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Research Article

Rationalising Community Engagement & Law Enforcement for Prevention and Control of Dengue: A Case Study in Selected Zone of MCD, Delhi

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A B S T R A C T

Introduction: Dengue fever has emerged as a major public health challenge globally. In Delhi, every urban locality has different socio-demographical factors which need planning & decision-making at the lowest level with the help of the local community. High population density, mixed population and movement are posing a challenge to Dengue control in Delhi. Improved clinical management of dengue has resulted in a decline in CFR from 4.2% in 2003 to 0.38% in 2015.

Material and Methods: The study was carried out from January 2022 to December 2022 and a monthly household survey was conducted in Civil Line Zone in Delhi. Primary Data included dengue cases, entomological Data, Dengue Intervention measures data i.e. vector control measures, school and community-based interventions and Law enforcement.

Results: During the study period, a large number (2974496) of houses were surveyed out of which 0.4% (13339) houses were found positive for mosquitoes. Of these houses, 7737 were issued legal notice and 5394 were issued court prosecution. 1789 houses were fined on the spot & Rs 1030700/- were charged which was highest in Delhi. Along with all interventions, sensitisation was also scaled up and about 1835 sensitisation meetings were also organised with Resident Welfare Associations in 2022 as compared to 846 meetings in 2021 in the Civil Line Zone. In addition to this staff rallies and school programs were also scaled up. The comprehensive efforts decreased morbidity and mortality due to dengue in the Civil line zone during 2022.

Conclusion: No single approach will lead to sustained programme management. A balanced approach between community sensitisation and enforcement during the collective fight against *Aedes* with community participation may be adopted. The comprehensive efforts coupled with the law imposing and penalising repeated carelessness have demonstrated successful control in the zone.

Keywords: Dengue, Community Engagement, Enforcement

Introduction

Dengue is a viral infection transmitted by the *Aedes* mosquito. It is caused by an Arbovirus having four serotypes called DENV 1, DENV 2, DENV 3 & DENV 4. Dengue fever has emerged as a major public health challenge in tropical and sub-tropical countries across the globe. There has been a 30-fold increase in global incidence of Dengue over the past 50 years. The World Health Organization (WHO) estimates that 50–100 million dengue infections occur each year. Approximately 75% of the global population exposed to dengue are in the Asia-Pacific region.[1] The rising number of dengue cases is also having economic effects besides the burden on the resources of hospitals. WHO has reported that dengue epidemics follow seasonal patterns and the peak transmission takes place after rains. The factors that contribute include favourable climatic factors leading to multiple breeding sites and high mosquito density. Lack of proactive control interventions and staff are also challenging issues that need to be addressed.[2]

There are many factors responsible for Dengue Transmission which need a coordinated multisectoral approach for vector control. There is no single method that can take care of the prevention of dengue. Integrated Vector Management has been coined as "a process for managing vector populations in a way that reduces or interrupts the transmission of disease". It needs coordination between health and non-health sectors and engagement with local communities besides taking control measures. This is also supported by a legislative framework.[3] Every locality has different ecological and socio-demographical factors hence uniform directions can't work for all localities. There is a need for planning and decision-making at the lowest level with the help of local community members.

Global strategy for dengue prevention and control, 2012–2020 was documented with specific objectives to reduce mortality and morbidity from dengue by 2020 by at least 50% and 25% respectively (using 2010 as the baseline). These objectives can be achieved by applying existing knowledge. Dengue mortality can be reduced by early case detection, appropriate management of severe cases, and timely identification and management of dengue outbreaks.[1]

In 1971, under the Urban Malaria Scheme, Municipal bodies/ urban area authorities were given a mandate for the prevention and control of Malaria across the country. The strategy was to implement urban bye-laws to prevent mosquito breeding in domestic/ peri-domestic areas, construction sites etc. and create awareness campaigns.[4] In Delhi, measures for prevention and control are taken by 3 civic bodies namely, the Municipal Corporation of Delhi, New Delhi Municipal Council and Delhi Cantonment Board.

The Municipal Corporation of Delhi (MCD), has an area of approx. 1484 sq. km under its jurisdiction and administratively, divided into twelve zones which provide civic amenities in diverse areas that include organised and planned residential areas, commercial establishments, rural and urbanised village areas along with resettlement and unauthorised colonies. The population density of Delhi has increased in past decades from 9,340 persons per sq km in 2001 to 11,320 persons per sq km in 2011 and in 2022, it is estimated to be more than 20 thousand.[5] High population density and mixed population with movement are posing a challenge in dengue control in Delhi.

MCD is responsible for prevention and control activities as per the guidelines of NCVBDC. The activities like disease surveillance, entomological surveillance, and control, environmental management, i.e. source reduction, capacity building, community behaviour modification, stakeholder engagement, law enforcement and operational research. Epidemiological and entomological surveillance are priority areas of preventive and control measures. There has been a shift of approach from vector surveillance and control to Integrated Vector Management for effective control and management of urban VBDs.

In Delhi, outbreaks of dengue have been reported in 2006, 2010, 2013 and 2015, which shows that the gap between outbreak years is decreasing. In 1996, a total of 10,252 dengue cases were reported from Delhi. Due to improvements in the clinical management of dengue, the case fatality rate (CFR) has declined from 4.2% in 2003 to 0.38% in 2015.[6] Figure 1 shows the number of cases and deaths in Delhi from 2016 to 2022.

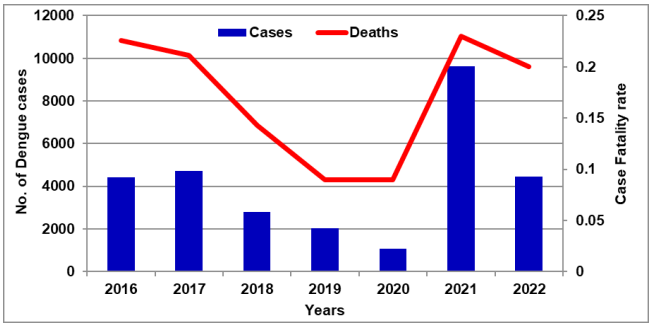

Figure 1.Year-wise Dengue Cases and Deaths Reported in Delhi

Materials and Methods

Study Design

This study was carried out from January 2022 to December 2022. Monthly data collection was done through monthly surveillance from January to December 2022. In this study, we analysed the monthly data on various measures undertaken in the Civil line zone of MCD for the prevention and control of vector-borne diseases.

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Study Area

The study area was the Civil Line Zone under the jurisdiction of the Municipal Corporation of Delhi (Figure 2).

Figure 2.Zone-wise Map of Delhi with Civil Line Zone and Yamuna River

Data Collection

Primary data included daily disease surveillance data reported from the Government of the National Capital Territory of Delhi and entomological Data generated by the Entomological Team of the Civil Lines zone. Primary data also included various measures taken in Delhi for prevention and control of Dengue i.e. vector control measures, involvement of School children and community-based interventions, involvement stakeholders, capacity building programme and law enforcement.

Secondary data was taken from weekly reports generated by the MIS Cell of Municipal Corporation of Delhi.

Results

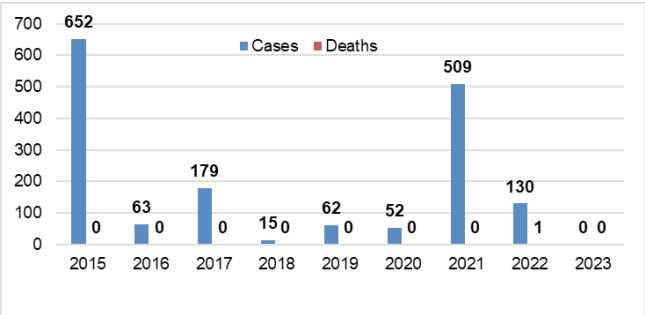

Figure 3.Year-wise Dengue Cases and Deaths Notified in Civil Line Zone

Figure 3 reveals year-wise dengue cases and deaths notified in the Civil Line Zone. Delhi experienced an epidemic in 2015 after 1996 when 652 cases were notified in the Civil Line zone few cases were reported in 2018, 2019, & 2020. Globally COVID-19 pandemic affected surveillance quality in 2020. In 2022, though Delhi had a large number of cases due to improved surveillance through the IDSP portal, in the Civil Line zone, extensive preventive measures supplemented by enforcement measures and community sensitisation modes helped in controlling the cases.

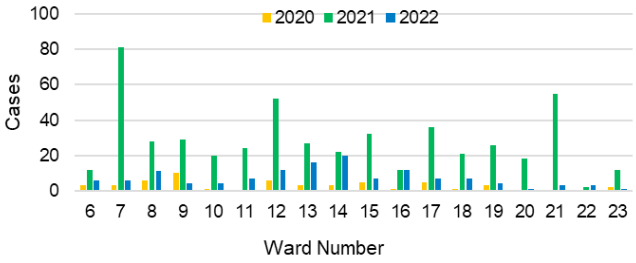

Figure 4.Year & Ward-wise Dengue Cases Notified in Civil Line Zone (2020-2022)

Figure 4 shows ward-wise and year-wise dengue cases notified in the Civil Line zone. Ward No 7, 12 & 21 reported highest number of dengue cases in 2021. A large number of cases were reported due to storage containers, citizens not taking an interest in checking their own premises, and most of the houses found locked during routine checking due to their job nature (labourers). Factors were analysed and special attention was paid to these three wards by intensified community mobilisation measures and strict enforcement actions as per provisions under malaria bye-laws of MCD. The impact was seen in 2022 when these wards had very few cases.

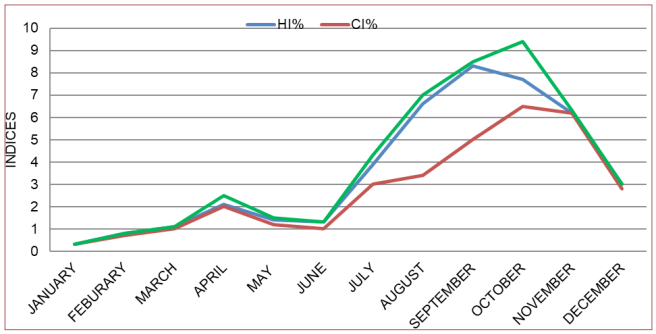

Figure 5.Month-wise Entomological Indices in Civil Line Zone, 2022

Entomological surveillance is one of the key activities performed in the zone by RRT under the supervision of a zonal entomologist. This practice is adopted in all zones of MCD. Vector surveillance includes surveillance of fixed high-risk sites and random sites. Figure 5 shows the average month-wise entomological Indices calculated based on the

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RRT data. These Indices are of importance as this data is calculated under the direct supervision of an entomologist. The figure shows the rise of all entomological indices from the month of March onwards due to the emergence of larvae from dormant eggs in mother foci. In May and June due to extreme hot and dry climatic conditions, the larval density declines and multiple breeding sites are created following monsoons favourable climatic conditions i.e. humidity and temperature. The objective of entomological surveillance is to keep the indices below critical levels so that disease does not get into epidemic proportions.

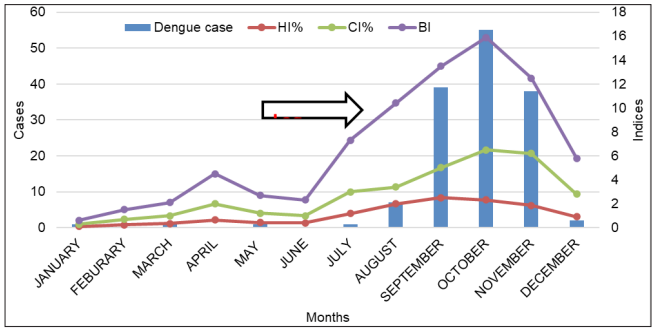

Figure 6.Breeding Indices and Dengue Cases in CLZ 2022

Figure 6 shows the correlation between cases and entomological indices. A lag period is observed between the rising of entomological indices and the notification of cases. This can be attributed to the extrinsic and intrinsic incubation period. The graph shows entomological indices start rising from the month of June and dengue cases show surge from August onwards. This lag period of 2 months can be explained on the basis of monsoons leading to multiple breeding sites, extrinsic and incubation periods, reporting of cases by hospitals and final notification by MCD after Epidemio-entomological investigation.

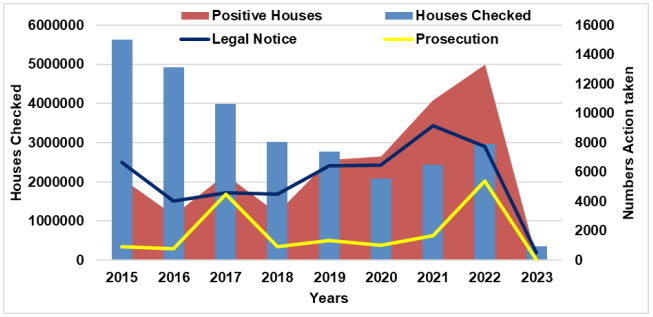

Figure 7.Year-wise Enforcement Action Taken in Civil Line Zone

Figure 7 shows the year-wise detection of breeding and enforcement action taken by the Civil Line zone. The highest entomological surveillance was recorded in 2022 and the maximum number of houses positive for mosquito breeding were detected. In 2022, 13,339 houses were found positive for mosquito breeding out of 2,974,496 houses checked. 7,737 persons were issued legal notice and 5,394 persons were prosecuted for creating mosquitogenic conditions. First time 1,789 persons were fined on the spot for creating mosquitogenic conditions and Rs 1,030,700/- were charged under the on-the-spot fine. This amount is the highest in any zone of Delhi. The advantage accrued is visible in terms of decreased morbidity and mortality in the Civil Line zone in 2022 whereas all other zones showed extensive dengue burden in Delhi in 2022.

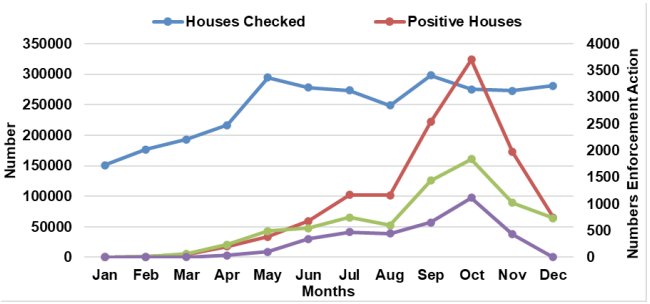

Figure 8.Month-wise Enforcement Action Taken in the Civil Line Zone in 2022

Figure 8 reveals the month-wise enforcement action taken as provisions under the malaria bye-laws of the DMC Act. Vector surveillance supplemented with enforcement action. The enforcement action started before the rising trend of entomological Indices.

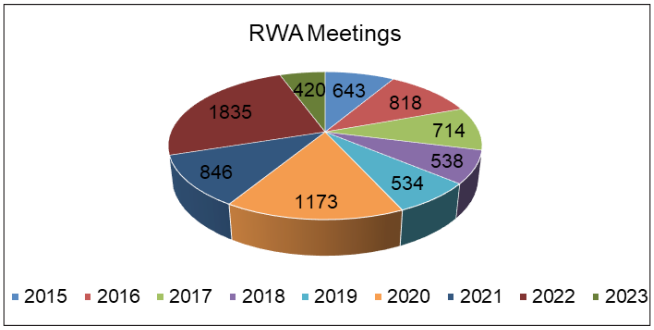

Figure 9.Year-wise Resident Welfare Associations Meetings Organised in the Civil Line Zone in 2022

Figure 9 shows the number of meetings organised to sensitise Resident Welfare Associations on the prevention and control of mosquito breeding and vector-borne diseases. The objective of these meetings was to sensitise community members and seek their engagement. 1835 meetings were organised as compared to 846 in 2021. These RWA meetings supplemented the role of enforcement action.

Figure 10 shows the year-wise RWA meetings, Awareness Rally by the staff of the Public Health department and various activities to involve school children. Staff rallies and school activities could not be carried out in 2020 and 2021 due to COVID-19 Pandemic. During the COVID-19 pandemic, social media was used for community sensitisation. All three activities were strengthened in 2022 and in maximum

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number as compared to previous years. These activities help in sensitising community members leading to behaviour change.

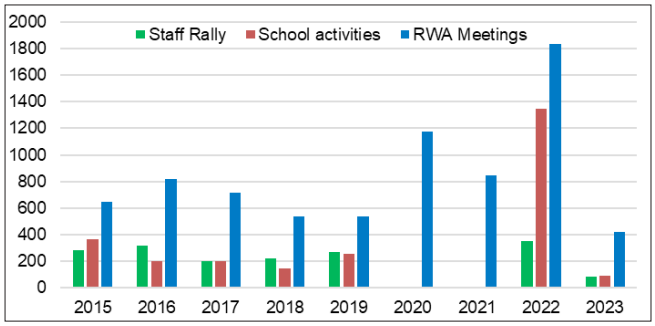

Figure 10.Year-wise Community Sensitisation Activities Organised in the Civil Line Zone

Figure 11 shows the month-wise behaviour change activities. These activities were continued from the beginning of the year but strengthened during the post-monsoon period to have a sustained effect. During the beginning of the year, behaviour change activities are less as at this time, preparation for domestic breeding checking, capacity building and other preparatory activities are organised. Strengthening behaviour change activities will have more impact before the rainy season so that the community can remember and correlate preventive measures during rains.

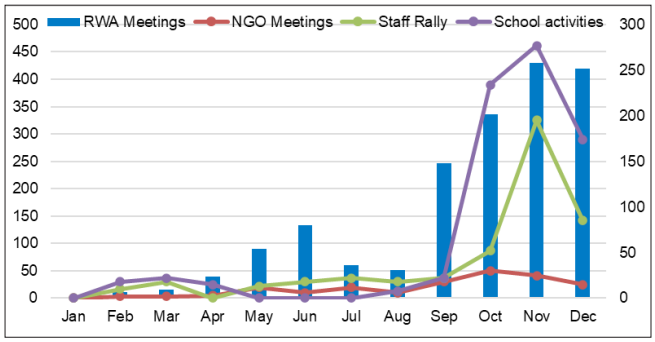

Figure 11.Month-wise Community Sensitisation Activities in the Civil Line Zone in 2022

Discussion

Few cases were reported in Delhi during 2018, 2019, & 2020 which can be attributed to the COVID-19 pandemic which had led to poor quality surveillance as the citizens were scared of going to hospitals for fear of getting diagnosed with COVID-19. 2021 large number of dengue cases have been notified due to improved surveillance. This is also supported by Figure 1. Private Hospitals were also directed to report all Dengue cases.

Integrated Vector management is a process for managing vector populations to break the transmission cycle and decrease the incidence of vector-borne diseases. This process includes vector control interventions used to supplement each other mode of action, collaboration with stakeholders, community engagement and a regulatory and legislative framework for public health. An IVM-based process should be cost-effective and have indicators to monitor the impact of interventions on vector populations. It should allow planning and decision-making at the lowest possible administrative levels.[3] In the present study the author wanted to assess the impact on vector indices and cases of dengue by 2 critical interventions of Law enforcement against offenders and by enhancing community sensitisation for their involvement. The visible impact was a reduction in number of dengue cases in 2022 as compared to previous years. 501 dengue cases were notified in the Civil Line zone in 2021 whereas 139 dengue cases were notified in the zone in 2022 despite improved surveillance mechanisms by involving IDSP in 2021.

Enforcement action was directly proportional to the number of houses found positive for mosquitoes during entomological surveillance. 7737 persons were issued legal notice for encouraging mosquitogenic conditions or creating mosquitogenic conditions. 5394 persons were issued a court challan and they had to appear before Municipal Magistrate for the offence of creating mosquitogenic conditions either as first offender or detection of breeding on multiple occasions. A major thrust of law enforcement was at construction sites.

Other factors for prosecution action were lack of vector control measures by contractors/ owners of major construction sites, lack of support from stakeholders, community members being resistant to behaviour change despite previous visits by health staff to their premises for breeding checking and health education, and community perception that *Aedes* control is the responsibility of the Government.

Role of Enforcement Action

The purpose of the legislation is to ensure compliance with pieces of advice/ messages to speed up behavioural changes.

The National Environment Agency of Singapore is taking all measures for the prevention and control of mosquito breeding in an integrated format in Singapore. They had strengthened Enforcement action for construction sites and Town Councils. In June 2020, a fivefold increase in the incidence of *Aedes* mosquito larvae detected in homes and common corridors in the residential areas was observed and it was decided to increase the composition fee for premises where multiple mosquito breeding habitats within the same inspection or where mosquito breeding has been detected even after a legal notice has been served within a dengue cluster area. Repeat offenders will also be given heftier penalties or sent to court.[7] In Singapore, three

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pieces of legislation, namely, the Infectious Diseases Act (IDA), the Control of Vectors and Pesticides Act (CVPA) and the Environmental Public Health Act (EPHA) provide very wide powers to prevent and control dengue. They prescribe hefty penalties against offenders for failure to comply with the laws. Despite that, the experience showed that it was inadequate to rely only on legislation to control dengue. It is more effective to make the community understand, through communication.[8]

The Parliament of The Democratic Socialist Republic of Sri Lanka has enacted the Prevention of Mosquito Breeding Act, No. 11 of 2007. This Act prohibited creating conditions favourable to the breeding of mosquitoes and elimination or the prevention of any other condition favourable to the breeding of mosquitoes, in or within the premises. Under this Act, it shall be the duty of every owner or occupier of any premises to ensure there is no breeding ground in or around his premises. In case the owner or occupier fails to comply with requirements imposed in this Act, he/ she shall be guilty of an offence under this Act and shall on conviction after summary trial before a Magistrate, be liable to a fine not less than one thousand rupees and not exceeding twenty-five thousand rupees and in case of a continuing offence, to a fine of one hundred rupees for each day on which such offence is continued to be committed after conviction.[9]

In Delhi, enforcement Action is taken under bye-laws, called the Delhi Municipal Corporation (Malaria and other Mosquito-Borne Diseases) Bye-laws, 1975 and extended to the entire area under the jurisdiction of the Municipal Corporation of Delhi. As per provisions of this Act, "no person shall keep or maintain upon or within the premises in his occupation any collection of standing or flowing water in which mosquitoes breed, or are likely to breed, or cause, permit or suffer any water within or upon such premises to term such collection in which mosquitoes breed or are likely to breed unless the collection of water has been so treated effectively, to prevent such breeding and natural presence of mosquito larvae, in any standing or flowing water, shall be an evidence that mosquitoes are breeding in such water".[10]

In a study by Tuli et al., it was reported that outbreaks of dengue and chikungunya can be contained through a multipronged approach including anti-adult measures, antilarval measures, IEC (information, education, and communication) activities, source reduction, enforcement etc. and by using molecular techniques such as RT-PCR for early identification and action. They had adopted these techniques to control Aedes breeding in a dump yard of all confiscated articles which is impossible to control due to multiple sites created by rainwater collection.[11]

Community Participation

Winch et al. observed that community participation is the best strategy for vector control in rural and periurban communities. It's also true there is no alternative to this strategy as this does not involve larviciding or space spraying. There is a need to understand how the government is approaching the community and how the community is already participating in Aedes control. There is a need to study community behaviour and Government agencies need to address the needs of the community in addition to involving the stakeholders to meet the demands of the community, e.g. sanitation department to provide adequate and timely services to clear the garbage.[12]

An in-depth knowledge, attitude and practices (KAP) study to know the attitude of citizens and the practices adopted by them for dengue prevention was conducted in six zones of the erstwhile North Delhi Municipal Corporation (NDMC). It was a descriptive cross-sectional study. On analysis it was observed that 65.75% of people related their source of knowledge to television and 64.5% to health personnel; 70.75% of the respondents knew that dengue is transmitted by the bite of a mosquito. However, a gap was observed in knowledge about common breeding places and the practices that need to be adopted by respondents for preventing dengue. Hence, there is a need to address the behaviour of community members. Although people have adequate knowledge, they do not adopt suitable practices to prevent dengue. There is thus a need for impact analysis and new tools and strategies that can be used for effective communication to seek community participation.[13] In a similar study by Palanivel Chinnakali et al., in Delhi observed that the majority of the respondents (96.3%) had heard about dengue. The important sources of information were television (54.9%) and newspaper/ magazines (51.7%). Around 89% of the study participants considered dengue a "serious problem." Nearly 86% of participants were aware of the spread of dengue by mosquitoes while 73% were aware of one of the correct breeding sites of *Aedes* mosquito. Mosquito mats/ liquidators were used by 61% of respondents, coils by 56% and repellent creams by 22%. It was suggested that awareness regarding dengue and mosquito control measures was satisfactory but programs should focus that this knowledge is translated into practice.[14]

In a study in Thailand by Suwannapong et al., findings confirmed the significance of the eco-health outlook on the dynamics of dengue transmission. Poor management of outdoor solid waste disposal influenced the household risk of dengue infection while having shrubbery areas reduced the household risk of dengue infection. Findings also reconfirmed that strong participation among community members and related stakeholders, such as local authorities,

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public health staff, school teachers etc., were the key factors of dengue prevention and control success.[15]

To achieve sustainable results for dengue control, interventions must fit the ground realities of daily life and must be based on a thorough understanding of the community's problems, especially in settlements on the periphery of Brazil's large cities. Likewise, far more investment must be made in the sector of sanitation and water supply services in such areas. Controlling mosquito infestation in households and commercial and industrial areas requires action from all intersectoral agencies and not just Community Participation in Dengue Control in Brazil the resident population. Strengthening the bonds between communities and health services should be an ongoing effort, rather than reserved for dealing with dengue epidemics.[16]

In a study in China, it was observed that routine dengue control measures rely mainly on vector control i.e. source reduction, larviciding and/ or insecticide space-spraying. However, the vector control strategy usually lacks effectiveness and sustainability while community involvement and enhanced government leadership strategies have been proven to be successful. This is based on community motivation which depends on the community's perception of the severity of the disease, and willingness to take responsibility. The study suggested that a comprehensive and enhanced dengue intervention strategy based on community engagement has a significant effect on controlling a dengue outbreak in areas where the dengue epidemic was mainly caused by imported cases.[17]

In a study in Chennai, India, a cluster randomised controlled trial was designed to measure the outcome of a new vector control package and process analysis; different data collection tools were used to determine the performance. Ten randomly selected intervention clusters (neighbourhoods with 100 houses each) were paired with ten control clusters. In the intervention clusters, Aedes control was carried out using a community-based environmental management approach like provision of water container covers through community actors, clean-up campaigns, and dissemination of dengue information through schoolchildren. The follow-up studies showed that there was a substantial increase in dengue understanding in the intervention group with only minor knowledge changes in the control group. Community involvement and the partnership among stakeholders (particularly women's self-help groups) worked well. After 10 months of intervention, the pupae per person index was significantly reduced to 0.004 pupae per person from 1.075 (P50.020) in the intervention clusters compared to control clusters. There were also significant reductions in entomological indices.[18]

Singapore is known for its use of legislation in dengue control and also plays the role of facilitator and educator to work with and help various target groups to implement a system or re-design structures to prevent mosquito breeding.

Conclusion

Integrated vector management relies on a range of vector control interventions, individually or in combination, with the primary objectives of balancing efficacy and cost-effectiveness in an ecologically acceptable and sustainable manner. No single approach will lead to a sustained programme. There is a need to adopt a balanced approach between education and enforcement during the collective fight against Aedes with the community. It is always useful to have a "stick" which can be used when the situation wants it.

Conflict of Interest: None

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