MOSQUITO MANAGEMENT DURING A PUBLIC HEALTH EMERGENCY

THE AMERICAN MOSQUITO CONTROL ASSOCIATION

September 2022

This document is meant to be a supplement to the 2021 version of the AMCA's *Best Practices for Integrated Mosquito Management*[1] manual, which can be found on the AMCA's website at https://www.mosquito.org/page/training. This supplement provides information regarding mosquito control in response to a water-related natural disaster or during increased risk of mosquito-transmitted disease. When using this document, reference the main manual for expanded discussion on many topics related to integrated mosquito management. The document consists of two parts:

1. The first part describes a high-level overview of information required to effectively respond to a mosquito-driven public health emergency.
2. The second part describes in detail the steps an organization can take to create a customized emergency response plan for their area.

The Centers for Disease Control and Prevention (CDC) funded the American Mosquito Control Association (AMCA) to create the *Mosquito Management During a Public Health Emergency* manual. The AMCA Board of Directors and Executive Committee hired a consultant to project manage, write, and edit the new manual. A steering committee of public health professionals guided the update, wrote portions of the text, and edited the final document. Various contributors provided additional perspectives and best practices, reviewed the text, and designed the final layout.

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2022 EMERGENCY RESPONSE SUPPLEMENT

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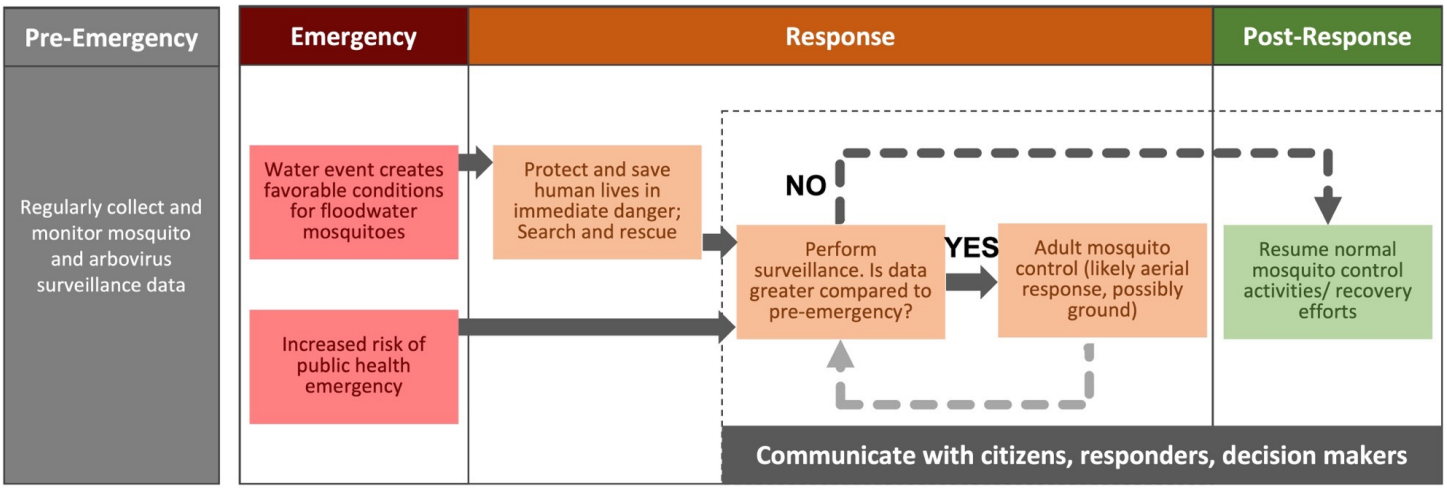
Mosquito Management During A Public Health Emergency

1. Mosquito-related public health emergencies fall into two categories (Figure 1):
    a. A weather-driven increase in the number or change in the species composition of mosquitoes.
    b. An increase in the risk of or actual human cases of mosquito-transmitted disease caused by endemic or recently introduced mosquito species or arbovirus(es).
2. Three main activities make up mosquito management emergency response:
    a. Surveillance- Collecting data on mosquitoes and/or arboviruses in the environment to determine when a situation exceeds predetermined thresholds to qualify as emergency status.
    b. Adult mosquito control- Using precision equipment to apply pesticides targeting adult mosquitoes.
    c. Community engagement- Engaging with different members and stakeholders in the community about the emergency situation and response.
3. Different levels of government and external organizations perform various roles during an emergency. People involved with response should understand their responsibilities and the role other agencies play as well. Nurture relationships among these different groups and people prior to an emergency to ensure a smooth and effective response.
4. All states, counties, and other local jurisdictions should have an emergency preparedness plan that details each facet of the agency's response to a mosquito-related public health threat.

Figure 1. Mosquito Control Emergency Response



Source: American Mosquito Control Association

5. Decision makers should negotiate and secure all contracts and cooperative agreements before an emergency to ensure seamless response from contractors and neighboring governments.
6. Emergency response managers should understand the federal, state, and local processes required to reimburse costs above what a program normally spends on mosquito control.
7. Establishing baseline data describing the number and species of mosquitoes in the area prior to a disaster can help determine emergency conditions faster and successfully secure reimbursement from the federal government.
8. Action thresholds should be set with pre-determined values that are used to identify when and what action to perform.
9. Public health professionals need to know where to perform mosquito control during an emergency. Creating maps of the most populated areas and habitat likely to produce mosquitoes can help focus treatment during emergency response.
10. Emergency managers should choose primary and secondary adulticide products based on known insecticide resistance profiles to use during emergency response. In addition to choosing the product, the manager should know how to secure and store the product.
11. Different groups of people need information during an emergency: outside responders, politicians, mosquito control technicians, and residents. Drafting and storing press release templates and public outreach materials in a database ready for use during an emergency can get information to people faster than trying to create communications during an active emergency.
12. Regulatory agencies may have special provisions for treatments during a declared public health emergency; however, all programs, both public and private, must stay in compliance. To avoid violating any regulations, ensure all licenses and permits are up to date and understand the specific requirements for each relevant agency.

PART ONE:
MOSQUITO MANAGEMENT EMERGENCY RESPONSE

MOSQUITO EMERGENCIES

Mosquito-driven public health emergencies (at any level of government regardless of federal declaration) can be broadly grouped into two categories:

1. Natural disaster situations resulting in dramatic increases in the number of biting mosquitoes within a short period of time- in particular, after significant rain or flooding events.
2. Potential or realized human disease outbreaks resulting from an increased risk of mosquito-transmitted disease caused by either endemic or newly introduced mosquito species or arbovirus(es).

Both of these situations can warrant public health officials to perform emergency mosquito management operations to quickly reduce the number of adult mosquitoes and their impact on residents and recovery workers. The factors leading to these two types of emergencies vary. Flood-related natural disasters often cause a rapid increase in mosquito numbers and a change in the species composition to very aggressive biting species.[2] Hurricanes are the most common cause of these types of emergencies, but other disasters such as heavy rains, tropical storms, wildfires, and other weather-related events can also result in the extreme accumulation of water. The underlying factors leading to increased human health risk and cases of mosquito-borne disease are more complicated and, as a result, are challenging to predict.[1] The following sections will explain factors attributing to and consequences of these two different categories of mosquito emergencies.

Natural Disasters

Natural disasters stemming from severe weather can place hundreds of thousands of people in immediate harm's way and often have lasting effects when a storm event severely damages the infrastructure of an area. In recent years, the frequency of extreme weather natural disasters has increased. Within North America, Central America, and the Caribbean, a weather-related disaster occurred on average once every 30 days in the 1970s; however, that average increased to once every seven days for the decades between 1990-2019.[3] The type of weather events can vary. However, of the 10 most costly weather-related disasters in this region, eight were storms, more specifically hurricanes.[3] These storms result in massive amounts of water and destructive winds that can wreak havoc and cause a variety of public health emergencies.[4] Hence, the increased frequency of storms in recent decades has also led to an increased frequency of mosquito-related emergencies.

Natural disasters cause a mosquito-related health emergency when flooding submerges floodwater mosquito eggs laid in soil resulting in potentially billions of floodwater mosquitoes emerging at once (Figure 2). Flooding during hurricanes (and other storms) happens when rain deposits large volumes of water and high wind speeds lead to changes to the landscape (e.g., knocked down trees and clogged water systems) resulting in accumulation of water in areas that may not have pooled water under non-disaster conditions. Approximately 7 to 10 days after the hurricane,[5] flooding can lead to an increased

Figure 2. Mosquitoes Collected During Surveillance

A.

A. Datasheet and petri dish containing 339 mosquitoes identified to species.

B.

B. Mosquitoes collected from a single trap night and distributed over a grid to estimate trap abundance.

Source: Broox Boze, Ph.D.

number of floodwater mosquitoes.[6] These floodwater mosquitoes generally do not transmit arboviruses[6]; however, mosquito trapping after a storm can capture tens of thousands of mosquitoes or more in a single night.[2, 7]

Mosquito populations that reach this size can interfere with recovery efforts and overwhelm residents in these areas. For instance:

- Uninhabitable homes and structures can force people to sleep outdoors and expose them to mosquito bites.
- Emergency supported clean-up efforts, such as debris removal, is often time-sensitive, and mosquito biting pressure can adversely impact this work.
- Emergency response workers getting bitten can make dangerous working conditions (e.g., individuals in bucket trucks repairing power lines can become distracted by 100-150 bites per minute, increasing the potential for mistakes and even falling).
- The massive amounts of mosquitoes can prevent children from standing at the bus stop and returning to school.
- People, especially children, may get secondary infections after introducing bacteria into the skin from scratching bites.[8]
- People cannot return to their normal routines resulting in mental and physical health effects.

Approximately four or more weeks after the hurricane,[2] permanent water mosquito species capable of transmitting a number of mosquito-borne viruses become abundant. Even though these species are capable of transmitting viruses to humans, cases of disease occur infrequently immediately after a storm.[9-11] However, the risk for disease transmission can increase as certain mosquitoes species emerge.[12]

Mosquito-Borne Disease

Increased risk of or human cases of mosquito-borne diseases can cause another type of mosquito emergency in the U.S. Unlike water-based natural disasters, determining when the risk of a mosquito-borne disease outbreak reaches emergency status is more complicated. Different biotic and abiotic factors can elevate the risk of mosquito-transmitted disease, including (but not limited to) the discovery of a new invasive mosquito species. The U.S. has several mosquito-transmitted viruses (also called arboviruses or arthropod-borne viruses) that present annual risk of infections to humans including (but not limited to): West Nile virus, eastern equine encephalitis virus, St. Louis encephalitis virus, and LaCrosse encephalitis virus.

A new or less common mosquito-borne virus may also threaten the safety of people living in the U.S. and territories. For instance, the introduction of Zika virus caused a mosquito-borne disease outbreak in the U.S. in 2016 and 2017.[13] Other viruses of concern to public health professionals due to their potential to become introduced include yellow fever, chikungunya, and dengue viruses. When the risk of human cases increases as determined by a rise in the number of infected mosquitoes compared to past years or an outbreak of human disease occurs, public health professionals may declare an emergency. The sections on Mosquitoes, Disease, and Management and Arbovirus Surveillance of the 2021 companion manual provides a more in-depth discussion on this topic.

EMERGENCY RESPONSE

The Federal Emergency Management Agency (FEMA) National Response Framework states that response after an emergency, "includes actions to save lives, protect property and the environment, stabilize the incident, and meet basic human needs following an incident. Response also includes the execution of emergency plans and actions to enable recovery."[14] Mosquito driven public health emergencies disrupt everyday life, recovery efforts, and threaten human health. Given this reality, the goal of mosquito control emergency response is to rapidly reduce biting mosquitoes to either enable recovery efforts in an area impacted by a natural disaster or protect human lives by reducing the risk of mosquito-transmitted diseases.

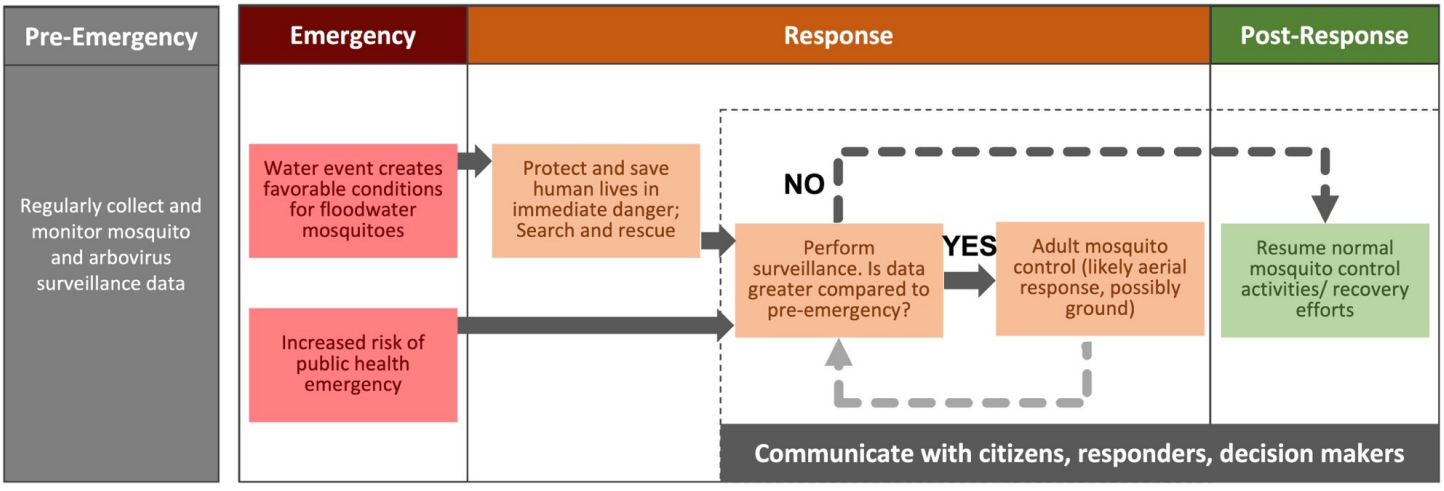
During non-emergency conditions, the best way to manage mosquitoes uses an integrated approach that collects data to inform control decisions and utilizes all control methods available and reasonable.[1] Similarly, emergency mosquito control operations rely on data to inform mosquito control professionals when and where to perform control efforts. However, due to time constraints in covering large geographic areas, emergency mosquito control operations primarily consist of three activities (Figure 1):

1. Surveillance
2. Adult mosquito control (generally aerial application of adulticides)
3. Community engagement

Surveillance

Mosquito and arbovirus surveillance generate data that serves three purposes during emergency response:

Figure 1. Mosquito Control Emergency Response



Source: American Mosquito Control Association

1. Indicate when a mosquito emergency occurs
2. Guide when and how to respond
3. Increase the likelihood of financial reimbursement following response

In the case of a natural disaster, public health officials may anticipate a mosquito emergency to follow shortly after the end of the event. However, in the case of a mosquito-borne disease outbreak, predicting when an emergency may occur is challenging, if not impossible.[1, 15] Regardless, public health professionals must use data to determine when an emergency exists and when it has ended. The best way to do this is by comparing either mosquito or arbovirus surveillance data collected during the emergency to a baseline generated during non-emergency conditions.

Ideally, a baseline is created by averaging three years of data[16] collected during the same time period from the same location under normal conditions. However, historic, baseline data does not always exist. In these situations, public health professionals should seek advice from their FEMA or similar state agency representative to identify other acceptable baseline data sources. Possible alternative sources of baseline data include surveillance data from geographically similar areas located relatively close to the emergency site, or in the case of a natural disaster, collecting data immediately after the disaster but before the mass emergence of floodwater mosquitoes. Regardless, an appropriate authority should approve all surveillance data.

Sources of surveillance data used to assess if a public health emergency exists include (Table 1):

- Mosquito surveillance data
  - Number of individual mosquitoes
  - Mosquito species present
  - Landing rate counts
  - Resident calls
- Arbovirus surveillance data
  - Mosquito trap collections
  - Virus-positive mosquito pools
  - Sentinel animal antibodies
  - Human and animal disease cases

In addition to determining when emergency conditions exist, mosquito control professionals use data to decrease the threat from biting mosquitoes by performing strategically timed control operations to reduce adult mosquito populations. Spraying an adulticide before adult mosquitoes emerge will not kill any mosquitoes. Alternatively, spraying weeks after an adult emergence does not eliminate biting mosquitoes before they threaten residents. Knowing the right time to perform emergency mosquito management requires real-time surveillance data. For more information, refer to the Mosquito Surveillance and Arbovirus Surveillance chapters in the 2021 version of the *Best Practices for Integrated Mosquito Management* manual.

Finally, reimbursement for control efforts typically requires surveillance data to qualify for financial reimbursement and verify the efficacy of control efforts. The *Public Assistance Program and Policy Guide* published by FEMA outlines data requirements to request reimbursement for emergency mosquito abatement following the declaration of a federal emergency.[16] In short, FEMA may provide reimbursement after[16, 17]:

1. A state, local, territorial, or tribal government's public health official makes a written request, and the state's Governor or Tribal Chief Executive requests the POTUS declare an emergency or major disaster.
2. The President makes the declaration.
3. Data validating that a mosquito driven public health threat exists.

Table 1. Emergency Response Surveillance Methods

Mosquito Emergency	Type of Surveillance	Methods
Water-Based Natural Disaster	Mosquito	**Landing rate counts-** The number of mosquitoes landing on a human per minute **CDC Light Trap-** Adult mosquito trap that uses light and carbon dioxide to lure mosquitoes near the trap and gentle suction to capture them in a net **Service requests-** The number of calls, emails, website submissions made by the public requesting mosquito control
Public Health Threat	Arbovirus	**Mosquito trapping-** Capturing adult mosquitoes in the environment to determine the number and species composition through space and time **Arbovirus testing-** Detecting the presence of virus in a group (or pool) of mosquitoes collected using an adult mosquito trap **Sentinel animals-** Blood is taken from animals (often birds) and tested for the presence of arbovirus such as antibodies, antigens, or live virus **Human and animal cases-** The number of humans or domestic animals symptomatic after infection with an arbovirus

4. FEMA has consulted with the CDC to verify a health threat exists.
5. Control operations use Environmental Protection Agency (EPA) registered pesticide products and apply them according to all label directions and rates.
6. Mosquito abatement complies with all other federal, state, and local laws.

Applicants are deemed eligible to receive assistance as defined by the four components of eligibility[17]:

1. "An applicant must be a state, territory, tribe, local government or private nonprofit organization.
2. A facility must be a building, public works system, equipment or natural feature.
3. Work is categorized as either 'emergency' or 'permanent.' It must be required as a result of the declared incident, located within the designated disaster area, and is the legal responsibility of the applicant.
4. Cost is the funding tied directly to eligible work, and must be adequately documented, authorized, necessary and reasonable. Eligible costs include labor, equipment, materials, contract work, as well as direct and indirect administrative costs."

Adult Mosquito Control

The only way to rapidly reduce the risk of active arbovirus transmission is to significantly reduce the number of infected adult mosquitoes in an area.[1] Furthermore, after natural disasters,

the sheer number of adult mosquitoes simultaneously taking wing warrant action to ease the suffering of affected human populations. As a result, emergency mosquito management operations consist mostly of adulticide applications using precision equipment. However, those responding often use many of the other routine components of an integrated mosquito management program (see the AMCA's *Best Practices for Integrated Mosquito Management* manual).

Because mosquito-driven public health emergencies often cover large geographic areas (e.g., county/parish wide or over multiple counties/parishes) and require treatment within a very narrow time frame, responders typically prefer aerial ultra-low volume (ULV) applications. Ground ULV applications via trucks and ATVs will often augment these applications, especially when specific areas of transmission persist or to target known emergence sites. However, because natural disasters often impact the infrastructure of an area with widescale flooding, destroyed roads, downed trees, and weakened bridges, ground applications may not always be feasible or safe.

Determining where to apply adulticides (i.e., delineating spray blocks) and the timing can prove challenging for those in charge of emergency operations. Decision makers must balance several factors such as population density of residents and recovery workers, public attitudes, specifics of the locations impacted by the emergency, ease of the application's flight plan, location of endangered species, and timing of mosquito populations. If impacted areas expect to seek federal reimbursement, emergency control efforts will typically focus on eliminating mosquitoes from more densely populated areas, as opposed to rural woodlands and farming areas.[16]

In general, applications should begin in geographic areas under the most strain (e.g., based on number of mosquitoes collected or proximity to at-risk populations) or with the highest risk of disease transmission. However, surveillance data must first verify an emergency exists. Very often, the availability of adequate surveillance data (as well as having the proper contracts, licensing, and staff in place) will determine the areas first targeted. Additionally, creating proper flight plans and ensuring Federal Aviation Administration (FAA) regulatory compliance affects the timing of treatment.

After determining the application area and timing, the most important consideration for decision makers is determining what pesticide (and a back-up product) to use. Carefully considering factors such as local regulatory compliance, active ingredient, formulation, published efficacy data, insecticide resistance status of local populations, public acceptance, and current supply chain can help inform this decision. FEMA will only reimburse emergency mosquito control missions that use products registered by the EPA.[16] Currently, the EPA has two registered classes of adulticides (Table 2): organophosphates and pyrethroids.[18,19] Ground applications may use a variety of products dependent upon the above listed criteria for consideration. Aerial applications, however, normally achieve the most consistent results when heavier product formulations are used.[20]

Community Engagement

Community engagement and communication are fundamental activities before and during emergency mosquito management operations. Vector control professionals need to share critical information to different groups within their community including government officials, staff, responders, and residents. The messages

Table 2. Adulticide Classes and Active Ingredients for ULV[a]

Insecticide Class[a]	Mode of Action	Active Ingredients[b]
Organophosphate	Acetylcholinesterase (AChE) inhibitors	Naled, malathion
Pyrethroid[c]	Sodium ion channel inhibitors	Phenothrin (sumithrin), pyrethrins, etofenprox, resmethrin, permethrin, prallethrin, deltamethrin

[a] AMCA does not endorse the use of any specific product. Any mention of a product name or active ingredient is not a recommendation or statement of efficacy.
[b] This list is not meant to be comprehensive. Adulticide formulations include ready-to-use, water dilutables, and oil dilutables. Always read and follow label instructions before applying any pesticide.
[c] Piperonyl butoxide (PBO) is a synergist commonly paired with pyrethroids to enhance efficacy.

and channels for each of these groups may vary but creating relationships (where possible) and establishing trust will facilitate smooth communication during a crisis and increase cooperation. To help facilitate the most effective communication during a crisis, the CDC provides a Crisis and Emergency Risk Communication (CERC) manual that provides best practices for anyone communicating to the public on behalf of an organization during an emergency.[21]

Government Officials, Staff, and Responders

Vector control professionals should build rapport with the community before a crisis to help establish trust and help achieve management goals. Inviting officials and public affairs to tour facilities and equipment can make decision makers aware of the functions and staff tasked with controlling mosquitoes. Additionally, these tours can facilitate local mosquito control and government to develop an emergency response plan. In the absence of such plans, the process of debate and discussion during the emergency can jeopardize efficient and effective responses.

Even in locations that may not perform routine mosquito management, situations can happen that require emergency mosquito control, and thus federal, state, and local governments need access to emergency funding. Making different agencies aware of where the responsibility lies to perform mosquito management helps ensure budget allocation and may prevent duplicated, and subsequently wasted, efforts.

During an emergency, communicating with officials, staff, and other responders must occur to coordinate the many activities required among several public, private, and municipal entities and protect these individuals from the crisis.

- Local government officials and leaders need to understand the situation in real-time to make informed decisions and communicate with other governmental organizations. Outlining an information sharing process beforehand to keep these individuals up to date eliminates confusion and saves time.
- Natural disasters may force personnel normally responsible for mosquito control

to evacuate. The ability to inform mosquito control personnel that the immediate disaster has ended and that they can return to duty must occur before recovery can begin. A clear communication plan including staff contact information, who holds what communication responsibilities, and when to contact staff will help facilitate the response.

- In some instances, responders from other areas of the country not familiar with aerial mosquito control may need information about emergency operations and what to do before and during the application. Pre-drafted communication templates targeting this audience will help share critical information these responders need to aid recovery efforts and protect themselves.

Residents and Other Community Members

Just as with government officials, communication with residents about mosquito control should occur before an emergency and is a critical component of an integrated mosquito management program. If possible, inviting all members of the community to facility open houses can aid in building trust with vector control professionals. For additional best practices on communicating before an emergency, the Community Engagement section of the AMCA's *Best Practices for Integrated Mosquito Management* manual provides tips vector control professionals can use to regularly engage their communities.

During a mosquito-driven public health emergency, mosquito control operations typically focus on areas that are most densely populated; thus, vector control professionals should prepare to communicate to everyone within the affected area. To help achieve communication goals during an emergency, the *CERC Manual* outlines six core principles to create effective messaging during a crisis.[21]

1. Be First- During an emergency, time is of the essence. Responding quickly and providing necessary information first can establish vector control professionals as the preferred source of information.
2. Be Right- Vector control professionals should share accurate information and explain the situation, why it has happened, what is known, what is not known, and what is being done.
3. Be Credible- Trust is important for a community to believe the information and change behavior.
4. Express Empathy- Disasters and increased risk of illness can scare people and make emotions run high. Addressing these feelings and realities can help build trust and rapport.
5. Promote Action- Providing actions people can perform to protect themselves and their loved ones helps restore order and gives people some sense of control over the situation.
6. Show Respect- When communicating with anyone, respect is crucial to build trust and foster cooperation.

Several communication channels exist to deliver messages to residents including digital highway signs, television media (Figure 3), social media, radio, and emergency text messaging alerts. Pre-drafted communication templates that public information officers can readily disseminate increases the speed and accuracy of information shared during an emergency. Communication professionals may need to tailor messages to a specific area, but some example topics may include how to protect against mosquito bites using personal protection measures, timing of and what to do during application missions,

Figure 3. Media Reporting on Emergency Mosquito Control

Source: Dan Markowski, Ph.D.

and how to contact vector control to report dangerous conditions. Additionally, vector control professionals should extend notification requirements to inform beekeepers and members of the public with chemical sensitivities that aerial applications will occur.

ROLES AND RESPONSIBILITIES

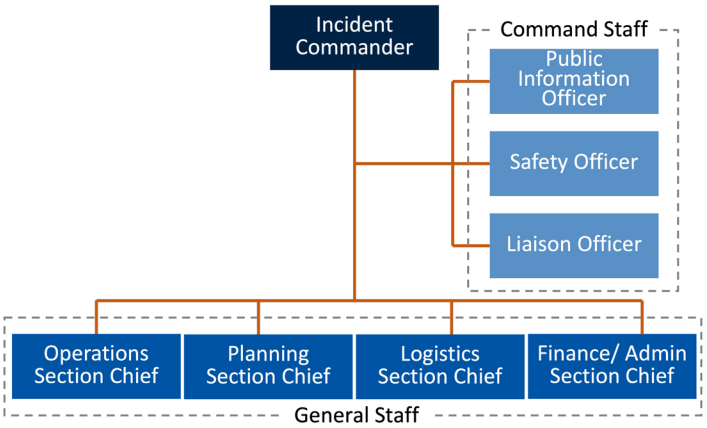
A mosquito emergency can happen fast, and the magnitude can range in scope drastically from the national level to a statewide response down to the municipal level. An effective response may require a coordinated effort from several levels of government and private organizations to share resources and tactics to regain control over the situation. When an emergency occurs, a focused response relies on a process that everyone understands and a clear chain of command with well-defined roles and responsibilities (i.e., activation of the incident command system). Additionally, people who hold responsibility for mosquito control must understand the roles and responsibilities provided by each level of their government response partners. Finally, private contractors frequently play a substantial role in managing a situation and restoring order.

National Incident Management System

Through FEMA, the National Incident Management System (NIMS) outlines a response approach that all levels of the government (national, state, and local) and organizations can use to address a wide range of situations including mosquito emergencies.[22] The NIMS provides standard language, processes, and resources, so different groups working together have a common, shared understanding during response. State and local governments are required to adopt NIMS to qualify for Federal Preparedness grants.[9, 23] To ensure all people better understand this system and their roles, FEMA offers required trainings through the Emergency Management Institute (EMI) to help prepare all individuals.[24, 25]

The NIMS also outlines an Incident Command System/Structure (ICS), or a standardized response system, including personnel hierarchy, with clearly defined roles and responsibilities that different members of an organization or government automatically assume once activated to coordinate all of the activities necessary to regain control of the situation (Figure 4).[22] There might be as many different operational structures as there are states and organizations. During an emergency, this complexity can further complicate a stressful situation because responders from different areas may not know who to report to, what their role is, or even what certain terms mean. To address this, an ICS may become activated.[25] In some instances, multiple agencies/organizations may need to respond to the emergency, and a unified command structure outlines how the different agencies' ICSs work together under one incident commander.[22, 23] Vector control personnel with ICS responsibilities

Figure 4. Incident Command Structure



Source: Federal Emergency Management Agency[22] (p. 25)

are encouraged to seek out other individuals with ICS roles from their organization before an ICS is activated. Ideally, having some familiarity with these people before an emergency situation will help the team respond more efficiently.

Government

Federal

For FEMA to provide assistance, the President of the U.S. must declare a federal emergency (Figure 5). This declaration occurs after a state's Governor or Tribal Chief Executive requests a federal emergency be declared.[26] Once the President makes this declaration, state and local governments have access to federal funding to potentially reimburse a portion of the additional cost over what the organization normally spends during a similar period of time without a disaster. To access these funds, communities must submit a Request for Public Assistance form.[17]

Other federal agencies may have an Emergency Support Function (ESF) during an emergency.[14,27] These functions will vary in the level of involvement during response, but in general they provide one or a combination of the following: funding, resources and equipment, and/or technical expertise.[22] Below is a brief description of some of the different federal agencies and their potential role during mosquito control emergency response:

Federal Emergency Management Agency- Leads and coordinates federal emergency response and assistance (including reimbursement) after the President of the U.S. declares a major disaster or emergency

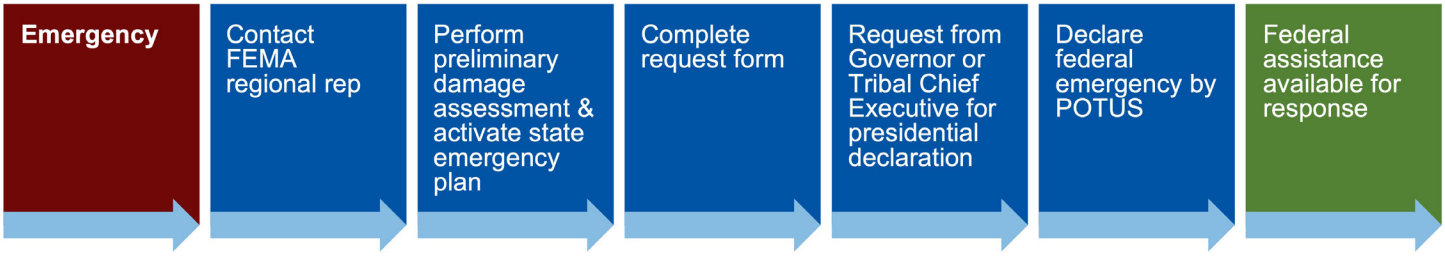
Centers for Disease Control and Prevention- Provides subject matter expertise about how to reduce the risk from mosquitoes and reviews human and non-human surveillance data to ensure emergency conditions exist

Department of Defense (U.S. Air Force[28])- Applies pesticides during presidentially declared emergencies when emergency control extends beyond the capabilities of local mosquito control districts and private contract services

Federal Aviation Administration- Ensures regulatory compliance when flying planes and drones during emergency response

U.S. Fish and Wildlife Service- Ensures proposed treatment areas protect humans and endangered/threatened wildlife

Figure 5. Path to Federal Assistance



Source: American Mosquito Control Association

Environmental Protection Agency- Ensures regulatory compliance during emergency use of pesticides

United States Department of Agriculture – Ensures treatment areas protect humans and certified crops produced on organic farms

State

Each state will determine when an emergency situation occurs and may have different data thresholds and requirements. Only the Governor can declare a state emergency. However, the person or agency responsible for communicating to the Governor when an emergency has occurred may vary for each state. Additionally, not all situations require the declaration of an emergency to initiate an emergency response. If the emergency situation warrants federal involvement, the Governor must petition the President of the U.S. to declare a federal emergency. Finally, counties, parishes, and other municipal levels may need to request assistance.

The agencies and decision makers involved during a mosquito emergency at the state level can vary between states. As a result, professionals with emergency mosquito control responsibilities for their state should seek to understand how their state performs mosquito control, collects data, and determines risk as soon as possible after assuming the position. However, some of the roles and responsibilities at the state level may include:

- Obtaining contracts for private service providers
- Allocating budget to cover emergency costs
- Requesting assistance using the proper process/channel
- Negotiating Emergency Management Assistance Compacts (EMAC) with nearby states (For more information about EMAC's, see the Negotiate Contracts and Cooperative Agreements section below)
- Coordinating aerial response plans during emergency
- Collecting surveillance data before an emergency
- Collecting geographic information system (GIS) treatment and surveillance data following the intervention
- Determining when thresholds are met to identify emergency conditions
- Creating maps that determine where aerial spraying may and may not occur
- Determining what product(s) to use
- Providing funding, resources, and equipment to local governments

Local

Just as with state roles and responsibilities, local government structure relative to mosquito emergencies varies tremendously. People operating at the local level should seek to understand how their state and local governments operate, and where they fit into mosquito control emergency response. Public health professionals at the local, city, and tribal levels may need to provide in writing the specific health threat posed by mosquitoes. Decision makers should additionally understand how to request emergency mosquito control services or additional funding to perform those services. For example, the Texas Department of State Health Services (DSHS) uses the State of Texas Assistance Request process for local jurisdictions to request emergency mosquito abatement following a weather event.[29] In addition to the request process, local governments should also understand the requirements to receive assistance such as budget for partial payment, surveillance data, and/or normal cost of mosquito abatement over a three-year period without an emergency.

In some situations, individuals running a mosquito control district during an emergency may not hold a leadership role for risk determination or within an ICS. However, these districts still perform vital services during an emergency and should plan to provide ICS leadership with surveillance and efficacy data required to improve the chance of successful outcomes. Communicating with residents, distributing educational and personal protective materials, and ensuring seamless continued regular operations (surveillance and control activities) keeps people safe while different groups mitigate the risk from the emergency situation. Additionally, private contractors may work directly with local mosquito control staff for logistical planning during an emergency operation. In some instances, local governments and districts may bear some of the responsibility to pay for a portion of the emergency mosquito control operations.

Contractors

In many instances, the size of the mosquito emergency can quickly grow beyond the capabilities of the local jurisdiction or state. In these instances, governments may need to hire an external organization to perform emergency mosquito control services. Several national and regional for-profit organizations exist that can respond during an emergency and perform services such as:

- Acquiring mosquito surveillance data
- Applying adulticides (specifically aerial, but ground as well)
- Handling media and PR inquiries

Ideally, choosing a contractor and negotiating the contract occurs before a public health emergency. People looking to hire a contractor should consider the following:

- The organization submitting a contract should be properly trained in mosquito control.
- All people involved should hold the appropriate licenses and be familiar with the pesticide product and equipment.
- The organization should have experience performing mosquito control during an emergency response.

Paying For Emergency Mosquito Control

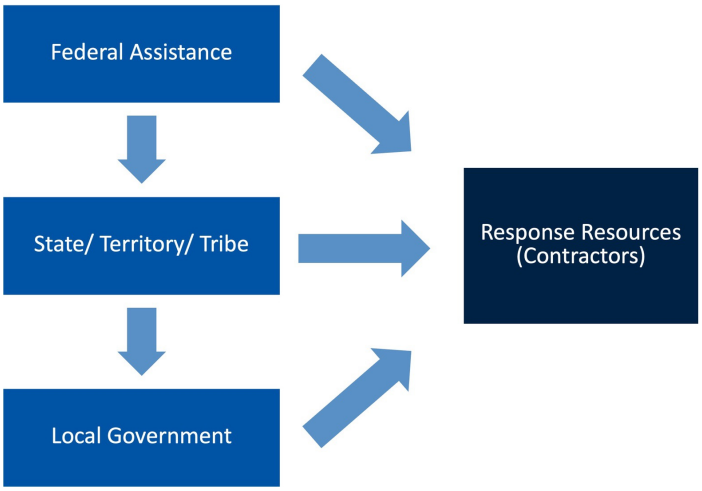
Emergency mosquito control is expensive[9,30,31] and can easily cost tens, if not hundreds, of thousands of dollars. For FEMA to provide assistance, the President of the U.S. must declare a federal emergency (Figure 5).[17, 32] FEMA has a Public Assistance Program that provides grants to state and local governments and some types of non-profit organizations to quickly respond and recover after disasters and emergencies (Figure 6).[32] When FEMA provides assistance, the funding first goes to the state, and then the state ensures the assistance reaches the local government.[5] Using this program, FEMA may reimburse a portion of the cost over what is typically spent during the same time period over an average of three years.[16] When FEMA provides funding through these grants, typical reimbursement is 75% of the cost (though this percent may change).[27] As a safeguard, state and local governments that could experience a mosquito emergency should allocate an emergency budget for their portion of the cost-sharing (i.e., the other 25% not reimbursed by FEMA).

FEMA has published a guidance document (*Public Assistance Program and Policy Guide*) that outlines the data requirements to request reimbursement for emergency mosquito abatement following the declaration of a federal emergency.[16] According to page 236 of this

document, FEMA may provide reimbursement after a state, local, territorial, or tribal government's public health official makes a written request, and FEMA has consulted with the CDC that there is:

- "Evidence of:
  - o Higher levels of disease transmitting mosquitoes in the impacted area following the incident;
  - o A significant number of disease-carrying mosquitoes in the area due to the increase in incident-related standing water; or
  - o The potential for disease transmission and human exposure to disease carrying mosquitoes based on the detection of arboviral diseases in sentinel organisms (poultry, wild birds, mosquito pools) in the impacted area prior to the incident, discovered during surveillance as part of mosquito abatement activities, or reported human cases in which transmission occurred prior to the incident.
- A determination that a significant increase in the mosquito population and/or the change of biting mosquito species poses a threat to emergency workers who are required to work out-of-doors, thereby significantly hampering response and recovery efforts.
  - o Such evidence may include an abnormal rise in landing rates or trap counts, significant changes in species composition or estimate of infection rates, when compared to pre-incident surveillance results.
- Verification from medical facilities within the affected area that an increase in the general public's exposure to mosquitoes has directly resulted in secondary infections, especially among those with weakened immune systems such as the elderly, the very young, or the sick. This may occur when increased numbers of residents in impacted areas with extended power outages are forced to open buildings for air circulation."

Figure 6. Assistance Flow Chart



Source: American Mosquito Control Association

The federal government surveillance data requirements for reimbursement are clear and applicable to any state or local government operating under a federally declared emergency. However, reimbursement data requirements for other levels of government (i.e., state and local governments) may vary. To ensure successful emergency mosquito control services and/or reimbursement, programs responsible for emergency response should seek to understand their local government's requirements and process for reimbursement **before** an emergency occurs.

PREPARING BEFORE AN EMERGENCY

Leaders that plan before a mosquito-driven public health emergency help ensure effective response and recovery to protect all persons in the affected area. The worst time to make a plan is during the emergency. Mosquito control personnel may need to worry about protecting their own immediate interests first (i.e., self, family, pets, farm, land, property) before performing emergency mosquito management. If these people become incapacitated or stranded during the acute emergency, they will not have time to prepare for mosquito management before floodwater mosquitoes emerge and subsequently may not protect the community. Additionally, regardless of the type of public health emergency, time is of the essence, and constructing a logistical response takes valuable time. For these reasons and more, any pre-emergency coordination and planning that can be accomplished BEFORE an emergency occurs allows for smoother response.

Write an Emergency Response Plan

All state, local, territory, and tribal governments should create a Mosquito Control Emergency Response Plan. Once a mosquito emergency has occurred, time becomes of the essence. Whether a hurricane has hit land or arbovirus surveillance data indicates high risk for human cases, a response plan guides recovery efforts. Additionally, passions and emotions run high during an emergency. Referring to a previously created emergency plan creates a clear plan of action and removes the influence of emotions and personal opinion from decision making.

Different areas may choose to create different types of plans. Some areas may have a relatively low risk of a water-related mosquito emergency. However, the risk of mosquito-borne disease threatens most, if not all, part of the U.S. As a result, the likelihood of the emergency happening (e.g., natural disaster and/or mosquito-borne disease outbreak) for an area should influence the type of emergency response plan created. Some areas may have plans that cover both scenarios, whereas others may only plan for one type of emergency. Part Two of this document provides a framework anyone can use to create a mosquito control emergency response plan.

Once written, emergency response managers should regularly review, practice, and evaluate the Mosquito Control Emergency Response Plan. Annual review ensures names and contact information remain up to date. During an emergency is not the time to find out that critical contact information no longer works within an agency. Review also provides an opportunity to revise the plan to include new or expand on existing sections. Additionally, practice allows people to gauge how well a response would be executed if an emergency happened at that moment and adjust accordingly. Regular review also creates the opportunity to practice how an organization would respond to additional, simultaneous, complicating circumstances such as issues with supply chain or conflicting public perception. Finally, a critical component of effective planning is regular evaluation of the plan. What lessons were learned from past experiences and events? Based on this, how should decision makers adjust the plan?

Dedicate a Budget

Mosquito control emergency response can cost a lot of money.[9, 30, 31] To prepare, people with response responsibilities should set aside money for emergency control measures. Federal, state, and local governments can have systems in place to help cover the costs associated with response and recovery during an emergency. However, these systems often require a cost-sharing agreement. For example, governments that qualify for emergency funding through FEMA often must pay for 25% of the efforts. If the impacted government cannot pay their portion, then FEMA will not provide financial assistance.

The amount of money to set aside can vary. Responses will need additional funds to cover operational expenses (surveillance, creating maps, and treatment), overtime for staff, and other surprise costs. A basic guide to estimate a sufficient budget for pesticide application is:

1. Create maps of the area
2. Identify the areas with the highest population centers
3. Calculate the acreage for these population centers
4. Expect at least $2.00 per acre* (*estimate based on the time of writing this manual)

Negotiate Contracts and Cooperative Agreements

Securing contracts pre-emergency eliminates the guess work over who will perform what action when and saves time. Even if an area has a well-established mosquito control district, disaster can eliminate critical infrastructure and equipment necessary for mosquito management. In this event, contracts negotiated before an emergency help make sure states and local government have the resources needed to respond. Additionally, contingency contracts can streamline the Request for Proposal, bidding, and award process, which can easily take weeks to months.

Pre-existing contracts may also save money by reducing the impact of inflation and locking in a fixed price. In many instances, the cost of goods and services increases with time. Before an emergency, negotiating contracts that last for several years could save governments money by stipulating a fixed price for services based on prices negotiated at the time.

Additionally, EMACs and Memorandums of Understanding (MOUs) established before an emergency enable states and local governments to help each other during emergencies. Neighboring states and counties may want to help, but when people from outside of the emergency respond, to whom do they report? If an employee gets hurt on the job, who pays the workers' compensation? Determining the answers to these and many other questions during the emergency response can delay one state from receiving resources from a neighboring state. An EMAC ensures, "states can share resources from all disciplines, protect personnel who deploy, and be reimbursed for mission related costs."[33] Similarly, MOUs facilitate sharing resources while also being non-binding. Negotiating these cooperative agreements before an emergency addresses all of these questions to allow a seamless response and resource sharing.

Decision makers should regularly ensure all contracts are up to date and define the terms of the agreement as explicitly as possible. Example questions that contracts should address include:

- What is the rate charged by the contract?
- What is the unit being charged? (e.g., per acre, day, trap, person)

- Is there a mobilization fee?
- What products will be used?
- When will the responding party arrive after the agreement becomes activated?
- Will there be a gasoline surcharge?
- Who is responsible for securing all licensing and permitting?
- How will pesticide applications be recorded and reported?
- Is there a retainer fee?
- Where will pesticides and aircraft be stored?
- Is there a centralized location available for contractors to use?
- What happens when the contractor services are suddenly needed by several agencies in disparate areas?

Choose Adulticide Product

Resource management is a major component of the NIMS and includes obtaining contracts from vendors to secure necessary products.[22] Emergency managers should determine what adulticides to use and how to acquire the products before the emergency. To be eligible for reimbursement through FEMA, "insecticide formulations must be among those approved and registered by the U.S. Environmental Protection Agency [EPA] for use in urban areas for mosquito control and must be applied according to label directions and precautions by appropriately trained and certified applicators. Furthermore, mosquito abatement measures must comply with all Federal and [state, local, territorial, and tribal] laws, ordinances, and regulations concerning vector control."[16] In addition to the FEMA requirements, a range of factors should be considered when choosing a product including availability, active ingredient, published efficacy data, public acceptance, formulation, application method, and desired application rate.

Create Maps

Experts in GIS should create preliminary maps of the area and determine where applicators might apply adulticides during an emergency (i.e., spray blocks). Public health professionals should prioritize densely populated areas and areas with conducive habitats for mosquitoes. Additionally, program managers should pre-determine no spray zones (e.g., lands with endangered or threatened species, chemically sensitive people, USDA certified organic farms, and apiaries). If an organization does not have this capability, partnering with other organizations such as city planning, water authorities, or universities with GIS capability may help create these maps. The Mapping chapter of the *AMCA's Best Practices for Integrated Mosquito Management* manual provides useful tips on using GIS, creating maps, and developing this capability.

Generate Baseline Surveillance Data

As discussed throughout this document, reimbursement for emergency mosquito control often requires data to show emergency conditions exist. Even within organizations that do not have an extensive surveillance program, collecting any kind of baseline mosquito surveillance data is better than no data. Baseline data can be as simple as a single CDC Light Trap placed and collected weekly to record the number and species of mosquitoes present. An internet search for the term "purchase mosquito surveillance traps" provides several manufacturers and distributors offering these items for sale. The sections on Mosquito Surveillance and Arbovirus Surveillance in the AMCA's *Best Practices for Integrated Mosquito Management* manual provides a more in-depth discussion.

Establish Action Thresholds

Action thresholds should be established to determine when emergency conditions exist. To determine if a public health threat occurs after a natural disaster, responders should collect mosquito trap and/or landing rate data and compare that information to baseline data. If this data meets or exceeds the pre-defined threshold, emergency conditions exist.

Determining a public health emergency from mosquito-transmitted disease is less straightforward. Local jurisdictions will need to establish local thresholds. The section on Setting Action Thresholds of the AMCA's *Best Practices for Integrated Mosquito Management* manual discusses different methods and considerations for creating action thresholds for arbovirus surveillance. In general, each species and habitat could have its own action threshold.

The threshold should also describe the response. Page 57 of the AMCA manual and the *CDC's West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control* contain a table with recommendations for a phased response to West Nile virus.[1, 34] Additionally, the California Department of Public Health outlines risk assessments for several mosquito-borne viruses in the *California Mosquito-Borne Virus Surveillance & Response Plan.*[35]

Cultivate Relationships

Public health professionals can prepare for an emergency by developing relationships with other members of the ICS and different political bodies. Building rapport with potential ICS collaborators before an emergency helps ensure a seamless working transition if an ICS becomes activated. Similarly, inviting different governmental organizations and political leaders to mosquito control facilitates and discussing the need for emergency mosquito control can remind decision makers to allocate sufficient budget and other resources. An open house may bring visibility and begin nurturing relationships. Once a year, invite everyone within the government structure to tour any facilities and learn more about mosquito control. Additionally, annual drills that review the emergency response plan and run through mock scenarios help prepare everyone involved and builds relationships.

Draft Communication Templates

Effective communication takes time and planning. Pre-drafted templates for the different communication needs during an emergency can hasten people receiving critical information. Public health professionals should work with their Public Information Officer or community engagement team to craft effective language and visuals. The Community Engagement section of the AMCA's *Best Practices for Integrated Mosquito Management* manual outlines a strategy to develop effective communications that consider the intended audience, communication delivery method, and messaging. This framework can help develop a database of pre-drafted templates to communicate to politicians, other officials, outside responders, staff, residents in the emergency area, and any other group.

Ensure Regulatory Compliance

During emergency response, mosquito control operations must still comply with all existing regulatory requirements. Annually, verify that personnel have all licenses and permits required to apply pesticides, supervise pesticide applications, operate the necessary vehicles, and any other activities. Make sure emergency operations remain in compliance with all requirements of the Federal Insecticide,

Fungicide, and Rodenticide Act (FIFRA)[36]; Clean Water Act (CWA)[37]; and Endangered Species Act (ESA)[38] including notification and no spray requirements. Understand the timing requirements to submit all required documents to remain in compliance with the National Pollutant Discharge Elimination System[39] and FAA Congested Area Flight Plans.[40] Generally, there are special exemptions to allow treatments during a public health emergency without receiving prior approvals; however, responsible parties must retroactively submit all required paperwork within the time period defined by the respective regulatory agency.

PART TWO:
FRAMEWORK TO CREATE RESPONSE PLAN

EMERGENCY RESPONSE PLANNING

A well-organized response during a mosquito-driven public health emergency starts with creating a Mosquito Control Emergency Response Plan. This plan guides the response efforts by providing:

- The context for the plan (i.e., why the plan is necessary and when to use it)
- A database of names and contact information of people involved in response
- Protocols to perform different activities
- A list of necessary resources and how to obtain them
- Templates to speed data collection and communicate to various groups

Public health professionals tasked with creating a Mosquito Control Emergency Response Plan may find the task daunting. There is no single right way to create a plan. Plans can vary in length from a couple of pages to long technical documents. Do not let perfection be the enemy of good enough. A three-page document with different categories and bulleted lists can help provide instruction to people during an emergency. Ideally, the plan is a "living document" that emergency managers revisit and practice annually, creating regular opportunities to revise and update the plan. Below outlines a strategy anyone can follow to create a Mosquito Control Emergency Response Plan for any level of government or organization.

Workshop Planning

To begin creating a formalized emergency response plan, gather several key people with insights and knowledge related to emergency mosquito control, mosquito control in general, and the specific government structure. This team ideally includes those involved in executing the plan. However, all of the people attending the workshop do not need to be internal. When possible, inviting external experts may generate innovative approaches to the plan or keep the workshop moving forward. Additionally, hiring or assigning a person to facilitate the workshop (i.e., keeping track of timing, moving participants through activities, capturing notes, and even creating the first draft of the response) can ensure success.

Ideally, everyone participating in the workshop should read Part One of this document before attending. By doing this, everyone in the room has a base understanding of the critical components of an emergency response plan and understands the objectives and necessity of the workshop. Additionally, the organizer should make accessible the following materials to everyone:

- Pen, pencil, and markers
- Paper to capture notes
- Large paper board or computer connected to a large screen everyone can see
- The questions listed below prewritten on the large paper board, power point slide, or similar note taking device
  - o Only write one question per page/ PowerPoint slide and leave adequate room for note taking
- Hard copies of this document to use during the workshop

- Access to the AMCA's *Best Practices for Integrated Mosquito Management* manual

Everyone attending the workshop should know their role and responsibilities. At a minimum, the workshop should have the following roles:

- **Moderator/facilitator-** This person (or persons) will be in charge of keeping track of the time, asking the questions below, facilitating a lively discussion, and moving participants through the series of questions.
- **Notetaker-** This person's sole responsibility is to capture notes and answers to all of the questions.
- **Participant-** These people will be responsible for answering the questions asked during the workshop, providing the information that will go into the response plan, and deciding on the final information to include in the response plan.
- **Project manager-** This person will be in charge of creating the first draft of the plan and responsible for seeking revisions and finalizing the plan.
- **Leader-** One person should be responsible for resolving any disagreements and potential conflicts that might arise. This person could be the same or different from the project manager listed above.

Refer to emergency response plans created by other organizations to help define what the final product from the workshop could look like. Appendix I of this document contains a list of publicly available response plans and documents. Consider starting with a nearby jurisdiction's emergency response.

Workshop Activities

Below is a list of questions to discuss during the workshop. The answers will create the content that will ultimately make-up the plan. Answering every question may not be necessary but including as many answers as possible is desirable. Remember, responsible parties can and should edit and expand the plan over time, ideally during the annual practice sessions.

Scope

1. Will this plan be for a mosquito-borne disease response or natural disaster emergency response? Should the organization create both plans?
    A. The goal is to define the scope of the document and answer any preliminary questions someone using the plan may have. Emergency response plan creators may take text for these sections directly from this document. If content from this supplement is used, please cite as:
        AMCA. 2022. *Mosquito Management During a Public Health Emergency*. American Mosquito Control Association. Sacramento, CA.

People Involved

1. Create a list of names, roles, responsibilities, contact information, and capabilities. Get as specific and granular as possible. Consider some of the questions below when creating this database.
    A. Who are the people involved in responding to the emergency?
    B. Who currently has mosquito control responsibilities?
    C. Who declares the emergency?
    D. Who performs surveillance?
    E. Who performs control?
    F. Who is in charge of maintaining the facilities?
    G. Who is in charge of the fleet?

H. Who is the FEMA regional representative?
I. Who is the CDC contact?
J. Who is the point of contact at the contracting business?
K. Who else should be included?

Organizational Protocols and Processes

1. What process should the organization follow to request assistance?
2. What agencies and departments are involved in this process?
3. Who are the decision makers (e.g., judges, state entomologist, epidemiologist, governor's staff, others)?
4. Who holds positions on the ICS (Figure 4)?
   A. If possible, visualize the process with a flow chart or "Yes/No" algorithm. Pages 13 and 14 of the Texas Department of States Health Services *Technical Guidance: Mosquito Abatement Post Weather Incident* document provide an example.
   B. If possible, visualize the chain of command starting from the finest level (district, town, county, tribe, etc.) all the way up to FEMA.
   C. Do not recreate the wheel. If a document or visual already exists for your organization, seek permission to use the existing asset.

Response Logistics

1. What emergency specific special circumstances does this plan need to cover?
   A. For example, when creating a plan for a natural disaster related public health emergency, where will employees/staff go during the natural disaster? Who will contact employees/staff? How will this person contact employees/staff during the disaster? When will employees/staff return after the disaster? Where will equipment be kept? How will the equipment and resources be moved to safety?
   B. During increased risk for arbovirus transmission, if staff are reallocated to a different priority, how will the plan accommodate reduced resources?
2. What methods will be used to perform surveillance? Include any protocols in this document to standardize the process. For more information, refer to the Mosquito Surveillance and Arbovirus Surveillance sections of the AMCA's *Best Practices for Integrated Mosquito Management* manual. Additionally, Appendices II & III of this document provide protocols for landing rate counts and CDC Light Traps that can be included in an emergency response plan.
   A. During a natural disaster related public health emergency, consider the following three surveillance methods (Table 1):
      i. Landing rate counts
      ii. CDC Light Traps
      iii. Service requests
3. How will an emergency be determined? What phased response will be used? What action threshold triggers a response? Refer to the Setting Action Thresholds section in the AMCA's *Best Practices for Integrated Mosquito Management* manual for the CDC's phased response to West Nile virus.
4. During the response, where will the emergency operation center (EOC) be? The third edition of the FEMA *National Incident Management System* guidance document provides information on EOC setup starting on page 35.[22]
5. What resources are required to respond? Pages 10 and 11 of the FEMA *National Incident Management System* document has

information to include when creating a database of resources.[22]

   A. What adulticide products will be used? What is the back-up product in case procurement cannot obtain the primary? How will the products be purchased? Where will they be stored?

6. What contractors are available? What services do the contractors provide? What contractor will be used during an emergency? Who will be the back-up in case the primary cannot respond?
7. What infrastructure is available for landing strips/logistical coordination for contractors/Department of Defense (i.e., where can they store their equipment? Planes? Staging?)

Communication

1. What groups (audience) need information about the emergency response? (e.g., external responders, residents, politicians, staff, etc.)
2. What communication templates exist? What templates need to be made?
3. Who will make the templates?
4. Where will templates be stored and accessed?
5. What channels will be used for communication?

Write the Plan

The project manager should create a first draft of the plan after the workshop by compiling all of the information, notes, and personal experiences. To divide the work more evenly, a different person may write each section of the plan, but a single project manager should still lead these different work streams. The project manager does not necessarily need to write the plan using complete sentences- bulleted lists may suffice especially if this is the first plan ever created. Creating a first plan is more important than creating the perfect plan. After completing a first draft, the different participants from the workshop should review and revise this draft. Then, the project manager should incorporate all of these revisions and finalize the completed emergency response plan. Once a final document has been approved, the project manager should disseminate the plan throughout the organization and store it in a database or website where others can readily access it.

Review, Practice, and Evaluate

After creating the plan, all major stakeholders should review and practice it at least once a year. This group should open the document, review the contents, and discuss every protocol. The practice session does not need to be extensive. At a minimum, consider scheduling a three-hour call with everyone involved and running through the following drills:

1. Describe what response would look like if an emergency was happening that day.
2. Manually call all of the people in the database. Make sure their contact information is up to date.
3. Review currently available resources. Where are they located at the moment? How much of what is available? Does anything need to be restocked?
4. Review the plan. Is everything in the plan still applicable? Is there an opportunity to add a new or expand a current section?
5. Evaluate the plan. Are there any revisions that can be made based on past experiences or events?
6. What budget is currently available to execute this response? Would this be enough to respond if an emergency happened today?

7. As time goes on and people become comfortable with the plan, consider incorporating realistic scenarios into the annual planning and practice that can further complicate response and challenge participants to think about how they would respond. For example, ask participants to walk through how they would respond if "the desired product will take 10 days to get there" or "there are public protests against the use of organophosphates."

Effective emergency response requires planning ahead of time and concerted efforts between several organizations. Regularly practicing, evaluating, and revising that plan based on experience and past events ensures the plan stays on top of mind, up to date, and as effective as possible. When the risk of an emergency is high, time is of the essence. Reviewing the information in the current supplement and making sure each organization has a plan ensures a rapid response and better protection of public health from mosquitoes and the pathogens they can transmit.

APPENDIX I- EMERGENCY PREPAREDNESS RESOURCES

*Emergency Preparedness Resources**

Agency	Resource Title	Resource Type	Emergency Type	Website
ASTHO	Before the Swarm: Guidelines for the Emergency Management of Mosquito-Borne Disease Outbreaks: A Project of the Mosquito Control Collaborative	Mosquito Response	Natural Disaster, Vector-Borne Disease	https://stacks.cdc.gov/view/cdc/21951
CA DPH	Response Plans and Guidelines	Mosquito Response	Vector-Borne Disease	https://westnile.ca.gov/resources_reports?resource_category_id=9
CDC	Emergency Operations Center	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.cdc.gov/cpr/eoc/eoc.htm
CDC	Vector Control for Environmental Health Professionals (VCEHP)	Training	Vector-Borne Disease	https://www.cdc.gov/nceh/ehs/elearn/vcehp.html
CDC	Aerial Spraying	Mosquito Response	Natural Disaster, Vector-Borne Disease	https://www.cdc.gov/mosquitoes/mosquito-control/community/aerial-spraying.html
CDC	West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control	Mosquito Response	Vector-Borne Disease	https://www.cdc.gov/westnile/resources/pdfs/wnvguidelines.pdf
CDC	Zika CDC Interim Response Plan	Mosquito Response	Vector-Borne Disease	https://www.cdc.gov/zika/pdfs/zika-draft-interim-conus-plan.pdf
CDC	Evidence on the Use of Integrated Mosquito Management to Reduce the Risk of West Nile Outbreak after a Flooding Event. A Potential Component of a Post-Disaster Integrated Mosquito Management Program	Mosquito Response	Vector-Borne Disease	https://www.cdc.gov/climateandhealth/docs/mosquitomanagementflooding_508.pdf
CDC	Epidemic Intelligence Service	Training	Vector-Borne Disease	https://www.cdc.gov/eis/about/index.html
CT	Connecticut Eastern Equine Encephalitis (EEE) Response Plan	Mosquito Response	Vector-Borne Disease	https://portal.ct.gov/-/media/CAES/DOCUMENTS/Mosquito-Testing/EEE-Response-Plan-2020.pdf

Emergency Preparedness Resources Cont.

Agency	Resource Title	Resource Type	Emergency Type	Website
EMAC	Emergency Management Assistance Compact	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.emacweb.org/
FEMA	Emergency Management Institute	Training	Natural Disaster, Vector-Borne Disease	https://training.fema.gov/emi.aspx
FEMA	National Incident Management System	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.fema.gov/emergency-managers/nims
FEMA	National Response Framework	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.fema.gov/emergency-managers/national-preparedness/frameworks/response
FEMA	National Preparedness System	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.fema.gov/emergency-managers/national-preparedness/system
FEMA	Public Assistance Program and Policy Guide	Emergency Planning	Natural Disaster	https://www.fema.gov/sites/default/files/documents/fema_pappg-v4-updated-links_policy_6-1-2020.pdf
FEMA	Request for Presidential Disaster Declaration Major Disaster or Emergency	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.fema.gov/sites/default/files/documents/fema_presidential-declaration-request_fema-form_010-0-13_2022.pdf
MA DPH	Arbovirus Surveillance Plan and Historical Data	Emergency Planning, Mosquito Response	Vector-Borne Disease	https://www.mass.gov/lists/arbovirus-surveillance-plan-and-historical-data#response-plan-
MA SRMCB	Massachusetts Emergency Operations Response Plan for Mosquito-Borne Illness	Mosquito Response	Vector-Borne Disease	https://www.mass.gov/massachusetts-emergency-operations-response-plan-for-mosquito-borne-illness
SCCMO	West Nile Virus Response Plan	Mosquito Response	Vector-Borne Disease	https://www.sccmo.org/DocumentCenter/View/724/St-Louis-Metro-Area-Action-Plan-PDF-?bidId=
SC DHEC	Post-Disaster Mosquito Control	Emergency Planning, Mosquito Response	Natural Disaster, Vector-Borne Disease	https://scdhec.gov/sites/default/files/media/document/Post-Disaster-Mosquito-Control-Consolidated-Resources_BEHS-2018.10.23.pdf#page=2

Emergency Preparedness Resources Cont.

Agency	Resource Title	Resource Type	Emergency Type	Website
SC DHEC	Mosquito Control Resources After a Natural Disaster	Emergency Planning, Mosquito Response	Natural Disaster	https://scdhec.gov/mosquito-control-resources-after-natural-disaster
Town of Batesburg-Leesville, South Carolina	The Town of Batesburg-Leesville Mosquito-borne Disease Response Plan	Mosquito Response	Vector-Borne Disease	https://www.batesburg-leesville.org/Data/Sites/1/media/mosquito-disease-respone-plan.pdf
TX DSHS	Technical Guidance: Mosquito Abatement Post Weather Incident	Emergency Planning, Mosquito Response	Natural Disaster	https://www.dshs.state.tx.us/uploadedFiles/Content/Prevention_and_Preparedness/commprep/response/Tech_Mosquito_Abatement_Post_Weather_%20Incident_2_25_19%20(2).pdf
TX DSHS	Zika Virus Annex	Emergency Planning, Mosquito Response	Vector-Borne Disease	https://www.texaszika.org/docs/Zika_Plan.pdf
USDA	Organic Certification and Accreditation	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.ams.usda.gov/services/organic-certification
US FWS	Endangered Species	Emergency Planning	Natural Disaster, Vector-Borne Disease	https://www.fws.gov/program/endangered-species

* All websites work at the time of writing this document. If in the future a link does not work, try an internet search of the agency name plus the document title to investigate if an updated version of the document exists.

APPENDIX II- BASIC LANDING RATE PROTOCOL

The following protocol can serve as a beginning point for organizations wanting to include surveillance protocols into their emergency response plans. This protocol should be modified to fit the needs of the specific plan and/or jurisdiction.

Protocol

Landing rate counts measure the number of mosquitoes landing on a person per minute. This data can help estimate the biting pressure and risk from mosquitoes in the environment when other surveillance methods are not available- in particular after a water-related natural disaster. Do not use landing rate counts to perform surveillance during periods of increased risk of arbovirus transmission (i.e., during a disease outbreak).

Landing rate counts should take place at least 24 hours before application of any emergency response pesticide and again within 48 hours after application. All pre- and post-application surveillance should be conducted in the same location.

1. Landing rate counts require two people. One person to stand still and allow mosquitoes to land on them (bait). The second person must collect and/or count the number of mosquitoes landing on the first person (collector).
2. Ideally, the same pair of bait and collector personnel perform landing rate counts at the same locations.
3. All people should wear solid, light color clothing whenever possible and maintain a consistent clothing color among the collectors and days to keep the results comparable.
4. No person should wear repellents, after-shaves, or perfumes.
5. Take all landing rate counts from a standing position.
6. Before starting the counts, the collector should disturb the surrounding vegetation.
7. Collections should be made after bait stands relatively still in the environment for 10 minutes. Following the 10-minute acclimation period, collector should begin counting and/or collecting mosquitoes off of bait.
8. Collector should only count mosquitoes that land within view.
9. If required for identification, use a mechanical or equivalent manual aspirator (lung powered) to collect mosquitoes.
    a. Collectors should store mosquitoes for later identification in vials or soft mesh bags and place in hard cooler. Make sure to avoid squishing or otherwise damaging mosquitoes.
10. Weather conditions should be noted (i.e., windy vs. calm, raining vs. clear, cloudy vs. sunny).
11. All landing rate locations should be GPS-referenced with latitude and longitude noted.
12. After collections are counted, the number of mosquitoes in each group for each species must be recorded, entered into a database, and mapped, so changes in mosquito abundance can be reviewed and verified by the appropriate source.

APPENDIX III- BASIC CDC LIGHT TRAP PROTOCOL

The following protocol can serve as a beginning point for organizations wanting to include surveillance protocols into their emergency response plans. This protocol should be modified to fit the needs of the specific plan and/or jurisdiction.

Protocol

CDC Light Traps use light and carbon dioxide to lure host seeking mosquitoes near the trap and a gentle suction to capture the mosquitoes. CDC Light Traps are a preferred surveillance method during a disease outbreak.

Surveillance should take place at least 24 hours before application of any emergency response pesticide and again within 48 hours after application. All pre- and post-application surveillance should be conducted in the same location.

1. Technicians bait traps with dry ice (or a similar source of carbon dioxide).
2. Rechargeable, 6-volt, or four D-cell batteries power the traps.
3. Traps are set in the afternoon and picked up the following morning, allowing for a minimum 12-hour collection interval. Include signage/contact information on the trap to clearly indicate this is a mosquito trap and someone to contact in case of questions.
4. Collectors should store mosquitoes for later identification in vials or soft mesh bags and place in hard cooler. Make sure to avoid squishing or otherwise damaging mosquitoes.
5. Technicians should transfer mosquito collections to a laboratory (or other suitable location) for sorting, identification, and counting.
6. All trap locations should be GPS-referenced, with latitude and longitude noted.
7. After collections are counted, the number of mosquitoes in each group for each species must be recorded, entered into a database, and mapped for a graphical presentation, so changes in mosquito abundance can be reviewed and verified by appropriate source.

Each designated treatment area should have approximately five traps and be geographically spaced to provide an accurate representation of adult mosquito populations in the treatment area. Larger treatment areas may require up to 10 traps. Adjust the number of traps as necessary based upon available resources and size of treatment area. Be mindful of spray blocks and drift when choosing sites both inside and outside treatment zones.

APPENDIX IV- LIST OF ACRONYMNS

ASTHO- Association of State and Territorial Health Officials

CA DPH- California Department of Public Health

CDC- Centers for Disease Control and Prevention

CT- Connecticut

CWA- Clean Water Act

EMAC- Emergency Management Assistance Compact

EMI- Emergency Management Institute

EPA- Environmental Protection Agency

ESA- Endangered Species Act

FAA- Federal Aviation Administration

FEMA- Federal Emergency Management Agency

FIFRA- Federal Insecticide, Fungicide, and Rodenticide Act

GIS- Geographic Information Systems

ICS- Incident Command Structure

MA DPH- Massachusetts Department of Public Health

MA SRMCB- Massachusetts State Reclamation and Mosquito Control Board

SC DHEC- South Carolina Department of Health and Environmental Control

SCCMO- St. Charles County Missouri

TX DSHS- Texas Department of State Health Services

ULV- Ultra-low volume

USDA- United States Department of Agriculture

US FWS- U.S. Fish & Wildlife Services

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