Zika Virus epidemic: Distribution and Effect of Containment Measures taken by Department of Health

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Abstract—*Zika Virus Disease (ZVD) is an emerging disease in India. Symptoms are generally mild but it's infection during pregnancy can cause other congenital malformations in infants. Because of its complications in pregnancy it becomes of public health importance. There was an epidemic in Jaipur in year 2018. This study was conducted to describe the epidemiologic curve and effects containment measures initiated by department of health to control it. Public health response initiated within three kilometer radius area from index case in the form of tracing & isolation of positive cases, tracking of fever cases & pregnant females in affected area. Vector control measures were taken and effect of control measures were assessed by difference in entomlogical indexes like Breateau Index (BI) and House index (HI). Total 159 Zika positive cases detected in 38 days, out of that 6 were from routine surveillance and 153 were from active surveillance. No mortality was reported. Timely containment measures were taken. Effect of these containment measures were significant (p<001) in the form of reduction in number of cases, Breauteau Index (BI) and House Index (HI). Number of cases became zero whereas mean BI and mean HI became less than 2 which was initially 35.01 and 21.72 respectively. It is concluded that with prompt public health response and intersectoral coordination resulted in containment of the outbreak.*

Keywords: Zika Virus Disease (ZVD), Epidemic Curve, Containment Measures, Breateau Index, House Index.

I. INTRODUCTION

Zikavirus is a member of the Flavivirus genus of the Flaviviridae family, which includes other globally relevant human pathogens such as dengue virus (DENV), yellow fever virus (YFV), West Nile virus (WNV), Japanese encephalitis virus (JEV), and tick-borne encephalitis virus (TBEV).[1,2]

Zika Virus infection is generally mild, typically last for 2–7 days but neurological disorders were linked to ZIKV infection, as there was an increase in the incidence of GBS, a postinfection autoimmune neuropathy that can result in weakness, paralysis, and death.[3,4,5] Most concerning is the sharp increase in the number of cases of microcephaly in newborns in the northeastern region of Brazil that is associated with ZIKV infection of pregnant women.[6]

ZIKV was first isolated in 1947 from a febrile sentinel rhesus monkey in the Zika forest, a research station of the Uganda.[7] ZIKV came to global attention in 2007, when it caused an explosive outbreak in Micronesia.[8] It is estimated that approximately 75% of the population of the island of Yap became infected during a 4-month period.[9] In the ensuing years, ZIKV spread throughout Oceania.[11,12] and then

was detected in Brazil in early 2015.[12,13] To date, a total of 86 countries and territories have reported evidence of mosquito-transmitted Zika infection.

Since 2013, with the first reported Zika virus (ZIKV) outbreak in the Marquesas Islands[1] and its subsequent spread to Brazil in May 2015[14], health agencies in India have been on alert and kept a watch on the Zika situation in India. On May 15, 2017, the Ministry of Health and Family Welfare, Government of India, reported three laboratory-confirmed cases of ZIKV disease from Bapunagar area, Ahmedabad, Gujarat, India[15] The cases were confirmed by real-time reverse transcription polymerase chain reaction (RT-PCR) test[16] With recent confirmation of one more Zika case from Chennai in India[17]

Zika virus resurfaces in India for the third time in two years and this third time is in Rajasthan. So this descriptive study is to describe its epidemic curve and containment measures taken for this epidemic.

II. METHODOLOGY

This community based cross sectional study was conducted at Directorate of Medical & Health Services (DMHS) Rajasthan, Jaipur (Rajasthan) India with the coordination of Entomology, Microbiology and community Medocine Department of State Government of Rajasthan.

2.1 Ethical Clearance

This present study was approved from Institutional Ethical Committee of SMS Medical College, Jaipur (Rajasthan) India.

2.2 First case of epidemic

On September 21, 2018 an 85 year old female, resident of Shastri Nagar, Jaipur city was found positive for ZVD. The patient had complaint of joint pain, redness of eyes, weakness and body ache, altered sensorium and seizures for the past 1.5 years. The patient was hospitalized on 11.09.18 with a diagnosis of "neurological disorder." She had no travel history before the episode and did not report fever in the previous 4 week period. Her blood sample was found Zika positive on routine surveillance testing in microbiology laboratory of SMS Medical College, Jaipur. As it was first positive case diagnosed, so sample was sent to National Institute of Virology (NIV), Pune for reconfirmation, where it was also found positive on 21.09.2018.

2.3 Area affected with Zika Epidemic

Mapping of area which included 3 km aerial distance (radius) of the index case in Shastri Nagar. It covered eightwards (division as per Jaipur Municipality) of the city. With the positive case in Rajput hostel, six more wards were included as cases reported from those areas. So total 14 wards were included for house to house survey. These wards were number 4,9,10,14,23,24,27,79,79B,80,81,82 and 83. In Jaipur city two epicenters Shastrinagar and Rajput Hostel, Sindhi Camp was there.

2.4 Containment Measures

State has its own surveillance program IDSP and SMS Hospital is a part of zika virus surveillance initiative of ICMR. House to house surveillance started for fever cases and pregnant women, pyrethrum focal spray was done in and around positive house, fogging was done in the affected area. Urine and blood samples were collected of febrile cases and pregnant women. Surveillance activities started in the affected areas.

2.5 Coordination with Other Departments

Intensive activities done with the help of:-Administration, Medical Education, Municipal Corporation, PHED, ICDS, Nursing college (students), Civil Defense, and Revenue Department. Some of these included:- provision of water to the public on a daily basis such that water storage can be avoided, imposition of penalties, provision of plastic water tanks to those who could not afford them and general sanitation work.

Teams were constituted having member/members from various departments. All the teams surveyed 14 wards of affected area with SDOs, ACMs, CDPOs, Doctors, VBD consultants, PG doctors of PSM department. After orientation of teams, teams were departed into field for their assigned work. Daily in the morning each team was provided essential logistics like Temiphose, IEC material etc for activities as per previous day's decision and they departed to the area assigned by officers. India.

Zika virus survey (ZVS):- ZVS was done in the affected area, Intensive house to house survey was done by ANMs, ASHAs, nursing students and workers from Nagar Nigam. This would include finding of pregnant female (marked as (P), acute febrile cases (marked as (F) breeding sites and larvae (marked as (L). Each house surveyed was marked with P, F & L. Anti-larval activities (chemical and biological) likeon spot source reduction, indoor residual spray (IRS), focal spray (space spray), fogging and identification of potential breeding sites in commercial and public places were done in the affected area.

2.6 Entomological Surveillance and Vector Management

Extensive entomological surveillance was done on a daily basis for assessment of the entomological indices like Breateau index (BI) and House index (HI) for planning of next day's activities accordingly. In vector management, overhead tanks /cisterns or underground reservoirs having mosquito proofing were vacated, rubbed dried then again used. Application of adequate amount of Temephosein potable water which could not be vacated. Non -essential containers were identified in affected areas by survey were destroyed. Plastic and solid waste from roof tops was removed. Coolers, Bird baths, cement tanks with low water volume and high density of larvae and pupa, flowerpots emptied, and other open ceramics scrubbed and dried during survey. Outdoor fogging done by cyphenothrine 5 EC (Dose:- 7 mL/L diesel) in affected area. Three rounds of fogging as per NVBDCP guidelines on day one, three and seven with prior intimation to the inhabitants of the area to keep their doors and windows open to ensure knockdown effect on adult mosquitoes. One round of Indoor Residual Spray (IRS) with synthetic pyrethroid and space spray with 2% pyrethrum extract was done in and around 50 houses with positive cases. Fogging was done by Jaipur municipality and was planned in such way that in radius of three kilometers movement should be outside to inside. larvivorous fishes (gambusia) were used in the large ornamental tanks/ fountains.

2.7 IEC and sensitization

IEC sensitizations were done as follows:-

- CMEs of governments & private doctors, especially gynecologist, pediatricians & MOs at Kanwatiya Hospital about Zika virus disease were conducted.
- Media sensitization workshop on Zika virus disease was done.

- IEC campaign run using pamphlets in local language, miking, meeting of community leaders and public representative, hand bills distribution from local mosque to create awareness and avoid panic.
- Awareness campaigns by Radio FM Jingles and TV visuals as well as on social media were done.
- Sensitization done of 450 school teachers.
- For awareness senior officers like ACS medical & health, MD NHM, Additional Director &Dy Director participated in talks& debates on TV & FM Radio.
- 15 LED vans displaying important messages at main points of affected area.

2.8 Precautions to be followed by Blood Banks in Jaipur and adjoining districts

As per the National Guidelines, all blood banks were instructed to strictly adhere to donor selection criteria & do screening for ZVD before accepting blood from any donor and not to accept blood from any donor till 2 weeks following complete recovery from any viral infection.

2.9 Precautions to be followed by eligible couples and sexually active individuals

- Pregnant women who were in first trimester and residing in the locality surrounding the zika affected areas were advised to get themselves tested for zika virus.
- Eligible couples planning pregnancy were told to avoid pregnancy till the control over disease is achieved through health counselor / health worker/ volunteers and were informed about the risk associated with zika virus disease.

2.10 Review technique

Daily feedback was taken by the Additional Chief Secretary (M&H) and other senior officials from the MOICs, VBD consultants, PHMs, and LTs at the DMHS. And instructions for next day's activities were given. The situation was also been reviewed in high level meetings chaired by Hon'ble HM and Chief Secretary (M&H).

2.11 Community Participation

374 volunteers were identified in different wards in the affected areas and provided orientation near their area regarding identification of larvae and source reduction methods.

2.12 Statistical analysis

Qualitative data were expressed in percentage (%) and quantitative data were summarized as mean and standard deviation (S.D.).

III. RESULTS

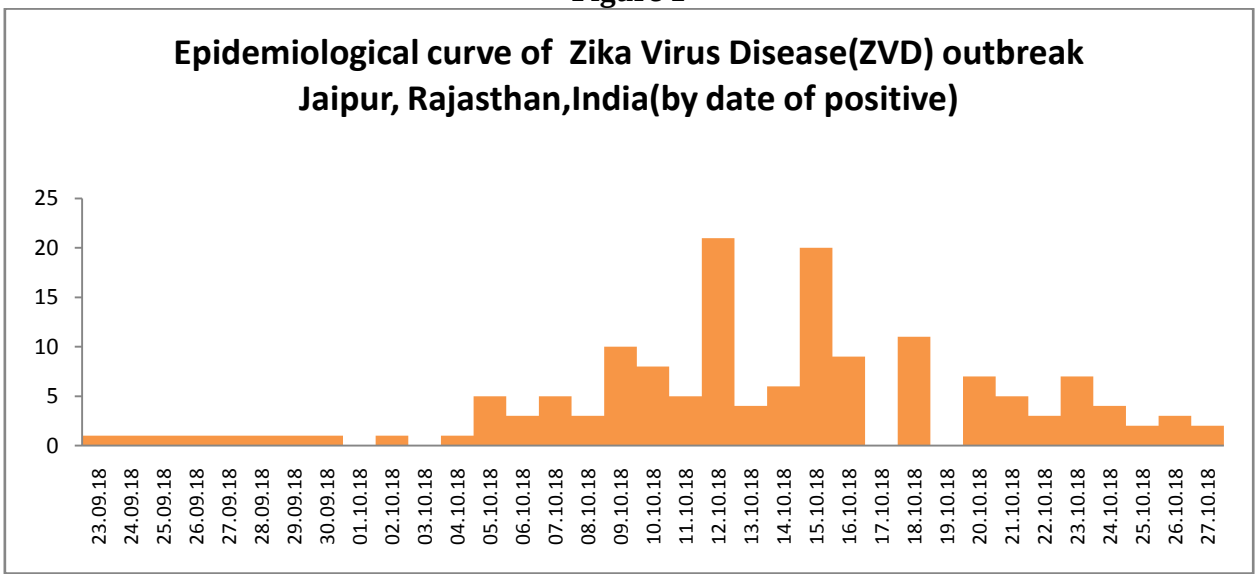
Total 159 Zika positive cases were detected in 38 days of this epidemic, out of which 6 cases were detected in routine surveillance and 153 were in active surveillance.

3.1 Date wise cases

Before 21.9.18 there was no case indentified as Zika virus, first case was confirmed on 21.09.18 on routine surveillance. On active surveillance in ZVS more cases were identifies which were shown in

epidemic curve (Figure 1) showing peak from 12.10.18 to 18.12.18 with a dip on 16.10.18. After 28.10 18 there was no case reported of Zika virus. (Figure 1)

Figure 1



3.2 Ward wise cases

Maximum cases (64.05%) were from ward no. 79 B, 82 and ward no 23 constituting 33 (21.57%) cases from ward no. 79 B & ward no 82 and 32(20.92%) cases from ward no. 23. In other affected areas there was sporadic distribution. (Table 1)

TABLE 1
WARD WISE CASES, BREATEAU INDEX AND HOUSE INDEX

S. No.	Ward Number	Number of Cases	Breateau index (BI)		House Index (HI)	
			Initial	Final	Initial	Final
1	4	1	4.1	1.5	3.1	1.5
2	9	5	25	1.2	18	1.2
3	10	1	21	1.2	8	1.2
4	14	3	34	1.2	26	1.2
5	22	2	20	0.9	15	0.9
6	23	**32**	**124**	0.6	**75**	0.6
7	24	10	28	0	20	0
8	27	2	34	0	27	0
9	79 A	6	14	1.4	11	1.4
10	79 B	**33**	14	0	5	0
11	80	4	23	0	14	0
12	81	14	34	0.7	17	0.7
13	82	**33**	57	0.5	40	0.5
14	83	7	58	1.1	25	1.1

Initially Breateau index (BI) was maximum (BI=124) in ward no 23 followed by in ward no 14,13,12, 8 etc. Likewise initial House index was highest (HI=75) in ward no 23 followed by ward no. 13,8,4,14 etc. (Table 1)

3.3 Correlation of number of cases with BI

Correlation of number of cases with BI was found significant (P=0.038) with correlation coefficient (r) 0.56. (Table 2)

3.4 Correlation of number of cases with HI

Likewise correlation of number of cases with HI was found significant (P=0.048) with correlation coefficient (r) 0.55. (Table 2)

TABLE 2
CORRELATION OF NUMBER OF CASES WITH BREATEAU INDEX AND HOUSE INDEX

Variables	Breateau index (BI)	House Index (HI)
Correlation Coefficient (r)	0.5576	0.5356
P. value	0.03831	0.0484
Slope	1.346	0.3602
Interceptor	20.3	13.07
t	2.327	2.197
Regression equation	Y=20.3+ (1.346)x	Y=17.07+ (0.36)x

3.5 Effect of containment measures

Effect of various containment measures taken were assessed in the form of reduction in number of cases, BI and HI.

Number of cases became zero whereas mean BI and mean HI became less than 2 which was initially 35.01 and 21.72 respectively. On analysis these were found significant (P<0.001). (Table 3)

TABLE 3
CHANGES IN NUMBER OF CASES, BREATEAU INDEX AND HOUSE INDEX

Variable	Number of cases		Breateau index (BI)		House Index (HI)	
	Initial	Final	Initial (Mean±SD)	Final (Mean±SD)	Initial (Mean±SD)	Final (Mean±SD)
Status	153	0	35.01+29.73	0.74+0.56	21.72+18.19	0.74+0.56
P Value	***P<0.001**		****P<0.001**		****P<0.001**	

***Chi-squuare Test** ****Unpaired 't' Test**

IV. DISCUSSION

India was warned previously to have epidemic of Zikavirus anytime by many authors.[18,19] Although this is the third epidemic of India but is with maximum cases. First epidemic of India was occurred in Gujrat and second in Chennai. In present epidemic total 159 Zika positive cases detected in 38 days, out of that 6 were from routine surveillance and 153 were from active surveillance. There was no mortality reported. In an epidemic in Bapunagar area of Ahmedabad, Gujarat, India, where three of the Zika cases were reported.[20]

Epidemic in Jaipur, Rajasthan surge with confirmation of Zika virus on date 21.9.18 and ends when there was no case reported on surveillance i.e. 28.10.18. Gujrat epidemic was between November 2016 and February 2017 in Bapunagar of Gujrat.[21]

Since September 22 when Zika virus reported in Jaipur, the neighboring state like Bihar, Gujrat, Haryyanaetc became alert regarding Adedes Aegypti. Ahmadabad Municipal Corporation (AMC) began active fogging in areas of previous epidemic.[22]

One patient from Hariharpur Lalgarh Village of Siwan was Zika Positive at SMS Hospital, Jaipur. Both Dengue & Zika virus is transmitted by same vector Aedesaegypti. Measures were taken in that area from 7 Oct 2018 by Health department.[23]

In present epidemic mean BI and mean HI was initially reported 35.01 and 21.72 respectively in this area. Almost similar observations were made by Nand Kishore et al[23] who reported BI and HI 20 & 25 respectively in their study. Despite the presence of the agent, susceptible host and ideal tropical climate, the prevalence is lower in India as compared to Brazil.[24]Effect of these containment measures were significant (p<001) in the form of reduction in number of cases. Number of cases became zero whereas mean BI and mean HI became less than 2 which was initially 35.01 and 21.72 respectively. In this epidemic cases were reported more with higher BI as well as in areas with higher HI. These observations were also supported by earlier studies that have shown that in nature, mosquito populations have varying proportions of individuals that differ in their susceptibility to the pathogen they transmit. This phenomenon has been observed in the case of malaria with *Anopheles culicifacies* in India.[25] as well as for chikungunya virus (CHIKV)[19] in the case of *Ae. aegypti.*

Thus, a high vector potential in a mosquito population is an important factor for causing outbreaks. However, effective transmission not only requires the presence of a higher per cent of susceptible mosquitoes in a population that feed preferably on human blood and have low threshold to pick up infection, but it also requires that the virus strain should be capable of infecting a variety of tissues in the mosquitoes and replicate profusely. Finally, viral pathogen needs to bypass all the refractoriness offered by mosquito body's immune responses, thereby infecting a human case.

V. CONCLUSION

This study conclude that the biggest epidemic of Zika virus in India, which was completely constrained within 40 days with effective containment measures like active search & testing of acute fever cases, pregnant women and proper vector control measures. Not much study are on Zika virus are available in India so further research is required to understand the ZIKV natural cycle in India.

CONFLICT OF INTEREST

None declared till now.

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