

COMPREHENSIVE MOSQUITO SURVEILLANCE AND CONTROL PLAN

2012



The City of New York
DEPARTMENT OF HEALTH AND
MENTAL HYGIENE

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New York City Department of Health and Mental Hygiene
2012 Comprehensive Mosquito Surveillance and Control Plan

EXECUTIVE SUMMARY

In 1999, New York City (City, NYC) experienced an unprecedented outbreak of encephalitis caused by West Nile (WN) virus, a mosquito-borne virus never before detected in the Western Hemisphere. That year, 59 cases of neuroinvasive disease (encephalitis, aseptic meningitis or acute flaccid paralysis) due to WN virus occurred in the New York City metropolitan region. Since 1999, WN virus has reappeared in New York City each year during the adult mosquito season. A total of 213 human cases of WN neuroinvasive disease (primarily encephalitis, aseptic meningitis, or acute flaccid paralysis), including 28 deaths, have occurred among New York City residents from 1999-2011. Human cases of WN fever (a less severe form of disease) have also been reported (n=38), although the estimated number of undetected or unreported WN fever cases is much higher over the same time period. Over the past thirteen mosquito seasons, WN virus has established itself in most of the continental United States, emerging as a major public health problem, and causing large outbreaks of neuroinvasive disease since 2002. Last year 474 human cases of WN viral disease, including 43 deaths, were identified nationwide (based on provisional data from Centers for Disease Control and Prevention (CDC) as of January 10, 2012).

The Department of Health and Mental Hygiene (DOHMH) Office of Vector Surveillance and Control (OVSC) routinely analyzes surveillance and control data from previous years in order to better prepare for the upcoming mosquito season. To ensure a coordinated approach in managing mosquito-borne disease outbreaks in the City, DOHMH has worked closely with the New York State Departments of Health (NYSDOH) and Environmental Conservation (NYSDEC), the U. S. Centers for Disease Control and Prevention (CDC), and other State and Federal and local agencies such as the Mayor's Offices of Operations (MOO) and Environmental Coordination, the New York City Office of Emergency Management (OEM), Departments of Environmental Protection (DEP), Parks and Recreation (Parks, DPR), Sanitation (DSNY), Police (NYPD), Citywide Administrative Services (DCAS), Information Technology and Telecommunications (DIIT) and the New York City Housing Authority (NYCHA).

The key to DOHMH's planning efforts is a primary emphasis on prevention. DOHMH devotes considerable resources to a citywide effort to prevent mosquito breeding, while enhancing existing disease surveillance, and public and medical provider education activities. The goal of this plan is to prevent disease caused by mosquitoes through aggressive source reduction and larviciding. Should surveillance findings indicate that a substantial risk exists for WN virus transmission to humans, adult mosquito control (adulticiding) is considered.

Surveillance data collected from 1999-2011 demonstrate that WN virus can be detected in mosquitoes weeks before there is a significant risk to human health. Therefore, routine surveillance of mosquito populations provides the City the opportunity to specifically target those neighborhoods and communities where the virus is reappearing or newly appearing. The goal of early detection is to enhance mosquito control in high-risk areas in an attempt to

interrupt the amplification of the virus before it has a significant impact on human health.

Although mosquitoes are most active in New York City from May through October, our strong mosquito prevention, surveillance and control efforts are year-round activities. The current Comprehensive Mosquito Surveillance and Control Plan is founded on the principles of Integrated Pest Management. This plan is designed to minimize the impact of mosquito-borne diseases through citywide surveillance measures and an integrated approach to mosquito management with control practices that are commensurate with the risk posed by these diseases. The comprehensive nature of the plan ensures the efficacy of the control measures while minimizing adverse impacts to the environment and human health from these measures. Below is a brief summary of the components of the plan:

Integrated Pest Management (IPM)

Integrated Pest Management or IPM is defined as “a decision support system for the selection and use of pest control tactics, singly or harmoniously coordinated into a management strategy, based on cost/benefit analyses that take into account the interests of and impacts on people, society, and the environment”. (Modified from Bajwa, W. I. and M. Kogan. 2002. Compendium of IPM Definitions (CID) - What is IPM and how is it defined in the Worldwide Literature? IPPC Publication No. 998, Integrated Plant Protection Center (IPPC), Oregon State University, Corvallis, OR 97331, USA).

The objective of the DOHMH WN Virus IPM Program is to prevent or reduce human cases of WN virus in the City. IPM, especially for WN virus, involves using all the tools available for prevention and control of mosquitoes and WN virus. Key components of WN virus IPM include community outreach and education, prevention of mosquitoes and the biting of humans by mosquitoes, surveillance and control (non-chemical considered first and if a chemical pesticide is used that it be the lowest toxicity pesticide that is efficacious on mosquitoes).

Public Education and Community Outreach

Through the media, advertising, presentations to community groups, collaboration with community boards and elected officials, and weekly posting of neighborhood level surveillance data and maps on the Department’s website, the OVSC will work in collaboration with the Bureau of Communications, and Offices of Community Affairs, to increase public awareness of mosquito-borne disease risk, surveillance, prevention and control. If surveillance data indicate an increased human disease risk that requires the application of pesticides to control adult mosquitoes, accurate and timely information of these mosquito control activities will be provided. Communications will provide the public with application schedules, the type of pesticides being used and how to reduce exposure. Additionally, the public will be informed about what to do in the event of pesticide exposure.

Human Surveillance and Provider Education

The DOHMH system for detecting mosquito-borne diseases among humans includes passive surveillance for cases of viral encephalitis and aseptic meningitis in hospitals (considered to

be suspect cases of WN viral illness during peak mosquito season), and required reporting of

laboratory results indicating current WN infection. Health care providers play a critical role in the detection, prevention and clinical management of mosquito-borne diseases. Advisories are sent at the beginning of the season and periodically throughout the season by e-mail to all hospitals in New York City. The Bureau of Communicable Disease makes ongoing efforts to educate New York City health care providers regarding diseases transmitted by mosquitoes, especially WN virus, and encourages reporting and testing of patients with encephalitis, aseptic meningitis, fever syndromes compatible with WN fever, and other diseases possibly caused by arboviral infection. While providers are encouraged to pursue testing using commercial laboratories, the DOHMH Public Health Laboratory (PHL) can test blood and cerebrospinal fluid samples for WN virus upon request. Providers can also submit specimens directly to the New York State Department of Health for WN virus testing as well as additional testing for other arboviruses.

Management of Mosquito Populations in New York City

DOHMH's OVSC utilizes IPM techniques to manage mosquito breeding sites by eliminating, where practical, sources of standing water and treating with biological larvicides (to kill the immature larval mosquitoes) areas of standing water that cannot be drained completely. DOHMH actively emphasizes, through public education and outreach efforts, the need to eliminate or report standing water. DOHMH conducts inspections following complaints of standing water and actively conducts surveillance for the presence of larvae. Mosquitoes trapped from all over the City are regularly tested for WN virus throughout the spring, summer and early fall.

Mosquito Surveillance

DOHMH's OVSC will monitor mosquitoes citywide by collecting larval and adult mosquitoes to determine the distribution, density and species. DOHMH will continue to test adult mosquitoes collected in New York City for WN virus at its own laboratories. With testing taking place locally, the time required to receive results showed significant reduction in the past seven years. This has allowed for increased public education, more focused mosquito-breeding reduction activities as well as more targeted control of larval and mosquitoes in area with increased viral activity.

Larval Mosquito Control

DOHMH will reduce mosquito breeding through the aggressive elimination of standing water and the application of larvicide to sites that cannot be emptied or drained. Through a public information campaign, DOHMH will urge residents to reduce breeding sites around their homes and commercial properties and to report potential mosquito-breeding sites. DOHMH will collaborate with elected officials, other City agencies and large property owners to eliminate standing water in empty lots, tire piles and other containers. DOHMH will also aggressively enforce the health code that requires elimination of standing water from properties throughout the City. These activities will be augmented with the application of larvicide to potential breeding sites where water cannot be eliminated, including catch basins citywide. Whenever WN virus is detected in an area, DOHMH will increase public

education, breeding site reduction and larviciding.

Adult Mosquito Control

A timely and appropriate response to mosquito and human surveillance findings is key to preventing an outbreak of human disease. DOHMH will implement a phased response to surveillance findings that will expand education, prevention and control activities in relation to the threat of an outbreak of human disease. If surveillance indicators suggest that the level of WN virus activity poses a significant threat to human health, adult mosquitoes will be controlled through the use of adulticides. Mosquito density and distribution, mosquito species, persistence of WN virus activity, weather, time of year, and the proximity to human populations will be carefully considered in determining the necessity for adult mosquito control. The accuracy, quality and efficacy of the adulticide application will be closely monitored to ensure compliance with Federal and State guidelines. If application of adulticides becomes necessary, DOHMH will provide advance notice to the public and to health care providers.

Surveillance of Potential Adverse Health Effects from Pesticide Exposure

In 2001, DOHMH completed a comprehensive environmental impact study on the pesticides used for adult mosquito control. The study concluded that at the relatively low levels at which adulticides are applied, the occurrence of adverse public health effects to the population from applying pesticides to reduce the adult mosquito population would not be considered significant when compared to the potential risk to the public health from West Nile virus or other mosquito-borne illness. However, health care professionals are informed and reminded throughout the mosquito season about potential health effects of pesticide exposure and the need to report pesticide-related illness to DOHMH and NYSDOH. DOHMH will monitor the adverse health effects associated with the application of pesticides for adult mosquito control.

Host Surveillance

Because of the limited value in New York City of dead birds as an early warning system for WN virus, DOHMH discontinued surveillance for dead birds in 2008. Dead bird surveillance did not serve as sensitive an indicator of WN virus activity as mosquitoes; therefore, reports of dead bird are no longer solicited by the DOHMH. However, DOHMH's OVSC in collaboration with the Zoonotic, Influenza and Vector borne Disease Unit (ZIVDU) in the Bureau of Communicable Disease will continue monitoring disease among pet birds and other domestic animals, particularly horses. Veterinary alerts will be faxed at the beginning of the season to all veterinarians in New York City. Veterinarians are required to report any suspicious animal cases with neurological abnormalities to DOHMH. Animals with neurological symptoms will be assessed to determine whether rabies is indicated before being tested for WN virus.

Research and Evaluation

DOHMH will conduct research to better understand where mosquito breeding occurs in New York City and how WN virus and other mosquito-borne viruses are maintained in our

environment. Furthermore, DOHMH will continue to evaluate more specific bird, mammal and mosquito surveillance indicators that signal a threat to human health and to assess the efficacy of larval and adult mosquito control.

INTRODUCTION

In late August 1999, the New York City Department of Health and Mental Hygiene (DOHMH) detected an unusual cluster of encephalitis cases in northern Queens. This was caused by West Nile (WN) virus, a mosquito-borne virus that had not been recognized in the Western Hemisphere prior to 1999. In 1999, the outbreak resulted 59 cases of neuroinvasive disease of which 44 were NYC residents that were hospitalized. There were 4 fatalities.

Since its introduction to New York City in 1999, WN virus has caused successive outbreaks in the United States each summer and fall, and has moved steadily westward. In 2003, WN virus caused the largest outbreak of neuroinvasive disease ever recorded in the Western Hemisphere, with 9,862 cases reported overall, including 264 deaths. In New York City, the virus has persisted and has become endemic, causing at least 213 neuroinvasive cases and 28 deaths. From 2000-2011, the number of neuroinvasive cases due to WN virus among New York City residents has ranged from 2 to 45 (median 12) per year.

In 2011, 9 cases of WN neuroinvasive disease were detected among New York City residents, all of which were possibly or probably acquired in New York City.

Provisional data from CDC as of January 10, 2012 indicate that there were 690 human cases and 43 human deaths reported in the United States in 2011. Please see the CDC homepage at <http://www.cdc.gov/ncidod/dvbid/westnile/index.htm> for more information.

Since 2003, universal screening of donated blood products has been conducted in New York City by the New York Blood Center, and 14 presumptively infected donors have been identified in New York City from 2003-2011. All implicated blood products were retrieved and removed from the blood supply.

The considerable and rapid spread of the virus throughout the country after 2002 provides ample evidence that WN virus is permanently established in New York City and in the United States. With this establishment of WN virus throughout the City and the region, having a routine, year-round Integrated Mosquito Management (IMM) program has become a necessity.

There are three probable mechanisms for WN virus overwintering within the City. The principle enzootic vector, *Culex pipiens*, overwinters in the adult stage; and it is believed that, at least, some infected mosquitoes successfully survive the winter. Alternatively, infected birds that remain in the area may harbor the virus throughout the winter months. As spring returns, the virus recrudesces within the birds and is readily passed to early season mosquitoes. A third mechanism is reintroduction of the virus into the area during the spring or early summer by infected migratory birds. Hence, a number of infected mosquitoes and/or birds are present within the City during the early spring months. At this time, the virus resumes its amplification cycle. As mosquitoes feed on birds, the virus is transmitted back and forth between the vector and the reservoir host populations allowing an increasing number of birds and mosquitoes to become infected. If environmental conditions are optimum for transmission, the virus amplifies to a theoretical point of “spill over”. At this point in the amplification cycle, the virus bridges out of the enzootic, bird-mosquito cycle

via bridge vectors. Bridge vectors are mosquito species that readily feed on humans and other mammals. It is at this point in the season, that transmission to humans occurs and when management actions are most critical.

An effective surveillance and control program should be able to detect virus during the amplification cycle prior to bridge vector involvement allowing for targeted, effective control of the mosquito population that are limited in scope. With WN virus, the presence of dead American crows, *Corvus brachyrhynchos*, has been the most sensitive indicator of viral activity in past years, though less so in recent years. Typically, infected mosquitoes signal the presence of local WN virus activity, and occur a month or more prior to human transmission. Eventually, proper surveillance will detect viral presence in the bridge vectors and finally in humans and other mammalian hosts. The goal of DOHMH's vector surveillance program is to detect the WN virus in local mosquito populations before sufficient amplification of the virus can occur, so that IPM practices can be implemented thereby reducing the number of infected mosquitoes and simultaneously reducing the risk of human transmission.

DOHMH extends its gratitude to the following collaborators with whom it has worked closely to develop a plan that meets the specific needs of New York City: the U.S. Centers for Disease Control and Prevention (CDC); the New York State Departments of Health (NYSDOH), Environmental Conservation (NYSDEC) and Agriculture and Markets; and New York City agencies, including the Mayor's Offices of Operations, New York City Office of Emergency Management and the Departments of Environmental Protection, Parks and Recreation, Sanitation, Police, Citywide Administrative Services, Information Technology and Telecommunications, the New York City Housing Authority, Wildlife Conservation Society and its other partners.

INTEGRATED PEST MANAGEMENT (IPM)

Prevention of Mosquitoes and WN Virus in Humans

Prevention is the key to the DOHMH WN virus IPM mosquito program. OVSC focuses its prevention efforts on source reduction, identifying locations of key permanent and semi-permanent breeding sites, and larviciding (backpack, aerial and catch basin). A major part of breeding source reduction involves citywide community outreach and education to engage the help of the public. Preventing the mosquito larvae from emerging into adults is the easiest and most environmentally-sound way to reduce the number of mosquitoes that may transmit West Nile virus in New York City. Larval habitats or breeding sources include stagnant water in artificial and natural containers (tires, unmaintained birdbaths, tin cans, clogged roof gutters, puddles, pot holes, tree holes) or an open area (flood-prone low-lying areas, marsh areas and other wetlands).

Key recommendations for preventing WN virus in humans include:

- a) People, especially those 50 or older, should take special care to prevent WN virus because they are more susceptible to severe WN virus symptoms
- b) Know the symptoms of WN virus
- c) If outside at dusk or dawn, wear long pants, long-sleeved shirts and socks
- d) Consider the use of an EPA and DEC approved insect repellent containing picaridin, IR3535, DEET or oil of lemon eucalyptus according to the label's directions
- e) Make sure doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes

Community Outreach and Education

Getting the message out to the public regarding personal prevention and breeding source reduction is a major part of the OVSC WN virus IPM Program. The more people know about mosquitoes and WN virus, the better they can protect themselves and help in reducing breeding sources. Through community outreach and education, OVSC makes presentations and provides information through its website and with literature on the personal prevention of WN virus.

Surveillance

The DOHMH WN virus Surveillance Program includes 1) monitoring of human cases 2) "in-season" surveillance of larval and adult mosquitoes and 3) "off-season" surveillance of overwintering adult mosquitoes and 4) identification and characterization of breeding sites.

Larval surveillance (supporting the major goal of source reduction) helps OVSC determine where to treat by ground equipment (manual and backpack pesticide applicators) and determine the timing for aerial larviciding. Larval surveillance includes dipping, breeding site identification and larval identification. Dipping is performed by taking a small amount of water using a sampling device called "dipper" and examining it for the presence or

absence of mosquito larvae.

Adult mosquito surveillance is a key to determine the density and type of mosquitoes present throughout the City and through testing determine the presence, location and intensity of WN virus. The mosquitoes are trapped using light, gravid and/or sentinel traps in about 52 (2011) locations strategically located throughout the City. Locations of these traps are based on current and past surveillance data. If WN virus is found in a location, supplemental traps are added to better determine the distribution of WN virus in the area.

Control

Control of mosquitoes using the principles of IPM includes 1) breeding source reduction, 2) habitat modification, 3) use of mass mosquito-trapping devices, 4) larviciding and 5) adulticiding. Non-chemical methods are always considered first, but if a chemical pesticide is required, then it will be the lowest toxicity and least persistent pesticide that is efficacious on mosquitoes.

Larviciding

Larviciding is the most efficient method of controlling mosquitoes. By larviciding aquatic breeding sites with naturally occurring biological pesticides, the larvae are killed before they emerge into adults. The larviciding effort includes 1) manual or backpack treatment of key breeding source locations, 2) aerial application to inaccessible breeding areas and 3) ground larvicidings of catch basins.

Adulticiding

DOHMH performs adulticiding only as a last resort, when source reduction and larviciding is ineffective to manage increasing populations of infected mosquitoes, and WN virus infected mosquitoes have been identified and meet established criteria for adulticiding. The decision to adulticide is based on data obtained from mosquito surveillance and testing, and established and successful algorithms/decision trees. OVSC uses two different algorithms depending on whether or not a human WN virus case is involved. The Positive Mosquito Pool Algorithm is driven by 1) the presence of WN virus in mosquitoes, 2) the persistence (ongoing activity) of WN virus in locations where positive mosquitoes were found, 3) the competency of infected mosquito species in transmitting WN virus, 4) the propensity of WN virus positive mosquito to bite humans and 5) the population density in area where WN virus positive mosquitoes were trapped. The Positive Human Case Algorithm is driven by 1) the presence of human case(s) in an area and 2) the evidence of local transmission of the virus (presence of positive WN virus mosquito(es) in area near the human case).

Detailed descriptions of above mentioned mosquito IPM practices are provided in the succeeding sections of this plan.

PUBLIC EDUCATION & COMMUNITY OUTREACH

Objective

To increase public awareness of mosquito-borne diseases.

Background

Each year, DOHMH launches a public education campaign to increase awareness of WN virus. This campaign highlights the need for New Yorkers to take personal protective measures against mosquito bites and to eliminate mosquito breeding sites around their homes. In past campaigns, this message was aired on television and radio and published in newspapers and magazines. DOHMH developed fact sheets and made information available in multiple languages to community-based organizations, community boards, elected officials, schools, and the general public. This information can also be downloaded from the DOHMH's website. In subsequent years, DOHMH staff has made several presentations to various community groups in the neighborhoods with higher risk of WN virus infection.

DOHMH promotes WN virus prevention strategies and community participation through a number of venues. In 2011, the Offices of Vector Surveillance and Control (OVSC) and the Office of Community Affairs conducted targeted outreach to senior citizen centers throughout the City. Approximately 3,000 bottles of insect repellents were distributed to seniors that year, along with public education materials. The Health Media and Marketing Office updated the informational materials for print and radio to promote personal protective measures and elimination of standing water. The Press Office made spray notifications and personal precaution announcements through the media. Materials were made widely available in hard copy and electronic form (through email and the Agency's website), in multiple languages. Information was also made available through 311 - the City's non-emergency information line.

In 2012, DOHMH will take standing water reports via the New York City's Citizen Service Center (311) and DOHMH's enhanced Web site (nyc.gov/health). Callers can receive comprehensive information about WN virus, including updated information about adulticiding (mosquito spraying) schedules by dialing 311. The Citizen Service Center provides callers with a live operator 24 hours a day, 7 days a week. DOHMH also provides information on WN virus through its web site (nyc.gov/health/wnv) in the form of fact sheets, press releases, larviciding, adulticiding schedules, and WN virus activity maps. This information is routinely faxed and/or electronically mailed to City agencies, elected officials, community boards, the Department of Education, hospitals, nursing homes, and associations of green grocers, day camps, and community organizations. DOHMH will work with the Department for the Aging (DFTA) for distribution of WN virus literature and insect repellents to the senior citizens at social gatherings and formal meetings.

Adulticiding information is made available through DOHMH's web site and 311, regular news broadcasts, scheduled advertising times on local radio, print media, and web sites of news organizations.

In 2011, DOHMH also began utilizing the Notify NYC System to reach out to the public in areas at higher risk of disease transmission. This system allows residents of the City to receive alerts on many different communication devices such as cell phones, landlines, pagers, and email accounts. The public is encouraged to register with Notify NYC via 311 or the web, to receive advanced notification of ground spray (adulticiding) and aerial larviciding events in their neighborhoods.

Planned Activities

WNV Summer Intern Initiative

- The OVSC and the Office of Community Affairs will hire summer interns (undergraduates and graduates) to develop and implement the 2012 WN virus Community Engagement Project. These interns will perform community education and outreach at different location throughout the City including making presentations to senior centers and other community groups, distributing literature at health fairs and answering questions about WN virus and other public health issues.
- Should neighborhood spraying become necessary due to elevated WN virus activity, student interns will work in the affected neighborhoods distributing literature to notify residents and merchants about upcoming spray events. The distribution of literature written in English (and other languages as appropriate) will inform the community about the times, dates and locations of spray (adulticiding) event(s) in and around the spray/treatment zones.

The following key messages will be communicated:

- The public will be informed about the City's comprehensive preventive strategies and activities (community education, surveillance, source reduction, larviciding, etc.) to address the threat of WN virus and to minimize the necessity of pesticide application for adult mosquito control.
- The public will be asked to help eliminate mosquito-breeding sites and to report standing water using the Citizen Service Center (311) and via DOHMH's Website (nyc.gov/health). The public will be advised to eliminate standing water sites (tires, buckets, and other water-holding objects) where mosquitoes can breed from their property. They will also be urged to change the water in bird baths once each week; to clean and chlorinate swimming pools or drain and cover if not in use; to prevent water from accumulating in pool covers; and to unclog gutters and down spouts.
- The Office of Community Affairs will increase public awareness of the nature of mosquito-borne diseases and the signs and symptoms of WN virus infections (headache, high fever, muscle pain, weakness and disorientation).
- The public will be informed about the proper personal protective measures to avoid mosquito bites such as ensuring that screens fit tightly on doors and windows, wearing protective clothing (long pants, long-sleeved shirts, and socks) and

appropriate use of insect repellents.

- Maps and tables showing recent WN virus activity by zip code will be posted on the DOHMH website in order to provide the public with up to date information on location of WN virus activity in the City. This information will be posted as soon as WN virus activity is detected, and updated on a weekly basis until viral activity has ceased.

If the application of pesticides to control adult mosquitoes becomes necessary, the public will be informed in a timely manner (at least 24 hours in advance with a goal of 48 hours prior to event) to reduce direct exposure to pesticides. The public will also be given detailed information about the pesticides being used and the potential risks associated with exposure. The public will be encouraged to contact the Poison Control Hotline (212-POISONS/764-7667 or 1-800-222-1222) with any suspected pesticide-related illness, symptoms or exposure.

- Fact sheets in several languages will be distributed to community-based organizations, community boards, elected officials, schools, elder care facilities, libraries, outdoor activity sites, and many other organizations Citywide.
- The Citizen Service Center (311) will be updated regularly with information pertaining to DOHMH pesticide spraying activities. Beginning in April, operators will be available 24 hours a day, 7 days a week for WN virus related inquiries and reports.
- DOHMH's web site (nyc.gov/health) will be regularly updated and, beginning in April, the public can use web-based forms for reporting standing water.
- Regular updates will be made to elected officials and community boards, who are essential to the City's communication activities about WN virus activity. Presentations, available in multiple languages, will be offered by DOHMH staff to community boards and a wide variety of organizations. These will include information about mosquito breeding site reduction and related DOHMH activities.
- Press releases regarding all activities will be issued regularly and DOHMH will work closely with the media to achieve accuracy of the WN virus coverage.
- In the event adulticiding is necessary:
 - Information will be released at least 24 hours in advance (in compliance with Local Law 37 and NYS DEC Regulation) with a goal of 48 hours in advance through the media, DOHMH Website, Citizen Service Center (311), and Notify NYC (if applicable). In addition, hospitals, pertinent City agencies, elected officials, community boards, schools, nursing homes, day camps, and community organizations will receive notice via fax and/or electronic email. Under certain conditions and with the approval of the NYSDOH, applications in green spaces (parks/cemeteries) may take place with less than the required 24 hour notice. For these cases, the green area will be closed to the public

during and a few hours after the application of adulticide.

- Police Department escorts will escort the applicator's trucks to announce that adulticiding is about to take place, and will urge people to go indoors to reduce exposure to pesticides.

HOST SURVEILLANCE

Objective

To monitor mammal and bird populations as a means of early detection of potential arthropod-borne diseases in the City

Background

Arthropod-borne viruses (arboviruses) cause diseases such as WN virus infection, Eastern equine encephalitis (EEE), St. Louis encephalitis (SLE), and La Crosse (LAC) encephalitis. These viruses are maintained in nature in a cycle of transmission between an animal host (the reservoir) and the mosquito. All of these viruses can cause human infections and have been responsible for epidemics over the past several decades. These viruses have their own specific ecologic and epidemiologic characteristics, and each has exhibited a tendency to extend geographic range and become established in new areas, which is of growing concern.

Among arboviruses, WN virus is currently endemic in New York City. Many species of birds have tested positive for WN virus, however crows and blue jays continue to be the birds most susceptible and are among major contributors to amplification of the virus. Their local populations have significantly declined as a result of WN virus epizootics in the last thirteen years. Other potential WN virus reservoir host birds in New York City are grackles, house sparrows, and American robins.

There will be no dead bird surveillance conducted by the DOHMH in 2012 as they have limited use as an early warning system for human disease in NYC. Also, with the exception of horses, mammals do not appear to be sensitive to WN virus. In the past, DOHMH's animal surveillance efforts have been assisted by a number of partner organizations, including the New York City Department of Parks and Recreation, the New York State Department of Agriculture and Markets, the Animal Medical Center, the Staten Island Zoo, and the Wildlife Conservation Society.

DOHMH will continue to ask veterinarians and other animal specialists to monitor for unusual illness and death among birds and mammals. The DOHMH will also continue to work with and receive animal test results for WN virus (and other arboviruses) from the New York City Wildlife Society. These data may be used in setting up supplemental mosquito traps in the areas from where infected mammals and/or dead birds are recently found.

Planned Activities

- At the onset of WN virus season, DOHMH will alert veterinarians to be vigilant for neurologic illness in vertebrates and to consider the possibility of an arbovirus as an etiology. WN virus and other arboviral infections are reportable diseases in animals, and any laboratory or veterinarian is required to report confirmed cases in New York City animals to DOHMH.

HUMAN SURVEILLANCE AND PROVIDER EDUCATION

Objective

To quickly detect human illness due to mosquito-borne diseases, especially WN virus.

Background

During 1999-2011, 213 New York City residents developed neuroinvasive disease due to WN virus. Among these cases, 27 died as a result of West Nile infection. Most of the neuroinvasive cases have occurred in older New Yorkers (median: 68 years; range 1-93). Thirty eight (38) cases of WN fever were also detected during this time period. The tables below summarize WN virus disease by borough and syndrome

West Nile Viral Disease by Borough, NYC, 1999-2011 (includes neuroinvasive and non-neuroinvasive cases)

Year	Bronx	Brooklyn	Manhattan	Queens	Staten Island	Unknown	Total
1999	9	3	1	34	0		47
2000	0	2	1	1	10		14
2001	0	2	3	2	2		9
2002	8	2	1	13	5		29
2003	6	8	2	11	4	1	32
2004	0	0	3	1	1		5
2005	3	3	1	5	2		14
2006	1	0	1	2	8		12
2007	1	7	1	7	1	1	18
2008	1	3	1	5	5		15
2009	1	1	0	1	0		3
2010	7	6	6	14	9		42
2011	2	2	2	5	0	0	11
Total Cases	37	37	21	96	47	2	240

In 2011, 11 New York City residents were diagnosed with WN neuroinvasive disease. These cases of WN viral disease possibly or probably became infected locally.

The table below summarizes morbidity and mortality due to WN virus in New York City from 1999-2011:

West Nile Viral Disease, NYC, 1999-2011

	Cases	Syndrome		Median age*		Deaths	
		Neuroinvasive	WN Fever	Yrs	Range	#	Case fatality rate*
2011	11	9	2	69	(41-82)	1	14%
2010	42	34	8	64	(19-87)	1	3.0%
2009	3	3	0	63	(60-73)	0	--
2008	15	8	7	64	(33-87)	1	13%
2007	18	13	5	75	(41-90)	5	38%
2006	12	8	4	64.5	(44-80)	2	25%
2005	14	11	3	61	(27-84)	2	18%
2004	5	2	3	34	(1-66)	0	--
2003	32	31	1	67	(8-93)	7	23%
2002	29	28	1	72	(22-86)	3	11%
2001	9	7	2	51	(44-75)	1	14%
2000	14	14	0	62	(36-87)	1	7%
1999	47	45	2	71	(5-90)	4	9%
Summary	240	204	36	68	(1-93)	27	13.2%

* Median age and case fatality rate calculated for neuroinvasive cases only.

Serosurveys performed in Queens (1999) and Staten Island (2000) provided an estimate of the proportion of WN viral infections that are asymptomatic or subclinical. Accordingly, an estimated 140 subclinical WN virus infections, including 30 cases of WN fever, occur for each case of neuroinvasive disease. Therefore, approximately 23,700 asymptomatic infections and 6,390 cases of WN fever have likely occurred among New York City residents from 1999-2011. The majority of asymptomatic infections and WN fever cases are undetected and unreported in New York City, since many individuals with febrile illness may not seek medical attention and may not be tested for WN virus even if they do see a provider.

As part of a surveillance and provider education program, the Bureau of Communicable

Disease offers presentations to health care providers. Medical alerts and advisories are issued via the Health Alert Network (broadcast e-mail) to all NYC hospitals, encouraging providers to promptly report cases of encephalitis, aseptic meningitis and acute flaccid paralysis from July through October, and to test these cases for WN virus. In July, 2010, the DOHMH Public Health Laboratory discontinued serologic testing for WN virus. Providers are now asked to send specimens to commercial laboratories for WN virus testing. Under special circumstances specimen transportation and testing is arranged by DOHMH (e.g. high suspicion for WN virus, possible transfusion or transplantation related case, or unusual clustering suggestive of an outbreak of WN virus or another cause of encephalitis).

If physicians request antibody testing for other arboviruses, such as dengue, eastern equine encephalitis and/or St. Louis encephalitis (SLE) viruses, specimens are referred to the NYSDOH Wadsworth Laboratory or the Centers for Disease Control and Prevention (CDC) for testing. Physicians may send cerebrospinal fluid (CSF) specimens from hospitalized patients with encephalitis to the Wadsworth Laboratory New York State Department of Health (NYSDOH) for testing by polymerase chain reaction (PCR) for a panel of viruses that cause human encephalitis.

In addition to West Nile, two other mosquito-borne infections have been found in NYC residents in recent years. Cases of dengue fever are detected every year, all of which were likely acquired outside NYC, in areas where dengue is endemic. In 2007, NYC's first case of illness due to chikungunya virus was diagnosed in a resident who acquired the infection while travelling to an area with an outbreak of chikungunya virus. DOHMH conducts passive surveillance for dengue fever, and facilitates testing for new arboviruses not normally found among NYC residents.

Planned Activities

- Beginning in early July, DOHMH will remind providers to report all suspected cases of WN virus neuroinvasive disease (encephalitis, aseptic meningitis or acute flaccid paralysis), and to test all hospitalized patients with these conditions for WN virus.
- From July through October, periodic e-mail advisories will be sent to all City hospitals and infectious disease specialists describing current WNV activity in NYC and emphasizing the importance of reporting suspected WN virus cases. DOHMH will provide the criteria for reporting and submission of appropriate laboratory specimens for WN virus testing.
- DOHMH will work closely with NYSDOH and CDC to ensure that surveillance data are standardized and remain confidential.
- DOHMH will educate health care providers to increase knowledge about the proper detection, prevention and clinical management of mosquito-borne diseases and other types of encephalitis and meningitis.
- Presentations will be made at local hospitals and to specialty societies as requested.
- The Bureau of Communicable Disease will work with partners to ensure that cases of

WN virus infection in persons who have received or donated blood products or organs are rapidly investigated and reported so that other affected blood products or organs can be promptly identified and withdrawn before they are used.

- DOHMH's Bureau of Communicable Diseases (BCD) will facilitate diagnostic testing for cases in which arboviral diseases other than WN virus or dengue are suspected by clinicians.

MOSQUITO SURVEILLANCE

Objective

To monitor the abundance of mosquito populations and detect the presence of arboviruses.

Background

Mosquitoes were collected weekly with 104 mosquito traps (light & gravid) from 52 permanent locations throughout New York City in 2011. To enhance virus surveillance in the areas where WN virus activity had been identified in mosquitoes and humans, 340 supplemental mosquito traps were placed at 170 locations throughout the City. In 2011, a total of 146,799 adult mosquitoes were identified to species levels, of which 92,294 belonging to twenty one species were tested for the presence of WN virus infection. Five mosquito species, *Culex pipiens*, *Cx. restuans*, *Cx. salinarius*, *Aedes albopictus*, and *Coquillettidia perturbans* were found infected with WN virus. Of the 4,642 mosquito pools tested, 181 tested positive for WN virus: 1 in Manhattan; 30 in Brooklyn; 9 in the Bronx; 52 in Staten Island; and 89 in Queens. *Cx. pipiens* was identified as the primary enzootic vector of WN virus from 1999-2011 based upon the number of positive pools. In fall and winter 2011, hibernating *Culex* females were collected from indoor resting sites and were kept at 80°F with 14:10 (L:D) photoperiod for 20-30 days and later tested for the presence of WN virus. No WN virus was detected in these mosquitoes

The risk of mosquito-borne disease depends on both the number of mosquitoes capable of transmitting the virus and the prevalence of the virus among these mosquitoes. Proper surveillance data on larval and adult mosquitoes is important for guiding appropriate prevention and control activities. Larval surveillance can provide information on expected adult mosquito density and can indicate areas where efforts to eliminate mosquitoes at their source (breeding sites) should be targeted. Adult mosquito surveillance and viral testing provide early predictive information about the potential for a disease outbreak.

Planned Activities

- DOHMH will continue to work closely with other City agencies to collect and map information on potential mosquito-breeding habitats.
- DOHMH will determine which areas should be regularly inspected for the presence of larvae. These sites will be subjected to routine inspection to determine the presence of mosquito larvae.
- Larval habitat information will be collected and updated throughout the season.
- In the urban areas, mosquito trapping will be conducted from sewer and adjacent buildings by using light traps in response to resident complaints.

- From June to October, DOHMH will trap adult mosquitoes at more than 50 permanent sites throughout the five boroughs. The trapping season may be lengthened or shortened depending on the weather.
- Mosquitoes will be collected using DOHMH miniature light and gravid traps on a weekly basis. Each trap collection will be sorted by species of mosquitoes collected. Information on the location, collection data, trap type and the total number of female mosquitoes will be recorded.
- Extra trapping will be conducted to collect day biting mosquitoes using omnidirectional Fay Prince traps and mosquito magnets.
- Adult mosquito trapping will be expanded in areas where WN virus is detected in mosquitoes, birds, other animals, and humans. This will help determine extent of viral activity and delineate spray zones.
- In the event that pesticides are applied for adult mosquito control, DOHMH will set traps more frequently to evaluate the efficacy of the control measures.
- The DEP will continue to use mosquito magnet traps to survey and control adult mosquitoes at wastewater treatment plants. Additionally, DOHMH will place mosquito magnet traps to survey and control adult mosquitoes in the Rockaways Peninsula.

LARVAL MOSQUITO CONTROL

Objective

To reduce the abundance of adult mosquitoes through the use of Integrated Mosquito Management (IMM) practices

Background

Culex pipiens, a primary vector of WN virus, is the most common mosquitoes found in the New York City. This species breeds quickly and lays its eggs in standing or slow-moving water containing decaying organic materials. Prime breeding sites include storm drains (catch basins), discarded tires, poorly maintained bird baths, clogged rain gutters, unused swimming and plastic wading pools, and puddles that last for a week or more. A single female *Cx pipiens* can lay between 100 to 300 eggs which can mature to adults within 10 days given ideal conditions. Eliminating breeding sites is the simplest and most effective way to reduce the number of mosquitoes. Every residential and commercial property owner should regularly inspect their property and buildings to determine if conditions are conducive to mosquito breeding and endeavor to eliminate those conditions. Mosquito breeding can be prevented by either eliminating the standing water (source reduction), or treating the water with larvicide to prevent mosquitoes from developing.

DOHMH's public education campaign emphasizes the need for New Yorkers to eliminate mosquito-breeding sites around their homes. From April to October 2011, DOHMH received 2,285 complaints of standing water through the City's Citizen Service Center Information Line (311); on DOHMH web site; from elected officials and community groups; and through field surveys performed by inspectors and exterminators. The DOHMH investigated each of the complaints. Every report led to a letter being sent to the property owner regarding the need to eliminate mosquito-breeding sites and 5,401 sites were visited and checked for the presence of mosquito breeding. In order to respond to egregious conditions, the Board of Health adopted a resolution that made standing water a public health nuisance and allowed for the issuance of Notice of Violations to unresponsive property owners. In 2011, 699 Notice of Violations were issued to unresponsive landlords and homeowners.

DOHMH will conduct need-base larviciding in accordance with permits issued by NYS Department of Environmental Conservation (DEC) in catch basins (street corner storm drains), sewage treatment plants, and areas of permanent standing water. DOHMH works with the New York City Department of Environmental Protection (DEP), the New York City Housing Authority, and the New York City Department of Parks and Recreation to treat catch basins and other mosquito breeding sites. Approximately 145,000 catch basins across the City will be inspected and/or treated at least three times each season by hand application of larvicides. In areas that are inaccessible by ground vehicles, larvicide may be applied aerially.

Presently, DOHMH uses larvicides with the active ingredients *Bacillus sphaericus* and/or

Bacillus thuringiensis var. *israelensis* (Bti)]. *B. sphaericus* and Bti are naturally occurring soil bacteria that produce toxins, which cause disease in mosquito larvae. These microbial larvicides are ideal for mosquito management because of their specificity to mosquitoes and their lack of toxicity to humans and other non-target organisms. The bacteria produce asexual reproductive cells (spores) which enable them to survive in adverse conditions. Additionally, they produce unique crystalline bodies (endotoxins) when eaten, dissolve in the intestine of the larvae and paralyze the cells in the gut, thus interfering with normal digestion and triggering the larvae to stop feeding. The spores can then invade other tissues, multiplying in the larva's blood, until the insect dies. Death typically occurs within a few hours of ingestion.

Planned Activities

DOHMH, and other City agencies continuously identify areas of standing water associated with surface grading problems, road construction, clogged sewers and catch basins, obstructed waterways that are mosquito-breeding habitat. Through interagency collaborative efforts, these conditions will be remediated as they are identified.

DOHMH will inform large-property owners and managers of the need to eliminate mosquito-breeding sites on their property or to properly treat them with larvicides.

DOHMH will work with the New York City Department of Sanitation to prioritize and enhance the enforcement of lot cleaning and to ensure an aggressive tire disposal program. Abandoned lots are particularly conducive to mosquito breeding, and in areas where WN virus has already been detected these lots will be targeted for remediation.

DOHMH will work with the New York City Department of Buildings to develop and implement a protocol requiring all City's demolition and excavation contractors to larvicide when their activities result in significant sources of mosquito breeding.

The public will be asked to help eliminate mosquito-breeding sites and to report standing water using the City's toll-free Citizen Service Center Line (311) and the DOHMH Web site (nyc.gov/health).

OVSC will monitor reported breeding sites; send letters to property owners asking them to address the problem; conduct on-site inspections of the more egregious conditions; make referrals to appropriate agencies for abatement; and, if necessary, issue notices of violation.

DOHMH will use VectoLex® (*Bacillus sphaericus*), VectoBac®/AquaBac®/Submit Bti Briquets® (*B. thuringiensis* var. *israelensis*, Bti), and VectoMax®/Fourstar® larvicides (mixture of *B. sphaericus* and *Bti*). Pesticide resistant management is a core component of this comprehensive mosquito control plan. DOHMH will continue monitoring local mosquito populations for resistance development for all above mentioned larvicides. Use of methoprene (Altosid®) may be considered if microbial larvicides stop producing desired results. Methoprene is an insect growth regulator used to control many types of insects. This chemical quickly breaks down in water and sunlight and does not persist in the soil. The U.S. Environmental Protection Agency has placed methoprene into the category of "least toxic" with regard to humans. Additionally, DOHMH will continue to explore other

registered products that may increase the effectiveness of the larviciding program.

Beginning in May, larvicides will be applied at wastewater treatment plants, parks, and other surface waters, if larval breeding is present. Applications will be made by hand, backpack or aerially via helicopter and continue to be applied as needed throughout the mosquito-breeding season.

Beginning in June, larvicides will be applied to sewers and to more than 145,000 catch basins citywide. Applications will continue, based upon larval surveillance findings, as needed throughout the mosquito-breeding season.

OVSC staff will intensify larval surveillance and control once WN virus activity is identified in an area. Targeted neighborhoods will have an expanded public outreach regarding breeding site elimination and personal protection; also community-specific media materials will be distributed.

DOHMH will work with the Parks Department and other partners to ensure that green areas (e.g., parks, cemeteries, and golf courses) receive adequate mosquito control, especially in areas where infected mosquitoes are found.

The DEP will continue to use larvae-eating fish at wastewater treatment plants.

DOHMH will provide occupational safety and health training to all employees involved in mosquito surveillance and control operations. Additionally, DOHMH will require that all employees from contracted vendors be provided with similar training as well as appropriate personal protective equipment.

For residents conserving rainwater, OVSC will recommend covering the barrels or other water holding containers with a tight-fitting lid or very fine mesh screen. Also, bacterial larvicides containing *Bti* can safely be placed in the barrels for mosquito larvae control.

ADULT MOSQUITO CONTROL

Objective

To reduce the abundance of WN virus infected adult mosquitoes in targeted areas through the judicious use of pesticides

Background

Comprehensive vector, and human surveillance data collected during the last twelve seasons have allowed DOHMH to develop a more sensitive protocol for determining and monitoring the level of WN virus activity and the risk for human disease throughout the City.

DOHMH practices Integrated Pest Management (IPM) for managing mosquito populations in the City. Adulticiding operations are only performed as a last resort when surveillance data indicate a significant risk of WN disease transmission to humans. During the last eleven years, only Anvil 10+10 containing sumithrin (d-phenothrin) was used for adult mosquito control. This product is a synthetic pyrethroid that has been used for more than 35 years. It provides a rapid knockdown of adult mosquitoes. Sumithrin exhibits low mammalian toxicity, degrades rapidly in sunlight, provides little or no residual activity, and does not accumulate in the environment. This product is applied at very small quantities per acre and is referred to as ultra low volume (ULV) application. ULV-delivery techniques minimize environmental impacts while effectively managing adult mosquito populations. In addition, all DOHMH adulticiding events are monitored by city, state and federal officials to ensure compliance with applicable laws and regulations.

The presence of mosquito-borne viral pathogens in or near New York City will result in one or more responses or interventions by DOHMH. These interventions can range from routine continuing existing surveillance to, in worst-case scenarios, large-scale aerial application of adulticides. DOHMH will utilize its surveillance data to assess the risk of an outbreak of human disease and the need to apply pesticides in a limited and targeted area to control adult mosquitoes by considering habitat; time of year; weather conditions; the intensity of viral activity; the distribution, density, species, age and infection rate of the vector population; and the density and proximity of human populations.

The response of DOHMH will depend upon, but not be limited to: if positive mosquito-species is/are human biter, the intensity and persistence of pathogen activity, proximity of pathogen activity to human populations within the City, time of year, mosquito population density, and weather conditions. Because these conditions can vary greatly and cannot be predicted, a consultation process will be used to determine which, if any, responses are appropriate, on a case-by-case basis. The responses initiated by the DOHMH can be grouped into 3 broad categories or levels of risk:

Planned Activities

Level 1 – No Pathogen Detection

DOHMH *Responses*: Surveillance and Control programs continue as outlined in the City's

Mosquito Surveillance and Control Plan. Periodic reports or communications are made to the WN virus Steering Committee providing current status of the various surveillance programs. Periodic press releases are issued providing the public with current surveillance results.

Level 2 – Initial or Single Pathogen Detection

Initial or a single detection of mosquito-borne viral pathogens in mosquito populations or avian populations in or near New York City will result in a move to Level 2 responses.

DOHMH *Responses*: OVSC recommendations will be communicated to the WN virus Steering Committee and the DOHMH Commissioner. Upon approval by the Commissioner, a press release will be drafted, notifying the public of the recent findings. Surveillance programs will continue with the following added activities:

- CDC Light Traps will be added to the area of concern if additional surveillance data are required.
- Larval surveillance and enhanced adult trapping will be conducted in affected areas if needed.
- Laboratory testing of mosquito pools will be given priority in primary vectors *Culex pipiens* and *Cx. restuans*, and bridge vector *Cx. salinarius*.
- Data from these additional traps and surveillance measures will aid in determining the extent of pathogen transmission and abundance of mosquito populations and be used to guide control measures, if applicable.

Level 3 – Continued or Multiple Pathogen Detections

Persistent detection of mosquito-borne pathogens or detection in bridge vector mosquitoes or in non-avian vertebrate populations in or near New York City will result in a move to Level 3 responses.

DOHMH *Responses*: OVSC recommendations will be communicated to the WN virus Steering Committee and the DOHMH Commissioner. Upon approval by the Commissioner, a press release will be drafted, notifying the public of the recent findings. Surveillance programs will continue as noted above. Control measures will be implemented.

- CDC Light Traps will be added to the area of concern if additional surveillance data are required.
- Larval surveillance and enhanced adult trapping will be conducted in affected areas if needed.
- Laboratory testing of mosquito pools will be increased in primary and bridge vector species
- Control measures to be considered:
 - Application of larvicides (including aerial applications) to areas breeding large numbers of mosquitoes

- Ground application of adulticides to immediate areas of concern
- Aerial application of adulticides may be considered in the event of epidemic
- Recommend the restriction and/or cancellation of outdoor evening activities
- Recommend the closing of outdoor recreational areas
- Monitor the efficacy of the adulticiding activities.
- DOHMH will comply with Local Law 37 of 2005, which sets forth requirements on pesticide use by New York City.
- DOHMH will consider EPA and NYS DEC registered products for mosquito control that contain the following active ingredients: sumithrin, permethrin, or naled. The City will continually review the available information on the health impact of pesticides. Any products used will be applied in compliance with City, State, and Federal laws and regulations.
- The public will be notified of adulticide schedules in advance, which will allow sufficient time to take any necessary precautions to reduce pesticide exposure. (See Public Education and Community Outreach)
- Hospitals will be notified regarding the adulticiding schedule. Information on the pesticide to be used will be provided to the public, physicians and other health care providers.
- Adult mosquito control will be scheduled when mosquitoes are most active and when weather conditions are conducive to successful application.
- Information will be released 24 hours in advance of the scheduled spray event through the media, the DOHMH web site, West Nile virus Information Line, and pertinent City and community organizations.
- DOHMH will monitor and assess control activities for any potential environmental and health effects through several measures, including pre- and post-spray environmental sampling and addressing pesticide exposure complaints received by DOHMH.

Depending on available resources, surveillance findings, and other criteria, DOHMH or its Contractor may apply targeted adulticides in response to community concerns about nuisance mosquitoes on the Rockaway Peninsula.

SURVEILLANCE OF POTENTIAL ADVERSE HEALTH EFFECTS FROM PESTICIDE EXPOSURE

Objective

To perform passive and syndromic surveillance to monitor for possible exposure to pesticides used to control adult mosquitoes and the potential health sequelae due to such exposure.

Background

Since exposure to pesticides has the potential to cause adverse reactions, particularly among those with pesticide sensitivity or underlying health conditions, beginning in 2000, DOHMH took additional care to provide advance notification whenever adulticide applications occurred. Prior to conducting adult mosquito control activities, information on pesticides was sent to all hospital emergency departments, which included product information on pesticides, Material Safety Data Sheets, and other information relevant to identifying possible exposures to pesticides. Each year since 2000, calls to the New York City Poison Control Center (NYC PCC) were monitored during pesticide spraying and relevant exposures were forwarded to the New York State Pesticide Poisoning Registry (NYS PPR) for review and possible inclusion in the registry. In 2001, active surveillance for pesticide-related health complaints was performed. In this regard, chart review was conducted in emergency departments and physicians were randomly surveyed in the affected areas by telephone to determine if any individuals had sought care for symptoms related to possible exposure to adulticides. No cases of individuals reporting to emergency departments or seeking care from their physicians for health complaints related to adulticide exposure were found through these activities. Additional research was conducted to determine whether pesticide applications associated with WN virus mosquito control were associated with negative health outcomes. As a recent publication reported, no such associations were found.¹

Beginning in 2002, syndromic surveillance was adopted as a surveillance tool to identify any possible respiratory symptom related cluster in areas in which a spray action occurred. If such a cluster is identified, DOHMH conducts further review of emergency department data to investigate the possible etiology of that cluster. In addition, the Poison Control Center monitors pesticide-related calls for number and severity that are geographically and temporally associated with spray events.

Planned Activities

Prior to conducting adult mosquito control activities, information on pesticides and their possible adverse health effects will be sent to all hospital emergency departments, including product information on pesticides, Material Safety Data Sheets, and other information relevant to identifying possible exposure to pesticides. Calls received by the New York City

¹ Karpati AM, Perrin MC, Matte T, Leighton J, *et al.* Pesticide Spraying for West Nile Virus Control and Emergency Department Asthma Visits in New York City, 2000. *Environ. Health Perspect.* 2004 Aug; 112(11): 1183-7.

Poison Control Center (NYC PCC) will continue to be monitored during pesticide spraying for geographic and spatial associations with spray events. These data will continue to be forwarded to the NYS Pesticide Poisoning Registry for possible follow-up and inclusion in the Registry. Syndromic surveillance will also continue to be utilized to identify possible asthma clusters in the zip codes in which spraying occurs. Statistical and field investigation methods for evaluating spatial and temporal clustering are described in recent publications.² In the event that a possible respiratory symptom cluster is identified, emergency department chart review will be considered to investigate the possible etiology of that cluster at nearby hospitals.

² See for example: Heffernan, R., F. Mostashari, D. Das, *et al.* New York City Syndromic Surveillance Systems MMWR September 24, 2004 / 53(Suppl);23-27; and Steiner-Sichel, L., J. Greenko, R. Heffernan, M. Layton, and D. Weiss. Field Investigations of Emergency Department Syndromic Surveillance Signals. New York City MMWR September 24, 2004 / 53 (Suppl.);184-189.

RESEARCH AND EVALUATION

Objective

To better understand the transmission and overwintering mechanism of mosquito-borne diseases and to assess the effectiveness of DOHMH surveillance, prevention and control methods

Background

One of the most important roles for public health professionals is to assess the potential impact of a disease on a population and to devise safe and effective methods for reducing the risk of disease transmission. DOHMH, in collaboration with CDC and NYSDOH, has studied closely the risk factors for infection, morbidity and mortality from WN virus. However, many questions remain about how the virus circulates in nature.

Furthermore, some of the control methods used for managing mosquito populations, especially the application of pesticides for adult mosquitoes, are not without potential impact. However, alternative control measures lack sufficient efficacy or environmental impact data to allow their wholesale integration into this plan. The environmental impact statement and other research endeavors are important tools used to assess potential adverse health effects associated with pesticide exposure. Additional research is needed in this area as well as in assessing improved techniques for larval and adult mosquito control in New York City.

Planned Activities

- DOHMH will continue to work closely with Federal, State, and Local partners to conduct research that will identify the most effective predictors of human illness from WN virus in New York City, including the analysis of overwintering mosquito populations and the use of predictive disease models.
- DOHMH will continue to refine the New York City-specific phased response for risk categories of mosquito-borne disease outbreaks based on the ongoing analyses of bird, mosquito, mammalian and human surveillance data.
- DOHMH will evaluate the most cost-effective methods of surveillance and control.
- DOHMH will research and evaluate the potential public health and environmental impact of the application of pesticides for adult mosquito control.
- In collaboration with CDC and NYSDOH, OVSC will publish new and relevant information about mosquito-borne disease transmission in New York City in peer-reviewed public health and medical journals.
- DOHMH will conduct research to determine the blood feeding preference of the mosquito vectors of WN virus in NYC using molecular techniques. This information

will help determine what animals are the primary hosts and focus surveillance and control activities accordingly.

- DOHMH will research and evaluate the development of resistance in mosquitoes due to the application of pesticides (microbial larvicides and adulticides).
- DOHMH will conduct an analysis to predict the risk of West Nile virus infections and the outcome of interventions in New York City using Probabilistic modeling techniques, Spatial Statistics and Geographic Information System (GIS).
- DOHMH will test hibernating mosquitoes for WN virus infection to determine their role in the overwintering of WN virus from one season to the next.
- The host seeking activity patterns of mosquitoes will be determined by using collection bottle rotator traps in various habitats such as marsh, urban areas and parks.
- Larval surveillance will be conducted before and after the control activities in the catch basins (storm drain) and natural breeding sites for determining larval control efficacy of the pesticides.

APPENDIX A:

QUESTIONS AND ANSWERS ABOUT WEST NILE VIRUS

Q: What is West Nile virus?

A: WN virus is a mosquito-borne virus that can infect humans, birds, horses and other mammals. In most humans, WN virus infection causes a mild or moderate, short-lived flu-like illness, or causes no symptoms at all. However in some cases, particularly among persons 50 years of age and older, it can cause serious neurological diseases such as encephalitis, meningitis, or acute flaccid paralysis. WN virus first appeared in North America in New York City in 1999. Since then, the virus has spread across the continental United States. Visit www.cdc.gov for more information on WN virus nationally.

Q: How is WN virus spread?

A: WN virus is predominantly spread to humans by the bite of an infected mosquito. In 2002 other methods of human transmission were discovered but appear to be rare. It has now been shown that WN virus can be transmitted to humans who receive transfusions of infected blood or blood products, or who receive infected organs through transplantation. Also, in 2002 there was one case of transmission from a pregnant woman to her fetus, and one probable case of mother-to-baby transmission through breast milk. Additionally, two laboratory workers were accidentally infected following injuries while handling infected birds. WN virus is NOT spread by casual contact such as touching, kissing, or caring for someone who is infected.

Q: Who is most at risk for getting WN virus disease from being bitten by an infected mosquito?

A: Anyone who is infected can potentially develop severe WN virus disease (e.g. encephalitis, meningitis, or acute flaccid paralysis). However, persons older than 50 have the highest risk of becoming severely ill. There is also increasing evidence that immunocompromised persons (e.g., people who are taking immunosuppressive medications such as prednisone, or people who have received organ transplants) are at higher risk for severe WN virus disease.

Q: Where did the WN virus come from?

A: Outbreaks of the WN virus have occurred before in Africa, Israel, Asia, Romania, Russia and France. Prior to 1999, the WN virus had never been discovered in the Americas. WN virus was most likely introduced by an infected bird or mosquito that was imported from a country where the virus is common.

Q: Can you get WN virus directly from birds?

A: Currently, there have been no reported cases of WN virus being spread directly from live or dead birds to the general public. However, dead birds can carry a variety of other

diseases and should never be handled with bare hands. Always use plastic bags or gloves to carefully place dead birds in double-plastic bags and then place dead birds in the outdoor trash.

Q: Besides mosquitoes, can you get WN virus directly from other insects or ticks?

A: Infected mosquitoes are the primary source of WN virus and caused the recent outbreaks in NYC. Although several types of ticks in Africa and Europe have been found infected with WN virus, there is no information to suggest that ticks or other insects in this country are able to transmit WN virus.

Q: What are the symptoms of WN virus?

A: Most people who are infected with WN virus either have no symptoms or experience a mild or moderate illness with symptoms such as fever, headache, fatigue, or body aches before fully recovering. Some persons may also develop a rash or swollen lymph glands. In some individuals, particularly persons 50 years of age and older, WN virus can cause serious disease that affects the brain and spinal tissue. Severe illness may include encephalitis (inflammation of the brain), meningitis (inflammation of the membrane around the brain and spinal cord), or acute flaccid paralysis (a polio-like syndrome in which muscles become very weak or paralyzed). Symptoms of more severe disease may include headache, high fever, stiff neck, nausea and vomiting, confusion, coma, tremors, convulsions, muscle weakness and/or paralysis. At its most serious, WN virus can cause permanent neurological damage and death. Among those people who need to be hospitalized for WN virus, 10-15% die of their illness. People who do develop symptoms normally become ill 3-15 days following the bite of an infected mosquito.

Q: If a pregnant woman gets infected with WN virus, can it affect her fetus?

A: Maybe. In 2002 there was one case of transmission of WN virus from mother to fetus during pregnancy. The newborn was infected with WN virus at birth and had severe neurological problems, including abnormalities of the brain and retinas. It is possible that WN virus caused these abnormalities in the baby; however, it is not proven.

More information is now being gathered about other babies born to mothers infected with WN virus during pregnancy in order to improve our understanding of the effects of WN virus on the fetus and newborn. Three other instances of maternal infection were investigated in 2002; babies born to these mothers appeared normal and had negative laboratory tests for WN virus. The Centers for Disease Control and Prevention (CDC) is currently investigating outcomes of about 70 pregnant women who were infected with WN virus in 2003.

Q: How is WN encephalitis treated?

A: There is no specific treatment for WN virus. Most people who become infected will get better on their own. In more severe cases, intensive supportive therapy is indicated, i.e., hospitalization, intravenous (IV) fluids and nutrition, airway management, ventilatory support (ventilator) if needed, prevention of secondary infections and proper nursing care.

Recently, some experimental treatments for WN virus have become available for people with severe disease. In New York City, two hospitals are participating in clinical trials of these experimental therapies. Not every patient with WN infection is eligible for these treatments. Patients or their families who want more information about these experimental treatments should ask their medical providers about them. Medical providers may contact the Bureau of Communicable Disease at the New York City Department of Health and Mental Hygiene for more information.

Q: Is there a vaccine against WN virus?

A: There is currently no human vaccine for WN virus, but several companies are working towards developing one. There is a WN virus vaccine that has been approved for use in horses.

Q: How long does it take to get sick if bitten by an infected mosquito?

A: Most people who are infected with WN virus have no symptoms or experience only mild illness. If illness does occur, symptoms appear within 2 to 15 days of being bitten by an infected mosquito.

Q: What should I do if I think I have WN encephalitis?

A: You should seek medical care as soon as possible if you develop signs of encephalitis **such as/including:** fever, muscle weakness, and confusion,

Q: What can I do to reduce my risk of becoming infected with WN virus?

A: From June through October, when mosquitoes are most active, take the following precautions:

- Wear protective clothing such as long pants and long-sleeved shirts.
- Avoid shaded, bushy areas where mosquitoes like to rest.
- Limit outdoor evening activity, especially at dusk and dawn when mosquitoes are most active.
- Use mosquito repellent when outdoors in areas where mosquitoes are active. Repellents containing the active ingredients DEET, picaridin, IR3535 or oil of lemon eucalyptus are approved for use by the US EPA and New York State for protection against biting mosquitoes. Extra precaution should be used when applying repellents to children and infants. Products containing oil of lemon eucalyptus should not be used on children younger than three. Always read the repellents label and follow instructions for use. Formulations containing more than 25% DEET are unnecessary and may enhance skin reactions on some people. As with all products, the user should follow the manufacturer's usage recommendations.

Q: What can I do around my home to help reduce exposure to mosquitoes?

A: Mosquitoes lay their eggs in standing or slow moving water. Also weeds, tall grass, and bushes provide an outdoor resting place for mosquitoes. Mosquitoes breeding or resting on your property can then enter homes through unscreened windows or doors, or broken screens.

- Repair or replace all screens in your home that have tears or holes.

- Eliminate any standing water that collects on your property.
 - Remove all discarded tires from your property.
 - Dispose of tin cans, plastic containers, ceramic pots, or similar water-holding containers.
 - Make sure roof gutters drain properly. Clean clogged gutters in the spring and fall.
 - Clean and chlorinate swimming pools, outdoor saunas and hot tubs. If not in use, keep empty and covered.
 - Drain water from pool covers.
 - Change the water in bird baths once a week.
 - Turn over plastic wading pools and wheelbarrows when not in use.
- Remind or help neighbors to eliminate breeding sites on their properties.

Q: What is the City doing to address the possible return of WN virus?

A: DOHMH, along with other City, State and Federal agencies, has developed a comprehensive plan to reduce the risk of illness due to WN virus. The main goal of this plan is to decrease the number of adult mosquitoes by eliminating their breeding sites wherever possible, and applying larvicides (to kill the immature larval form of the mosquito) to areas with stagnant water that cannot be drained completely. The City also will regularly test mosquitoes for WN virus throughout the spring and summer. If WN virus is found at levels that indicate a threat to human health, local applications of pesticides may be undertaken to prevent people **from** becoming infected.

Q: Is the City planning to apply pesticides as was done previously?

A: If WN virus is detected in the community, the City's initial response will be to intensify its efforts to reduce mosquito-breeding sites and increase its levels of larviciding in those areas in which WN virus has been found. Reducing the adult mosquito population with pesticides (adulticides) approved by the US Environmental Protection Agency (EPA) will be done if necessary to prevent human illness. The decision to spray, either on the ground or by air, will be based on surveillance information and the documentation of WN virus activity at a level that indicates a threat to human health. Adulticiding will be concentrated in areas most at risk for disease occurrence.

Q: What health risks are posed to people and pets from pesticides for adult mosquitoes?

A: In the amounts used, risks to people and pets are relatively low. However, some people may be more sensitive to such pesticides and may want to reduce their chance of exposure by following the suggestions below. Anyone experiencing persistent or significant adverse reactions to pesticides should seek medical care or call the NYC Poison Control Center at (212) POISONS or (212) 764-7667.

Q: Will the public be notified in advance about spraying activities?

A: Residents can learn about adulticiding schedules in advance through public service announcements, the media, the City's website (nyc.gov/health), and a telephone information line (1-877-WNV-4NYC).

Q: If the City sprays pesticides for adult mosquitoes, what can I do during spraying to reduce the risk of exposure to pesticides?

A: If spraying becomes necessary, the NYC DOHMH recommends that all individuals take

the following precautions to avoid direct exposure to pesticides and reduce the reactions:

- Some individuals are sensitive to pesticides. Persons with asthma or other respiratory conditions are especially encouraged to stay inside during spraying since there is a possibility that spraying could worsen these conditions
- Air conditioners may remain on. But if you wish to reduce the possibility of exposure to pesticides, set the air conditioner vent to the closed position, or choose the recirculate function
- If you wish to minimize your exposure to pesticides, you may want to bring children's toys, outdoor equipment and clothes from outdoor areas inside during spraying
- If outdoor equipment and toys are exposed to pesticides, they may be washed with soap and water to reduce the possibility of exposure
- Wash skin and clothing exposed to pesticides with soap and water

Anyone experiencing adverse reactions to pesticides should seek medical care or call the NYC Poison Control Center at (212) POISONS or (212) 764-7667.

Q: If I live in an area where birds or mosquitoes with WN virus have been reported, and a mosquito bites me, am I likely to get sick?

A: No. Evidence indicates that the chance of human infection and illness resulting from WN virus is quite low. In addition, the greatest risk is to those over age 50. These members of the population should take the greatest care to prevent exposure to mosquito bites.

Q. I've gotten a mosquito bite. Should I be tested for WN virus?

A: No. Illnesses related to mosquito bites are still uncommon. However, you should see a doctor immediately if you develop symptoms such as high fever, confusion, muscle weakness, severe headaches, and stiff neck or if your eyes become sensitive to light. Patients with mild symptoms should recover completely and do not require any specific medication or laboratory testing.

Q: Should I report dead birds to the Health Department?

A: No. The Health Department will no longer take reports of dead birds to monitor for WN virus. Testing of birds for WN virus had limited value as an early warning system for the WN virus infection. If you have a dead bird on your property, please dispose it of. While there is currently no evidence that WN virus can be spread directly from birds to people, dead birds can carry other diseases and, therefore, should never be handled with bare hands. Use plastic bags or gloves to carefully place dead birds in double-plastic bags and then place dead birds in the outdoor trash.

For more information about West Nile virus, call the New York City Citizen Service Center, 24 hours a day, seven days a week, by dialing 311 or check the DOHMH Website at nyc.gov/health.

GLOSSARY

adulticide	a type of pesticide used to kill adult mosquitoes
<i>Aedes sollicitans</i>	<i>See Ochlerotatus sollicitans</i>
Altosid	brand name of methoprene, a type of larvicide
arbovirus	shortened term for arthropod-borne virus, a virus that is carried by arthropods
arthropod	a group of an animal that does not have a backbone and have jointed walking appendages, such as insects, spiders and lobsters
<i>Bacillus sphaericus</i>	a bacterium; type of biological pesticide used to control mosquito larvae in water (mosquito larvae die after ingesting this bacterium)
<i>Bacillus thuringiensis</i> var. <i>israelensis</i> (Bti)	a bacterium; type of biological pesticide used to control mosquito larvae in water (mosquito larvae die after ingesting this bacterium); bacteria found in Mosquito Dunks®
bridge vector	an arthropod (in this case, a specific species of mosquito) that serves as a main transmission of virus between the reservoir (birds) and humans.
catch basins	grates seen at street corners and in other properties for water runoff
<i>Culex pipiens</i>	a species of mosquito, the primary vector for West Nile virus, commonly found in urban areas; breeds in fresh, but stagnant water, such as backyard containers and storm drains
DEET	DEET (chemical name, N,N-diethyl-meta-toluamide) is the active ingredient in many insect repellent products
Eastern equine Encephalitis (EEE)	mosquito-borne viral disease that causes inflammation of the brain; similar to West Nile
encephalitis	inflammation of the brain, which can be caused by numerous viruses and bacteria, including West Nile virus
Environmental Impact Statement (EIS)	A document that describes the impact on the environment from a proposed action (in this case, the application of

	pesticides to control adult mosquitoes).
FourStar	brand name for the larvicide based on mixture of <i>Bacillus sphaericus</i> and <i>B. thuringiensis</i> var. <i>israelensis</i> (<i>Bti</i>)
gravid traps	mosquito traps designed to attract pregnant female mosquitoes
Interactive Voice System	an automated telephone system by which information can be accessed by choosing from a set of options
IR3535	IR3535 (3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester) is the active ingredient in many insect repellent products
larvae	immature mosquitoes that live in water; stage which hatches from the egg, prior to adult stage
larvicide	a type of pesticide used to control immature or larval mosquitoes
light traps	mosquito traps outfitted with a light to attract mosquitoes
meningitis	inflammation of the lining of the brain and spinal cord that can be caused by a virus or bacteria
methoprene	a type of (synthetic) insect growth regulator used to control larval mosquitoes; it prevents mosquito larvae from emerging and developing into adult mosquitoes
mosquito breeding site	a location where mosquitoes lay eggs, usually in stagnant water with organic material
mosquito pools	a group of mosquitoes of the same species, collected in given area and combined at the laboratory for testing for the presence of West Nile and related viruses
naled	an organophosphate pesticide used to control adult mosquitoes
neurology	the study of the nervous system and its disorders
<i>Ochlerotatus sollicitans</i>	species of mosquito that breeds in salt marshes
outbreak	an unexpected increase in frequency or distribution of a disease
permethrin	a synthetic pyrethroid pesticide used to control adult mosquitoes; active ingredient in the product Biomist®

pesticide	substance used to kill pests such as insects, mice and rats; an insecticide is a form of pesticide
picaridin	(chemical name, 1-Piperidinecarboxylic acid, 2-(2-hydroxyethyl)- 1-methylpropylester) is the active ingredient in many insect repellent products
piperonyl butoxide	An additive to pyrethroid pesticides that improves the effectiveness of the active ingredient
resmethrin	a synthetic pyrethroid pesticide used to control adult mosquitoes; active ingredient in the product Scourge [®]
salt marsh	areas of vegetation in bodies of salt water that may support the breeding of certain types of mosquitoes such as <i>Ochlerotatus sollicitans</i> ; example of salt marshes is Jamaica Bay.
sentinel	an early warning system, in this case, for the presence of virus (e. g. , sentinel chickens)
serologic	of, or relating to, serum
source reduction	the removal or reduction of larval mosquito habitats
St. Louis encephalitis (SLE)	mosquito-borne viral disease that causes inflammation of the brain; very similar to West Nile virus
sumithrin	a synthetic pyrethroid pesticide used to control adult mosquitoes; active ingredient in the product Anvil 10+10 [®]
VectoBac	brand name for the larvicide <i>Bacillus thuringiensis</i> var. <i>israelensis</i> (<i>Bti</i>)
VectoLex	brand name for the larvicide <i>Bacillus sphaericus</i>
VectoMax	brand name for the larvicide based on mixture of <i>Bacillus sphaericus</i> and <i>B. thuringiensis</i> var. <i>israelensis</i> (<i>Bti</i>)
vector	an organism (an insect in most cases) capable of carrying and transmitting a disease-causing agent from one host to another
viral	of, or relating to, a virus
viral encephalitis	inflammation of the brain caused by a virus, such as West Nile virus

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