Delaware General Health District

Zoonotic Disease: Surveillance and Control Guide

Delaware General Health District
Division of Environmental Health
Residential Services Unit
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I. Introduction

The following guide aims to give insight into the activities performed at the Delaware General Health District to prevent and control the incidence of zoonotic disease. Extended procedures and decision trees, outside of this document, may exist and be used for the programs listed. It is important to note that some programs are governed by the Ohio Revised Code, Ohio Administrative Code, and Regulations of the Delaware General Health District.

According to the Ohio Department of Health (ODH), a zoonotic disease is a disease that can be spread from animals to humans [25]. The Centers for Disease Control and Prevention (CDC) estimates that 60% of existing infectious disease and 75% of emerging infectious diseases come from animals [7]. Recognizing this, the Delaware General Health District aims to prevent zoonotic disease through a comprehensive zoonotic disease program that includes surveillance, education, and control measures where appropriate. This may include the control of vectors such as mosquitoes or ticks, quarantine orders for animals, and education campaigns aimed to raise awareness of new and important zoonotic diseases. The Health District's priority is to prevent zoonotic disease through education and environmental controls. When the use of pesticide for vector species becomes necessary, application of larvacide is preferred to adulticide, as the larvacide is more effective at reducing the overall vector population. Efforts are focused to only include affected areas when pesticide must be used. Furthermore, those individuals who apply pesticide are Sanitarians and/or approved by the Ohio Department of Agriculture as applicators and receive continuing education on the subject matter. For some programs; laws, rules, and regulations exist for which enforcement activities may be pursued when no other means for compliance exists.

II. Mosquito-Borne Disease

A. Introduction

The Delaware General Health District believes mosquito surveillance is a vital piece of a comprehensive zoonotic disease program. Furthermore, the Health District recognizes that mosquitoes are a significant disease vector that needs to be monitored and controlled. Therefore, and based on Ohio Revised Code 3709.22, 3707.07, and 3707.32, the following mosquito control guide was established for the Delaware General Health District. This guide was developed following the best practices and information contained in the existing literature. The Delaware General Health District provides the following steps to effectively reduce the risk of mosquito-borne disease in the population of the Health District; observational community surveys, education/advertisement, larval mosquito surveillance and control, avian surveillance, adult mosquito surveillance and control, and human/animal disease surveillance.

B. A Brief Introduction to Diseases of Interest

The following are mosquito-borne diseases of interest within the Health District. They were chosen because of their occurrence or possibility to occur within the Health District. Other mosquito-borne diseases may occur that are not outlined herein.

1) West Nile Virus

West Nile Virus is a mosquito-borne disease spread primarily by the culex mosquito [6]. The transmission cycle of West Nile Virus involves a circular transmission between birds and mosquitoes [10]. Once the prevalence of West Nile Virus substantially increases in the mosquito population, it may be transferred to a human [10]. A human is considered a dead end host; this is because the virus is not transmitted back to mosquitoes from a human [10]. Typical symptoms of West Nile Virus include fever, headache, body aches, joint pain, vomiting, diarrhea, and rash [13]. The maximum incubation period is 21 days but is typically 2-14 and more commonly 2-6 days [28]. Fatigue and weakness may last for weeks to months [28]. Note: Other methods of transmission of West Nile Virus exist and are not covered in this document but include through pregnancy, breastfeeding, blood transfusions, in laboratories, and organ transplants [10].

2) La Crosse Encephalitis Virus

La Crosse Encephalitis virus is a mosquito-borne disease spread primarily by the Aedes triseriatus mosquito [11]. The transmission cycle involves a circular transmission between mosquitoes and typically small mammals [12]. A human is considered a dead end host; this is because the virus is not transmitted back to mosquitoes from a human [12]. La Crosse Encephalitis virus can be spread from female mosquitoes to eggs and survive winter. Typical symptoms of La Crosse Encephalitis Virus include fever, headache, nausea, vomiting, and tiredness, and in more severe cases, encephalitis [11]. The typical incubation period is 5-15 days and recovery typically occurs in a few days if severe symptoms do not occur [19].

3) Zika Virus

Zika Virus is a mosquito-borne disease spread primarily by the Aedes aegypti and Aedes albopictus mosquitoes [8]. The transmission cycle for Zika Virus is circular between humans and mosquitoes where an infected human can infect a mosquito and an infected mosquito can infect a human (it is speculated non-human primates maintain the transmission cycle in the wild) [9]. Typical symptoms of Zika virus include fever, rash, joint pain, headache, and red eyes [8]. Typical incubation is less than 2 weeks with duration typically less than a week [14]. A mosquito infected with Zika virus is infected for the life of the mosquito [15].

Following an announcement in February 2016 by the World Health Organization (WHO) declaring Zika virus a public health emergency of international concern, the Delaware General Health District began offering educational material regarding Zika virus [30]. On April 13, 2016 the Centers for Disease Control and Prevention (CDC) confirmed the suspected link between, a birth defect, microcephaly and Zika Virus [4]. Note: other methods of transmission of Zika Virus exist and are not covered in this document but include through pregnancy, blood transfusion and sex [9].

C. A Brief Introduction to Mosquitoes of Interest

The following are mosquitoes of interest within the Health District. They were chosen because of their occurrence or possibility to be found within the Health District. Other mosquitoes exist but are not outlined herein. The mosquito life cycle involves eggs, larvae, pupae, and adult. Depending on weather the lifecycle lasts 8-10 days [16]. Typical lifespan of a mosquito is approximately 30 days. Each phase of life of a mosquito gives an opportunity to control the population.

1) Culex Mosquitoes

The culex mosquitoes are active dusk to dawn [28]. They breed in stagnant water such as ditches or small ponds without water movement [28]. Multiple studies have been conducted on the flight range of this mosquito and found the mean flight range to be less than 1 mile [18, 21]. Culex mosquitoes are established in Ohio and are routinely found in the Health District's monitoring traps.

2) Aedes Triseriatus Mosquitoes

Aedes triseriatus is a mosquito which is active during both daylight hours and night [11]. Aedes triseriatus is commonly known as the tree hole mosquito as they look for containers or tree holes to lay eggs. Ae. triseriatus is established in Ohio. Flight range for Ae. triseriatus is thought to be low [22, 27].

3) Aedes Albopictus Mosquitoes

Aedes albopictus is established in Ohio [3]. This mosquito is commonly known as the Asian tiger mosquito. These mosquitoes feed on both animals and humans [15]. These adult mosquitoes will typically die at temperature less than 32 degrees Fahrenheit. Ae. albopictus bites both day and night [15]. Eggs can survive up to 8 months in addition to surviving cold temperatures. Ae. albopictus typically flight range is 200 meters [17].

4) Aedes Aegypti Mosquitoes

Aedes aegypti may be imported, but cannot survive the winter in Ohio (consistently less than 50 degree Fahrenheit) [3]. This mosquito prefers to live close to humans and feed on humans [15]. This mosquito is commonly known as the yellow fever mosquito [17]. Ae. aegypti bites both in day and night [15]. Eggs can survive for up to 8 months, but cannot survive in cold temperatures. Flight range for Ae. aegypti is approximately 200 meters [23].

D. Bats and Mosquitoes

The Health District maintains that bats are not an effective way to reduce the mosquito population. The diet of bats has been examined by multiple studies. The little brown bat's diet consists of less than 2% mosquitoes [29]. A comparable study showed the big brown bat's diet was also dominated by larger bugs [1]. Incorrect extrapolations have sometimes led to incorrect beliefs about bats and mosquitoes. However, bats can transmit rabies; a disease that if left untreated is nearly 100% fatal to humans. For these reasons, the Health District advises against the use of bats and bat boxes as a means to control mosquitoes.

E. Observational Community Surveys

Observational community surveys occur at the beginning of the mosquito season. The goal is to survey a statistically significant number of homes that can be generalized for the entire Health District. These surveys are designed to find the most common form of mosquito breeding areas within the Health District and guide the education efforts for the year (e.g. if an abundance of gutters are found with stagnant water, advertisements and messages will be used to remind residents to clean gutters to promote water flow thus preventing mosquito breeding).

F. Education

Education efforts are made to raise awareness of mosquito-borne diseases. This is accomplished by multiple methods including classes, billboards, social media, advertisements, press release, and other forms. Ensuring the community understands the environmental controls they can take to help reduce mosquito habitat will provide a more effective means of control than the repeated use of larvacide and adulticide. The Delaware General Health District's prevention message involves the following:

1. Empty containers that can hold water such as birdbaths, children's toys, and tires at least every 7 days.
2. Avoid outside activities when mosquitoes are most active. For most, this is dusk and dawn, but for Aedes mosquitoes this can be both day and night.
3. If outdoors when mosquitoes are active wear long sleeved, light colored clothing.
4. If outdoors when mosquitoes are present, use repellant containing DEET or Picaridin according to label directions.

5. Replace damaged screens on windows and doors to prevent mosquito migration into the home.
6. Install aerators or fountains in ponds to disrupt mosquito development.
7. Travelers returning from Zika-affected areas or those diagnosed with Zika virus should avoid local mosquito bites for 3 weeks.
8. Couples who have traveled to a Zika affected areas should use condoms or avoid sexual contact for 8 weeks if neither partner has symptoms.
9. Females who have traveled to a Zika affected area should use condoms or avoid sexual contact for 8 weeks.
10. Males who have traveled to a Zika affected area should use condoms or avoid sexual contact for 6 months
11. Pregnant women or women who are trying to become pregnant with travel plans to a Zika-affected area should consider postponing travel, speak with their physician, and follow the mosquito bite prevention techniques previously mentioned.
12. Couples who are currently pregnant and returning from Zika-affected areas should consult with their physician as soon as possible upon returning and use condoms or abstain from sexual contact for the length of the pregnancy.

G. Surveillance

Surveillance is a vital piece of any program designed to prevent disease. Surveillance efforts are used to determine what areas need additional attention for both educational campaigns and control efforts. The surveillance season is between the months of May and September. For some diseases, such as Zika Virus, surveillance efforts differ as mosquitoes cannot currently be tested for Zika Virus. Complaint locations as well as heavily populated areas are considered when determining areas where surveillance is needed. Additionally, the Health District utilizes a mapping component that is posted on the Vector/Insect section of the Health District's website to show locations of surveillance activities. Surveillance of mosquito-borne disease in the Health District includes: public reporting, larval surveillance, avian death reporting, adult mosquito surveillance, and human disease surveillance activities.

1) Public Reporting

The Delaware General Health District receives notices of mosquito nuisances from the public throughout the mosquito season. The initial response to these nuisance complaints is to encourage the elimination of breeding sites by following the steps mentioned in the education section of this document. When inspecting the site; general observations are noted about the presence of mosquitoes, the presence of standing water, and the presence of mosquito larvae. When standing water is present, education will be provided to the property owner on abatement of mosquito habitat and the option of larval control will be considered.

2) Larval Mosquito Surveillance

When a nuisance complaint is received about a potential mosquito breeding site, inspections are performed at the potential site. When inspecting the site; general observations are noted about the presence of mosquitoes, the presence of standing water, and the presence of mosquito larvae. When inspecting for larvae, the inspector may take sample groups from the breeding site, using a larval dipper, and count the numbers for each larval development stage. When standing water and larvae are present, education will be provided to the property owner on abatement of mosquito habitat and the option of larval control will be considered.

3) Avian Surveillance

While testing of dead birds is no longer performed, the reporting of dead corvids is an important aspect of surveillance activities. Corvids (typically crows and blue jays) are more sensitive to West Nile Virus than other avian species; and because of this, almost always die as a result of the exposure [6]. The report of corvids deaths have preceded some outbreaks of this disease in other cities, therefore dead crows and blue jays can be an early warning sign that West Nile Virus is present [6]. The general public is encouraged to report the incidence of dead crows and blue jays. This is completed through a passive surveillance system located on the mosquito section of delawarehealth.org.

4) Adult Mosquito Surveillance

Depending on the disease, adult mosquito surveillance can indicate patterns of disease. An active surveillance system can detect disease risk in humans as much as 2-4 weeks before onset in the human population [20, 24]. The initial placement of traps is based on a balance of requests, human population, and collection numbers. The initial data is collected and analyzed; if the number of mosquitoes collected is sufficient to keep the trap on location it remains, if not another proximal location is identified and the trap may be moved.

For West Nile Virus, mosquito surveillance of culex mosquitoes has been shown to indicate disease presence 2-4 weeks prior to human disease (20, 24). For monitoring West Nile Virus, the CDC gravid trap is used to monitor mosquito populations within the Health District. Approximately 23 CDC gravid traps are deployed throughout the district in public/private areas. The CDC gravid trap is designed to capture female culex mosquitoes that look to deposit their eggs. The female culex mosquito is targeted because they are the only culex mosquitoes that bite.

Differing from West Nile Virus, mosquitoes cannot currently be tested for Zika Virus; therefore alternative methods of mosquito surveillance are utilized. Further complicating the surveillance of Zika Virus is the fact that the CDC gravid trap utilized to capture culex mosquitoes that transmit

West Nile Virus does not capture the Aedes mosquitoes that would transmit Zika Virus [5]. Therefore, the Health District utilizes BG Sentinel traps to monitor populations of Aedes albopictus and Aedes aegypti mosquitoes. The BG sentinel trap is designed to catch female Aedes mosquitoes using visual and olfactory cues [5]. Samples collected are separated by species and counts are recorded. The Health District then monitors mosquito populations to help determine if and when control activities may be needed for a specific area.

After they are collected, samples are transported to an appropriate lab for arbovirus testing when applicable. The infection rate of mosquitoes is calculated and tracked throughout the year based on the results supplied by the appropriate laboratory. When positive mosquitoes are found or a human/equine case is confirmed, control methods as activated based on the control section of this document.

Additionally, the Health District utilizes a mapping component that is posted on the Vector/Insect section of the Health District's website to show locations of surveillance activities.

5) Human Surveillance

Human mosquito-borne disease surveillance is conducted by the Disease Prevention Team of the Health District. When cases are identified, the Environmental and Personal Health Divisions within the Health District work together to investigate the case and determine if control measures are appropriate.

H. Control

Mosquito control activities range from individual homeowner action to the application of pesticide by the Health District. When conditions exist where the Health District deems it appropriate to activate pesticide controls, Sanitarians and/or individuals licensed with the Ohio Department of Agriculture perform these activities. Control activities include environmental, larval, and adult mosquito control activities.

1) Environmental Controls

Environmental controls are those activities the homeowner may take to reduce or eliminate mosquito breeding habitat. Homeowners who recognize potential breeding grounds that hold water for more than seven days are encouraged to empty such containers. When large bodies of water are present where it is impractical to empty, such as a pond; an aerator, or fountain, can be added to provide circulation and movement of the water. This movement of the water disrupts the development of mosquitoes. These controls are the most cost effective and efforts homeowners can take on their own and are greatly encouraged by the Health District.

2) Larval Mosquito Control

Larval control of mosquitoes is preferred over adulticide application by the Delaware General Health District as it is a more effective form of mosquito control. When an area is identified in need of larval control, based on a valid public complaint or request by the political subdivision, larval control can be considered. Before the larvacide is applied, written permission is requested of the owner of the property. Larvacide is applied by hand or by back-pack based application. Finally, educational material is provided to the property owner and/or public in order to make them aware of larval control.

3) Adult Mosquito Control

If used correctly, ULV adulticide can reduce the mosquito population [2]. In order to control the population of adult mosquitoes and prevent transmission of disease, the Delaware General Health District will adulticide in the event of a positive test for a mosquito-borne disease in mosquitoes or a probable or confirmed human/equine case and may consider other factors such as mosquito population counts. In the event that adulticide application will be made, communication will be made to the public and political subdivisions through signs posted in the immediate area of the fogging zone, appropriate press releases/social media posts, and indicators placed on the mosquito map located on the Health District's website. Fogging zones are established by flight patterns of specific mosquitoes. In most cases, the application zones are based on the mean flight ranges of the specific mosquitoes.

a) Truck-Based Application

The Delaware General Health District's truck-based application consists of Ultra-Low-Volume (ULV) cold aerosol spraying. This method is used to provide immediate control of existing mosquito populations. The technique used forces a large volume of air through a specially designed nozzle that shatters the liquid chemical into aerosol mist, resulting in an environmentally safe low dosage rate of approximately ¾ of a fluid ounce per acre. The chemical that is currently utilized is Masterline Kontrol 4-4 (Permethrin).

Weather Conditions necessary for adulticide spraying include:

1. Temperatures consistently above 50ºF
2. Wind velocity below 10 mph and,
3. No current precipitation

A mileage count is recorded for each application. These logs are used for accurate reporting of pesticide coverage and use. If community residents are allergic or philosophically opposed to fogging, "shut-offs" are indicated on spray routes. A "no fog" list

that incorporates street addresses and phone numbers of those who wish to be notified directly before the fogging is initiated to aid the applicators in alerting concerned individuals.

b) Backpack-Based Application

In addition to truck-based application, the Health District may deploy backpack-based applications to gain a more complete elimination of mosquitoes near a case of disease presence when humans are not a dead end host as is the case for Zika Virus. This will involve sanitarians and/or those approved by the Ohio Department of Agriculture to apply pesticide treating an area prior to the truck-based application. Depending on the targeted mosquito, backpack-based applications will be conducted either at 10' and below for Aedes mosquitoes, as this area is the typical resting area of Aedes mosquitoes; or, above 10' for Culex mosquitoes as this is the typical resting area of the Culex mosquitoes. If applying for Culex mosquitoes, drift should be considered. If applying for Aedes mosquitoes drift should not be a concern with the spray height used. Spraying will occur in areas around the home such as under decks and will work outward 50' but will not be performed on flowering plants. At the end of the application appropriate handouts will be supplied to the property owner if applicable.

4) Pesticide Resistance Testing

In order to ensure that the pesticide used for adult mosquito control is effective on the local mosquito population, pesticide resistance testing should occur yearly. Decisions on product purchases should be based on the results of the pesticide resistance testing.

5) Honey Bees

The MSDS for Kontrol 4-4 notes that the substance is toxic to honey bees [35]. To reduce the chance for honey bee interaction the MSDS dictates that the product must not be applied while honey bees are actively visiting the treatment areas, except when treatment is made to prevent or control a public health threat [35]. Even though the application made by the Health District is to prevent a public health threat, the Health District does observe this warning to protect the honey bee population. The Health District does not begin fogging until dusk (typically 8:00PM-9:00PM) to protect honey bee populations. This is consistent with studies on honey bee foraging patterns which indicate honey bees are active throughout the day from 6:00AM-7:00PM and most active from Noon to 7:00PM [36].

I. Human/Animal Disease Response

The transmission cycle of the disease is considered when formulating response plans. When mosquitoes have the potential to transmit a disease from an infected person to a non-infected person thereby creating local transmission different approaches must be taken to protect the community. This Health District's goal is to prevent and limit all transmission of disease. In the case where a human or nonhuman primate is identified as suspect, probable, or confirmed to have a transmissible disease where such human or primate is not a dead end host, control measures will be implemented in an attempt to prevent the disease from being transmitted to others in the area. Containment will be based on the flight range of the potential vector mosquito.

In the case of a mosquito-borne disease outbreak, the Delaware General Health District responds by assessing the area, educating the public, larvacide application when appropriate, and adulticide application as indicated by policy. After the initial notification of a disease outbreak it is necessary to assess the area and determine a possible location(s) where the exposure to the infected mosquito occurred. After a location is determined, door to door education of the public may occur. The education includes handing out pamphlets, reminding residents to reduce the amount of standing water at their property, and discussing other pertinent information concerning mosquito-borne disease. Next, observations are made about the amount of standing water in the area. If there is significant stagnant water, larvaciding should occur. After larvacide is applied, the last measure to help ensure public safety from arboviral disease outbreak is to adulticide in the area around the predetermined location. In the event of death or an epidemic the Health District reserves the right to suspend the "no fog" list in the interest of protecting public health.

1) Assessment

The Delaware General Health District responds by assessing the area, supplying patient preventative measures, educating the public, larvacide application, when appropriate, and adulticide application as indicated by policy. After the initial notification of a disease it is necessary to assess the area and determine a possible location(s) where the mosquitoes may be present and the number of residents affected. In this phase temperature, location, travel history of patient, and other factors are considered to ensure an appropriate response.

2) Patient Preventative Measures

After notification that a patient is suspect, probable, or confirmed to have a transmissible mosquito-borne disease, such as Zika Virus, the patient will be supplied with a packet of information and tools to prevent mosquito bites. This packet may include: condoms to prevent sexual transmission, mosquito repellant to prevent mosquito bites, window/door screen repair kits to prevent mosquitoes from entering the dwelling, and educational material regarding mosquitoes and the diseases they carry.

3) Education Campaign

After initial assessment for a probable or confirmed case, door-to-door education of the public may occur. The education includes handing out pamphlets, reminding residents to reduce the amount of standing water at their residence, and discussing other pertinent information concerning mosquito-borne disease.

In the event canvassing is needed to alert the public, a canvassing task force will be assembled containing different disciplines within the Health District. One estimation for such a task estimates a team of two could reach approximately 100 homes per hour [26]. A real incident in the Health District in 2017 allowed for an opportunity to further analyze the time involved in canvassing a neighborhood. This incident revealed that Health District teams of two were able to reach 34 homes per hour or 44.5 acres per hour. For estimating time and staff needs, the number of 34 homes/hour/team will be utilized.

The Health District will utilize half of the fogging zone as the canvas zone. Attempts will be made to complete the canvasing within 3 hours. This estimation does not include briefing and debriefings. Task forces will be made consisting of 2 staff members of different disciplines. Each task force may be supplied with educational material, maps, safety vests, a communication radio, water, and insect repellent. The Operations Chief will be on scene for coordination and will have surplus materials.

4) Control

For a probable or confirmed case, after education of the area is complete and during the door-to-door campaign, observations are made regarding the amount of standing water in the area. If there is significant stagnant water, larvaciding should occur based on the larval mosquito control section of this document.

After larvacide is applied, the last measure to help ensure public safety from an arboviral disease outbreak is to adulticide in the area around the predetermined location in accordance with the adult mosquito control section of this document. This may include both truck-based and backpack-based applications. In the event of death or an epidemic the Health District reserves the right to suspend the “no fog” list in the interest of protecting public health.

J. Non-Native Disease Response

In the case of a non-native mosquito-borne disease found in a subject within the Health District’s jurisdiction, the Health District will employ prevention measures appropriate with the disease. If there is potential of local spread of the disease from human-to-mosquito-to-human, and the mosquito vector has been proven to

exist in the area, the Health District may utilize larvaciding, adulticiding, and public education as appropriate.

K. Cost of West Nile Virus and Return on Investment

The cost of West Nile Virus is documented in different studies as well as a method to predict the number of human infections. These methods were combined to determine the community savings of a mosquito prevention and control program in 2017 and the table calculator developed that is used by the Health District [31]. This calculator estimates the number of predicted human West Nile Virus (WNV) infections based on the work of Kilpatrick, Kramer, Campbell, Alleyne, Dobson, and Daszak [32]. The predicted infections are combined with estimates of the cost of a West Nile Virus case during an outbreak. A study in 2002 estimated the average medical cost of a case of WNV was $27,610 [33]. In 2005 another study estimated the average cost of a case of WNV during an outbreak to be $13,971 and a cost of $1,170 for those with mild infection, not requiring hospitalization [34]. This data is compared with the program cost to ensure the program offers a positive return on investment to the community.

III. Tick-Borne Disease

A. Introduction

The Delaware General Health District recognizes that ticks are carriers of diseases that affect humans including Lyme Disease and Rocky Mountain Spotted Fever. Therefore, the following tick control guide was established for the Delaware General Health District. The Delaware General Health District provides the public with the following steps to effectively reduce the risk of tick-borne disease in the population of Delaware County; tick education, tick surveillance and human disease surveillance.

B. Education

Education efforts are made to raise awareness of tick-borne disease prevention. Ensuring the community understands the measures they can take to protect themselves is the main goal related to tick-borne disease. Different forms of education are made available throughout the year including posts on social media websites, information on the Health District's website, press releases as applicable and supplying tools for the public to remove ticks. The Delaware General Health District uses the acronym "TICKS to remind the community throughout the year to:

1. **T**: treat clothing or skin with repellents
2. **I**: inspect yourself clothing, and gear for ticks
3. **C**: clean & disinfect any area where a tick was removed
4. **K**: keep record of the date the tick was removed
5. **S**: shower or wash off as soon as possible after coming indoors.

Additional recommendations include:

6. Wear light colored clothing.
7. Stay in the center of paths to prevent ticks from attaching from the shrubbery where they may be present.
8. Avoid heavy vegetation areas that likely harbor ticks.
9. Mow areas of high grass

C. Surveillance

Surveillance is a vital piece of a comprehensive prevention and control plan. Surveillance efforts are used to determine what areas need additional attention for education campaigns. During the course of the surveillance season, the Delaware General Health District receives notices of ticks in the community. Surveillance of tick-borne disease in the Health District includes: tick and human surveillance activities.

1) Tick Surveillance

The Delaware General Health District takes reports of ticks for tracking purposes. In some events of disease, trapping of ticks in an area will be conducted through "flagging" for identification of the species in an area.

2) Human Surveillance

Human tick-borne disease surveillance is conducted by the Disease Prevention Unit of the Health District. When cases are identified, the Environmental and Personal Health Divisions within the Health District work together to investigate the case and determine appropriate measures.

D. Control

Educating the public on the proper measures to avoid contact with ticks is the Health District's primary tool in controlling tick-borne disease. If a citizen brings a tick into the Health District's office, staff sanitarians will identify the tick to the best of their ability and review other pertinent tick-borne disease information.

E. Human Disease Response

In the case of a tick-borne disease outbreak, the Delaware General Health District responds by assessing the area and educating the public. After the initial notification of a disease outbreak it is necessary to assess the area and determine a possible location(s) where the exposure to the infected tick occurred. After a location is determined, door to door education of the public may occur. The education includes handing out pamphlets, educating the public on proper precautions to take while outdoors, and discussing other pertinent information concerning tick-borne disease.

1) Education Campaign

In the event canvassing is needed to alert the public, a canvassing task force will be assembled containing different disciplines within the Health District. One estimation for such a task estimates a team of two could reach approximately 100 homes per hour [26]. A real incident in the Health District in 2017 allowed for an opportunity to further analyze the time involved in canvassing a neighborhood. This incident revealed that Health District teams of two were able to reach 34 homes per hour or 44.5 acres per hour. For estimating time and staff needs, the number of 34 homes/hour/team will be utilized.

The Health District will utilize appropriate zones to canvas. Attempts will be made to complete the canvasing within 3 hours. This estimation does not include briefing and debriefings. Task forces will be made consisting of 2 staff members of different disciplines. Each task force may be supplied with educational material, maps, safety vests, a communication radio, water, and insect repellent. The Operations Chief will be on scene for coordination and will have surplus materials.

IV. Rabies Prevention/Control

A. Introduction

Rabies is a very serious disease that affects animals and humans and can result in death if left untreated. Recognizing the dangers associated with rabies, The Delaware General Health District works to protect the public from the threat of rabies. This is performed by monitoring bite/exposure reports, investigating exposures, prohibiting wild/exotic animals in the Health District, and requiring residents to vaccinate their pets in accordance with the Ohio Revised Code, Ohio Administrative Code, and Regulations of the Delaware General Health District.

B. Education

Education efforts are made throughout the year to raise awareness of rabies prevention. Ensuring the community understands the measures they can take to protect themselves and their animals are goals of the rabies prevention and control program. Different forms of education are made available throughout the year including posts on social media websites, information on the Health District's website, and press releases as applicable.

C. Surveillance

All animal bites/exposures are required to be reported to the Delaware General Health District in accordance with the Ohio Revised Code, Ohio Administrative Code, and Regulations of the Delaware General Health District. Upon receiving reports the Health District makes record of the exposure and issues orders to quarantine to the animal owner as applicable.

D. Control

All dogs, cats, and ferrets in the Health District are required to be vaccinated for rabies. Vaccination helps protect both pets and owners from rabies. All animals involved in a bite/exposure are required to be quarantined or humanely euthanized in accordance with the Ohio Revised Code, Ohio Administrative Code, and Regulations of the Delaware General Health District. Upon completion of the quarantine period the animal must be observed by a veterinarian and appropriate vaccines administered. If the animal is humanely euthanized or dies during the quarantine period the animal is required to be submitted to the Health District for testing.

Bats are of special concern as they are the predominant animal found to be rabid in the Health District. Any time a bat is found in a home the situation should be assessed for potential exposure. A bat can bite without the victim being aware of the bite therefore individuals sleeping, impaired, mentally handicapped or children should be considered exposed.

V. Animal Mass Death Reports

In the event an unusually large number of animal deaths are reported within the Health District, Health District personnel will investigate in coordination with appropriate state agencies.

VI. Other Zoonotic Disease

Reports of other Zoonotic Disease will be handled on a case by case basis in accordance with the Ohio Revised Code, Ohio Administrative Code, and Regulations of the Delaware General Health District. Complaints will be investigated and public health significance determined. Coordination with other entities will be initiated as applicable.

When the critical indicator of a zoonotic disease in surpassed based on records from the Disease Prevention Unit, appropriately educational efforts will be conducted.

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