

# Intersectoral Collaborations for the Prevention and Control of Vector Borne Diseases: A Scoping Review

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## ABSTRACT

**Objectives.** This scoping review aimed to support a landscape analysis to identify lessons learned about intersectoral collaborations (ISCs) by describing their existing models in the context of dengue, malaria and yellow fever.

**Methods.** A scoping review following the methodology of Joanna Briggs Institute was performed using the following inclusion criteria: studies involving humans; studies discussing intersectoral collaborations, malaria/dengue/yellow fever, and prevention or control at any level; and studies in countries endemic for the aforementioned diseases. Studies were screened using Covidence, while data were extracted using NVivo.

**Results.** Of the 7,535 records retrieved, 69 were included in the qualitative analysis. Most ISCs were initiated by multilateral organizations and ministries of health, and none by communities. Strategies included advocacy, health education, research, public health measures, resource mobilization, service delivery and training; mostly employed on a community level. Monitoring and evaluation were mostly formative, ongoing, and participatory. Gaps included administrative and policy barriers, resource shortages, and inadequate research and training.

**Conclusions.** Multiple models of ISC exist in the literature. There is a need to develop a comprehensive framework for an effective and sustainable multisectoral approach for the prevention and control of VBDs ensuring adequate resources, active stakeholders, and strategies that span the entire socio-ecological spectrum.

**Key Words:** dengue, disease vectors, intersectoral collaboration, malaria, review [Publication Type], vector borne diseases, yellow fever

## INTRODUCTION

Vector-borne diseases both impede human development and result from a lack thereof, having the highest burden in the least developed populations in the world.<sup>1</sup> In recent years, there has been an increase in the number of cases and fatalities from arboviral infections other than malaria such as dengue and yellow fever, despite strong prevention and control efforts. Malaria case incidence has fallen by around 18% since 2010, however the rate of decline has stalled and in some cases reversed between 2014 and 2016.<sup>2</sup> According to the 2013 Global Burden of Disease Study, the incidence of dengue more than doubled every decade from 1990 to 2013.<sup>3</sup> However, the actual numbers of cases are underreported and misclassified, with a large discrepancy between academic estimates and reported burden due to a lack of capacity for surveillance.

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The Multisectoral Action Framework for Malaria (MAFM) initiated by the United Nations Development Program (UNDP) called for action in multiple sectors to complement existing malaria control strategies. Its goal was to present implementable actions for countries to transform malaria processes from being solely a health sector responsibility to a shared responsibility via a multi-pronged approach. After its launch in 2016, there has been a standing initiative to expand the MAFM to other vector-borne diseases, in the context of the Sustainable Development Goals.<sup>4</sup> The WHO currently recommends Integrated Vector Management (IVM) for the prevention and control of dengue, however data on its impact on the disease was deemed insufficient. One of the key elements for the successful implementation of IVM is collaboration through the optimal use of resources, monitoring and decision-making; however, in the context of dengue, the extent of collaboration and challenges in implementation globally is vague.<sup>5</sup>

This scoping review aimed to support a landscape analysis to better identify the knowledge gaps and lessons learned about inter-sectoral collaborations for the prevention and control of vector-borne diseases and how stakeholders are working together to achieve the implementation of a global strategy by describing existing models and frameworks related to inter-sectoral collaborations for the prevention and control of selected vector-borne diseases – specifically dengue, malaria, and yellow fever, alongside strong efforts to prevent and control malaria.

## METHODS

### Scoping Review of Literature

A scoping review of literature, which is “aimed at mapping key concepts, types of evidence, and gaps in research related to a defined area or field by systematically searching, selecting, and synthesizing existing knowledge”, was conducted to address the study objectives, adopting the methodology of Arksey & O'Malley (2005) and Levac, Colquhoun, & O'Brien (2010) as collated by The Joanna Briggs Institute.<sup>6-9</sup>

This scoping review addressed the question, “What models of inter-sectoral collaborations have been implemented in countries where vector-borne diseases are a priority issue, and what are documented effects on the prevention of vector-borne diseases?”.

Records that satisfied all of the following criteria were considered for inclusion in the review: (1) discusses the population, concept AND context parameters contained in the research question, (2) any type of article, e.g., case studies, primary researches, reviews, editorials, etc., (3) accessible full-text article, (4) available in the English language, and (5) published between 01 January 1985 and 31 December 2016. These criteria, which were determined a priori, were selected to increase the sensitivity or comprehensiveness of the search, consistent with the intent of a scoping review.

A preliminary search of PubMed was done using search terms categorized into population, concept, and context. Population included studies with humans; concept included studies that tackled (a) intersectoral collaborations, (b) malaria/dengue/yellow fever, and (c) prevention/control at any level; and context included studies that discussed countries endemic for malaria, yellow fever, and/or dengue. A secondary search of all included databases (i.e. PubMed, Scopus, ProQuest Central and the Public Library of Science/PLoS) was then conducted using the expanded list of search terms. All records obtained from the different databases were deduplicated manually, and by using EndNote™ X8 (Thomson Reuters, 2016)<sup>a</sup> and Covidence (Veritas Health Innovation Ltd, 2017).<sup>b</sup> Using Covidence, abstracts of the records were each screened independently by two reviewers, and conflicts were resolved by an arbitrator. Included records were moved to full-text screening, where they were further scrutinized. If a study met the inclusion criteria, the full-text was imported to NVivo 11 Pro (Version 11.3; QSR International Pty Ltd, 2016)<sup>c</sup> for qualitative data analysis. Data from the final list of included records were extracted using NVivo. Reference lists of records included for qualitative data analysis were examined, and records assessed to be relevant for the study were subjected to both abstract and full-text screening. No hand searching was done, and articles that required purchase for full-text accessibility were not included due to feasibility considerations.

Data on study characteristics (e.g. author/s, publication year, country of origin, type of publication), aims and methods of the publication, outcomes measured, stakeholders and proponents of the intersectoral collaboration, source of funding and resources used by the collaboration, goals and outcomes, strategies employed, mechanisms for monitoring and evaluation, and the gaps in policy, research, and training were identified from the full-text of the article, and coded into nodes pre-specified according to review objectives using NVivo (Appendix). Data abstracted from the selected records were determined from the standard list as prescribed by The Joanna Briggs Institute, modified to suit the objectives of the review. As major themes and constructs emerged, in-vivo nodes were either expanded or merged with existing nodes. Data on the country of

a EndNote is a software that acts as a reference manager. Its features include deduplication of references, integration with Microsoft Word, and reference organizing, among others. For further information, readers may visit <https://endnote.com/product-details/>.

b Covidence is a screening and data extraction tool which allows a team to undertake most of the labor-intensive steps in a review process. For further information, readers may visit <https://community.cochrane.org/help/tools-and-software/covidence/about-covidence>.

c NVivo is a qualitative data analysis software that aids in the organization, analysis, synthesis, and visualization of qualitative and mixed-methods data. For further information, readers may visit <https://www.qsrinternational.com/nvivo/what-is-nvivo>.

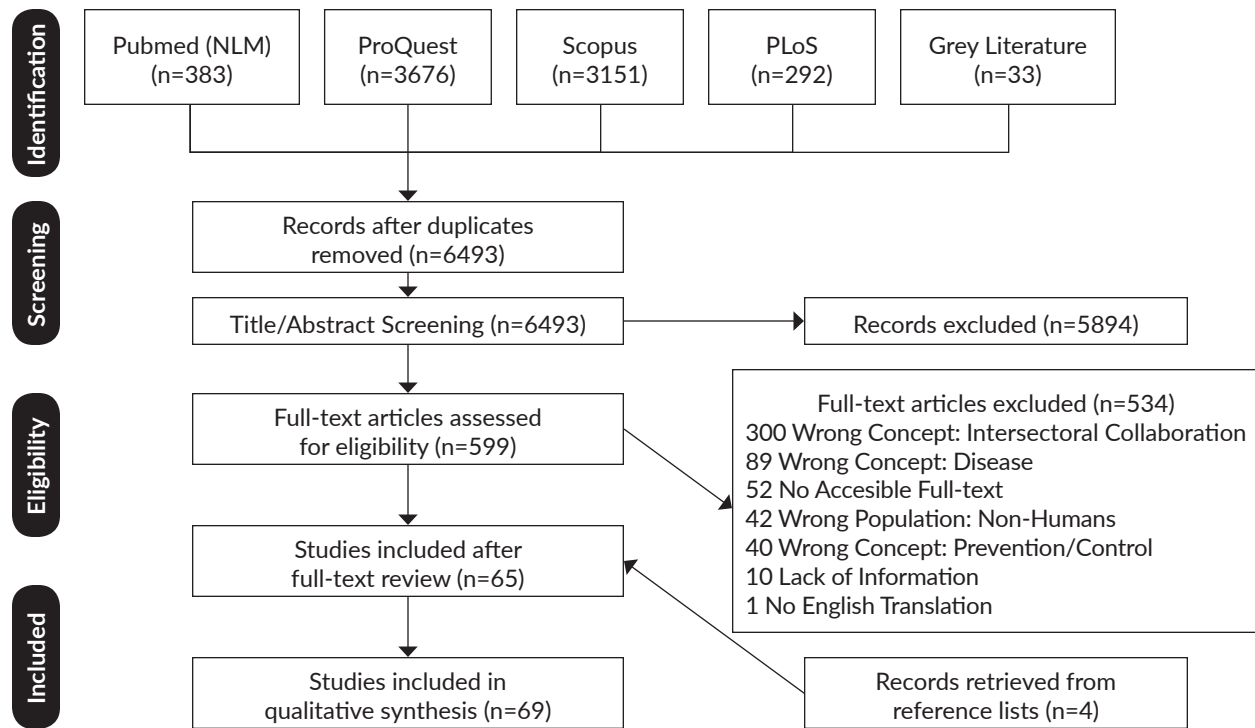


Figure 1. PRISMA Flow Diagram.

origin of all studies was synthesized and visualized using the mapping functionality of Tableau (Tableau Software)<sup>d</sup>. After the coding of data from all included studies, data was synthesized by cross-tabulating nodes.

## RESULTS

The scoping review yielded 7,535 records, of which 69 were included in qualitative data analysis following title and abstract screening, full-text assessment, and review of reference lists (Figure 1).<sup>11-79</sup>

Out of the 69 records included in the review, 11.6% were published in 2005, and 39.1% were original journal articles. Other articles included conference proceedings, institutional reports, journal articles (commentaries), journal articles (reviews), periodicals, theses/dissertations, and websites. The countries with the greatest number of published records were Tanzania (15), Kenya (12), Ghana (10), Uganda (10), and Zambia (10) (Figure 2). There were 59 records that discussed malaria and 13 records that discussed dengue fever. No literature for yellow fever was found.

For this review, the different intersectoral collaborations (ISCs) were named based on the type of control program (i.e. either dengue or malaria, and the place involved). These

include the following: the Malaria Control Programme (MCP); Dengue Control Programme (DCP); Roll Back Malaria (RBM); Multilateral Initiative for Malaria (MIM); Asian Centre of International Parasite Control (ACIPAC); Global Fund for AIDS, Tuberculosis, and Malaria (GFATM); Primary Health Care (PHC) for Nepal; and Integrated Vector Management (IVM).

## Structure and Composition of Intersectoral Collaborations

Majority of the intersectoral collaborations were initiated by multilateral organizations and ministries of health, and none by community-based organizations. Table 1 shows the overall distribution of stakeholders, with gray cells indicating the proponents of the collaborations.

Thirty organizations assisted in the funding of the various collaborations. Seventeen of these funders belonged to the public sector, mainly other development aid agencies. There were five institutions of mixed-type ownership (GFATM, RBM, WHO, International Development Research Centre (IDRC), and the Pan American Health Organization (PAHO)). Funding of most ISCs identified were mostly sourced from government of the country involved.<sup>10,19,28,32,33,35,39,45,55,56,69,75</sup> Meanwhile, other collaborations were funded directly by the GFATM, the US Agency for International Development (USAID), as well as the IDRC.<sup>11,18,19,24,27,34,48,53,56,62,65,71,75,77</sup>

The most frequently occurring resources used were human resources – researchers and health

<sup>d</sup> Tableau is a data visualization software which has an interactive data mapping feature through the use of built-in postal codes, latitudes, and longitudes. For more information, readers may visit <https://www.tableau.com/products/desktop>.

**Table 1.** Summary of stakeholders per Intersectoral Collaboration

Official Name of ISC	Academe and Research Institutes	Civil Society Organization	Community	Government Agency – Ministry of Health	Government Agency – Other	Industry	Multilateral Organization
ACIPAC	4	5	1	3	4	1	7
DCP <sup>1</sup>	1	1	0	0	0	0	1
DCP Latin America and Caribbean <sup>2</sup>	4	1	5	7	6	1	8
DCP Asia <sup>3</sup>	2	0	5	2	2	0	0
GFATM Uganda	0	0	0	1	0	0	0
IVM	0	0	0	1	0	0	1
RBM & MIM <sup>4</sup>	13	27	3	3	12	12	27
MCP	6	5	1	5	6	2	18
MCP Africa <sup>5</sup>	47	17	22	29	30	8	27
MCP Latin America <sup>6</sup>	5	7	0	5	8	2	8
MCP Asia <sup>7</sup>	4	2	4	5	8	3	1
MCP Papua New Guinea	0	1	0	0	1	0	1
PHC Nepal	0	0	0	1	0	0	0

1 DCP and DCP (Ecohealth)

2 DCP Argentina, DCP Brazil, DCP Cuba (Havana), DCP Cuba (Santiago de Cuba), DCP Americas, DCP Americas (Service Delivery), DCP Caribbean

3 DCP China, DCP Vietnam, DCP Sri Lanka

4 Multilateral Initiative on Malaria, Roll Back Malaria Afghanistan, RBM & MIM

5 MCP Africa, MCP East Africa (Ecohealth), MCP East and Central Africa (Ecohealth), MCP Ghana, MCP Kenya, MCP Kenya and Tanzania, MCP Tanzania, MCP Tanzania (CONTACT), MCP Tanzania (Urban), MCP Tanzania (Voucher), MCP Zambia

6 MCP Argentina, MCP Brazil, MCP Colombia, MCP Latin America, MCP Mesoamerica and Hispaniola

7 MCP China, MCP India (Kheda Project), MCP Laos, MCP Malaysia, MCP Thailand



Color gradient reflects the number of multisectoral collaborations identified in each country.



**Figure 2.** Distribution of intersectoral collaborations for malaria and/or dengue prevention and control, by country/territory.

workers such as physicians, malariologists, and public health officers; environmental consultants such as vector control technicians and entomologists; and community leaders, members, teachers, and volunteers (Table 2).<sup>10-13,19,20,23,25,27,28,32-34,36,38,40,42,43,48,50,55,58,59,61,63,65,67,71,76-78</sup>

### Strategies for ISCs

Strategies employed were classified into the CDC's social ecological model of health, further being classified into type of strategy, as summarized in Table 3. Most strategies were employed on the community level, followed by the policy level. Only three categories – health education, public health measures, and training – had interpersonal-level strategies (Table 3).

### Monitoring and Evaluation

Monitoring and evaluation mechanisms were classified based on the nature of the goal, their duration, and the extent to which the evaluators were involved (i.e. whether they were formative or summative, one-shot or ongoing, and participatory or objectively observational, respectively). Formative evaluations are those that normally occur during a project's implementation, with the aim to improve on the current program design, while summative evaluations are those that simply want to summarize the impact or outcome of a project. One-shot evaluations are those conducted at the end of a program without any information having been collected beforehand, while ongoing evaluations are those that continuously occur throughout the duration of the project. Participatory evaluation is conducted by actively engaging stakeholders of the program, including community members and state authorities; while objective observation is normally conducted by researchers or an external party with the sole task of evaluating the project without involving stakeholders. Nineteen ISCs were found to have employed formative methods of evaluation, while eight employed summative methods; 19 ISCs had ongoing methods of monitoring and evaluation while seven had one-shot

methods; and 13 ISCs used participatory mechanisms, while another 13 used objective observations.<sup>13,16,17,20,21,27,28,30,32,34-36,38,40-43,45,47,50,51,53,56,58,60,61,63,65-68,71,73,78</sup> Mechanisms for monitoring and evaluation were not identified in 22 records.

### Goals and Outcomes

Initiatives for the prevention and control of vector-borne diseases all had the same goal – to reduce morbidity and mortality rates of vector-borne diseases. Among the ISCs that used advocacy or health promotion strategies, it was only the Malaria Control Programme in Africa that indicated a specific goal, which was to develop national research policies for the resolution of national problems.<sup>33</sup> A summary of specific ISC goals and their resulting outputs and outcomes are summarized in Table 4.

As a result of these ISCs, collaborative committees were formed in communities where there were previously none.<sup>25,33,40</sup> Existing vector control programs and networks expanded to areas surrounding the pilot communities, and international summits and community meetings were conducted for the discussion of these diseases and their control.<sup>30,58,65,69,73</sup> Teamwork and coordination skills of the various stakeholders were also enhanced as a result of their frequent interactions, and the empowerment of the communities together with intersectoral coordination allowed for the sustainability and even expansion of the projects after withdrawal of external support.<sup>30,32,55,58,65</sup>

The impact of all the strategies employed by the ISCs was seen in a decrease in the morbidity and mortality rates of dengue and malaria, and in behavioral changes such as increased stakeholder participation and community ownership.<sup>16,25,27,32,42,44,55,61</sup> Control programs were strengthened through the adoption of technology and an increase in resources. Overall, malaria and dengue were recognized as problems in the community that are controllable and preventable through combined local and international efforts.

**Table 2.** Resources used by ISCs for the prevention and control of vector-borne diseases

Material			Human	Financial	Policy		
Infrastructure	Equipment	Supplies			Legislation	Support	Mobilization
<ul style="list-style-type: none"> <li>Laboratory facilities</li> <li>Anti-malaria centers</li> <li>Research and training centers</li> <li>On-site clinics</li> <li>Project headquarters and offices</li> </ul>	<ul style="list-style-type: none"> <li>Laboratory equipment</li> <li>Technical equipment</li> <li>Storage equipment</li> <li>Vehicles</li> </ul>	<ul style="list-style-type: none"> <li>Insecticide-treated bed nets</li> <li>Medicines</li> <li>Promotional materials</li> <li>Educational materials</li> </ul>	<ul style="list-style-type: none"> <li>Health workers</li> <li>Entomology and environmental experts</li> <li>World leaders, government officials</li> <li>Teachers, students, parents</li> <li>Researchers</li> <li>Technicians and operators</li> <li>Community members</li> </ul>	<ul style="list-style-type: none"> <li>Monetary assistance from the ff:                             <ul style="list-style-type: none"> <li>Governments</li> <li>Private institutions</li> <li>Multilateral organizations</li> <li>Philanthropic foundations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Creation of a malaria committee</li> <li>Formulation of strategic plans for control</li> <li>Development of school and occupational health policies</li> <li>International declarations</li> <li>Foreign relations</li> </ul>	<ul style="list-style-type: none"> <li>Endorsement and adoption of the ISC projects by the government</li> <li>Strong political commitment</li> </ul>	<ul style="list-style-type: none"> <li>Provision of human and financial resources by national and local governments</li> <li>Government promotion and encouragement of community participation</li> </ul>



**Table 3.** Strategies of the various ISCs distributed across the social ecological model of health

	Interpersonal	Organization	Community	Policy
Advocacy		<ul style="list-style-type: none"> <li>Negotiation with pharmaceutical industry for affordable prices of new drug combinations</li> </ul>	<ul style="list-style-type: none"> <li>Holistic approaches to management (IVM)</li> <li>Collaboration between local government and technical experts</li> <li>Social mobilization, media campaigns and community health promotion</li> <li>School-based activities using the participatory learning action (PLA) approach</li> <li>Social marketing of insecticide treated materials</li> </ul>	<ul style="list-style-type: none"> <li>Program creation for malaria by multinational groups</li> <li>Implementation of comprehensive legislations</li> <li>Regulation of activities related to VBD transmission</li> <li>Calls to action for health systems strengthening</li> <li>Increase in investment against malaria</li> <li>Establishment of networks at regional, national and international levels</li> </ul>
Health Education	<ul style="list-style-type: none"> <li>Usage of the child-to-child approach</li> <li>Face-to-face encounters for health promotion</li> </ul>	<ul style="list-style-type: none"> <li>Development of curricula and model schools for malaria prevention</li> <li>Decentralization of school supervision</li> </ul>	<ul style="list-style-type: none"> <li>Campaigns spearheaded by students and teachers to raise awareness about malaria using creative methods (e.g. plays, performances, and visual aids)</li> <li>Initiatives such as ecoclubs and demonstrations for treatment, care and maintenance of bednets</li> <li>School-based activities using the PLA approach</li> <li>User-friendly textbooks and manuals for both students and teachers</li> <li>Local mass media, community meetings, information, education and communication (IEC) materials</li> </ul>	<ul style="list-style-type: none"> <li>Distribution of national and international teaching and IEC materials</li> </ul>
Health Research			<ul style="list-style-type: none"> <li>Development of new drugs, insecticides, models of disease epidemiology, vaccines and mosquito traps</li> <li>Epidemiological and entomological research on malaria and dengue prevention and control</li> </ul>	<ul style="list-style-type: none"> <li>Research as a basis for specific vector-borne disease control measures</li> <li>Evaluation of the impact of the use of impregnated mosquito nets</li> </ul>
Public Health Measure	<ul style="list-style-type: none"> <li>Active dengue case findings by family doctors</li> </ul>	<ul style="list-style-type: none"> <li>Provision of insecticide-treated materials to those who could not afford them, courtesy of the district health teams and research groups</li> <li>Organization and infrastructure of cooperatives</li> </ul>	<ul style="list-style-type: none"> <li>Environmental modification and manipulation, risk surveillance, and social mobilization</li> <li>Epidemiological methods such as mapping of communities, rapid survey index, and the malaria information system</li> <li>Multidisciplinary risk assessment and surveillance system</li> <li>Interdepartmental collaboration for mosquito control program management and social mobilization</li> <li>Diagnosis and treatment including health check-ups and community diagnosis</li> </ul>	<ul style="list-style-type: none"> <li>Reduction of taxes on antimalarials</li> <li>Temporary lifting of the ban on DDT for selective residual house-spraying</li> <li>Collaboration and creation of committees and task forces for proper management of programs for VBD control</li> </ul>
Resource Mobilization			<ul style="list-style-type: none"> <li>Funding from international donors for countries that shifted to better insecticides, and the Global Fund for the strengthening of local public health capacity</li> <li>Community self-sufficiency through alternative income generating schemes and contributions by municipalities</li> </ul>	<ul style="list-style-type: none"> <li>Decentralization of the malaria control program</li> <li>Establishment of a malaria medicines and supply service for procurement of antimalarials</li> <li>International funding from the Global Fund for shared surveillance systems</li> </ul>
Service Delivery		<ul style="list-style-type: none"> <li>Efficient diagnostic methods</li> <li>More effective treatment methods</li> <li>Inclusion of insecticide-treated nets (ITNs) and artemisinin-based combination therapies (ACTs) as major part of program scale-up costs</li> </ul>	<ul style="list-style-type: none"> <li>Networks on malaria control in complex emergencies, trained teachers involved in laboratory diagnosis of malaria in children, and distribution of synthetic antimalarials</li> </ul>	<ul style="list-style-type: none"> <li>Activities carried out nationally and internationally in cooperation with stakeholders such as the WHO</li> <li>Introduction of novel combination therapies recommended by WHO</li> </ul>
Training	<ul style="list-style-type: none"> <li>Collaborators guided householders to practice simple mosquito control methods</li> </ul>	<ul style="list-style-type: none"> <li>Recruitment and support of graduate and postgraduate students in Africa for research projects on malaria and dengue</li> </ul>	<ul style="list-style-type: none"> <li>Training of teachers for school-based interventions, and of health personnel for school health management</li> <li>Training of locals for transition and sustainability of control routines</li> <li>Community and field training for health professionals</li> </ul>	<ul style="list-style-type: none"> <li>Promotion by UN-FAO to improve pest management in environmentally benign ways, empower farmers and tap indigenous knowledge</li> </ul>

**Table 4.** Goals, outputs and outcomes of ISCs for the prevention and control of VBDs

	Advocacy/ Health Promotion	Health Education	Health Research	Public Health Measure	Resource Mobilization	Service Delivery	Training	Collaboration
<b>Goal</b> <i>To reduce the morbidity and mortality of vector-borne diseases</i>	To formulate national research policies oriented to the solution of national problems	To raise awareness of the problem of vector-borne diseases and how to prevent and control them	To gather data on vector-borne diseases, improve surveillance, and develop tools and strategies for prevention and control	To implement prevention and control strategies for vector-borne diseases	To attract additional funding and highlight low-cost and effective interventions	To provide early diagnosis and prompt treatment of vector-borne diseases	To enhance capacity of personnel in both health and non-health sectors for successful program implementation	To strengthen coordination and partnerships with other sectors for the prevention and control of vector-borne diseases
<b>Output</b>	Publications, community road shows, videos, and documentaries were used for promotion.	School curricula incorporated vector control, and symposia were held to build networks.	Research for the development of new approaches to vector and disease control were conducted and encouraged.	ITNs, larvicide treatment, mesocyclops, and new technology for monitoring were frequently used.	Most of the funds used in these ISCs were obtained from other organizations.	Doctors were deployed to malaria-endemic countries and antimalarial drugs were distributed.	Training workshops were held for technical staff and health professionals to broaden their knowledge about VBDs.	More vector control committees were created, and projects were expanded.
<b>Outcome/ Impact</b>	Awareness about VBDs was raised in the involved communities. As a result of intersectoral coordination, the number of activities for prevention and control and creation of public awareness increased.	Both children and adults showed significant improvements in their knowledge on vector control. There was more active participation in prevention and control efforts by the community.	Research leadership especially in Africa was enhanced by various programs for the prevention and control of malaria. Multi-center research networks and projects for the prevention of VBDs resulted from the collaborations.	Malaria and dengue incidence and prevalence markedly declined. The mosquito vectors were either eliminated or greatly reduced through community participation in the prevention measures.	Intersectoral collaborations encouraged project funding by and participation of different institutions. The availability and capabilities of human resources for health in the communities also increased.	Compliance with treatment for malaria and dengue increased.	Control programs gained partners such as school teachers and community volunteers to aid in implementation of activities. The employment rate of the community workers involved in the prevention activities increased.	The number of stakeholders engaged in the programs increased, making project implementation easier. Sustainability showed marked improvement, and activities were expanded to other areas as a result of the increased interest of community leaders.

## Gaps

The problems or gaps encountered in the planning and implementation of the prevention and control programs were categorized into the following: administrative, resource, policy, research, and training/capacity building (Table 5). They were further classified as either antecedent or mediating conditions. Antecedent factors are the conditions present before implementation began, such as environmental characteristics and innate skills and values of community members, while mediating factors are those that occur during the implementation proper, such as staff turnover or withdrawal of financial support.<sup>79</sup>

## DISCUSSION AND CONCLUSION

To the best of the authors' knowledge, this review is the first to synthesize evidence for models of intersectoral collaborations specifically for vector-borne diseases. The comprehensive strategies support the stand of the

Multisectoral Action Framework for Malaria on how very few (if any) social and environmental determinants of the disease are the sole responsibility of a single sector, particularly the health sector. Most of the articles discussed intersectoral approaches for the prevention of malaria and were also concentrated in the African region. Studies that discussed approaches for the prevention and control of dengue, on the other hand, amounted to less than half of the articles included in this review. Less than half of the articles talked about interventions based in Asia and Latin America, where dengue is a leading cause of child morbidity and mortality.

There were many gaps or challenges that impeded successful implementation and lowered chances of project sustainability, most notably the disconnection between stakeholder responsibilities. The observation that there is a lack of communication between multilateral organizations and local governments is of great concern, because nearly all studies included in this review had multilateral organizations as their proponents, while no studies were initiated by

Table 5. Gaps encountered by ISC

	Administrative	Resource	Policy	Research	Training
<b>Antecedent</b>	<p><b>Sustainability</b></p> <ul style="list-style-type: none"> <li>- Poor quality infrastructure and inappropriate systems</li> <li>- Lack of initiative and interest of donors and stakeholders regarding the issue</li> </ul> <p><b>Implementation</b></p> <ul style="list-style-type: none"> <li>- Disconnected inter-stakeholder relationships</li> <li>- Lack of consultation in planning; Lack of robust strategies</li> </ul>	<p><b>Sustainability</b></p> <ul style="list-style-type: none"> <li>- Lack of human resource development, increased migration, and increased staff turnover</li> <li>- Lack of funding due to global economic crisis</li> <li>- Inadequate facilities and equipment for diagnosis and treatment</li> <li>- Lack of technical support from multilateral organizations</li> </ul> <p><b>Accessibility</b></p> <ul style="list-style-type: none"> <li>- Geographical barriers</li> <li>- Logistical barriers such as lack of vehicles, drugs, ITNs</li> </ul>	<p><b>Accessibility</b></p> <ul style="list-style-type: none"> <li>- Taxation, increased costs due to import taxes and VAT</li> <li>- Uneven competitive field between locally-produced nets and imported nets</li> <li>- Existing principles for the handling of foreign currency contradictory to provisions in the grant proposal</li> </ul> <p><b>Implementation</b></p> <ul style="list-style-type: none"> <li>- Unclear policies on role of voluntary health workers</li> <li>- Lack of an overarching strategic vision for GFATM</li> <li>- Donors' lack of confidence in the proponents and in the feasibility of the program</li> <li>- Globalization-from-above accompanied by a lack of accountability</li> <li>- Stifling political environment</li> <li>- Policy-culture mismatch, i.e. government attempts to promote indoor mosquito nets failed because residents would sleep outdoors.</li> </ul>	<p><b>Availability of Data</b></p> <ul style="list-style-type: none"> <li>- Lack of accurate epidemiological data and data on donor support for program planning</li> <li>- Hesitation to disclose data on malaria control funding</li> <li>- Scarcity of research capacity</li> </ul> <p><b>Geographical Barriers</b></p> <ul style="list-style-type: none"> <li>- Difficult terrain and geographical complexity</li> <li>- Unsuitability of existing models to target regions</li> </ul> <p><b>Research Methods</b></p> <ul style="list-style-type: none"> <li>- No available techniques for data analysis</li> <li>- Difficulty in measuring mortality and other variables</li> <li>- Absence of an internal control arm in a before-and-after community intervention leading to limited interpretation of results</li> </ul>	<p><b>Preexisting levels of comprehension, knowledge, and skills</b></p> <ul style="list-style-type: none"> <li>- Low levels of English competency leading to difficulty in comprehending technical matters</li> <li>- Different levels of knowledge and skills among trainees within the same sector and between different sectors (such as health vs education)</li> <li>- Difficulty in adopting an intersectoral mindset and systems-level thinking</li> <li>- Shortage of skilled and knowledgeable staff</li> <li>- Inadequate local capacity for malaria control</li> </ul> <p><b>Training mechanisms and priorities</b></p> <ul style="list-style-type: none"> <li>- Inadequate training, insufficient logistic support, poorly sustained motivation schemes, and lack of community support</li> <li>- No expert training (or access to current training material relating to mosquito abatement) for existing municipal health teams leading to poor standards of training and practice</li> <li>- Poor or absence of training on malaria in pre-service curricula for schools of medicine, nursing, pharmacy, and laboratory technology</li> </ul>
	<b>Mediating</b>	<p><b>Sustainability</b></p> <ul style="list-style-type: none"> <li>- Lack of facilitation, continuity, and sustained community participation</li> </ul> <p><b>Implementation</b></p> <ul style="list-style-type: none"> <li>- Insufficient monitoring and supervision</li> <li>- Limited source reduction efforts</li> <li>- Delays in service delivery due to fears of staff</li> <li>- Work overload due to change in system; disparities in salary levels between field workers and municipal-level officers</li> <li>- Neglect of the role of epidemiology in prevention activities</li> </ul>	<p><b>Sustainability</b></p> <ul style="list-style-type: none"> <li>- Misuse and discontinuity of funds</li> <li>- Difficulty in recruiting and retaining health professionals</li> <li>- Fluctuations in electrical, water, fuel and IT services; lack of sustained political support</li> </ul> <p><b>Accessibility</b></p> <ul style="list-style-type: none"> <li>- Inaccessibility of ACTs and ITNs;</li> <li>- Insufficient and discontinuous supply of insecticides</li> </ul>	<p><b>Accessibility</b></p> <ul style="list-style-type: none"> <li>- Economic barriers, such as price hikes implemented by shopkeepers in response to discounts laid in place by the prevention/control program</li> <li>- Re-introduction of taxes and tariffs on mosquito net products for the generation of internal revenue</li> </ul> <p><b>Implementation</b></p> <ul style="list-style-type: none"> <li>- Poor implementation of prevention and treatment guidelines in both public and private sectors</li> <li>- Disagreements between sectors, i.e. recommendations by multilateral organizations were deemed unnecessary by some malariologists</li> <li>- Malaria patients refused treatment or pretended to take the drugs but sold them instead</li> </ul>	<p><b>Research Methods</b></p> <ul style="list-style-type: none"> <li>- Incomplete data due to irregular collection of slides</li> <li>- Failure to address the effects of clustering</li> <li>- Possible underestimation of the effectiveness of the interventions</li> </ul>



community members. This top-down approach makes stakeholder relationships more susceptible to disconnect, highlighted also by several instances wherein projects would not be sustained by local governments after departure of the representatives of multilateral proponents; in the case of RBM, despite the formation of a steering committee, there was a lack of facilitation after the departure of the RBM support officer. Ownership of the programs by the community was an issue, as multiple cases cited the lack of understanding, interest, and initiative as a reason for discontinuity.

A lack of research capacity, including baseline data, skilled and knowledgeable staff, and models for data analysis that could be contextualized to studies done in local communities, was evident for both malaria and dengue control programs. Without baseline epidemiological, entomological, and demographic data, plans for the development of vector control programs would not be effective and fit to the local community. Baseline data could be produced only with the availability of skilled and knowledgeable staff – another identified gap. Low levels of English competency, inadequate skills in data collection, management, and implementation of malaria control, and a difficulty in looking beyond the disease itself for health professionals were all pre-existing challenges in capacity building and implementation of vector borne disease control programs. These challenges highlighted the need for a more intersectoral mindset in approaching disease prevention and control. The lack of research capacity and the inability to train local staff to address this problem contributed to the issues of dengue case under-reporting and misclassification.

Like other literature reviews, the results of this scoping review were dependent on the availability of information on the review question - in this case, existing models of inter-sectoral collaborations for the prevention and control of vector-borne diseases. Due to time constraints, foreign language articles were not included, no hand searching was done, and only three vector borne diseases were included in the scoping review: dengue, malaria, and yellow fever. However, there were no articles that discussed yellow fever deemed to be relevant to the research question or that discussed inter-sectoral collaborations for the prevention of yellow fever in detail. Additionally, only articles published between 1985 and 2016 were included, and so the publications on the Eliminate Yellow Fever Epidemics (EYE) Strategy that were published in early 2017 were not included despite having discussed intersectoral collaborations to some extent.<sup>80</sup>

In spite of these challenges and limitations, the results show the comprehensive framework needed for an effective and sustainable multi-sectoral approach to the prevention and control of vector borne diseases. Before a vector-borne disease control program may be rolled out, adequate resources must be secured. All stakeholders must actively participate from the planning phase (one identified gap was the lack of consultation among stakeholders in

program planning). Stakeholders include academe and research institutes, civil society organizations, communities, ministries of health, government agencies (especially the education and agriculture sectors), industries, and multilateral organizations. Sustainable funding must be ensured through the cooperation of all stakeholders and the active engagement of the community, as a major challenge identified was the decrease in foreign aid from other countries and from multilateral organizations. Strategies must be comprehensive and be employed throughout the entire socio-ecological spectrum – from an individual level, to organizational processes and systems, to community level interactions, and to policies and entire systems. Strategies include advocacy and health promotion, health education, health research, public health measures, resource mobilization, service delivery or provision, training and capacity building, and an overarching effort to collaborate with one another.

In conclusion, this review shows that an ideal approach for the prevention and control of VBDs includes a collaboration among active stakeholders to deliver effective strategies including but not limited to health education and public health measures. Community involvement through training and capacity building ensures the sustainability of the interventions.

As both intersectoral collaboration and vector-borne diseases are broad topics that hinge on social and economic development, future research may delve deeper into issues of financing, investment in human resource development for, and supply and demand of ITNs and drugs for such programs by conducting economic evaluations including but not limited to cost utility analyses and labor market analyses. The lack of financial resources and of human resources were identified as factors that blocked sustainability and limited effectiveness of the interventions. Scoping reviews on similar topics may also consider wider time frames, given the high yield of articles from this particular area of research and given the nature of a scoping review in itself.

### Statement of Authorship

CTA conceptualized the scoping review; CTA, ACB, KLC, EAR and MSS contributed and approved the design. MLR, CHT and CTA prepared the draft publishable manuscript, and prepared the responses to reviewers' comments. All authors participated in data collection and analysis, and approved the final version submitted.

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## APPENDIX

Nodes	Subnodes
Outcomes measured in the paper	—
Stakeholders involved in the ISC	<ul style="list-style-type: none"> <li>● Academe and Research Institutes</li> <li>● Civil Society Organization</li> <li>● Community</li> <li>● Government agency - Ministry of Health</li> <li>● Government agency - Other</li> <li>● Industry</li> <li>● Multilateral organization</li> </ul>
Proponent/Initiator of the ISC	
Specified goal/purpose of the ISC	<ul style="list-style-type: none"> <li>● Primary</li> <li>● Secondary</li> </ul>
Source and type of resources of the ISC	<ul style="list-style-type: none"> <li>● Financial</li> <li>● Human</li> <li>● Material</li> <li>● Policy or Political support</li> </ul>
Strategies or activities implemented by the ISC	<ul style="list-style-type: none"> <li>● Advocacy</li> <li>● Health education</li> <li>● Health research</li> <li>● Public health measure</li> <li>● Resource mobilization</li> <li>● Service delivery or provision</li> <li>● Training</li> </ul>
Corresponding outputs and outcomes of the strategies implemented by the ISC	
Mechanisms for monitoring and evaluation of ISC	—
Gaps encountered by the ISC	<ul style="list-style-type: none"> <li>● Administrative</li> <li>● Resource</li> <li>● Policy</li> <li>● Research</li> <li>● Training</li> </ul>