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Entomological surveillance of dengue vector *Aedes aegypti* in Delhi during COVID-19 pandemic

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Abstract

Introduction: Dengue has become endemic in Delhi and incidences are alarmingly risen due to key factors similar as occurring globally i.e. large scale migration to Delhi for economic avenues has led to mushrooming of unauthorised areas and lack of 24 X 7 water supply has compelled citizens to store water in improper containers thus increasing breeding sites. In Delhi, staff of vector-borne disease control programme was dedicated to prevention and control of COVID-19 Pandemic thereby compromising the entomological surveillance and control measures for VBDs.

Material and Methods: This is a descriptive study based on analysis of entomological data generated during surveillance by the entomological team of City SP Zone under North Delhi Municipal Corporation from January 2020 to Jun 2021. Peridomestic areas were checked for the presence of mosquito breeding. If the container was found positive either source reduction was done or was treated with Temephos Granules.

Results: In Delhi, previously approx. 70% of dengue cases were reported from the age group 11 to 40 years. In 2020, due to lockdown, no mobility in the human population might have restricted the Dengue cases. High breeding was reported during unlock period and dengue cases from mid-July 2020 onwards were increased. During post-monsoon, the number of positive containers increased proportionately may be due to reduced surveillance.

Conclusion: Vector surveillance and strategies of Integrated Vector Management (IVM) suffered during Lockdown of 2020 and 2021. Any neglected co-infection of dengue along with COVID may lead to diagnostic and case management challenges. Hence surveillance of VBDs can't be ignored in such situations as COVID-19.

Keywords: COVID-19 pandemic, entomological surveillance, lockdown domestic breeding checkers

Introduction

Dengue is an arboviral disease predominantly reported from tropical and sub-tropical countries. It's a rapidly spreading disease across the globe and the number of countries reporting dengue fever has increased dramatically. Before 1971 only 9 countries reported the dengue epidemic but presently dengue is endemic in more than 100 countries and more than 129 countries are at risk of Dengue. Approximately three billion people reside in areas at high risk for virus transmission^[1].

Dengue is a viral infection caused by the transmission of a single-stranded RNA virus of the family Flaviviridae. DENV is transmitted by female mosquitoes of species *Aedes aegypti*, whose life cycle is strictly associated with anthropic activities. This mosquito uses mostly artificial containers for oviposition and larval growth. Such containers are variable but are often found in domestic or peridomestic environments. To a lesser extent, it can also be transmitted by another species *Aedes albopictus*^[1]. *Aedes albopictus* have adapted to breed in manmade containers also, which is added to its natural tree hole breeding habit in urban areas of Delhi^[2].

Dengue may present with a wide spectrum of diseases that range from severe flu-like symptoms to severe dengue with the involvement of multiple organs and shock. The majority of cases are subclinical hence remain uncaptured.

Dengue has emerged as a major Public Health challenge in Delhi. It has become endemic in Delhi and incidences are alarmingly risen due to key factors similar as occurring globally i.e.

large-scale migration to Delhi for economic avenues has led to unplanned urbanization which in turn leads to mushrooming of unauthorized areas. This has further compromised civic amenities affecting water supply and solid waste management leading to increase water-storing habits thus increasing breeding sites^[3]. Delhi reported its first outbreak in 1996, with more than 10000 cases and 423 deaths. A large number of cases have been reported during 2003, 2006, 2010, 2013, and 2015. An upsurge of dengue cases was reported from Delhi at regular intervals of 3-4 years. Since 2013, this gap has decreased and seasonal occurrence has become perineal case reporting^[4].

Urban Malaria Scheme (UMS) of the Government of India envisaged Civic bodies to implement measures for vector control in urban areas^[5]. At present all programs have been brought under the ambit of the National Vector Borne Disease Control Programme. The strategies defined under this program are disease surveillance, vector surveillance, and integrated vector management with supportive interventions^[6].

Dengue transmission is influenced by climatic factors rainfall, temperature, and relative humidity (RH). The breeding of mosquitoes outdoors is dependent on rainfall and the life expectancy, life span, and length of larval life are greatly dependent on RH and temperature^[7].

World Health Organisation in March 2020 declared Novel Corona Virus as Global COVID-19 Pandemic which has impacted human lives worldwide and in Delhi 2nd wave has been reported during March 2021. WHO 'PAHO' has advised that in Countries where limited staff is available and VBD staff is diverted for prevention and control of COVID-19, there is a need for integrated surveillance including both epidemiological and entomological surveillance. There is a need to adopt proper diagnostics to differentiate dengue cases from COVID-19 as both may present with similar symptoms. Entomological surveillance should address high-risk areas of dengue for taking integrated vector control measures^[8]. The sharing of Public Health human resources for the prevention and control of activities related to COVID-19 has posed challenges for the prevention and control of vector-borne diseases (VBDs) in Delhi. Common breeding sites also poses Challenge for surveillance field workers. The main indoor breeding sites are earthen pots for water storage, concrete water storage tanks, uncovered water storage tanks or metal drums, flower vases, saucers under the ornamental plant pots, soft drink bottles, water trays of refrigerators, etc. This is the first time Delhi has experienced a Global Pandemic which has extended even during the transmission period of another epidemic-prone disease that is already endemic in Delhi. This study has been carried out to study challenges in carrying out Entomological Surveillance which is a key strategy for the prevention and control of Dengue.

Materials And Methods

In 2012, the erstwhile Municipal Corporation was trifurcated into North Delhi Municipal Corporation (North DMC), South Delhi Municipal Corporation (South DMC) & East Delhi Municipal Corporation (East DMC) making a total of five civic bodies in Delhi. These civic bodies carry out their obligatory functions through Administrative zones. There are 6 zones in North DMC, 4 in South DMC, and 2 in East DMC. Zones are further divided into wards. Each ward represents the constituency of the elected Municipal Councillor. There

are 272 Municipal Wards in Delhi. And 104 wards in North DMC. There is one Malaria Circle in each ward that carries out all measures as envisaged under National Vector Borne Disease Control Programme.

City Paharganj (City SP) zone is one of the six zones under North DMC and comprises a walled city area of Delhi. This zone has major hubs for trades and commerce. Socio-cultural practices and water storage practices make it vulnerable to high breeding indices. All 13 municipal wards of City SP Zone namely Shastri Nagar, Sadar Bazar, Kishanganj, Anand Parbat, Civil Lines, Chandni Chowk, Jama Masjid, Ajmeri Gate, Bazar Sita Ram, Delhi Gate, Quresh Nagar, Ballimaran, and Ramnagar were selected for this study. The selection of the Zone was done based on the accessibility of the zone and the consistency of the cases.

Study Design: This is a descriptive study based on analysis of entomological data generated during surveillance by the Entomological Team of City SP Zone.

Study Period: The study period is from January 2020 to Jun 2021.

Data collection

Entomological Surveillance was carried out by Domestic Breeding Checkers (DBC) under a beat program monitored by Entomologist. DBCs are trained manpower for checking to breed and imparting health education. Houses and their peridomestic areas were precisely checked for the presence of mosquito breeding. Different types of containers Over Head water storage tanks (OHT), large water storage containers like drums, small water storage containers like buckets, cans, pots, cattle drinking water tank (Haudi), etc i.e. If containers were found positive either source reduction was done or larvicide, temephos (1ppm) was used according to the volume of water as prescribed by National Vector Borne Disease Control Program (NVBDCP). Data obtained from the household level were collated and tabulated for the calculation of larval indices. Indices calculated were, House Index (HI), Container Index (CI) & Breteau Index (BI) as per WHO guidelines^[3]. In addition to this data on dengue cases were obtained from the MIS cell of South Delhi Municipal Corporation (SDMC) Dengue is a notifiable disease in Delhi and an MIS cell has been created in South Delhi Municipal Corporation (SDMC) for coordination of case surveillance and notification. Data presented in this communication has some data i.e. dengue cases case fatality rates were collected from MIS Cell of SDMC.

Data Analysis

The data were analyzed using Microsoft excel. Larval indices were calculated using a simple mathematical formula.

Results

A present study which was conducted during COVID-19 period from June 2020 to June 2021 shows Dengue is decreasing since the 2015 outbreak. It is evident from figure 1 that there was a sporadic appearance of dengue cases from the year 2010 to 2015 during this period case fatality was high gradually after 2015 the fatality rates have gone down to 0.09 in 2020. Dengue cases notified in Delhi since 2010 and case fatality rate due to dengue. During an outbreak in the year 2015 about 16000 cases were reported, despite this case

fatality rate was not high this may be attributed to better case management and awareness. In a study in Delhi, it was observed that more than approx. 70% of dengue cases were from

the age group 11 to 40 years^[9] which is involved in outdoor activities. In 2020 due to lockdown, no mobility in the human population might have restricted the cases (Fig.1).

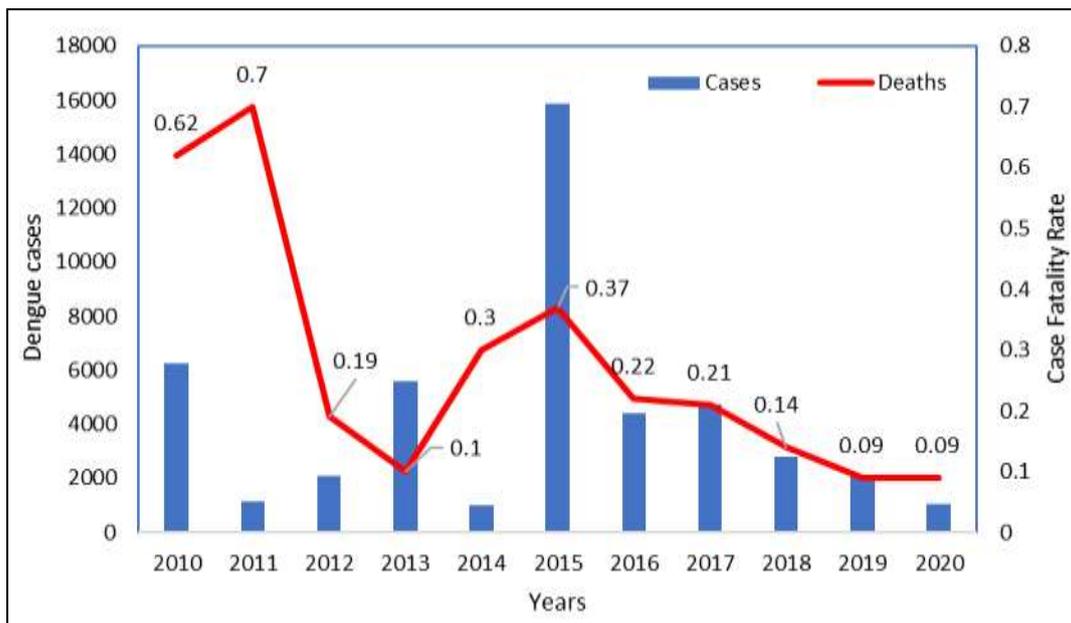


Fig 1: Dengue cases and deaths reported in Delhi from 2010 to 2021

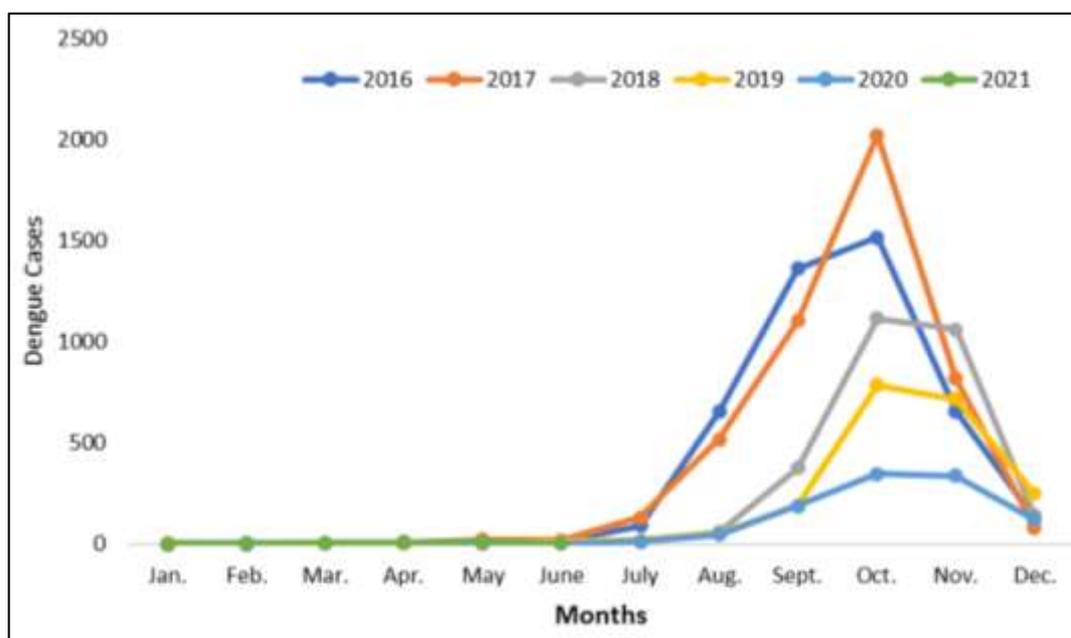


Fig 2: Seasonal variation in dengue case appearance from 2016 to 2021

Delhi monthly dengue case data shows that there is a seasonal pattern in cases appearance start buildup during July every year and peaks during October and start reducing in winters during December and January. It has been observed that the cases are also started reporting in the Non-transmission period

i.e. Jan & Feb. Analysis of entomological Indices in subsequent figures shows in 2020, high breeding Indices were reported during unlocking period which resulted in dengue cases from Mid July 2020.

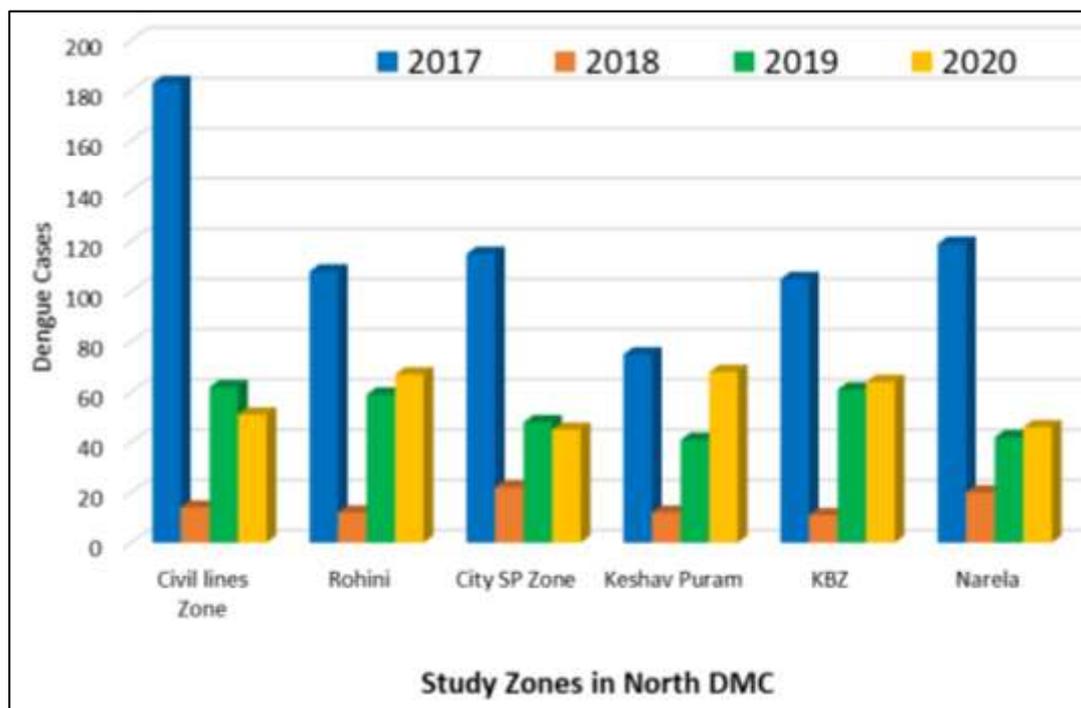


Fig 3: Zone wise Dengue cases reported in North DMC (2017-2020)

It is evident from the dengue cases of different zone that in 2017 cases were high which significantly reduced during 2018 in each zone. After 2018 the cases are seen increasing.

Dengue cases were low in City SP Zone and Civil Line Zone in 2020 as compared to 2019 (Fig. 3).

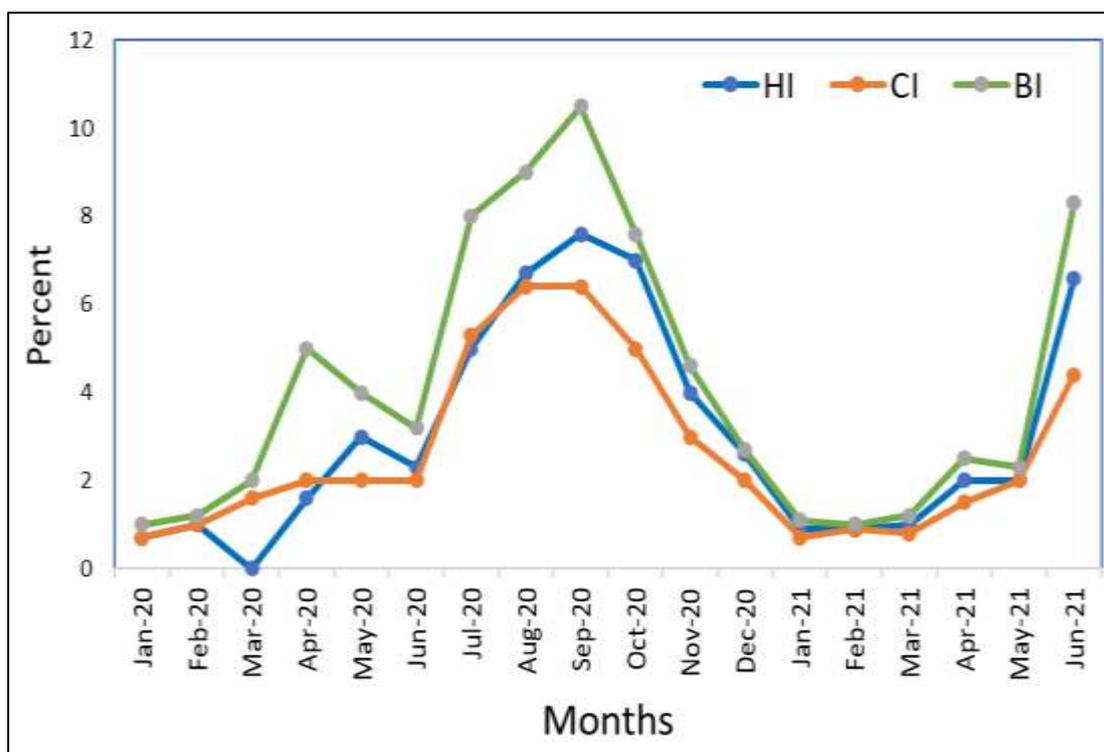


Fig 4: Larval Indices (HI, CI, BI) observed from March 2020 to Jun 2021

Figure 4 shows entomological indices were least during winter months as breeding is found only in key containers however, breeding increases June onwards and reduces during January to March. The breeding pattern shows that there are very few months from January to March when breeding indices were seen lowered (Fig 4). In 2020, the highest

container index of 6.4 was observed in Aug and Sep whereas breteau index (BI) observed during the corresponding period were 9 and 10.5 respectively. During the Lockdown period in 2020, the Container Index of 2% was observed in Apr, May, and Jun. Breteau index of 5, 4 & 3.2 was observed for three months respectively.

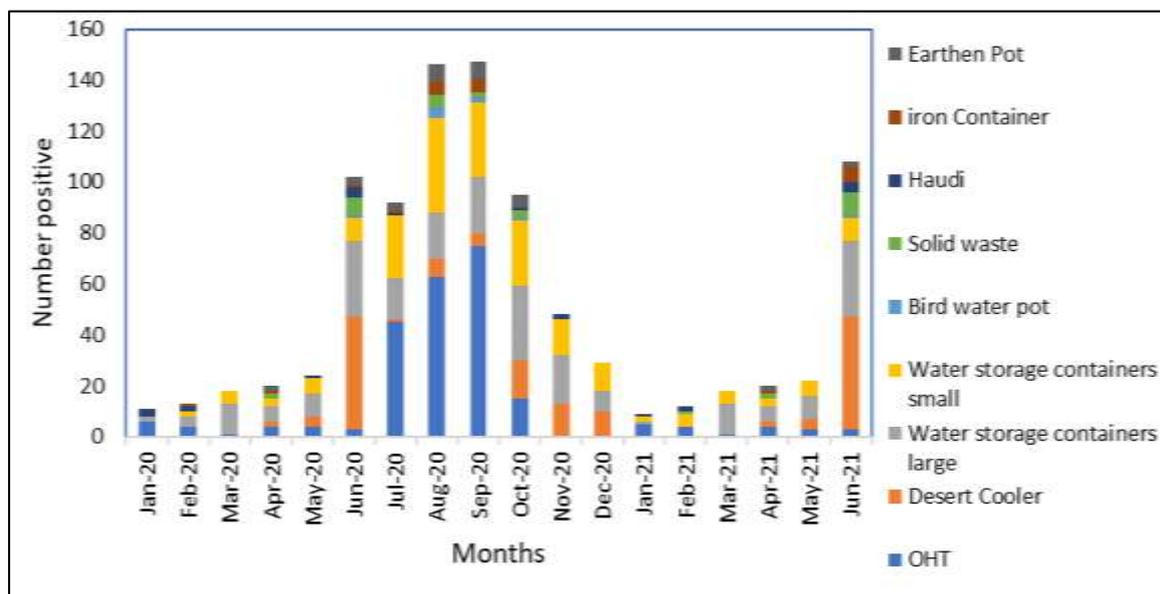


Fig 5: Types of containers found positive in different months.

Overhead Tanks are positive as key containers whereas water storage containers were found to be key containers during the lockdown period. During post-monsoon and transmission season, the number of positive containers had increased proportionately due to spill of breeding from key containers and other significant containers to peridomestic sites. This can also be due to the strengthening of Entomological Surveillance during unlock period (Fig.5).

Constraints

On 24th March 2020, the Prime Minister of India, in his address to the Nation, imposed Nationwide Lockdown. On 19 Apr 2021, the Chief Minister of Delhi announced a lockdown in Delhi to prevent the further spread of the COVID-19 Pandemic. Field manpower which is responsible for Anti larval and Anti adult measures was deployed for sanitization activities, as a result, these key measures were affected, and as a result vector surveillance and control measures were affected. However, after the unlock period, these measures were initiated in peridomestic areas only. Indoor surveillance remained could not be initiated. The increase in surveillance activity showed concordance with increased entomological indices^[10].

Discussion

Public Health Department of City SP Zone of North DMC is taking all measures for prevention and control of Vector-Borne Diseases in the area under its jurisdiction. These measures are taken as National guidelines issued by NVBDCP from time to time. Dengue has become an endemic and epidemic-prone disease in Delhi. Delhi had experienced an upsurge of COVID-19 cases in March and all manpower dedicated for VBD was diverted for prevention and control of COVID. Field workers were deployed for Sanitisation and Domestic Breeding Checkers were deployed for raising community awareness. This made the National Vector Borne Disease Control program come to a standstill. Domestic Breeding Checkers have the key role of surveillance of vectors in domestic and peridomestic settings and simultaneously impart health education to the families visited by them.

Delhi observed about 1072 Dengue cases in 2020 which is grossly less than all previous years. In 2020 and 2021 less breeding was observed during the lockdown period and breeding increased following unlock period. This can also be due to decreased vector surveillance and also supplemented by the breeding checking practices adopted by citizens. Water storage containers both large and small were observed as key containers during the lockdown period of 2020 and 2021.

In 2021, Breeding indices (BI, CI, HI) were observed to be increased during 2021 from the corresponding months of 2020 which may be attributed to the lockdown situation when proper surveillance was compromised. With the rise in environmental temperature the breeding spills over to other sites and hence high breeding indices have been observed but again there is the dip in entomological Indices during the Lockdown period and a similar pattern is observed in Jan to Jun 2021.

Study conducted by Tuli, et al (2020) on the impact of COVID-19 pandemic on prevention and control of dengue in Delhi, India have also observed that sharing of human resources and manpower of VBD for activities related to prevention and control of COVID-19, posed challenges for prevention and control of vector-borne diseases (VBDs) in Delhi. The study also emphasized the involvement of social media for increasing community awareness, as social media was a widely used tool during the lock down period and new tools like the employment of Gravid Trap/ Ovitrap traps might supplement surveillance activities^[10]. Same observations have emerged in the present study also.

A study by Nagpal et al (2013) focused on containers types and key containers for *Aedes* breeding have also shown that there was a threefold increase in container indices of overhead tanks and curing tanks of non-transmission to transmission season while in other containers the rise was more than five times in Delhi. Overhead tanks act as a key container of *Aedes* breeding in Delhi as it shows consistent breeding throughout the year. Other containers supported *Aedes* breeding intermittently. In the current study also key container was found to be the overhead tanks similar to earlier studies^[11, 12]. In a study, Frederik et al. (2020), propagated that gaps in practices and knowledge related to vector-borne disease

control need to be identified and stakeholder departments must be expressed on their role for prevention and control of breeding especially during the COVID-19 pandemic and deficiencies must be overcome. A comprehensive preparedness action plan needs to be prepared and all resources must be made available [13]. It was observed in a study during the lockdown period in Karnataka that the House index increased during the lockdown period than pre lockdown period in 2020 due to pause in vector control program the findings in Delhi are similar [14]. In the lockdown period, Breeding Indices were more than pre unlock period but the Indices increased drastically in the post-lockdown period due to improved entomological surveillance.

It has been observed that in case a full range of measures for prevention and control of vector-borne diseases are not taken appropriately, there will be an increased risk of an outbreak of cases of vector-borne diseases. Policymakers must realize the need to have proactive Policies with provisions for allocation of sufficient resources to tackle vector-borne diseases in the era of COVID-19 [15]. These findings have also been highlighted in this study as the full range of entomological surveillance and control activities had suffered due to sharing of dedicated existing health manpower of VBD. The government of India has also observed that essential services including reproductive, maternal, newborn, and child health, prevention and management of communicable diseases, treatment for chronic diseases to avoid complications, etc. need to be continued [16]. Policymakers should contribute to policies that are proactive to manage the vector-borne disease through allocating appropriate manpower.

A study in Brazil suggested that arboviral diseases with COVID-19 in Latin America and the Caribbean (LAC) region similar challenges in manpower allocation, health infrastructure for COVID-19 management was observed [17].

Source reduction of mosquito breeding sites and adult control measures should be implemented in areas affected by or at risk of dengue following COVID-19 and Information from the available entomological surveys should be used to identify the key breeding sites for *Aedes*. Key containers should be monitored (and eliminated whenever possible) by the community should be offered simple and effective options for the safe use of water storage containers. Health care staff must be sensitized to the need for social distancing and protective measures while carrying out vector surveillance and control measures [18]. During this lockdown period, a lot of campaigning was carried out by the DBC workers which helped in decreasing the breeding sites. Among the evident best practices for prevention of dengue transmission is still source reduction by community engagement.

Conclusions

COVID-19 global pandemic have taught several lessons. There is utmost need to manage the pandemics as and when they appear. However, other outbreak-prone diseases like dengue chikungunya and zika should not be ignored during such health emergencies also. During COVID-19 pandemic, vector surveillance and control activities suffered during lockdowns and staff deployed for prevention and control measures for COVID-19 during 2020 – 2021 hampered the routine activities of vector surveillance. Dengue transmission along with COVID also faced challenges in diagnostic and case management due to which cases could not be noticed. There is a need to have robust second-line trained manpower

backup who can be made available during such unforeseen diseases as COVID-19. In 2020, during lockdowns, indoor larval source reduction was solely dependent on residents themselves as advised through house cleaning campaigns. It is a high time to introduce some newer tools in VBD surveillance and control which can prove to be supplementary during such unprecedented events like corona or in any other natural disasters.

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