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## Where and how the dengue vector control program should focus its attention? - A study from Metropolitan City of Maharashtra

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### Abstract

Maharashtra faced a tremendous increase of dengue incidence in last 4-5 years. In India, there is an absence of specific drug and effective vaccine for dengue, so 'Vector Control' remains a greatly operable solution for its control. The epidemiological studies based on vector indices may play a great role in achieving reduction of transmission. The mixed study design was carried out in Mumbai city. Content analysis of transcripts of 'Key Informants Interview (KII)' and 'Focus Group Discussion (FGD)' was done manually. Percentages, range and mean values for data on Dengue incidence were calculated. On analysis, both the 'Breteau index' and 'Container index' were found high in the year 2016 (0.31, 0.34) as compared to last two years (0.18, 0.16 and 0.18, 0.20). There was an initiation of new cadre like 'Mosquito Breeding Detector' for control of larvae in the community. However, the response rate to the appeals was still low.

**Keywords:** Dengue incidence, Breteau index, Vector control, Maharashtra.

### 1. Introduction

Dengue is a mosquito-borne infection found in tropical and sub-tropical regions around the world. The *Aedes Aegypti* mosquito is the primary vector of dengue. In the absence of specific drug and effective vaccine for dengue, 'Vector Control' remains a greatly operable solution for its control. In Asia, government services routinely conduct vector control using the characteristically 'top-down approach' of vertical programmes that consist of larviciding water containers and space spraying of insecticides in neighborhoods with reported dengue cases [1].

The global incidence of dengue has grown dramatically in recent decades. Over 2.5 billion people – over 40% of the world's population – are now at risk from dengue. WHO currently estimates there may be 50–100 million dengue infections worldwide every year [3]. In the past 15 years, there has been a dramatic resurgence of dengue and dengue hemorrhagic fever worldwide, with increased frequency of epidemics and geographic expansion of both the mosquito vectors and the viruses. Lack of effective control of *Aedes Aegypti*, the principal mosquito vector of dengue viruses has been discussed as the important reason of such resurgence [4]. Various national and international studies have indicated the wrong beliefs of people in community about situations responsible for spread of vector of dengue like – garbage, poor hygiene, open sewage near residence etc [2].

This increase in risk of dengue is due to rapid, urbanization, life style changes and deficient water management including improper water storage practices in urban, peri-urban and rural areas, leading to proliferation of mosquito breeding sites. Many of the Indian states have recently (2012) faced dengue outbreak as mentioned by Mariappan *et al* [5]. There is a continuous rise in dengue cases in Maharashtra in last 4-5 years. The public health department of Mumbai city initiated community based activities for vector control rather than just implementing National, state driven vertical program.

Chiaravalloti Neto *et al* at Brazil showed significant reduction of breeding when different innovative approach was undertaken to achieve maximum community participation [6].

The present study was aimed to find what are different strategies that are implemented in the city for the vector control of dengue. In addition, the reasons for success or failure of the strategies was also studied.

### Study context

As per census 2011 the population of Mumbai was 18400000<sup>[7]</sup>. The city is governed by Municipal corporation of Greater Mumbai (MCGM) which consist of a Mayor, Municipal Commissioner, Deputy commissioner etc. Mumbai city is divided into three regions (Eastern, Western and City) and seven zones. There are 24 wards in the city. The Corporation takes care of the civic functions of the metropolis. The Corporation launched 'Special Five Point Program' in 2012 as a response to Dengue hyper endemicity out of which, first three were specific for the vector control of Dengue as follows-

1. Workplace intervention- Breeding surveillance and IEC activities were carried out in offices, schools and construction sites of the city.
2. Contact tracing- Medical officer of Health of the ward gives information to PCOs about new positive dengue case in the area and PCOs do active search for breeding.
3. Coordination with Housing Societies-residents of the area / housing societies were issued penalty on finding the active breeding sites in their residence. People were also motivated to take active part in searching for breeding sites.
4. Coordination with Pvt. health care facility & 5. Medical check-up camps.

Asst. Insecticide Officer (Asst. IO) & Pest Control Officer (PCO) is recruited exclusively for each ward. A total of 33 staff is headed by three Deputy IOs, which in turn are headed by a Head of Insecticide Office. Their main job is to conduct the surveillance for vector population for different communicable diseases like Malaria, Dengue and Leptospirosis etc. All PCOs, Junior Observers (JOs) and Asst. IOs do a daily surveillance in the given ward area. They all search for breeding sites of mosquito on daily basis. This data is submitted to Insecticide office on daily basis.

The Epidemiology cell of city is involved in ongoing surveillance for all Monsoons related Diseases (MRDs) like Malaria, Dengue and Leptospirosis etc. The data on MRD is retrieved from all Public Health facilities of 24 wards on daily basis.

### Material and Methods

The study was conducted from August 2016 to December 2016 in Mumbai city, India. Mixed methods (Qualitative and Quantitative) were used as a study design.

*Study population and study period*

#### Quantitative

The line list of dengue cases registered at all health care systems was prepared on daily basis. The data was collected and compiled at Epidemiology cell of the city. The data of the period 2014 to 2016 was collected from the period from Epidemiology cell.

The slums and high-rise buildings of the city are under surveillance of Insecticide department. PCOs and JOs everyday collect the data on mosquito breeding. The cumulative data was mobilized from Insecticide office.

#### Qualitative

Purposive sampling was used for selecting the Key Informants. In depth interviews of three Key informants were

conducted, viz-Head of Insecticide office (IO), Head of Epidemiology cell of the city and Head of Community Medicine department of Tertiary Medical College. The Key informants were busy most of the times. Interviewer persuaded telephonically with officials and finally obtained the appointment. Total four key informant interviews were conducted with two Heads of Community Medicine, one Asst.IO and one Head of Epidemiology cell. The experience of all officials ranged from five to 30 years. The interview lasted for 25 minutes on an average (Range 18-45 minutes). An official permission from Head of IO was sought for inviting PCOs, Junior Observers (JOs) and Asst. IOs from the seven zones of city. The staff were contacted telephonically and invited for Focus group discussion on topic of 'Vector control activities at Mumbai and Practical difficulties in vector control'. The experience of workers ranged from one year to 15 years. One FGD was conducted, as the group was highly vocal and participative in nature.

A staff trained in Qualitative research method conducted an interview. The resident doctor of Community Medicine assisted the interviewer in taking the notes and clicking photos.

### Data management & analysis

#### Quantitative

Data on 'Larval indices' and 'Dengue cases' from all 24 wards of Mumbai was mobilized from Entomology department and Epidemiology cell respectively. Larval indices like Breteau index and Container index were analyzed with use of Microsoft Excel. Mean, range and proportion were calculated. Spot maps according to larval indices and graphs on dengue incidence were prepared.

#### Qualitative

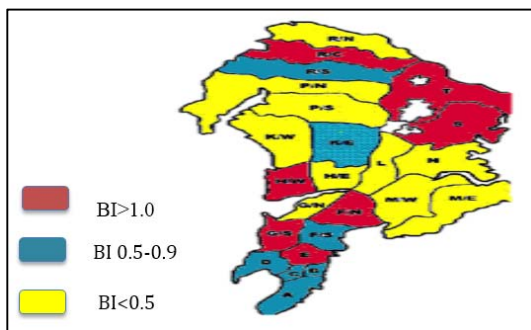
Interviews were audio-recorded, transcribed verbatim, and analyzed for common categories using manual techniques to help sort and store the data in a retrievable and searchable format. Transcripts were reviewed, immersing the researcher in the data. Notes were made in the margins with each read including general impressions of main concepts for each participant. Emerging code categories were documented on a separate sheet, color coded, and defined according to participant's own descriptions. Once defined, the process of categorizing began. Once all codes were reviewed in reference to the original data, categories were formed. The researcher repeatedly referred to the descriptive and reflexive notes when making decisions to group codes. A transcript of the interviews was done on the same day by interviewer. The manual content analysis was done to code and categorize the data.

An ethical approval from Institutional Review Board was obtained.

### Results

The Breteau index (BI) and Container Index (CI) of Mumbai city was calculated for the year 2014 to 2016. The larval indices rose from the year 2014 to 2016. The mean BI rose from 0.18 to 0.31 and CI raised from 0.16 to 0.34 in three years. The dengue cases rose from 857 in the year 2014 to 1088 in 2016. Deaths due to dengue were 12 in 2014 and 7 in 2016. All the officials mentioned about 'Lack in peoples participation' for control of dengue vector. The response to

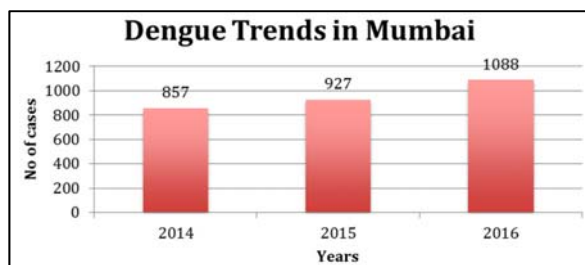
new initiative “ Mosquito breeding detector’ was less than 25% to the appeals done in Mumbai. They all suggested some new initiatives for future vector control in the city.



**Fig 1:** Ward wise map of Mumbai showing larval indices of Aedes mosquito.

The BI and CI of 7 Wards (E, F-South, G-South, F-North, H-West, K East, R-Central,) was more than >1.0. It was between 0.5 -1.0 for wards ‘A’, ‘B’, ‘D’, ‘S’, ‘R-South’ as Medium risk. And BI was lower than 0.5 for all other remaining wards (C, G North, H-East, K-West, T P- South, P-North, R -North, M-East, M-West, N, L).

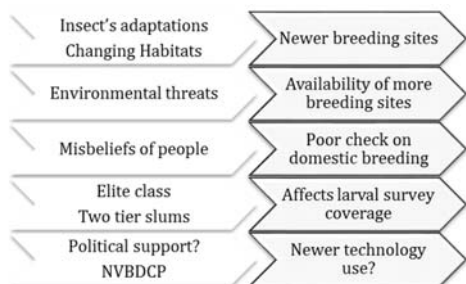
**Table 1:** Year-wise Dengue cases in Mumbai



There was increasing trend in dengue cases at Mumbai over three years. Deaths due to dengue were 12, 8 and 7 in 2014, 2015 and 2016 respectively.

**Challenges to vector control activities in Mumbai**

From the transcripts, challenges were coded into eight codes grouped into five categories. These along with suggestions provided by the respondents to address the challenges to vector control are listed in the table and are briefly described below.



**Fig 2:** Informants views on ‘Reasons for Poor control of Mosquito in City’.

The officials stated the major reasons for poor control of mosquito during the Key Informant Interview or Focus Group Discussion as follows: -

**Category I: Newer breeding sites**

There was an increase in mosquito population because of its extraordinary adaptations and changing habitats. For example- the flight range of mosquito is increased, so it has started breeding at top floors of high-rise buildings. Previously the mosquito was known to be of shy nature, but it has changed over to open nature-so it is breeding in many open sites also.

**Category II: More breeding sites in the community.**

People use ‘Tarpaulin’ over their slums to prevent leakage in rains and mosquito breeds in small grooves there. Fluctuating rains are some new environmental threats that create lots of small water pools that serve as breeding site for mosquito.

**Category III: Poor check on the current breeding sites.**

People think that ‘solid garbage and waste harbors the dengue vector’, they were not aware of ‘clean water as source for mosquito breeding’. Residents of slums keep lots of junk items outside their houses and because of concave nature of these items, rainwater gets collected and mosquito started breeding there.

**Category IV: Poor response to Larval survey.**

Residents of high-rise buildings were very reluctant to allow BMC inspectors for active searching of larval breeding at their residence. According to workers, these areas were having huge number of breeding sites because of their likings towards decorative items collection at houses.

**Category V: Unavailability of newer technology for mosquito control.**

The officials had asked about possibility of some new methods like genetic incompatibility for adult mosquito control, but higher officials informed them that there is long waiting time for such methods. Junior observers specifically mentioned the need of local leaders support while insecticide spraying in narrow gullies of city that is lacking currently.

**Response to New Initiatives**

As per the information given by officials of Insecticide branch, an initiative of recruiting “Mosquito Breeding Detectors” (MBDs) from community started in the year 2015. Approximately 17542 & 10013 appeals were distributed in 2015 and 2016. The response rate was 24.3% and 27% in two years. Finally, 2639 (15%) and 1973(19.7%) were appointed in 2015 & 2016 respectively. There was a negligible response from those MBDs for larvae reporting even after appointment. The families with a recent dengue case in their house; however, showed prompt active response to detect breeding.

**New Propositions by Officials and Workers**

In the FGD, the workers and Asst. IOs not only expressed their problems in breeding control activities but also provided insights into potential strategies to improve the vector control. Few of them coated that the health program like Diabetes control gained the success after incorporating Brand Ambassador in the city. There was a strong proposition to involve Private Medical Practitioners and Brand Ambassadors

for motivating people to actively reduce the breeding sites in their own premises.

## Discussion

**Summary-** The larval indices like Breteau and Container index were low at Mumbai. The present study demonstrated the gradual rise of Dengue cases in Mumbai over three years. However, there was a decline in deaths due to dengue. Few wards like E, G-South, F-North, R-Central, T were at high risk of dengue because of huge vector population. The different stakeholders mentioned about the need of peoples participation in vector control program was poor and suggested some innovative approaches in order to increase the same.

The study indicated the larval indices like 'Container index' and 'Breteau index' were much below the critical level (i.e. less than 10), however, gradual increase in the levels over three years is a matter of concern. The findings are comparable with that of Asom (CI-1.5-5.6) in 2013 and Cuba (BI-0.1) [8, 9]. Other studies in rural Maharashtra and southern India showed very high larval indices (BI-9.05-45.49) [10, 11]. Poor cooperation of people to inspectors may have led to low coverage for active search of breeding sites which in turn might have resulted in such low BI and CI levels. An independent report by another NGO had also shown intimidating picture of rising dengue cases in the city [12]. The rise in dengue cases is consistent with that of state data [13]. The control of dengue deaths is however a soothing finding.

In the metropolitan city, the control of *A. aegypti* is extremely difficult because of the mosquito's changing biology and behavior and also the uncooperativeness of people. As per content analysis of qualitative data, the vector control is beyond the scope of Health department alone. Elimination of all breeding sites in the city is logistically near impossible.

People are more aware of dengue disease but unfortunately unknown to habitat of vector. Correspondingly, vector control agents at Brazil emphasized the population's lack of adherence and the fact that they (the control agents) were confused with garbage collectors [14].

Some innovative approaches like MBD were being explored by city health officials however it was not much successful. At Mexico the Patio-Limpio (clearing of open courtyard area) strategy was used for training local people to identify, eliminate, monitor and evaluate vector breeding sites systematically in households. The study emphasised the need for a sustainable process to encourage individuals to maintain efforts in keeping their environment free of dengue [15]. Similarly, the innovative community-based interventions at Chennai under the Eco-bio-social research showed drastic reductions in vector densities in some sites [11].

The success of the Dengue vector control program depended on cooperation and participation of many groups, especially the families in the community. When the family leaders have good attitude and are capable of carrying out the vector control protocol, the risk factor leading to the incidence of Dengue virus infection can be reduced [16].

Considering the positive response from families with recent dengue case for breeding search, researchers developed a new IEC material especially designed for a dengue case that is hospitalised for creating awareness. The evaluation of the tool was planned in subsequent phase of research.

**Limitation-** Adult mosquito survey data would have highlighted more details for vector control in the city however the data could not be made available.

## 5. Conclusion & Recommendation

The knowledge about dengue vector habits and capacity of community to control these breeding sites must be acknowledged and strengthened.

The study recommends culturally appropriate health education material suitable for the positive hospitalised dengue patient.

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