

Community engagement to control dengue and other vector-borne diseases in Alappuzha municipality, Kerala, India

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ABSTRACT

Introduction Vector-borne diseases (VBDs) are a serious threat in many Indian states, including Kerala. Community-based decentralized planning and engagement are effective strategies that can make positive behavioral changes to control VBDs.

Methods This community-based implementation research was conducted during November 2016 – October 2018 in Alappuzha municipality in Kerala, India. It was conducted in two phases. In the first phase, formative research was conducted to know the community's profile and perceptions and thus to plan and develop an appropriate intervention. Baseline data on some entomological indicators were also collected. These data were used to assess the impact of the intervention by comparing with the post-intervention data. In the second phase, an intervention through the community's engagement was implemented in selected wards. The activities included the formation of community committees and the vector control and source reduction activities with the community engagement and inter-sectoral coordination.

Results The intervention resulted in a positive change among the community to engage in vector control activities. These efforts along with inter-sectoral coordination resulted in successfully implementing vector source reduction activities. In both wards, pre- and post-intervention entomological data (house index: 16.7 vs 6.0 and 64.2 vs. 8.6; container index: 24.8 vs. 12.1 and 37.7 vs. 18.1; and Breteau index: 21.3 vs. 7.3 and 47.7 vs. 8.6) revealed a considerable vector source reduction.

Conclusion The findings of this study suggest considering and including community engagement in public health policy as the main thrust to control VBDs.

KEYWORDS

Community engagement; community participation; vector-borne diseases; vector control; formative research; intervention; prevention

Introduction

Vector-borne diseases (VBDs) are among the fastest spreading infectious diseases of the twenty-first century[1]. VBDs are endemic in more than 100 of the 193 member states of the WHO[1]. The epidemiological profile of VBDs is changing, owing to global climate change leading to warmer temperatures and changes in rainfall patterns. About 700,000 deaths, accounting for 17% of all deaths due to infectious diseases, annually are attributable to VBDs[1]. VBDs are emerging as a challenge to the public health systems, particularly in the Southeast Asia region, including India[2]. In 2006–2007, India experienced a large chikungunya outbreak. The state of Kerala was the most affected in the country and contributed 55.8% of chikungunya cases[3]. Kerala reported a considerable prevalence of six VBDs, namely, malaria, dengue, chikungunya, Japanese encephalitis, West Nile virus and lymphatic filariasis[4]. Alappuzha district is endemic to these VBDs, particularly dengue and Japanese encephalitis [5].

Infectious disease control discourse needs to promote the self-determination of communities[6]. VBDs,

being strongly influenced by environmental and community behavior, cannot be controlled by programs that do not involve the affected community. Conventional community participation strategies often reinforce the power inequalities of society and give little room for communities' self-determination. Strategies, where communities' involvement is deeper, are likely to recognize and accept the right of the communities to self-determination. Community engagement is a process where the community engages and makes decisions itself by designing and governing all the activities which focus to reduce health inequalities and address issues of population health[7]. Community engagement aims to create a sense of trust, identify extra resources, apply sound communication, and enhance the overall result as a better program with sustainable collaborations [8,9]. The community participation can increase people's social capital and thus can positively impact their health and well-being. The community engagement pathways depend on many factors, such as information, consultation,

training, coordination, co-production, delegation of power, and advocacy and partnership building[10].

We studied the impact of a community engagement approach for the control of VBDs in two wards (administrative blocks) of the Alappuzha municipality. We describe the methodologies adopted and the pathways of the community engagement during the intervention. Also, the outcomes of community engagement, the methods to control VBDs and the merits of community engagement are presented.

Methods

This community-based implementation research was conducted in the Pazhaveedu and Vadackal municipal wards of Alappuzha municipality during November 2016-October 2018.

Study area

Two wards were selected for intervention based on the number of confirmed Japanese encephalitis cases in 2013. Out of 52 municipal wards in Alappuzha municipality, 12 municipal wards reported confirmed cases of Japanese encephalitis. The areas were selected based on the history of Japanese encephalitis and other VBDs like dengue and chikungunya, and *Aedes* density. Pazhaveedu ward covers an area of 0.44 square kilometers and has a population of 3,616. The ward has several natural canals and abandoned rice paddies, rivulets, canals, ponds, estuaries, and rice paddies on its border. Vadackal ward covers an area of 0.72 square kilometers and has a population of 4,632. Vadappozhi, an estuarine ecosystem that connects the Arabian Sea to the canals of Alappuzha, is in Vadackal ward. Fishing is the predominant livelihood activity.

Formative research and baseline survey

Formative research was conducted during November 2016-April 2017. A household survey, 41 key informant interviews, 301 in-depth interviews and nine focus group discussions were conducted to understand the profile of the communities and their perceptions on community engagement and vector control. An entomological survey was also conducted in both study wards. All water-filled containers were examined for immature stages of *Aedes* species using fine-meshed fishnets. All larvae and pupae from each mosquito positive container were collected, counted and brought to the laboratories and reared until adult emergence for identification. Potential mosquito breeding sources like thrown-away broken bottles, buckets, jars, pots, and so on were found in both wards. Plastic water drums and unused open wells were significant sources of mosquito larvae in these

areas. Adult mosquito samples were collected using light traps.

Post-interventions survey

After completing the intervention, along with the qualitative research, entomological survey was repeated to assess the impact of the intervention in terms of reduction in vectors and their source.

Statistical analysis

Based on the entomological data, house index (HI), container index (CI), Breteau Index (BI), and pupal index (PI) were calculated. The HI was the percentage of houses or premises infested with larvae or pupae, and was calculated by formula, $HI = (\text{infested houses or premises} / \text{houses or premises inspected}) \times 100$; the CI was the percentage of water-holding containers infested with *Aedes* larvae or pupae, and was calculated by formulae, $CI = (\text{containers positive with } Aedes \text{ larvae or pupae} / \text{containers inspected}) \times 100$; the BI was the number of positive containers per 100 houses inspected, and was calculated by formulae, $BI = (\text{number of positive containers} / \text{houses inspected}) \times 100$; and the PI was the number of pupae per 100 premises, and was calculated by formula, $PI = (\text{total number of pupae} / \text{houses or premises inspected}) \times 100$.

Ethical consideration

The study was approved by the Institutional Ethics Committee of National Institute of Virology (Pune, India) and the Institutional Ethics Committee of T.D. Medical College, Alappuzha. All the study participants, including the members of various committees, were duly informed, and their written informed consent (in Malayalam, the local language) was obtained.

Intervention

During the formative research, the community members and key informants have arrived at a consensus on the need for community-based intervention and pooling of resources for various activities for controlling VBDs. The communities expressed their willingness to participate in this intervention. An intervention with clearly defined objectives and operational modalities, including that for pooling community resources, was conceptualized jointly by all stakeholders, namely, the researchers, municipality and the community. Through discussions, it was agreed upon to (i) develop a community intervention model to reduce the vector breeding in Pazhaveedu and Vadackal municipal wards; (ii) understand the way the community intervention contributed to eco-bio-social factors to control

vectors in the selected wards; and (iii) understand the strengths and weaknesses of this community-based intervention to assess its sustainability and the scope for scaling up. The intervention, including the evaluation, was carried out during May 2017–October 2018.

Intervention strategies

The following general principles were discussed during community meetings and were implemented – (i) the primary target for intervention was vector control (both breeding reduction and anti-adult measures); (ii) based on the assessment of feasibility and anticipated effectiveness, each community decided on the risk reduction strategies that they adopted; (iii) the intervention measures were implemented through various committees constituted by the community members; (iv) the implementation committees collaborated with the local self-government, public health system, and the other relevant agencies (explored for public–private partnership); (v) the capacity of the community for implementing the intervention measures was strengthened and necessary training was imparted to suitable persons within the community; (vi) the optimum size of grass root level implementation household group was 35–60 households; (vii) the intervention activities in each household group were implemented by a group-level committee; (viii) a supervisory committee to supervise and review the activities of a cluster of two group-level committees was responsible for 70–120 households; (ix) each ward has about 750 households and therefore the number of clusters in each ward was six; and (x) finally, the overall supervision of all the activities in each ward was carried out by a steering committee. [Figure 1](#) depicts various committees formed for the implementation of multiple activities for vector control.

The committees

As per the intervention plan, three levels of committees, *viz.*, steering committee, cluster committee, and group-level committees were formed in each ward. The steering committee was responsible for the overall coordination and monitoring of the ward-level activities. Each ward was divided into six clusters and each cluster into two groups. Thus, six cluster committees and 12 group committees were formed for the field level activities ([Table 1](#)).

The steering committee consisted of elected members of the local self-government, religious functionaries, and socially active citizens with higher community acceptance. During the formative research, potential members of the steering committee were met, and their consent to serve as members of the steering committee was sought. Subsequently, cluster committees and group-level committees were formed. The cluster- and group-level committees were formed purely based on people's keenness to participate irrespective of their political, religious, caste or gender differences. Their willingness was based on the perceived need to minimize VBDs in the community and vector control as a means to achieve this. The intervention developed has been modified in a timely manner according to the suggestions, plans, and feasibility as assessed by various group-level committees. The decision-making process in the committee meetings was guided by the broad intervention framework formulated by the research team. All the activities listed in the final action plan approved by the group-level committee were implemented.

A training program for listing the households was provided to the group members. This enabled to follow uniform guidelines. The group committees enumerated and listed households in their respective clusters under the supervision of cluster committees. Assigning a unique identity number to each household helped the group members to identify the houses

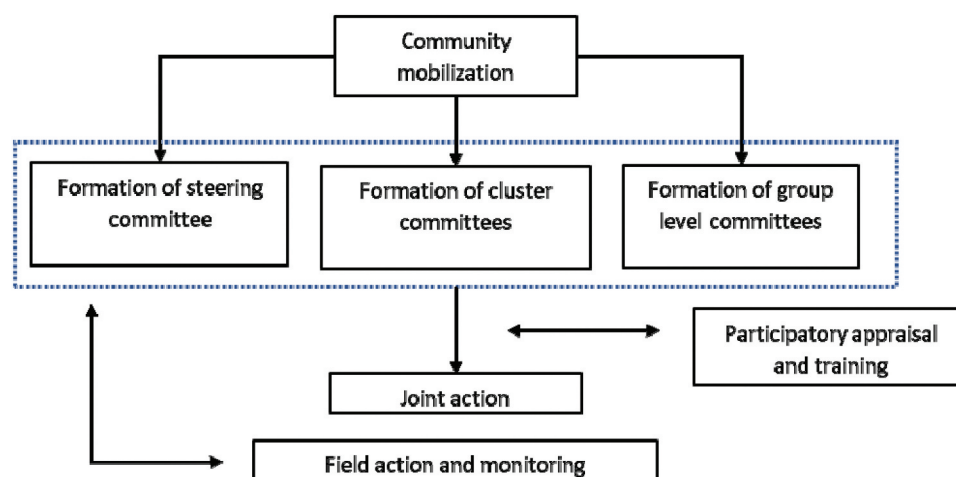


Figure 1. Scheme of intervention through community engagement for vector-borne diseases control.

Table 1. Details of committees.

Committee	Number per ward	Number of members involved	
		Pazhaveedu block	Vadackal block
Steering Committee	1	29	31
Cluster Committees	6	54	54
Group level committees (2 per cluster)	12	159	130

during the monitoring process. The formation of committees was followed by the information dissemination meetings and the community organization process. Steering committee coordinated the cluster committees' activities, while cluster committees coordinated group-level activities. Each committee maintained records of their decisions, minutes of the meetings, and diary records of the field activities they carried out in the community. The cluster committees hosted the group committee formation, meetings and the training programs for the group committee members. The protocols for planning and executing the activities and monitoring were clearly defined. The role and responsibility of the cluster committees to monitor the activities of the group committees and that of the steering committee to monitor the activities of both the cluster and group committees were finalized. The research team ensured that these activities were evidence-based and are supported by scientific principles.

Community organization

The formation of various committees was crucial in the plan of action as we considered it as an integral part of research and community intervention ethics. Formative research findings and the purpose of the study were disseminated widely in both the wards. Because of it, the community members knew the existing situation and felt the need to control mosquitoes and the need to organize themselves (engaging actively) for this common need. The formation of the committees at the ward, cluster, and group levels facilitated the community mobilization processes. The participation of the community members in the committees was purely by their willingness and the acceptance of the community, thus honoring the right of the individual and the community for self-determination.

The research team met the democratically elected municipal councilors and other key persons several times to discuss the choice of community members of the steering and cluster committees. The research team was keen to know their opinion about who should be the committee members. The duties and responsibilities of the members of each committee were explained to the selected members, and their consent was obtained. The frequent visits to the

community members and discussions with them during the process of community organization before forming the committees helped to mobilize the community for the formation of the committees and later for the implementation of the committees' decisions. There were some hurdles such as bad weather, occasional inadequate response from the community, and difficulty in accessing some community members.

Intervention strategies

Each group-level committee chose the intervention strategies that they would implement in their respective household group based on their assessment of feasibility, perception of effectiveness, in concurrence with the research team. The strategies adopted at the group level are summarized in Figure 2.

Activities for improving awareness

Awareness activities were conducted through (i) poster campaigns; (ii) house-to-house awareness campaigns for source reduction; (iii) distribution of notice/pamphlets/brochures regarding community engagement to control VBDs; and (iv) social media campaigns (through WhatsApp groups of the committee members). These activities were planned and done under the supervision of the steering committee. The poster campaigns and social media campaigns received good response from the community.

Waste management

Cluster committees carried out waste management program to remove and dispose of the waste. The improper garbage disposal was perceived as one of the causes of mosquito breeding as the dumped waste often created waterlogging. Health hazards of indiscriminate dumping of garbage in public places were discussed in the cluster- and group committee meetings. Waste management measures included awareness generation, mass cleaning drives, and household inspection. A waste management strategy was adopted by two clusters in each of the wards. One of the clusters implemented a systematic program to collect plastic waste from all the households in the cluster once a week and sent it to the aerobic compost and plastic waste management unit run by Alappuzha municipality. A monthly contribution of Rs. 15 (\approx US\$ 0.2) was collected from each household for this. One of the community members was assigned the task of collection and transport of the waste to the aerobic compost unit. In one cluster, a mass cleaning through voluntary participation was also conducted. The

Sl. No.	Functions and Activities	C1		C2		C3		C4		C5		C6	
		P	V	P	V	P	V	P	V	P	V	P	V
1	Class on VBDs and vector control	●	●	●	●	●	●	●	●	●	●	●	●
2	Poster Campaigns and installation of hoardings	●	●	●	●	●	●	●	●	●	●	●	●
3	Training for house listing	●	●	●	●	●	●	●	●	●	●	●	●
4	Listing of household and institutions	●	●	●	●	●	●	●	●	●	●	●	●
5	Distribution of Vector Control Monitoring Cards (VCMC)	●	●	●	●	●	●	●	●	●	●	●	●
6	House to house awareness campaigns and monitoring visits	●	●	●	●	●	●	●	●	●	●	●	●
7	Setting up of Larvae trap		●		●								
8	Poster competition/Poster Campaign through children												
9	Plastic waste management and mass cleaning activity							●		●	●	●	
10	Submitting official request to Municipality for Chemical Spraying/fogging	●	●	●	●	●	●	●	●	●	●	●	●
11	Chemical Spraying Activity Support	●	●	●	●			●	●			●	●
12	Intervention programme (with contact details of committee members) notice/pamphlet/leaflet distribution	●	●	●	●	●	●	●	●	●	●	●	●
13	Second level Poster Campaign regarding vector control and installation of hoardings	●	●	●	●	●	●	●	●	●	●	●	●
14	Redistribution of VCMC in flood-affected clusters									●		●	

Figure 2. Major functions and activities of the cluster committees in Pazhaveedu (P) and Vadackal (V) wards of Alappuzha municipality.

following remark of a cluster committee coordinator reflects the community's perception on the importance of vector control activities and the role of waste management.

"The major source of mosquito larvae we identified after the field monitoring visits in our cluster area was the plastic waste thrown carelessly. We have done an awareness campaign against plastic waste littering. But we were not getting visible results. Then, we thought about plastic waste collection and disposing it at the municipality plastic disposal system situated 4 km away from our place. The community members were willing to participate, and thus through waste management, our cluster could find a way to control the mosquitoes too."

Larval trap – a local innovation

An innovative larval trap was devised by a cluster committee of one of the wards. This was implemented in two clusters of Vadackal municipal ward. The trap was a container filled with water kept in an open space that attracted mosquitoes to lay eggs. The larvae in the traps were sieved out using a cloth sieve once in a week and were destroyed. A member of a cluster committee observed,

"The source reduction activity using larvae trap was quite an environment friendly. Earlier, the larvae on the straining clothes after straining were destroyed along with the cloth by burning. Now we are planning to use these collected larvae to feed the guppy fishes. This is a biological and natural way to eliminate these larvae and does not have any environmental impact."

Availing the public health system's facilities and inter-sectoral coordination

Cluster- and steering committees played a crucial role for inter-sectoral coordination. Members of these committees discussed the importance of community engagement and motivated the people (in their neighborhood) and ensured that the premises of the household clean by removing the vector breeding sources. Four clusters in Pazhaveedu ward and three clusters in Vadackal ward requested their municipal councilors for chemical spraying resulted in spraying in these clusters by the municipality. Steering committees of both wards sought the support of the municipality. The Alappuzha Municipal Council appreciated the community. The researchers received a letter of appreciation for their efforts, and it showed Alappuzha municipality's interest to implement similar interventions in other wards of the city.

Monitoring through vector control monitoring card (VCMC)

The community-engaged intervention to control VBDs gave importance to monitoring activities. The vector source monitoring was done through a specific method using VCMC. VCMC cards were provided to each household by group committees. On this card, the details of the household and the vector sources were noted down in detail after each visit of the committee members. This helped the household to carry out source reduction activities appropriately. Similar

monitoring of vector source reduction was carried out in local institutions in these wards.

Results

Baseline survey

The formative research showed that there were a total of 1,623 households (852 in Pazhaveedu and 771 in Vadackal) including those under construction and vacant houses. Household details and phone numbers were recorded. Each house was marked with a unique number that identifies each house with its ward, cluster and group details.

Pre-implementation entomological indices

An entomological survey (Table 2) was conducted in 151 and 150 households and 11 and 8 institutions in Vadackal and Pazhaveedu, respectively. Potential mosquito breeding sources like thrown-away broken

bottles, buckets, jars, pots, and so on were found in both wards. Plastic water drums and unused open wells were significant sources of mosquito larvae in these areas. The culture of waste management is observed to be linked directly to these issues. The indices in Vadackal ward were HI = 64.24, CI = 37.7, BI = 47.7, and PI = 27.8. In Pazhaveedu ward, these indices were HI = 16.67, CI = 24.81, BI = 21.33, and PI = 10.67.

Post-implementation entomological survey

After 1 year of implementing the intervention, the entomological survey was repeated with the participation of the community. There is a remarkable source reduction as seen by various indicators in both the wards (HI: 16.7 vs 6.0 and 64.2 vs. 8.6; CI: 24.8 vs. 12.1 and 37.7 vs. 18.1; and BI: 21.3 vs. 7.3 and 47.7 vs. 8.6) (Table 2). The distribution of entomological indices by clusters is presented in Figure 3, which showed an overall decrease in the entomological indices after the intervention.

Table 2. Entomological survey results of pre- and post-intervention in Pazhaveedu and Vadackal wards of Alappuzha Municipality.

	Pazhaveedu block		Vadackal block	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
House index	16.7	6.0	64.2	8.6
Container index	24.8	12.1	37.7	18.1
Bretaux index	21.3	7.3	47.7	8.6
Pupal index	10.7	-	27.8	-

Evaluation

Evaluation of the intervention was carried out at different levels. The committees evaluated their activities through meetings conducted in their concerned clusters. In the cluster meetings, the committee members shared the feedback from the households. For the detailed evaluation, all committees of each ward met and appraised. These evaluation meetings identified

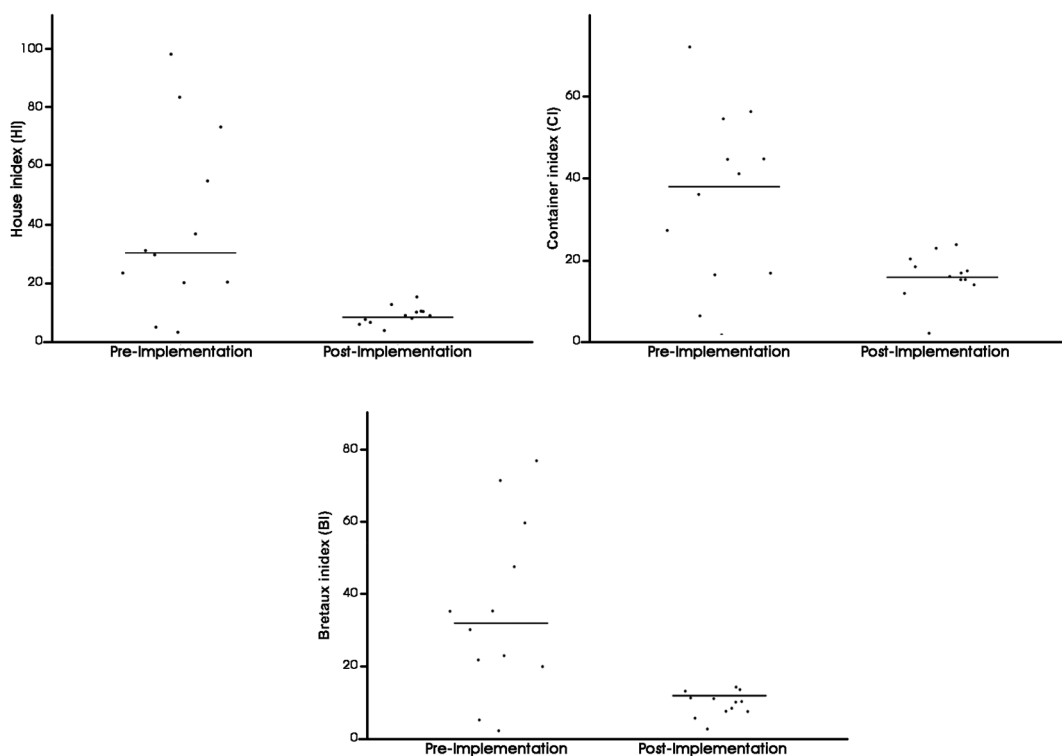


Figure 3. Changes of entomological indices during pre- and post-implementation of the intervention.

the issue of social contamination, which has slowed down the members' engagement activities. The committee members admitted that the time and coordination of the community were not as anticipated during the meeting. All the cluster committees explained their activities as part of the intervention and the challenges they faced in implementing those activities. The committees which did not complete the house listing and VCMC distribution explained the challenges they faced. The evaluation of the program summed up major challenges faced by the implementation of the intervention program. The major challenge was the coordination of the community members, which was less than desired. The participants were not always available together at a given time. Some pre-scheduled activities had to be postponed owing to religious functions, political engagements, or other cultural festivities. The chairperson of the Alappuzha municipality also participated in the meeting held in Vadackal and acknowledged the positive impact of the intervention.

Discussion

The present study demonstrated that community engagement, coupled with inter-sectoral coordination, lead to improved vector control, especially the source reduction, where people's engagement played a pivotal role. Inter-sectoral coordination with people's participation lead to intensified vector control activities. It may be highlighted here that partnership among various stakeholders, namely, the community, municipality and the researchers created an active and enthusiastic environment to achieve the targets set to achieve vector control by playing respective roles responsibly. The impact of these efforts is visible through post-intervention entomological indices.

It is known that community-based programs effectively controlled and prevented VBDs like dengue in Asia and the Americas[11]. The importance of similar community engagement and citizen involvement, which are still not adequately considered, should be prioritized according to the geographical variation and sociocultural differences[12]. Thus, there is a need for community engagement, and the involvement of local authorities to encourage communities and inter-sectoral coordination[13]. Various committees of the Government of India on primary health care pointed out the essentiality of community participation [14,15].

Community participation has a pivotal role in restraining and curbing VBDs [16–18]. Engagement of households and community has a prominent role in controlling mosquitoes because the issue is inextricably entwined with the lives of people and their surroundings. VBDs spread by the *Aedes* mosquitoes are of particular importance at the community level given they live and breed in and around where people live.

The study revealed that there is a continuous and ongoing interaction between community and health personnel; the community will develop a sense of responsibility and accept public health programs as their own. *Aedes* breeding always exists in the tropical semi-urban habitations of Kerala, but usually is of moderate intensity. The community usually engages itself, though informally, in the process of reducing the breeding in their surroundings. However, transforming these informal actions into a formal and organized activity, multi-stakeholder engagement, and modeling the process at the grassroots level is essential for better coordination of public health with other sectors [19–21]. One of the key policy principles of India's National Health Policy (2017) is the promotion of community participation in health planning processes[22]. The 'bottom-up' method has value by making responsive and sustainable health behavior change through a process involving people and thereby empowering the community. However, it must have a continuous and steady process of a well-built collective community base[23]. Tacitly, the processes, benefits, and outcomes of community engagement are comparatively a new area of study or have not been considered adequately.

Civic engagement makes democracy work, and social theorists argue it with many examples from different sectors[24]. Though the concept of people's participation is familiar in Kerala, health-specific community-based engagement activities are not wide. Despite being aware of the importance of preventive healthcare, the people and the political governing system believe more in curative medicine and consider the pharmacological interventions paramount; and gives little importance to environmental management, leading to a higher disease burden at the community level[25]. Moreover, community-based interventions are normally difficult to implement and often, the impact is not visible immediately. These, in turn, discourages the governments from spending time, money and human resources to develop such interventions in the community[26]. However, community-based intervention is the best affordable way of controlling VBDs, especially when the cost of treatment and infirmity is high, and there is no specific treatment and vaccination available[27].

The impact of an integrated community-based approach for dengue control is demonstrated that community-based approach is more affordable compared to the top-down program[28]. Although our study did not conduct a cost-benefit analysis, it revealed the importance of community engagement on dengue prevention, particularly source reduction. However, there is a need to improve the capacity of the community through shared leadership, systematic planning, local-level communication, and behavior modification activities for greater ownership[17]. High

burden of VBDs in Kerala is evident as there has been a substantial increase in VBDs-related morbidity, and people perceived the threat of VBDs. There is a need to reform the indicators and signs of development with more community-engagement practices. The medical and healthcare practices are the main objectives in developmental and health policies, and they were misunderstood as the key for development. The community-based public health practices are also to be considered as objectives of these policies. This intervention study demonstrated the importance of community-engaged practices in the control of VBDs. The people have the perceived threat of VBDs, and this perceived threat enabled to engage them. An intervention program to control mosquito larval production in Honduras based on community engagement has improved dengue-related knowledge and a substantial decrease in the household entomological indices by 20% from the second month of the intervention itself[29]. The systematic review examined the implications of various types of dengue vector control intervention programs and identified that dengue control intervention programs were successful, especially when the intervention programs use a community-based integrated approach, which is focused and implemented based on consideration of local eco-epidemiological and sociocultural parameters along with information, education and communication (IEC) strategies to increase awareness among the people in the community and dissemination of best practices[30].

Two major observations could be made from this research. First, the community is the prominent and major part of disease control and health-related activities. The community is willing to participate as they perceived the threat of VBDs, and they are well aware of their rights and strengths. Secondly, the formation of different levels of committees in the neighborhood with adequate facilitation strengthened the community engagement activities. The group committees initiated disease control activities in their locality with a feeling of collective responsibility. These observations make it clear that community-engaged interventions are feasible in controlling and preventing VBDs.

The policy recommendation from the study is the importance of community engagement and inter-sectoral coordination in disease control. The main concern of the community engagement program is its sustainability and replication of positive effects of such interventions within the community and other areas. There are three points to focus on to maintain the outcomes of community engagement programs: first is to address the infrastructural issues such as sanitation, waste management, and vector-breeding source reduction; second, continuous actions and coordination with the local self-government and support of other non-governmental institutions within the

community; and thirdly, the integration and implementation of community engagement strategies to the government-run routine VBD control and source reduction activities.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Indian Council of Medical Research [Adhoc/2014/77/HSR].

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