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Research Article

Entomological Survey during Zika Virus Infection in Ahmedabad, Gujarat

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A B S T R A C T

Three laboratory-confirmed Zika virus cases were reported from Bapunagar area, Ahmedabad District, Gujarat on 15 May 2017. Vector survey was done at two residential localities and one Govt. Hospital of the affected area and five Private Hospitals nearer to these colonies. Laboratory detection of Zika virus in field collected mosquitoes was done by using RT-PCR. During *Aedes* immature survey out of 2558 total houses searched in Ahmedabad affected area HI (5.6) and out of 4439 total containers searched CI & BI (3.1, 5.4) while on seeing individual affected area it was found that at Parmeshwar park the entomological parameter HI was found high (11.3). The overall main potential breeding containers in the affected areas were found mainly to be Scrap (50%), Kothi (Cement tank) (16.7%) and Mud pots (7.7%). High HI shows high risk of transmission of the disease. Total *Aedes* Mosquito collection for RNA extraction process shows that out of 103 total F1 generation reared mosquitoes had Females (54%) and Males (45.6%) while out of total 35 mosquitoes collected by aspirator had Males (57%) and Females (43%) and all were found negative for Zika Virus during RT-PCR. These results demonstrate that such high *Aedes* indices can lead to new episode of vector borne diseases especially in concern with Zika outbreak. Potential breeding sources like scrap materials, water logging due to leakage in water supply, bird pans and plastic cups were found with *Aedes* breeding during the survey suggesting the potential of the area for disease transmission.

Keywords: Zika Virus, Vector Surveillance, *Aedes aegypti*

Introduction

Zika is a new emerging viral disease transmitted by bite of infected *Aedes* mosquitoes (*Aedes aegypti* and *Aeedes albopictus*) (Marchette,1969, Grard G *et al.,*2007). These mosquitoes bite during the day and typically cause asymptomatic or mild infection (fever and rash) in humans, identified originally in Africa (MacNamara, 1954) and later in other tropical regions, including South America, where it may be associated with an increased incidence of microcephaly in babies born to mothers infected during pregnancy. Zika infections in adults may result rarely in Guillain–Barré syndrome (Cao-Lormeau *et al*., 2016). Since the 1950s, it has been known to occur within a narrow equatorial belt from Africa to Asia. From 2007 to 2016, the virus spread eastward, across the Pacific Ocean to the Americas, leading to the 2015-16 Zika virus epidemic.

Outbreak Location

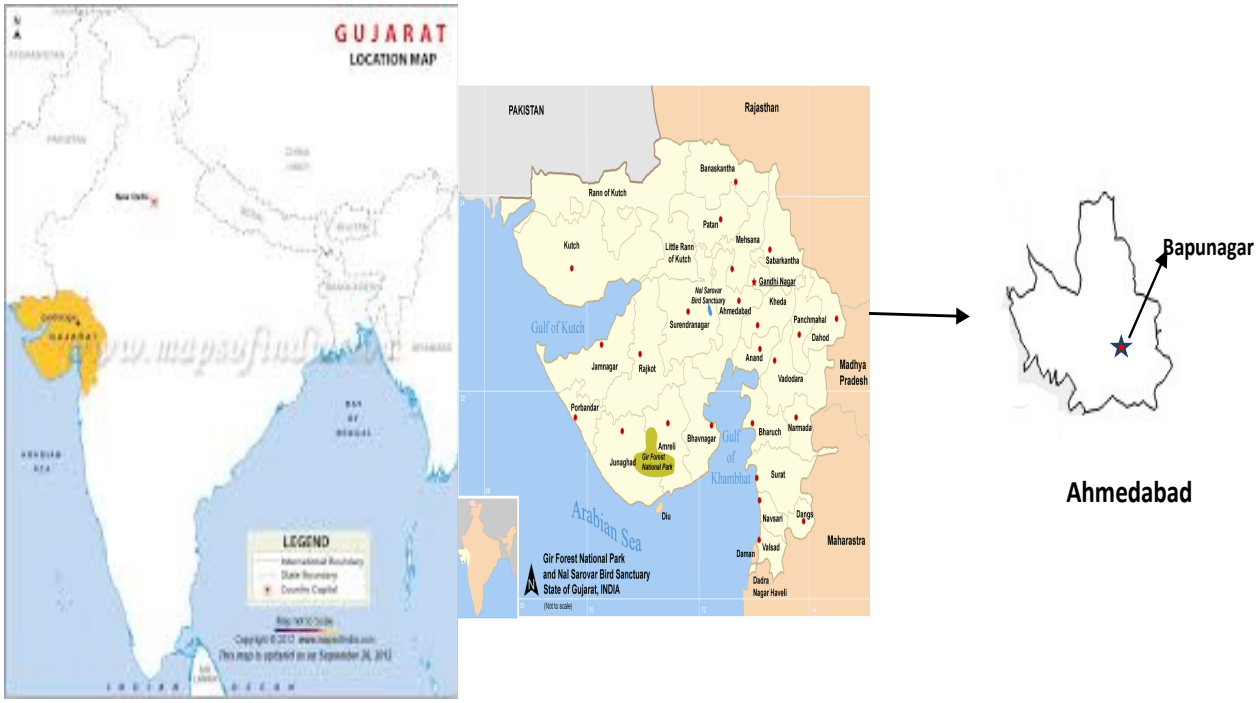

Figure 1.Map showing Outbreak location of Ahmedabad District

Methodology

A Tour was planned to do vector surveillance at different government/ private hospitals & some localities at Ahmedabad (Gujarat) for a period from 19th to 24th June 2017. Depending on the objectives of inspection, the survey included larval sampling, pupal surveys for determining which containers are most productive in term of adult mosquito output and adult mosquito collection not only provides information on which viruses are circulating in the population but also serve as an early warning signals and surveillance system for outbreak or epidemics. The affected area of Ahmedabad city, Bapunagar has a population of 1, 25,000 and houses around 2500 while Gopalnagar has a population of 12,000 and houses around 2106. Both these areas have slum population commonly illiterate and houses are congested with potential breeding sources and discarded material. It decided to conduct Zika virus testing on field collected mosquitoes samples. Laboratory detection of Zika virus on field-collected mosquitoes was done by using molecular methods, such as reverse transcription PCR (RT-PCR) or virus isolation protocols. Sample handling conditions recommended for these assays include maintaining a cold chain from field to laboratory to preserve live virus and mitigate degradation of virus RNA. Ideally, mosquitoes were stored at a temperature of −70°C or below and later in the Laboratory they were proceed for testing.

Results

An *Aedes* immature survey was carried out in 2558 total houses and out of 4439 total containers searched in overall Ahmedabad affected area House Index (5.6) Container Index & Breteau Index (3.1, 5.4) were calculated. While on seeing the individual affected area it was found that at Parmeshwar park the entomological parameter HI (11.3) was found high above the critical value (Sanchez L *et al,*2006). The overall main potential breeding containers in the affected areas were found mainly to be Scrap (50%), Kothi (Cement tank) (16.7%) and Mud pots (7.7%) (Table 1).

An *Aedes* immature survey was also carried out in Private & Municipal Corporation Hospitals of Ahmedabad. Out of 52 total premises and out of 90 total containers searched in these Hospitals House Index (0.0), Container Index & Breteau Index (6.7, 10.0) was recorded only for SCL Hospital (MCD). The overall main potential breeding container in the surveyed Hospitals was mainly Bird pots (20%) (Table 2).

During adult collection, out of 28 adult mosquitoes collected, highest numbers of mosquito collected were *Ae. aegypti* (57%) form the most affected area of Ahmedabad, which is a important vector of Dengue, Chikungunya & Zika virus (Table 3).

During *Aedes* survey in various hospital visit of the affected area show that vector surveillance activities were carried out effectively. But with some issues as in case of Civil Hospital (BJMC) were basement water logging was found and in SCL Hospital were Bird pots were found to be potential breeding sources (Table 4).

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Figure 2.Type of vector breeding places in Ahmedabad affected area in concern with Zika cases

Table 1.Result of *Aedes* Immature Survey Report at Ahmedabad

Localities	BJMC		Parmeshwar Park		Bapunagar		Gopalnagar	
Entomological Parameters								
House Index	0.0		11.3		6.8		1.7	
Container Index	1.8		4.8		3.7		1.4	
Breteau Index	0.0		11.3		6.2		2.0	
	Searched	Positives	Searched	Positives	Searched	Positives	Searched	Positives
Total houses	0	0	106	12	1746	118	706	12
Total containers	282	2	249	12	2935	109	973	14
Total Kothi (Cement Tank)	4	0	18	3 (16.7%)	221	11 (4.9%)	39	0
Barrel (Plastic Drum)	6	0	89	2 (2.2%)	1072	52 (4.9%)	488	7 (1.4%)
Mud pots	1	0	15	1 (6.7%)	119	2 (1.7%)	13	1 (7.7%)
Underground Cement tanks	4	0	25	0	277	10 (3.6%)	142	1 (0.7%)
Overhead Cement tank	24	0	47	0	20	0	0	0
Inside Storage tank	27	0	20	3 (15.0%)	378	17 (4.5%)	32	0
Scrap	2	1 (50%)	1	0	83	6 (7.2%)	7	0
Bird/Cattle pots	53	0	10	1 (10.0%)	42	3 (7.1%)	13	0
Others	161	4 (2.5%)	24	2 (8.3%)	723	8 (1.1%)	243	5 (2.1%)

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Table 2.Result of *Aedes* Immature Survey Report of Private & Municipal Co-operation Hospitals

Hospitals	Narayana (Pvt.)		GCSMC (Pvt.)		SCL(MCD)		Saviour (Pvt.)		VS (MCD)	
Entomological Parameters										
House Index	0.0		0.0		0.0		0.0		0.0	
Container Index	0.0		0.0		**6.7**		0.0		0.0	
Breteau Index	0.0		0.0		**10.0**		00		0.0	
	Sear-ched	**Positives**	**Sear-ched**	**Positives**	**Sear-ched**	**Positives**	**Sear-ched**	**Positives**	**Sear-ched**	**Positives**
Total Premises	9	0	16	0	10	0	1	0	16	0
Total containers	16	0	39	0	15	1	3	0	17	0
Total Kothi (Cement Tank)	1	0	5	0	6	0	0	0	2	0
Barrel (Plastic Drum)	2	0	5	0	2	0	2	0	4	0
Mud pots	3	0	3	0	0	0	0	0	7	0
Underground Cement tanks	0	0	0	0	0	0	0	0	0	0
Overhead Cement tank	0	0 (0%)	4	0 (0.0%)	0	0 (0.0%)	0	0 (0.0%)	0	0 (0.0%)
Inside Storage tank	1	0 (0%)	9	0 (0%)	2	0 (0%)	1	0 (0.0%)	0	0 (0.0%)
Scrap	7	0 (0%)	1	0 (0.0%)	0	0 (0%)	0	0 (0.0%)	0	0 (0.0%)
Bird/ Cattle pots	2	0 (0%)	12	0 (0.0%)	5	1 (20%)	0	0 (0.0%)	0	0 (0%)
Others	0	0 (0%)	0	0 (0%)	0	0 (0%)	0	0 (0%)	4	0 (0%)

Table 3.Result of Adult mosquito collection-Total Catch

S. No.	Locality	Species collected	No. collected
1.	B J MC	*Cx. quinquefasciatus*	11
2.	Bapunagar	*Ae. aegypti*	16
3.	Gopalnagar	*An. stephensi*	0
		Cx. quinquefasciatus	1

Table 4.Result of Larval collection at Ahmedabad Hospitals

S. No.	Hospitals	Species collected	No. collected
1.	Civil hospital / B.J. Medical college (Govt.)	*An. stephensi*	0
		Ae. aegypti	0
		Cx. quinquefasciatus	02
2.	SCl Hospital, Saraspur (AMC)	*An. stephensi*	0
		Ae. aegypti	**01**
		Cx. quinquefasciatus	0

Total *Aedes* Mosquito collection for RNA extraction process shows that out of 103 total F1 generation reared mosquitoes had Females (54%) and Males (45.6%) while out of total 35 mosquitoes collected by aspirator had Males (57%) and Females (43%) and all were found negative for Zika Virus during RT-PCR (Table 5).

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Table 5.Result of *Aedes* Adult mosquito for RNA extraction process

Aedes Adult mosquito Collection for RNA extraction process						
S. No	Reared F1 Generation		Mosquito Collection by Aspirator Tube		Total Pools (28) of mosquito made for RNA extraction	
	Male	Female	Male	Female	Male	Female
1	47	56	20	15	14	14

Discussion

The first major outbreak of ZIKV infection was detected in 2007 in Yap Island, where up to 73% of the population was estimated to have been infected (Duffy *et al*., 2009). By 2014, the virus started spreading eastward across the Pacific Ocean, to some part of French Polynesia and then to Easter Island. Presently, the Zika outbreak has reached to a pandemic level after its spread to Mexico, Central America, the Caribbean and South Americas (McKenna, 2016). The WHO declared a Public Health Emergency of International Concern on January 28, 2016, keeping in view the lesson learnt from the African Ebola outbreak (WHO, 2016). The virus is mainly spread by the *Aedes aegypti* mosquito, which is commonly found throughout the tropical and subtropical Americas, but also by *Aedes albopictus*, "Asian tiger" mosquitoes that now have become widespread up to the Great Lakes area of the United States (Moritz *et al.,* 2015). Studies show that the extrinsic incubation period in mosquitoes is about 10 days (Hayes, 2009).

The potential societal risk of Zika virus can be delimited by the distribution of the mosquito species that transmit it (its vectors). The global distribution of the most cited carrier of Zika virus, *A. aegypti*, is expanding due to global trade and travel (Kraemer *et al.,*2015). Fast dissemination of this virus in different geographical areas is a major concern for non-endemic regions where the population does not possess herd immunity to ZiV virus and abundant presence of the vector *Aedes* mosquitoes. Till now the only report on the possible presence of ZiV in the Indian subcontinent is the detection of antibodies against ZiV(16.8% prevalence) mostly in the Bharuch district of the then Bombay State, Gujarat and Nagpur in 1954, which could be a result of cross-reactivity with other flaviviruses as dengue was found prevalent in these areas (Smithburn, 1954). Now in year 2017, Zika outbreak has occurred in India in Ahmedabad district of Gujarat State.

On analyzing Table 1, which depicts the results of entomological indices calculated in the outbreak affected residential colonies shows high risk of transmission of the disease due to High House Index. This also shows that the application of control measures of vector is not been carried out effectively in these colonies. These high indices also shows the early warning signal for the occurrence of further outbreak of Dengue & Chikungunya to be happened in these areas in near coming days and specifically an urge need to prevent new episode of Zika virus.

Zika virus has become a critical problem needing serious attention. This virus is transmitted through mosquito bites, *Aedes* and it is strongly influenced by climatic factors such as temperature, rainfall and humidity. Vector distribution to the other potential habitats spreads rapidly after post monsoon season. Rainfall and humidity are also likely to play role in transmission of Zika virus by accelerating the development of the vector. The rainy season is the right time for the vector mosquitoes to hatch their eggs.

Finally, the important fact is that Zika virus infection has multimodal transmission. The non-mosquito transmission is possible and this makes a significant distortion in the relationship between either rainfall or temperature and Zika virus infection prevalence.

Conclusion

High *Aedes* indices, inadequate knowledge of the field staffs, human resource and financial constraints, poor IEC / BCC, inactive Link workers working at base level had lead to new episode of vector borne diseases especially in concern with Zika outbreak in Ahmedabad city. Potential breeding sources like scrap materials (sanitary ware, thermocol boxes, old pipes etc), water logging due to leakage in ater supply, bird pans and plastic cups in open space were found in both the affected residential colonies and Hospitals which were of utmost concern.

Conflict of Interest: None

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