

Research Article

Report of First Outbreak of ZikaVirus from Kanpur Nagar, Uttar Pradesh, India

S Kamal¹, Ramesh Chandra², Ashish Kumar³, DN Giri⁴, VK Chaudhary⁵, Asfia Hashmi⁶, Kalpana Baruah⁷

¹National Centre for Disease Control (NCDC), Patna, Bihar, India.

^{2,3,4,5}Regional Office of Health & Family Welfare (NCVBDC), Kendriya Bhawan, Aliganj, Lucknow, Uttar Pradesh, India.

⁶District Tuberculosis centre, O/o Chief Medical Officer, Kanpur Nagar, Uttar Pradesh, India.

⁷Directorate of NCVBDC, 22, Sham Nath Marg, Delhi, India.

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Corresponding Author:

S Kamal, National Centre for Disease Control (NCDC), Patna, Bihar, India.

E-mail Id:

shaukatkamal25@yahoo.in

Orcid Id:

<https://orcid.org/0000-0002-3358-1572>

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A B S T R A C T

The first laboratory-confirmed case of Zika virus disease was reported from Kanpur Nagar district of Uttar Pradesh in the month of October 2021. The index case of this outbreak was a male patient of 57 years of age and resident of Jakodia compound, Pokharpur, Kanpur Nagar (UP). The patient had been suffering from body aches for the last two days, high-grade fever for one day, redness and itching of eyes for two days and throat pain for two days. With these complaints, the patient went to the Seven Air Force Hospital, Kanpur on October 13, 2021. There was no past history of blood transfusion of the patient. Since the patient was not responding to treatment, different samples like serum, nasal swab and throat swab were sent to the National Institute of Virology (NIV), Pune where he was finally diagnosed with Zika virus disease. Neither the patient nor any family members had any past history of travel to any other state/ country for the last six months. Thus, this was the first case of ZIKV in the state from Kanpur Nagar district. A total of 5583 samples were collected between October 23, 2021 to December 22, 2021, out of which 142 samples were found positive for Zika virus, however, no major anomaly was detected in any of these Zika-positive cases. Containment zones were identified, and contact tracing and intensified entomological surveillance activities were carried out in these areas with the active participation of local urban bodies and the State Health Department. A total of 4329 numbers of contacts were traced, out of which 702 were primary contacts and 3627 were secondary contacts. In Entomological activities, a total of 91817 houses were searched and out of these 1262 houses were found positive for *Aedes* larvae breeding (H.I 1.37 %). A total of 692925 numbers of containers were searched from the affected area, out of which 1414 containers were found positive for *Aedes* breeding (C.I 0.20% & B.I 1.54). This is the first outbreak of Zika virus from the state of Uttar Pradesh reported so far. There is an urgent need for intensified entomological surveillance and source reduction along with other vector control measures, community participation and IEC activities to prevent such outbreaks in future.

Keywords: Zika Outbreak, Surveillance, Intervention Measures, Entomological Surveillance Source Reduction Activity

Introduction

Uttar Pradesh is the largest state of India and is comprised of 75 revenue districts and 18 divisions. It has a vast area of 243,286 km² and 230 million population (199.81 million as per 2011 census) with a population density of 828 persons per km.² The topography & environmental conditions of the state, including the availability of rich irrigation facilities provide congenial conditions for the development of different vectors transmitting various diseases, among which included all six vector-borne diseases (VBD) viz. malaria, dengue, Chikungunya, Japanese encephalitis (JE), Kala-azar & Lymphatic filariasis. These diseases remained prevalent in Uttar Pradesh till September 2021; until the invasion of Zika Virus (ZIKV), reported by a male patient aged 57 years, resident of Jakodia compound, Pokharpur, Kanpur Nagar (26.4499° N, 80.3319° E) (UP). The patient suffered from body aches for the last two days, high-grade fever for one day, redness and itching of eyes for two days and throat pain for two days. With these complaints, the patient went to the Seven Air Force Hospital, Kanpur on October 13, 2021. The patient gradually developed breathlessness and semi-consciousness and was put on a ventilator for five days. There was no past history of blood transfusion of the patient. Since the patient did not respond to treatment, different samples like serum, nasal swab and throat swab were sent to the National Institute of Virology (NIV), Pune, where he was finally diagnosed with Zika virus disease. District Kanpur is located in the centre of the state and has been historically important as the main Industrial city of North India since the British period and is famous for the leather industry. Air Force Station at Chakeri and Public Sector Undertaking companies, Hindustan Aeronautics Ltd. for Aircraft manufacturing., Ordnance Factory for arms are also known for their repute. Kanpur District was split in April 1981 into two districts, Kanpur Nagar and Kanpur Dehat. Outbreak/ occurrence of Zika virus case relates to district Kanpur Nagar. The population of Kanpur Nagar district (2011 census) is 4581268 (2459806 ♂ + 2121462 ♀) (rural-1566000 & urban-3016000) and as per estimates of 2022 & 2023, it becomes 6047274 & 6367963, respectively. The population density is 1449/km² or 3750/mile² with a sex ratio of 852 as per the 2011 census and 862 as per 2022 estimates and a literacy rate of 81.31%, a good tool to implement the control operations with minimum efforts. The district has very good medical facilities as there is one Govt. Medical College, two Super Speciality hospitals and an Air Force Hospital. The district also has one of the largest Urban Malaria Units in the country for 120 wards of the city under the supervision of 12 Inspectors & 120 SFWs, from which 100 teams were constituted and deployed for surveillance and control operations.

The ZIKV occurrence has been termed as an emerging

mosquito-borne disease threat in Kerala (India)¹ but it is not for Kerala but for the whole of India due to the widespread prevalence of its vector. The name of the virus Zika is termed after its locality of presence i.e. Zika forest in Uganda while undertaken yellow virus surveillance in 1947² and isolation of the virus in 1948 from the Aedes mosquito.³ Undoubtedly ZIKV is an emerging instance not only for the state but the country too as only four cases of ZIKV were reported from Gujarat⁴ in November 2016 (one pregnant woman for 37 weeks gestation with no anomaly); one male case confirmed for ZIKV from Krishnagiri district of Tamil Nadu in July 2017. Rajasthan,⁵⁻⁷ Madhya Pradesh,⁵ Kerala and Maharashtra reported 159, 127, 1 & 68 ZIKV confirmed cases in September-October, 2018, October-November 2018, July 2021 and July-August, 2021, respectively, out of which 63, 42, 1 & 7 pregnant women were reported positive for ZIKV.

The main objective now became to ascertain the area affected by the virus: epidemiological investigation; screen/ diagnose the patients at the earliest: strengthening the diagnostic tools at the local level; ascertain the vector involved in transmitting the virus i.e. entomological investigation: training to staff & surveillance; contain the spread of the disease i.e. vector control measures and plan for long term containment measures: disease prevention.

Material and Method

The teams constituting health personnel were deployed to undertake the case search of the patient and collect whole blood, serum or urine samples from persons having symptoms similar to the affected person, direct contact persons of the patients (primary contacts) and nearby persons (secondary contacts). Treatment of the patients was carried out in government hospitals.

The epidemiological case search was carried out in 0.50, 1.00 and 1.50 km radius of the index case residing in Jakodia compound, Pokharpur, Kanpur. The pregnant women in the 1st, 2nd and 3rd trimesters were also searched and their foetus ultrasounds were performed to find any cerebral anomaly.

The entomological surveillance was also undertaken in 0.50, 1.00 and 1.50 km radius of the index case and indices were determined. Moreover, the active breeding sites searched were removed/ eliminated by evacuating the water containers and turning them upside down. The close vigil was kept on the situation and activities carried out were properly monitored.

Intensified IEC/ BCC activities were performed through different media and interpersonal communication for case reports & anti-vector drive- including extensive fogging, spraying, use of larvicides, source reduction and sanitisation

of the community for not allowing water collection for more than a week in their surrounding areas (both inside and outside) and cover maximum part of their body by wearing full sleeves clothing. 18 pools of mosquito samples belonging to four species highly prevalent in the ZIKV-affected two localities (Pokharpur & Air Force Station Chakeri), were collected and sent to the Malaria Institute

of India, New Delhi (Indian Council of Medical Research) for confirmation of the ZIKV in the vector mosquitoes.

During this period blood donors with a history of fever in the previous two weeks were strictly deferred to ensure check on the possible entry routes. The analysis of the data was done for meaningful contention and is presented in this paper.

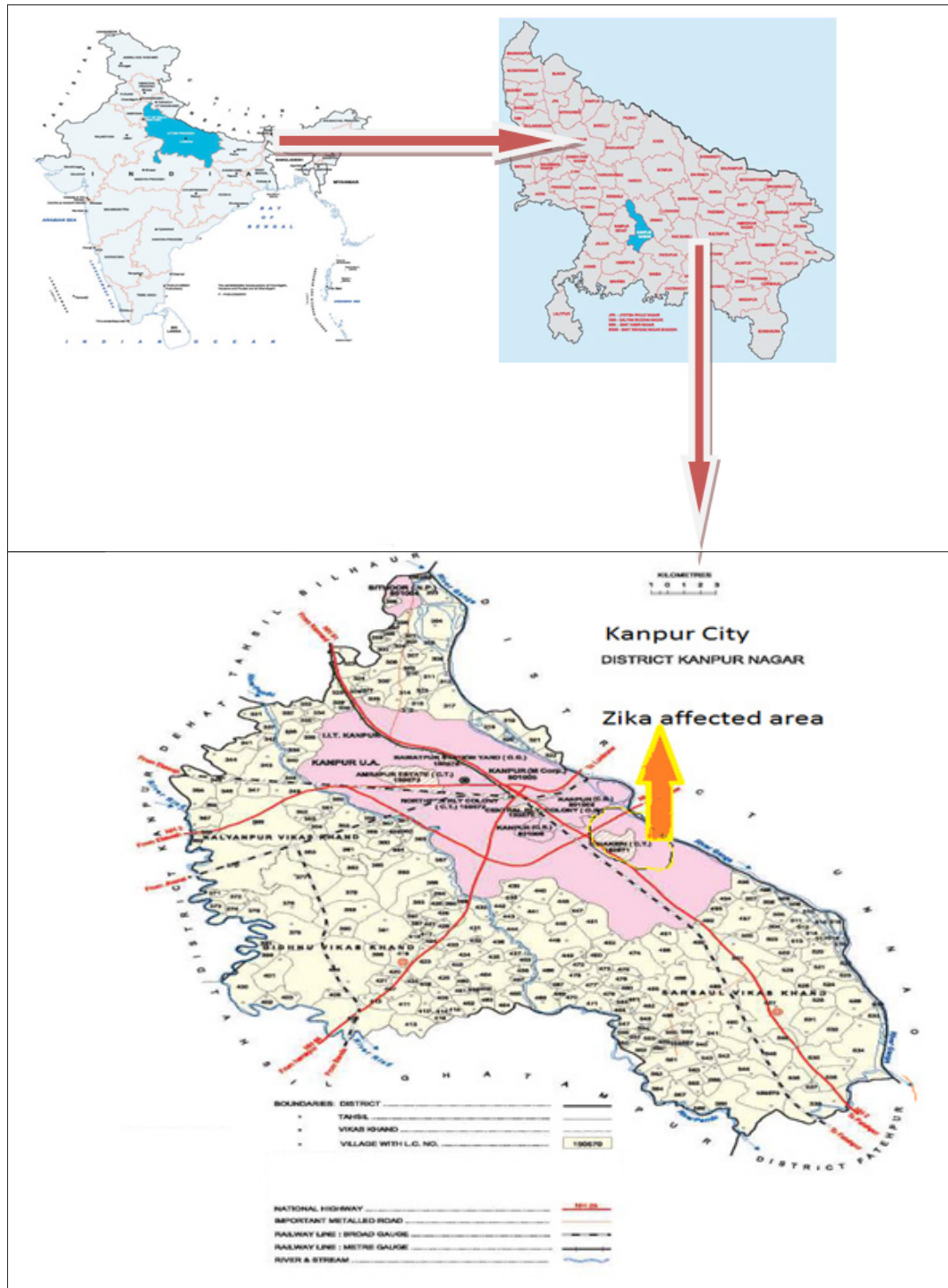


Figure 1. Zika Virus Affected Area of District Kanpur Nagar (Uttar Pradesh)

Results and Discussion

Epidemiological Surveillance

It is apparent from Table 1 that the 1st or index case of this outbreak was a male patient aged 57 years, resident of Jakodia compound, Pokharpur, Kanpur Nagar (UP). The patient suffered from body aches for the last two days, high-grade fever for one day, redness and itching of eyes for two days and throat pain for two days. With these complaints, the patient went to the Seven Air Force Hospital, Kanpur on October 13, 2021. The patient gradually developed breathlessness and semi-consciousness and was put on a ventilator for five days. There was no past history of any blood transfusion to the patient. Since the patient was not responding to the treatment, different samples like serum, nasal swabs and throat swabs were sent to the National Institute of Virology (NIV), Pune, where he was finally diagnosed with Zika virus disease. Thus, this was the first case of ZIKV from the Kanpur Nagar district and can be termed as an outbreak of the ZIKV in the state. The symptoms resembled those of patients of ZIKV infection reported in Kerala state. With the symptoms of the index case considered as standard symptoms of ZIKV, the epidemiological case search was carried out within a 0.50, 1.00 and 1.50 km radius of the index case with 100 teams of health personnel. As such 5583 (including 702 samples of primary contacts & 4329 samples of secondary contacts) blood/ serum samples were collected and examined, out of which 142 samples were found positive for ZIKV. All cases were from localities in close vicinity of the Air Force Station. It is interesting to note that ZIKV was reported from all age groups (Table 2) but the females outnumbered the males. The youngest age of ZIKV positive was 4 years (2.11%) and the oldest age was 80 years (0.70%). Female children < 10 years were more affected (8.34%) than males (5.72%). However, males between 10-20 years were more affected (21.43%) than females (13.89%) but 50% of females between 20-40 years were found ZIKV positives in comparison to 37.14% in males, which is far below that of females and is a matter of much concern. 11 pregnant women were also found positive for ZIKV [07 of 3rd trimester (five from Cantt. Area and two from Harjinder Nagar), one of 2nd trimester from Darshanpurwa and three of 1st trimester (two from Harjindernagar & one from Krishnanagar)] three deliveries (one from Cantt. Area and two from Harjindernagar) took place and were found without any anomaly including microcephaly. No anomaly was detected in any of the 11 ZIKV-infected pregnant women and the condition remained stable. All ZIKV-positive cases after proper treatment became negative for ZIKV on 08.11.2021 (the index case of Pokharpur locality) and the last 142nd case on 10.12.2021 (related to Meerpur Talwa Cantt. area).

Entomological Surveillance

The entomological surveillance supported in elimination of the breeding sites of the *Aedes* mosquito, the potent vector of the ZIKV with the help of Urban Malaria Unit staff, one of the largest UMU in the country with 120 supervisors, of which 100 teams were deployed for surveillance and elimination the breeding sources (Source reduction). The anti-drive campaign against the communicable diseases and vectors of vector-borne diseases was conducted every year during April & October, and this drive was effective during the month of the occurrence of ZIKV, helped in overcoming its spread as the vector indices were found very low, the elimination of which also helped in the check on stopping the disease spread (Tables 3 & 4). The ZIKV vector could not build up its high density due to an anti-drive campaign against the vectors of vector-borne diseases conducted one month preceding the occurrence of ZIKV as is evident from the vector indices, which were found very low. The index case had no history of movement to the ZIKV-affected area and probably might have contracted infection through the infected imported from the ZIKV-affected area through Arial mode, as the inhabitation of the index case is very close to the Air Force Station.

It is obvious from Table 5, that out of the 18 pools of mosquito samples belonging to four highly prevalent species in the ZIKV affected two localities (Pokharpur & Air Force Station Chakeri), one pool of *Aedes aegypti* was found positive for ZIKV by the National Institute of Malaria Research (Indian Council of Medical Research), New Delhi, which confirms the low-grade transmission of the disease in the area as the other three species were not found positive for ZIKV. Moreover, none of the 18 pools of mosquitoes was found positive for dengue virus (DENV).

The intensified IEC/ BCC activities lead to active community participation for early diagnosis & treatment of ill persons and elimination of vector breeding sites, thereby containing the further spread of the disease virus, consequently interrupting the transmission of the disease. The ZIKV spread could be limited to a very small area (Figure 1) by undertaking epidemiological surveillance and prompt treatment of the cases detected in the search after laboratory diagnosis. The episode of the ZIKV was contained within 50 days duration of the 1st case report, as no case was reported after December 3, 2021.

Continued efforts in epidemiological and entomological surveillance with intensified IEC/ BCC activities are required to be instituted to prevent any further recrudescence and there is an urgent need to strengthen and prepare for the public healthcare system to prevent and contain the Zika virus outbreak in the state of Indian perspective.

Table 1. Epidemiological Surveillance Undertaken in ZIKV-affected Area of Kanpur Nagar, UP

S. No.	Particulars	Effect/ Achievement	Remarks
1.	Duration of surveillance activities	October 23, 2021 to December 22, 2021	-
2.	The first case of Zika Virus reported	October 13, 2021	As admitted on this date
3.	Total blood/ serum sample collected/ examined	5583	-
4.	No. of samples from primary contacts	702	-
5.	No. of samples from secondary contacts	3627	-
6.	No. of samples found positive for ZIKV	142	-
7.	No. of pregnant women positive for ZIKV under ANC	11	-
8.	Anomaly detected in pregnant women/ foetus positive for ZIKV under ANC	NIL	03 deliveries in November 2021

Table 2. Age-wise and Sex-wise ZIKV Cases Reported in Kanpur Nagar, UP from 23.10.2021 to 02.12.2021

S. No.	Age Group (Years)	Total No.	% of	Total No.	% of	Total No.	% of
		of Female	Total ♀	of Male	Total ♂	of ZIKV	Total ZIKV
		Cases	Cases	Cases	Cases	Cases	Cases
1	2	3	4	5	6	7	8
1.	< 5	2	2.78	1	1.43	3	2.11
2.	≥ 5 – ≤ 10	4	5.56	3	4.29	7	4.93
3.	> 10 – ≤ 20	10	13.89	15	21.43	25	17.61
4.	> 20 – ≤ 30	19	26.39	13	18.57	32	22.54
5.	> 30 – ≤ 40	17	23.61	13	18.57	30	21.13
6.	> 40 – ≤ 50	10	13.89	10	14.29	20	14.08
7.	> 50 – ≤ 60	6	8.33	10	14.29	16	11.27
8.	> 60	4	5.56	5	7.14	9	6.34
	Total	72	100.00	70	100.00	142	100.00

Table 3. Entomological Surveillance Undertaken in ZIKV-affected Area of Kanpur Nagar, UP

S. No.	Type of Habitat	Total No. Searched	Total No. Found Positive for Aedes Larvae/ Pupae	Index Calculated	Remarks
1.	Houses	91817	1262	HI = 1.37%	Very low indices to maintain the disease transmission
2.	Containers	692925	1414	CI = 0.20%	
3.	Containers/ 100 houses	$\frac{1414 \times 100}{91817}$	-	BI = 1.54	

Table 4. ZIKV affected locality wise Entomological Surveillance in Kanpur Nagar in the last Quarter of 2021

S.No.	Locality Name	Total No. of ZIKV cases reported	No. of Houses Surveyed	No. of Larva +ve Houses	No. of Containers Checked	No. of larva +ve Containers	HI	CI	BI
1	2	3	4	5	6	7	8	9	10
1	Tiwaripur	18	5922	122	52551	134	2.06	0.25	2.26
2	Tiwaripur Baghia	10	4717	106	39252	137	2.25	0.35	2.90
3	Tiwaripur Manas Vihar	2	392	9	6106	9	1.10	0.15	1.10
4	AFS Head Quarter	16	429	6	2473	6	1.74	0.24	1.74
5	AFS Ahirwa	2	821	1	808	1	1.00	0.12	1.00
6	AFS Ghaukheda	1	2811	16	13863	16	0.90	0.12	0.90
7	Pokharpur	15	955	125	68564	130	1.30	0.19	1.35
8	Adarsh Nagar	10	3766	59	51872	64	1.03	0.12	1.12
9	Harjinder Nagar (HN)	3	5864	8	3397	8	2.06	0.24	2.06
10	HN-Kazikheda	12	778	4	1747	4	2.01	0.23	2.01
11	HN-Ompurwa	7	6642	47	17264	52	1.76	0.30	1.95
12	HN-Shiv Katra	7	331	62	35700	62	1.40	0.17	1.40
13	HN-Ramgali	5	1128	8	2482	8	2.30	0.32	2.30
14	HN-Safipur	2	3725	23	6875	23	2.53	0.33	2.53
15	HN-Lal Bungalow	3	50	7	4747	7	1.15	0.15	1.15
16	Shyam Nagar	3	50	72	54110	83	1.36	0.15	1.57
17	Bhawani Nagar	3	5284	40	37964	47	0.60	0.12	0.71
18	Cantt. -Faithfulganj	9	1778	112	46888	124	1.72	0.26	1.90
19	Cantt. -Lal Kurti	2	8090	121	21259	124	3.98	0.58	4.08
20	Cantt. -Kakori	1	100	14	4412	15	2.25	0.34	2.42
21	Meerpur	1	320	2	12013	2	0.13	0.02	0.13
22	Jajmau- KDA Colony	2	588	4	11612	4	0.25	0.03	0.25
23	Jajmau- JKColony	2	100	20	21045	21	0.57	0.10	0.60
24	Jajmau-Makdoom Nagar	1	201	7	11583	8	0.38	0.07	0.43
25	Daheli Sujapur	2	252	31	25570	33	0.82	0.13	0.88
26	Darshanpurwa	1	9651	27	32451	27	0.60	0.08	0.60
27	Mawaiya Chakeri	1	6427	6	2473	6	1.74	0.24	1.74
28	Barra-5	1	50	3	16157	4	0.10	0.02	0.13
29	Other 23 localities		20595	200	87687	255	0.60	0.23	1.81
	TOTAL	142	91817	1262	692925	1414	1.37	0.20	1.54

Table 5. Entomological Screening Undertaken in ZIKV-affected Areas for ZIKV and Dengue in Kanpur Nagar, UP

S. No.	Mosquito Species Tested	Name of Locality and Mosquito Species Collected for Test						Remarks
		Pokharpur			Airport Chakeri			
		No. of Mosquito Pools			No. of Mosquito Pools			
		Tested	+ve for ZIKV	+ve for DENV	Tested	+ve for ZIKV	+ve for DENV	
1.	<i>Aedes aegypti</i>	04	01	0	0	0	0	One pool blood fed
2.	<i>Aedes albopictus</i>	05	0	0	03	0	0	-
3.	<i>Culex quinquefasciatus</i>	04	0	0	0	0	0	One pool blood fed
4.	<i>Armigeres sp.</i>	01	0	0	01	0	0	-
	Total	14	01	0	04	0	0	

Conclusion

It can be concluded from the above findings and discussion that the first case of ZIKV was reported for the first time from the district of Kanpur Nagar of Uttar Pradesh (India) on October 13, 2021. Since this was the first case of ZIKV from the Kanpur Nagar district of Uttar Pradesh (India), can be termed as an outbreak of ZIKV in the state. 142 blood/serum samples were found positive for ZIKV out of the total 5583 samples examined. 11 pregnant women were also found positive for ZIKV in different periods of gestation [seven of 3rd trimester (five from Cantt. Area and two from Harjinder Nagar), one of 2nd trimester from Darshanpurwa and three of 1st trimester (two from Harjindernagar & one from Krishnanagar)]. No anomaly was detected in any of the ZIKV positive in the foetus, as three deliveries occurred in the month of November 2021. The vector indices were found very low (HI = 1.37%, CI = 0.20% & BI = 1.54), which are weak to support active disease transmission, though one pool of *Aedes aegypti* was found positive for ZIKV.

The intensified IEC/ BCC activities lead to active community participation for early diagnosis & treatment of ill persons and elimination of vector breeding sites, thereby containing the further spread of the disease virus, consequently interrupting the transmission of the disease. The ZIKV spread could be limited to a very small area. The follow-up action in the ensuing years also prevented the occurrence of ZIKV in the city. No case of ZIKV was reported from any part of the state during 2022 and 2023 (till April). The situation of the ZIKV in the state is under control.

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