattle, combined with high sandfly density near these animals and human cases, strongly suggests zoonotic transmission and sandfly-mediated transmission. Future outbreaks should prioritise rapid blood sample collection and vector-virus isolation to strengthen chain-of-transmission mapping.

Declarations

Ethical approval and consent to participate:

The investigation was conducted as part of the public health emergency response to this outbreak. Ethical protocols of the National Centre for Disease Control (NCDC) were followed, and verbal informed consent was obtained from all interviewees or their parents.

As this was a public health response to a health emergency, which is a mandate of the state health department, the investigators were part of the state health department response team.

No samples or investigations were carried out for research purposes or beyond the control of disease; hence, it was considered a non-research public health activity for which ethical clearance was not required.

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All data collected during the investigation was anonymised, and participant data was

All procedures contributing to this work comply with the ethical standards set forth in the relevant national and institutional guidelines for the care and use of laboratory animals.

Availability of data and materials:

The data that support the findings of this study are available from the state health department under the Rajasthan Government. Restrictions apply to the availability of these data. Data are, however, available from the authors upon reasonable request and with permission of the state.

Clinical Trial Number: Not applicable

Competing interests

The authors declare that they have no competing interests to declare that are relevant to the content of this article.

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Authors contribution

AD, DA and AS conceived the study design. DA and AS acquired on-field data. AD, DA and AS analysed the data and reported the results. AD, SC and ST wrote the original manuscript text and prepared the tables. DA and AS created the figures. SC, ST, PA and AB substantially revised and edited the manuscript. All authors reviewed the manuscript, approved the submitted version, and agreed to be personally accountable for the manuscript.

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Disclaimer:

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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Figures



Figure 1

Distribution of Acute Encephalitis Cases in the blocks of Dungarpur and Udaipur

*The spots show the location of cases and not the exact number of cases in the block

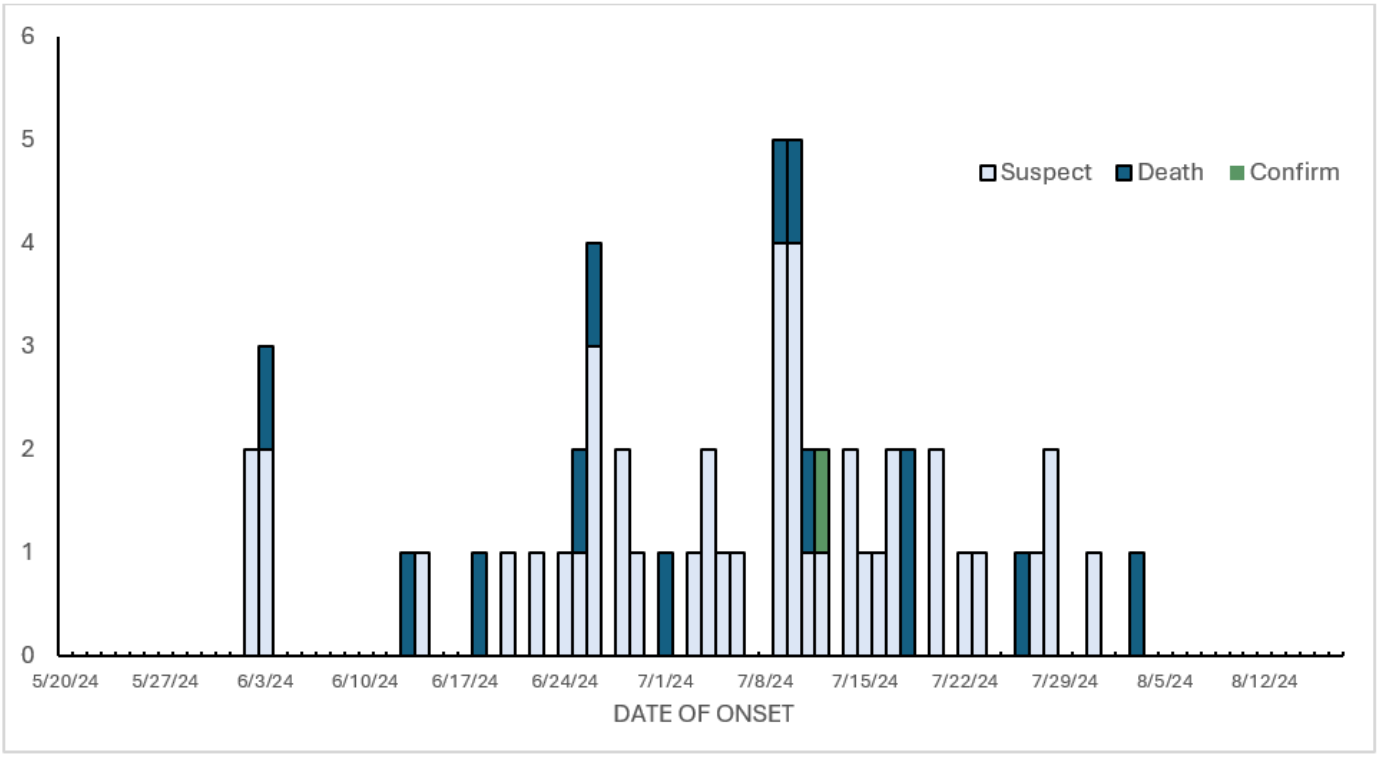


Figure 2

Epidemic curve of the cases based on the date of symptom onset/death, Dungarpur and Udaipur, Rajasthan, July 2024 (N =58)

Supplementary Files

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