CASE STUDY

Excerpt from

Landscape of Anticipatory Action for Health in a Changing Climate

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Vector-borne disease

A good example of disease-driven Anticipatory Action (AA) plans is those that are focused on vector-borne diseases. The following information provides evidence around health outcomes of AA for vector-borne disease, along with examples of AA currently happening in the Philippines and Colombia using the 4Ms (Model, Mandate, Method, Means) framework.

Evidence review

Globally, public health agencies make large annual investments in the management of vector-borne disease. When considering the impact of climate change on vector-borne diseases, there is a long-standing need for new committed financial resources to "strengthen, rather than distract from or compete with, existing health structures and priorities" (Campbell-Lendrum et al. 2015, 5). This call for integration with existing programs and approaches was echoed in key informant interviews, which noted the risk of ongoing silos in approaching vector-borne diseases, as well as a risk that resources for AA could in fact detract from funding needed to ensure adequate healthcare systems overall in countries with a high vector-borne disease burden.

The Global Vector Control Response Plan 2017–2030 (WHO 2017) outlines both the feasibility of preventing vector-borne diseases and the significant need for ongoing management and planning to do so. Many countries have policies and programs for vector control, but they are not always implemented as planned or ideally envisioned. Efforts to act in advance of outbreaks are associated with activities such as disease surveillance rather than formal AA frameworks. In general, effective preventive approaches often target the vectors that transmit disease-causing pathogens, including through reducing human-vector contact and reducing vector survival (WHO 2017). Predictive modelling, surveillance and risk mapping, early warning systems, and AA like pre-positioned resources (e.g., vector control kits) are all important means for preventing vector-borne diseases (WHO 2017, Charnley et al. 2025).

The vector-borne diseases identified as key to address through AA are malaria and dengue, particularly due to their climate sensitivity and projected increase in a warming climate (Vogel et al. 2024). Other work similarly advocates for the need for AA to address these and other mosquito-borne diseases, noting that they are among the

largest causes of death in low-income countries—an estimated one million people per year (Panwar 2021). Latin America, the Dominican Republic, Barbados, Colombia, Peru, Cuba, Ecuador, Brazil, Argentina, and Mexico have developed early warning systems for dengue, malaria, Chagas disease, and leptospirosis. These systems are based on surveillance and monitoring, and they trigger information campaigns, fumigation, destroying of vector breeding sites, and distribution of insecticidal nets and repellents. Mosquito nets are considered to be highly effective for reducing the risk of mosquito-borne diseases, especially when treated with insecticides. Studies have found they reduce the risk of malaria by 56% (Yang et al. 2018). There do not seem to be available studies on the *timing* of mosquito net provision in AA interventions and resultant outcomes.

Predictive models for vector-borne disease are under development in many countries. The Malaria Anticipation Project (MAP) is implemented by Médecins sans frontières (MSF) in South Sudan and uses a pilot predictive model developed for the initiative; the model's predictive performance is considered very high at 2 weeks' lead time (75% classification accuracy) and strong even at 8 weeks' lead time (70% classification accuracy) (MSF 2024). This suggests the viability of AA for anticipating malaria, although further evidence is needed as the initiative continues. The Government of Brazil has evaluated several dengue forecasting models, finding that many models underestimate the peak of recent epidemics. The government is now using an ensemble approach of many models to issue dengue forecasts (Araujo et al. 2025). In Barbados, a climate-health collaboration has resulted in the development of a "Caribbean Health Climatic Bulletin," which is being used to scale up public messaging during times when climatic conditions are conducive to dengue spikes. They are now designing alert levels linked to specific AA (Stewart-Ibarra et al. 2022). Further collaboration between universities, research institutions, government agencies, and civil society is needed to operationalize predictive models that have been developed to incorporate climate information with surveillance information (Santos-Vega et al. 2024).

Example of high-potential design

Model: Epidemiological model integrating surveillance and weather information to predict outbreaks of vector-borne disease. These models range from simple statistical models to complex models that use machine learning, incorporating climate information (temperature, precipitation, humidity) as well as historical and neighboring dengue cases to make their forecasts (Chen & Moraga 2025). Some models also incorporate socioeconomic data, such as house type and density, into the forecast models (Jain et al. 2019).

Mandate: Government leadership supported by civil society mobilization of people or resources when needed.

Method: Given limited resources for vector control, determine the location and amount of control efforts that should be scaled up based on forecasts.

Means: Government funding optimized based on forecast information for greatest efficacy at controlling vector-borne disease, supplemented by humanitarian resources in certain cases.

Case study: Philippines government

The Philippine government's Anticipatory Action (AA) model for vector-borne diseases is structured around a decentralized yet coordinated approach to disease surveillance, environmental sanitation, community action, and interagency response. This model functions across multiple levels—from national health policy frameworks down to barangay[2]-level implementation. Central to the model is the partnership between the Department of Health (DOH) and local government units (LGUs), working through existing structures such as Barangay Health Centers, City Epidemiology and Surveillance Units (CESUs), and Barangay Health Emergency Response Teams (BHERTs).

Model: Disease surveillance triggers action to reduce the spread of dengue fever in the Philippines. For example, ordinance No. SP-3232, S-2023 created the Quezon City Epidemiology and Surveillance Division (QCESD) under the City Health Department, institutionalizing a dedicated unit for real-time disease monitoring and coordinated outbreak response (Quezon City Council n.d).

In February 15, 2025, the Quezon City government declared a dengue outbreak due to the rise in dengue cases. On April 10, 2025, cases dropped

2 A "barangay" is a small territorial and administrative district forming the most local level of government in the Philippines.

by 90% as 123 barangays were cleared from outbreak status (Quezon City Government 2025). The Quezon City local government utilized the multipronged and multistakeholder strategies, early detection, and community education campaigns. This includes the Department of Health's 5S dengue prevention strategy,[3] and communities were likewise encouraged to do the 4 o'clock habit—eliminating mosquito breeding sites by cleaning their surroundings at 4 p.m., when mosquitoes are most active, at dusk. In addition to these, barangay health workers continue to conduct lectures and education programs to raise community awareness and encourage collaboration among various community stakeholders to ensure a comprehensive control and prevention of dengue. The local health officials have been closely monitoring cases all year round, especially during rainy season and the unexpected rains during summer as the Department of Health has declared dengue to be a year-round risk (Quezon City Government 2025).

Mandate: The government's authority to act on vector-borne diseases is grounded in national health policies such as the Department of Health's National Dengue Prevention and Control Program and the Local Government Code of 1991, which mandates that local government units or LGUs lead the delivery of primary healthcare and disease prevention programs. Its programs center on five major components, namely surveillance, case management and diagnosis, integrated vector management, outbreak response, health promotion and advocacy and research (Guad et al. 2021). It employs the general strategies for dengue management, such as the "5Ss." To implement this, the DOH issues administrative orders and national guidelines, such as the Integrated Dengue Vector Management (IDVM) strategy and AO 2020-0016 (implementing the Disease Surveillance and Response System), which formalizes protocols for early detection and community-based response. Several guidelines have been outlined by the Department of Health for dengue management.[4]

At the local level—based solely on data from Quezon City—the mayor and barangay captains are held accountable for sanitation, waste management, and outbreak control measures. These responsibilities are reinforced through several key city ordinances that operationalize public health mandates on vector-borne disease prevention. Ordinance No. SP-2097, S-2011 established the Quezon City Comprehensive Dengue Prevention and Control Program Plan, providing a structured and long-term framework for dengue mitigation across the city. To promote early childhood protection, Ordinance No. SP-2330, S-2014 mandates that children in public day care centers wear scrub suits as long pants—a preventive measure aimed at minimizing mosquito exposure.

Complementing these efforts, the National Climate Change Action Plan (NCCAP) sets a broader strategic direction from 2011 to 2028, prioritizing food security, water sufficiency, ecological and environmental stability, human security, climate-smart industries and services, sustainable energy, and knowledge and capacity development (Climate Change Commission 2011). While national frameworks for AA are in place, it must be noted that the doctors interviewed were generally unfamiliar with the term "Anticipatory Action." Instead, they commonly use the term "preparation." In the case of early actions against dengue, the doctors mentioned that they follow directives from the Quezon City Health Department, which in turn adheres to guidelines from the Department of Health (DOH).

In addition to government programs, the humanitarian sector has developed several methods to scale up supportive actions when a dengue outbreak is forecasted in the Philippines. Red Cross entities developed a dengue forecasting model that uses weather information to forecast dengue caseloads every month, and this information triggers AA, such as dengue emergency medical units (DEMUs), mobilizing community health volunteers (CHVs), and social media campaigns promoting prevention and control measures. The Philippines Red Cross also carries out hygiene promotion

3 5Ss: S (1): search and destroy breeding sites through regular clean-up programs; S (2): self-protection measures. Pertains to the use of protective clothing, especially among children; S (3): seek early consultation through fever express lane to swiftly attend to individuals with dengue symptoms. Free dengue test kits were also available in facilities; S (4): support fogging and larviciding in hotspot areas; and S (5): sustain adequate hydration.

4 These include: AO 2016-0043 Guidelines for the Nationwide Implementation of Dengue Rapid Diagnostic Test; AO 2012-006 Revised Dengue Clinical Management: Guidelines; AO 2001-0045 Guidelines on the Application of Larvicides on the Breeding Sites of Dengue Vector Mosquitoes in Domestic Water; DM 2017-0353 Implementation Guidelines for Initial Implementation of Nucleic Acid Amplification Assay – Loop Mediated Isothermal Assay (LAMP) as One of Dengue Confirmatory Tests to Support Dengue NSI RDT; DM 2015-0309 Reactivation of Dengue Fast Lanes and Continuing Improvement of Systems for Dengue Case Management and Services; and DM 2014-0112 Technical Guidelines, Standards and other Instructions for Reference in the Implementation of Sentinel-based Active Dengue Surveillance (Department of Health n.d.).

on safe usage of water and cleaning of mosquito breeding sites, and garbage disposal.

The Philippine Health Insurance Corporation (PhilHealth) has introduced Early Action Health Alerts, which are ongoing information dissemination efforts at the start of anticipated hazards such as an increased heat index. For example, PhilHealth released memos in March and April 2025 stating, "PhilHealth reminds everyone that there are inpatient benefits packages for common summer-related illnesses available at accredited hospitals nationwide" and then listed a variety of common illnesses associated with heat.

Method: The Philippines implements a combination of proactive health surveillance, vector control, community engagement, and risk communication. City and barangay health workers are trained to detect early warning signs using both syndromic surveillance and rapid diagnostic tools such as antigen tests for dengue. During outbreaks, Fever Express Lanes are opened in city health centers and hospitals to expedite diagnosis and medical attention for those suspected of having dengue. In high-risk areas, ovi-larvae traps are installed to monitor mosquito populations and inform targeted fogging operations. In Quezon City, this data is gathered and stored by the City Epidemiology Surveillance Unit (CESU). The data for fogging and spraying operations are kept by the Sanitation Department. Surveillance in Post Extreme Emergencies and Disasters (SPEED) was an award-winning innovation in syndromic disease surveillance that can be utilized for AA. Through mobile messages, trends in diseases can be quickly transmitted to a central database that can be accessed by authorities so they can start interventions before disease reaches alarming levels. Dengue prevention initiatives are actively implemented across all barangays through the "4 o'clock habit."

Additionally, specific barangays have implemented various targeted actions, highlighting local adaptations of dengue prevention programs. This includes (nonexhaustively):

- Barangay Bagong Silangan Health Center: deploys IKOT boys (sprayer operatives) who conduct house-to-house area spraying
- Barangay Pinyahan Health Center: holds dengue lectures twice weekly to raise community awareness
- Barangay Balingasa: distributes one larvae trap containing larvicide solution to every household
- Barangay Cubao: conducts flip chart lectures focused on dengue education
- Barangay Project 6: operates a Viber Information Hub for timely dissemination of health messages from the Health Emergency Preparedness Office (HEPO)
- Barangay Krus na Ligas: provides a "fever fast lane" service on weekends to accommodate patients with fever and respiratory symptoms
- Barangay Pansol: promotes the "5S of Dengue:" Search and destroy breeding sites; Seek early consultation; Say yes to spraying; Stay hydrated; and Self-protection
- Barangay Old Balara: conducts dengue forums and maintains spot maps for case contact tracing

Table 4 provides an overview of recent actions taken for dengue fever in the Quezon City region of the Philippines. Information dissemination activities were wide-ranging, from public forums to Facebook campaigns, and the government also carried out large-scale mosquito reduction activities such as spraying.

From the table it is also important to realize a key point: dengue management in Quezon City—based on interviews with doctors from selected Barangay Health Centers—is deeply rooted in the long-term practice of community wellness. A clear example of this integration is the city's waste management system, which includes waterways cleanup, waste collection in identified markets, schools, and institutions, as well as regular sanitation inspections of business establishments. Alongside a variety of other initiatives, these efforts are supported by the Department of Sanitation and Cleanup Works of Quezon City (DSQC), which provides daily waste collection services to all barangays and households.

TABLE 4. Examples of recent actions to manage dengue fever in Quezon City, Philippines. This table provides an indication of the number of government actors involved and the types of actions that are taken to manage dengue risk.

HEADLINE	ACTORS	ACTIONS
Sabayang Clean-up Nov 23, 2024	Quezon City (QC) Health Department (QCHD) Barangays in Districts 1, 2, and 4	• Clean-up drive • Information drive
Quezon City declares outbreak amid rise of dengue cases Feb 15, 2025	Quezon City Government QCHD Mayor Quezon City Epidemiology & Surveillance Division (QCESD) Barangay Spraying Teams Sanitary Inspectors Barangay Officials School Administrators	• All 66 QC Health Centers open weekends • Fever express lane and free dengue test kits in health centers and hospitals • Spraying and fogging in areas with clustered cases • Pre-clinic lectures, dengue awareness assemblies, and forums in barangays • Briefing of Barangay Officials and School Administrators
Dengue Outbreak Meeting with QC Barangays Feb 15, 2025	Mayor QCHD Barangay & Community Relations Dept. Committee on Barangay Affairs Chairperson Councilor School Division Superintendent QCESD Metro Manila Center Health Development	Press Conference
Dengue Outbreak Meeting with QC Barangays Feb 15, 2025	Quezon City 142 Barangay Captains QCHD Barangay & Community Relations Dept. Committee on Barangay Affairs Chairperson Councilor Hospital Director Schools Division Superintendent QCESD	• Meeting on the declaration of outbreak • Briefing on preventative actions such as clean-up drives, mosquito fogging, and encouraging citizens to clean at home • Listened to suggestions and recommendations from barangay captains

TABLE 4. Continued

HEADLINE	ACTORS	ACTIONS
Spraying and Fogging Feb 15, 2025	QCHD QC Environmental Sanitation Division QCHD-trained barangay personnel	• Spraying, misting, fogging, and larviciding • Encourage citizens to follow QCHD and QCESD on Facebook for updates
Anti-dengue Misting and Spraying Feb 17, 2025	QCHD Barangay Officials	• Anti-dengue misting and spraying in areas with confirmed dengue cases • Dengue community lectures and lay fora • Clean-up drives
"Alas Kwatro, Kontra Mosquito" – Department of Health Feb 24, 2025	Department of Health Secretary Mayor QCHD Barangay Batasan Hills Chairperson District 2 Action Officer Purok leaders Volunteers	4 o'clock habit • Clean-up drive • Distribution of insecticide, insect repellent, cleaning materials, and brochures • House-to-house information campaigns
Tips to Preventing Dengue	QCESD	Social media infographics Website page Digital flyer

Means: Financial and human resources for these anticipatory activities are drawn from a mix of national subsidies and LGU allocations under the Internal Revenue Allotment (IRA) system. The DOH provides technical guidance, training, and medical commodities—such as test kits, larvicides, and personal protective equipment—while LGUs are responsible for funding day-to-day operations and barangay-level logistics. Human resource mobilization includes barangay health workers (BHWs), public school teachers, sanitation officers, and a large number of volunteers trained under the Barangay Health Emergency Response Teams. Cities such as Quezon City and Manila also maintain dedicated surveillance units that coordinate with barangay focal persons for outbreak alerts and logistical mobilization. Additional support is often provided by partners such as UNICEF, the Philippine Red Cross, and local civic groups like the Rotary Club, which contribute to both educational campaigns and medical supply chains. These partnerships extend the reach of AA and contribute to filling resource gaps at the community level.

To ensure these efforts are sustained, institutionalizing AA must be seriously considered, especially in areas like waste management and vector control. According to the doctors interviewed, regular garbage collection and initiatives like the 4 o'clock habit—which encourages daily cleaning of potential mosquito breeding sites—have become usual practices that are actively promoted and sustained within the community in Quezon City. However, monitoring these programs has become increasingly challenging. Some barangays have adopted creative strategies to maintain public engagement. For instance, A. Orquinaza of Barangay Old Balara interestingly shared that climate change and health-related questions were integrated into the Q&A portion of their community pageant (personal communication, April 14, 2025)—an innovative effort to raise awareness in a localized and engaging manner.

Barangay Health Centers, however, often contend with multiple patient concerns simultaneously, which stretches their limited resources and exposes structural weaknesses in healthcare delivery. Doctors from Krus na Ligas, Bagong Silangan, Batasan Hills, Balingasa, and Pansol report critical manpower shortages, with doctor-to-patient ratios reaching 1:25,000 (D. Demetria & R. Asuncion, personal communication, April 14, 2025; C. Palad, personal communication, April 14, 2025; K. Ariap, personal communication, April 14, 2025; M. Lim, personal communication, April 23, 2025; J. Alisuag, personal communication, April 14, 2025). Such imbalances severely compromise outbreak response, as noted by a physician from Old Balara. These staffing challenges are compounded by inadequate facilities and limited capacity-building programs for health workers, particularly in Batasan Hills and Holy Spirit (K. Ariap, personal communication, April 14, 2025; G. Trespeses, personal communication, April 15, 2025). Another pressing issue is the lack of consistent, localized information dissemination. Health communication in Quezon City remains largely centralized through the Health Department's Facebook page and the Health Education and Promotion Unit, while many barangays lack their own platforms for direct community engagement. This top-down approach limits resident participation and weakens responsiveness.

Successes and impact: Local evidence suggests that AA has contributed to significant outcomes in disease detection, outbreak control, and behavioral change. According to a press release from the Quezon City local government from February 15, 2025, CESUs have used real-time reporting of febrile illnesses and antigen testing to quickly identify clustering of dengue cases, allowing for more targeted fogging and household visits (Quezon City Government 2025). Fever express lanes also allow for the early detection and diagnosis of dengue in those with fevers, minimizing morbidity and possibly mortality in dengue cases. In Barangay Pansol, an interviewee explained that community health workers' outreach led to a notable increase in resident participation in clean-up drives and a reduction in reported mosquito breeding sites. In Project 6, digital Viber groups allowed for real-time reporting of symptoms and water-related issues, enabling barangay leaders to organize quicker responses, according to a key informant. In flood-prone areas like Krus na Ligas, meteorological data is used to inform the strategic pre-deployment of prophylactic medications after storms, which helped reduce severe complications from leptospirosis. Lectures and flip chart seminars have been regularly implemented for information dissemination on the ground. During the pandemic, LGUs enlisted the help of Department of the Interior and Local Government (DILG) personnel for more detailed surveillance and reporting of disease data to fill personnel gaps. Several barangays have also noted increased involvement of youth, women, and civic groups in outbreak planning, and informants attribute this to the institutionalization of Barangay Health Management Councils (BHMCs), which include a wide range of community stakeholders.

Return on Investment (ROI): While national data on ROI for anticipatory health interventions is limited, international studies and local program reports suggest considerable savings in avoided treatment costs, hospitalization, and outbreak response logistics. According to WHO estimates, integrated vector management approaches can reduce dengue-related health expenditures by 30%–40% when coupled with community-based preventive action (WHO 2017). In urban barangays of Metro Manila, barangay leaders have anecdotally reported reductions in unnecessary emergency room visits due to early detection and the use of antigen testing kits. Furthermore, digital coordination and crowd-sourced surveillance reduce the burden on health staff and enable efficient triage of cases. These cumulative savings, while difficult to quantify uniformly across regions, make a strong case for institutionalizing AA in vector-borne disease management.

Case study: Colombian Red Cross

In Colombia, the Colombian Red Cross, with support from the German Red Cross, has been actively funding the development of a Dengue Emergency Action Plan. This protocol aims to enhance preparedness and response efforts by implementing Anticipatory Action (AA) to address and mitigate the impacts of dengue outbreaks, which are often exacerbated during El Niño events. By focusing on proactive measures, the initiative seeks to reduce dengue's health and socioeconomic burden in the country, ensuring a more timely and effective response to outbreaks driven by changing climatic conditions.

It is being developed closely with the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), the National Institute of Health, and the Ministry of Health. This multidisciplinary approach

integrates climate data, epidemiological surveillance, and public health strategies. The protocol is intended to support health authorities in implementing timely interventions under extraordinary conditions, thereby reducing the impact of outbreaks on affected communities.

Model: This protocol has established two key triggers for activation. The first trigger is based on assessing the early epidemiological conditions of dengue in the prioritized regions, explicitly using the endemic channel—a tool that defines risk levels based on historical data to identify potential outbreaks. When the cases move beyond the safe zone within this channel, which indicates increased risk, it signals the need for action. There is an approximately two-month delay between cases leaving the safe region and the onset of an outbreak. When this first condition is met, a second trigger is activated, relying on a predictive product called "El Boletín Clima y Salud," developed by the National Institute of Health. This forecast provides predictions about the likelihood of increased transmission in the targeted areas two months in advance, enabling AA.

Given the limited resources for vector control, this protocol aims to prioritize and allocate efforts to the 10 departments in Colombia with the highest risk of experiencing a dengue outbreak. The risk assessment is based on a comprehensive vulnerability indicator that integrates multiple factors: exposure to the vector (considering the biological suitability of mosquitoes influenced by climate, breeding site availability, and human demographic factors), transmission intensity (affected by the persistence of the virus and the presence of susceptible individuals), and community and institutional resilience (including self-care behaviors, water access and usage, risk perception, and healthcare capacity). To accurately identify high-risk areas, a mechanistic model is being developed that captures the heterogeneities in entomological parameters, climate variables such as temperature and rainfall, and social determinants like overcrowding and WASH conditions. This approach allows for a spatially and contextually nuanced understanding of vulnerability, enabling targeted vector control efforts in communities most likely to experience outbreaks, thereby optimizing resource use and maximizing impact.

Mandate: The Ministry of Health, the National Institute of Health, and the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) collaborate through the Technical Roundtable on Climate Variability and Change. These institutions jointly produce the Climate and Health Report, a monthly publication that analyzes climate forecasts concerning dengue and malaria. The report identifies which municipalities are at increased risk for these two diseases. It also includes recommendations for four additional health outcomes: snakebites, leptospirosis, acute diarrheal disease, and acute respiratory infections.

Method: When the mechanism is activated, AAs are implemented to reduce the risk of dengue transmission. These actions include targeted vector control activities such as larviciding and insecticide spraying in high-risk areas and community engagement campaigns focused on education about effective water management practices to eliminate mosquito breeding sites. Waste collection campaigns are also intensified to reduce standing water and environmental hazards that facilitate mosquito proliferation. These proactive measures aim to curb the early transmission stages, strengthen community resilience, and prevent the escalation of outbreaks in vulnerable regions.

Means: This mechanism will complement and support the existing government-funded efforts, ensuring a more coordinated and targeted response. Additionally, resources from the IFRC will be allocated to enhance these AAs, providing technical assistance, logistical support, and funding to strengthen vector control activities, community engagement, and environmental management. This integrated approach aims to optimize resource use, improve preparedness, and effectively reduce the risk and impact of dengue outbreaks in the prioritized regions.