

TORONTO STAFF REPORT

November 13, 2002

To: Board of Health
From: Dr. Sheela V. Basrur, Medical Officer of Health
Subject: West Nile Virus Program

Purpose:

This report provides the Board of Health with an update on the 2002 Toronto Public Health (TPH) West Nile Virus (WNV) program along with recommendations for 2003.

Financial Implications and Impact Statement:

In October 2002, TPH made a provisional recommendation that \$777,700 (gross) / \$388,850 (net) be added to the TPH base budget for WNV prevention and control through the 2003 Operating Budget process. These amounts correspond to the service levels funded 100% by the Province during 2002 with technical adjustments for cost-of-living increases, etc.

This level of funding would enable continuation of 2002 service levels for public education, human and vector surveillance, data analysis and reporting, along with technical assistance in communicable disease control for local health professionals. It does not cover the costs of mosquito control measures, such as larviciding (chemical treatments to kill mosquito larvae) or adulticiding (spraying of chemicals that kill adult mosquitoes).

Service level options for larviciding are outlined in this report, with the recommended service level (Option 2) costing \$720,000 gross / \$360,000 net. Adulticiding (if required in the opinion of the Medical Officer of Health after larviciding has already been conducted) would cost an additional \$80,000 gross / \$40,000 net.

If 2002 WNV service levels are maintained in 2003 along with the recommended provisions for chemical mosquito control, the overall operating budget impact would be \$1,577,700 gross / \$788,850 net, which is \$800,000 gross / \$400,000 net above the provisional budget recommendation.

The Chief Financial Officer and Treasurer has reviewed this report and concurs with the financial impact statement.

Recommendations:

It is recommended that:

- (1) the Board of Health endorse the following components and service levels for the 2003 WNV Program:
 - (a) primary prevention of WNV through source reduction, public education, surveillance and mapping (\$777,700 gross / \$388,850 net);
 - (b) larvicidal control of mosquitoes across the City (\$720,000 gross / \$360,000 net) (Option 2);
 - (c) a retainer for a licensed pest control service that would be used only if, in the opinion of the Medical Officer of Health, the use of adulticides is necessary as an effective and essential strategy to reduce WNV transmission to humans and when all other measures to prevent this health hazard have failed (\$80,000 gross / \$40,000 net);
- (2) the Board of Health urge the Minister of Health and Long Term Care to provide substantially increased resources (in both personnel and equipment) for the Central Public Health Laboratory in order to provide more timely access for local physicians and public health officials to preliminary WNV test results;
- (3) the Board of Health urge the Minister of Health and Long Term Care to provide a Level 3 laboratory in Ontario to improve the timeliness of confirmatory testing among probable human cases of WNV disease;
- (4) this report be referred to the City's Budget Advisory Committee for consideration during the 2003 operating budget process;
- (5) this report be referred to the Economic Development and Parks Committee and to the Works Committee for their information; and
- (6) the appropriate City officials be authorized and directed to take the necessary actions to give effect thereto.

Background:

West Nile Virus is a mosquito borne virus that circulates primarily in birds (particularly crows and blue jays). The virus was first isolated in 1937 in Uganda and has caused outbreaks of human illness in Africa, West Asia and Eastern Europe. WNV was first detected in Ontario in

2001 when 128 birds collected in Ontario (41 from Toronto) showed evidence of WNV infection.

In February 2002, TPH attended a meeting organized by the MOHLTC to establish a co-ordinated approach to WNV. The outcome of this meeting was an agreement to focus 2002 public health efforts on surveillance, public education, and mapping.

City Council did not approve a staff recommendation to introduce a cost-shared WNV program during the 2002 operating budget process, opting instead to request 100% funding by the Province. In April 2002, the Minister of Health and Long Term Care announced \$2.5 million for WNV in one-time, 100% provincial funds, and in September 2002 the Province announced a further \$9 million for the 2002/2003 fiscal year, this time on a 50:50 cost-shared basis.

In April 2002, the MOHLTC provided TPH with \$764,000 in one-time, 100% provincial funds for WNV activities in 2002. These resources were used to provide the essential components of the 2002 WNV program described below. The subsequent provincial allocation to Toronto of \$212,000 in 50:50 funds could not be used due to lack of matching municipal dollars in 2002.

Comments

2002 WNV Program:

Human Surveillance:

Surveillance for human cases of WNV is provincially mandated under the Control of Infectious Diseases program and relevant Regulations under the Health Protection and Promotion Act. Information on each reported case is transmitted to the MOHLTC and is summarized in reports circulated to health professionals. To ensure timely reporting of encephalitis cases seen in Toronto hospitals, TPH sent a weekly e-mail bulletin to all infection control practitioners to remind them of the WNV case definitions and to provide them with updates on the occurrence of WNV in Toronto. A summary report of the human epidemiology of WNV was circulated to infectious disease specialists in early November 2002.

Communication and Education:

Public information about reducing personal risk and eliminating mosquito breeding areas was provided through the mass media, in print materials at libraries and community centres, through TPH's information line and website, and by advertisements in the TTC and on OMG bins. Key messages focused on reducing the risk of exposure to WNV by taking personal precautions (i.e. wearing long sleeved shirts and pants along with mosquito repellent to protect the skin) and by eliminating standing water around the home where mosquitoes could breed.

In coordination with the MOHLTC, TPH provided information to hospital infection control practitioners in May 2002 on the signs, symptoms and testing procedures for WNV. Day nurseries and long term care facilities were given relevant information during the summer, and a July 2002 update was sent to family physicians in "Communique", the TPH Communicable Disease Control newsletter. Information on WNV was also provided to the Board of Health, other city staff and interested individuals upon request.

Standing Water:

Calls regarding standing water were investigated on a complaint-driven basis on private and public lands, at which time these locations were recorded on a City database and educational materials were distributed.

Bird Surveillance:

In 2001, Toronto Public Health conducted active bird surveillance with the goal of detecting the first signs of WNV in Toronto. To maximize coverage across the city, Toronto Public Health asked the public to call Toronto Animal Services (TAS) to report dead bird sightings. Dead birds were collected by TAS staff and sent to the Canadian Cooperative Wildlife Centre for WNV testing. Through these efforts, WNV was first detected in a dead bird in Toronto in August of 2001, and a total of 41 positive dead birds were found across the city.

In 2002, bird surveillance focused largely on dead crows, the species most susceptible to death due to WNV and the best early warning of viral activity. Active surveillance for dead birds was conducted by TAS and by Parks and Recreation staff on City property. The WNV Information Line received many reports of dead bird sightings from the public, which served as a key indicator of WNV activity. There was also a substantial increase in total calls to the TAS information line (338-PAWS) during the peak period of media attention to WNV; over 13,000 additional calls were received during the month of August, the majority of which were related to WNV.

At the outset of 2002, the public were asked not to report dead birds to TAS, as the presence of WNV in Toronto had already been established the previous year. Instead, TPH advised City residents on safe disposal methods for dead birds. However, in response to escalating demand from the public as the season progressed, TAS expanded its pick-up of dead birds to include private property if the complainant was unable or unwilling to dispose of it themselves.

Mosquito Surveillance and Control:

As part of a pilot program with surrounding Health Unit partners and Brock University, light traps for adult mosquitoes were set up across the City. Twenty (20) permanent trap locations were sampled once a week for the entire mosquito season. A second round of trapping was also conducted each week, in which 16 moveable traps were placed in “hot spots” (ie. areas where large numbers of crow deaths were reported or areas in which positive crows were found).

With the cooperation of Works and Emergency Services, TPH also conducted mosquito larval dipping in some of the approximately 200,000 catch basins across the city. This provided valuable information on the length of the mosquito breeding season, the level of mosquito activity and the species of mosquitoes found in Toronto, and it confirmed that catch basins are a significant source of mosquito breeding.

At the outset of 2002, there was insufficient evidence of human health risk to warrant pre-emptive, chemical mosquito control. Accordingly, TPH emphasized non-chemical mosquito

control through source reduction, and public education messages focused on reducing mosquito breeding sites around the home. TPH also supported other agencies in reducing mosquito breeding on their property and responded to complaints of standing water that could serve as mosquito breeding sites.

Interagency and Interdepartmental Cooperation:

Over the course of the 2002 WNV season, TPH worked closely with the MOHLTC, Health Canada and neighbouring health units to review the WNV situation as it progressed in Toronto and Ontario. TPH also relied on a number of outside agencies to conduct testing for WNV, including Brock University (for mosquito testing) and the Canadian Cooperative Wildlife Centre in Guelph (for dead bird testing), as well as the provincial Central Public Health Laboratory and Health Canada's National Microbiology Laboratory in Winnipeg (for human testing).

TPH also worked with other City of Toronto departments and union officials to develop appropriate precautions to reduce the risk of mosquito bites among outside workers. Works and Emergency Services (WES) staff assisted TPH in accessing storm water catch basins for larval surveillance, and TPH consulted with WES on the Wet Weather Flow Management Plan to find creative ways to prevent temporary storm water storage areas from becoming mosquito breeding grounds. TPH also assisted WES and Parks and Recreation in resolving standing water complaints from the public involving City lands.

Capacity Building:

TPH built in-house WNV capacity through staff training (e.g. in mosquito surveillance methods), and by acquiring key pieces of equipment necessary to support the WNV program (e.g. microscopes for mosquito identification). TPH also initiated the development of a WNV module for THEIS (Toronto Healthy Environments Information System) with a mapping component to support future assessment, reporting and decision making on WNV and other public health issues and concerns.

Preliminary Results for 2002:

Mosquito activity in 2002 ended with the arrival of cold weather. However, test results for adult mosquitoes are still being received, and some people with suspect or probable WNV infection still await the results of additional laboratory testing to confirm their diagnosis. The following is a summary of the activities and year-to-date statistics from the TPH West Nile Virus program as of November 1, 2002.

Bird Surveillance:

From May to November 2002, Animal Care and Control Officers responded to 1,411 bird related calls and documented 846 dead crows, 280 other dead birds and 285 injured crows. It should be noted that, due to limited laboratory capacity, health units could only submit up to four specimens per week. This was consistent with the number of bird specimens required for representative surveillance on a national level, according to Health Canada's recommendations.

Accordingly, TAS submitted 41 crows for testing; 21 of these birds were sampled and eight birds tested positive for WNV.

Mosquito Surveillance:

To date, 62 “pools” or batches of adult mosquitoes have tested positive in Toronto. In addition, the presence of mosquito larvae was confirmed in 91% of the 390 catch basins tested.

Human Surveillance:

From August 1st to November 1st, 2002, 247 cases of encephalitis were reported to TPH. This compares to an average of only 31 encephalitis cases reported to TPH in the same time period over the past 3 years, representing an 8-fold increase in this disease category.

On August 30, 2002, TPH received the first laboratory report of WNV infection in a Toronto resident. Over the next 2 months, there were 15 confirmed, 30 probable and 59 suspect cases of WNV infections reported to TPH (see Appendix 1 for case definitions). An additional 92 cases of viral encephalitis were also reported that are still being investigated and may have been due to WNV. The balance of 51 cases were diagnosed with illnesses other than WNV.

Table 1 shows the distribution of WNV-related cases by age and sex. The median age of cases was 53 years, and 59% were 50 years of age or older, an age beyond which there is increased risk of more serious complications from WNV infection. It should be noted that many infections are believed to be mild or asymptomatic and therefore would not be represented in the burden of illness outlined below.

Table 1 – Age and Sex Distribution of Encephalitis and WNV Cases in 2002

Age Group	Female	Male	Total
0-34	18	16	34
35-49	24	23	47
50-59	18	17	35
60-69	12	16	28
70-79	15	22	37
80+	8	7	15
Total	95	101	196

Seven cases have died (one confirmed, three probable, two suspect and one encephalitis - undetermined), and the exact cause of death for each of these cases is being investigated.

Hospitalization is another measure of clinical severity. A total of 112 patients are known to have been admitted to hospital, 37 cases did not require hospitalization, and 47 cases are being investigated to determine whether or not hospitalization had been required. Table 2 shows the distribution of hospitalization by case type.

Table 2 – Hospitalization of West Nile Virus Cases, 2002

	In-Patient Care Required	Never Hospitalized	Unknown	Total
Confirmed WNV Infection	13	2	0	15
Probable WNV Infection	16	8	6	30
Suspect WNV Infection	33	22	4	59
Encephalitis – Undetermined	50	5	37	92
Total	112	37	47	196

Contrary to initial expectations, serious WNV disease was not confined solely to elderly people with pre-existing medical conditions. Significant morbidity occurred among previously healthy young individuals, 34 of whom were less than 35 years of age. Even among cases that have not yet been confirmed, illness frequently required hospitalization and caused prolonged fatigue, muscle weakness, disability and substantial recuperation time.

Large numbers of confirmed and probable cases were also reported in Peel Region and in Halton Region to the west of Toronto. This pattern is consistent with the relative focus of WNV activity in the west region of Toronto as outlined in Table 3.

Table 3 – Regional Distribution of WNV and Encephalitis Cases in Toronto, 2002

Region	East	North	South	West	Unknown	Total
Confirmed WNV Infection	3	2	2	8	0	15
Probable WNV Infection	0	8	6	15	1	30
Suspect WNV Infection	4	13	25	17	0	59
Encephalitis – Undetermined	12	12	4	62	2	92
Total	19	35	37	102	3	196

The high volume of diagnostic specimens submitted to the provincial Central Public Health Laboratory created time delays of 6 weeks or longer to receive test results. Subsequent testing at the federal laboratory involved a further 3 week delay. Therefore, additional capacity is required at the provincial laboratory in order to ensure more timely medical diagnosis and appropriate

care. This would also help TPH make timely decisions about appropriate public health responses to WNV.

2003 WNV Program:

The epidemiology and natural history of WNV in North America is still unfolding and difficult to predict. For the past two years, the WNV program has been planned and funded on a year-by-year basis. However, the unexpected occurrence of human illness in southern Ontario in 2002, combined with evidence of WNV in birds in almost every health unit in Ontario, make it essential for Toronto to establish a permanent WNV program.

To identify essential components and service levels for WNV prevention and control, TPH consulted other health units that face a similar risk of WNV activity in 2003 as well as mosquito control experts from other jurisdictions that have experienced substantial WNV activity. In addition, TPH staff have worked closely with the MOHLTC and the provincial Ministry of the Environment, participated in a province-wide meeting organized by the Council of Ontario Medical Officers of Health (COMOH), and continue to participate in a taskforce organized by the Central East health units to share information on possible chemical WNV control activities in 2003. TPH will also participate in consultations with area health care professionals early in 2003. All stakeholders consulted by TPH agree that the following basic components (i.e. surveillance, education, source reduction and preventative mosquito control) should be included in a WNV program in 2003.

These components fall into an integrated pest management (IPM) approach. IPM is a decision-making process that anticipates and prevents pest activity by combining several strategies to achieve a long-term solution which minimises the use of pesticides and the impacts on human health and the environment, while ensuring effective pest control.

In situations where source reduction is not feasible or desirable (e.g. in stormwater catch basins or the removal of wetlands), there are essentially two methods available for controlling mosquito populations: the use of larvicides to control mosquitoes in the larval stage before they reach adulthood, or the use of adulticides to control them once they are in the adult biting stage.

Although all pesticides have some negative impacts on the environment, the use of larvicides is generally preferable to the use of adulticides for a number of reasons. First and foremost, the larvicides being considered for use in Toronto are less toxic to humans than adulticides. In addition, these larvicides can be applied in a more controlled manner and are not as toxic to other insects and aquatic life. In contrast, adulticides are more toxic to humans, tend to be applied in a more dispersed manner and can kill or affect a wider range of non-target species. A single application of adulticide will reduce the number of mosquitoes for only a few days and thus may need to be repeated several times to reduce mosquitoes over the desired length of time.

Therefore, larvicidal activity represents a preventive approach to the problem of vector control in that its goal is to reduce the peak number of mosquitoes before they develop into biting adults. Larviciding early-on in the mosquito season will help to prevent or reduce the need to use adulticides later on in the season.

Essential Components and Service Levels:

It is recommended that the basic components of the 2002 WNV program be continued in 2003. A specialized team will continue to plan and implement the TPH responses to WNV (inspections and complaint response, dead bird response, mosquito surveillance and control, epidemiology and human surveillance, communications and reporting), and to evaluate WNV activities on an ongoing basis. For 2003, this approach should include chemical control of mosquito larvae in the City's stormwater catch basins. In addition, a licensed pesticide control service should be held on retainer should the use of adulticides be necessary as an effective and essential strategy to reduce WNV transmission to humans and when all other measures to prevent this health hazard have failed.

Human surveillance and follow-up of reported cases is mandated by the Health Protection and Promotion Act and must continue even if the WNV program is not funded in 2003. However, the increase in encephalitis case reports during 2002 required re-prioritization of work in the Communicable Disease Control service to ensure timely follow-up of all reported WNV cases. Additional resources in this area will be required to ensure timely follow-up of human cases without compromising existing communicable disease control programs.

Surveillance of dead birds and mosquitoes should also continue in order to provide a full picture of the epidemiology of WNV in Toronto when assessing possible human cases. TPH should also continue to investigate complaints of standing water on privately-owned lands and the information gathered from these investigations will be tracked. Surveillance data are also needed to plan and evaluate larviciding and to fulfill the regulatory requirements for adulticiding, if required by order of the Medical Officer of Health. In addition, TPH will work with Works and Emergency Services and Toronto Parks and Recreation to expand mosquito surveillance in surface waters on public property and work on the mapping of surface water on city-owned properties will commence. All this work is necessary to prepare for a comprehensive mosquito control program for 2004, should this become essential.

Public education is an essential tool in the fight against WNV. The preferred method for reducing mosquito populations is by removing breeding grounds. Educational outreach will remind the public of the need to eliminate mosquito breeding sites on private property, and to use personal protective measures to prevent mosquito bites. For 2003 it will be necessary to enhance this aspect of the plan by increasing outreach capacity especially in areas of increased WNV activity and to reach Toronto's diverse communities. This could include intensive local media coverage and house-to-house WNV information distribution.

Options for Chemical Control of Mosquitoes:

Given the substantial human morbidity and mortality caused by WNV in 2002, non-chemical measures will not be sufficient to manage the risk of human WNV infection in Toronto in 2003. Chemical control of mosquitos will augment source reduction for vector control and potentially can reduce the risk of human infection from WNV.

Stormwater catch basins have been identified as an important place where *Culex pipiens* mosquitoes breed. This mosquito species is the main one that transmits WNV in North America. TPH proposes to implement a larval control program that will commence in late June - early July 2003 in the City's approximately 200,000 stormwater catch basins.

There are two low-impact products currently available in Canada that can be used for the control of mosquito larvae: methoprene and *Bacillus thuringiensis var israelensis* (Bti). Methoprene, a synthetic mosquito growth hormone that prevents mosquitoes from becoming adults, is available in long-lasting formulations but has some impact on other insects and aquatic life. Bti, a bacteria that produces a toxin that kills mosquitoes is more environmentally friendly. However, there are no long-acting formulations of Bti available in Canada, making it less effective and more costly to use in catch basins. Since Bti would need to be applied more often than methoprene, TPH proposes to use methoprene in 2003, at a cost of \$1.80 per catchbasin, per application.

To be effective, larvicides must be applied early in the mosquito breeding season and need to be applied at least twice. The larviciding options presented below represent an incremental approach to vector control.

Option 1 - \$360,000 gross / \$180,000 net

Option 1 involves larviciding all of Toronto's approximately 200,000 catch basins once during the summer. One application of granular methoprene, which provides approximately 3 weeks of larvicidal activity, could significantly reduce the peak number of adult mosquitoes in Toronto if it is applied at the appropriate time in the season and if the product does not fail. However, due to the unpredictable nature of the climatic and ecological conditions that could interfere with the activity of methoprene, combined with the possibility of product failure because the application may not occur at exactly the right time, this option leaves no margin for error and thus cannot be counted on to deliver significant risk reduction.

Option 2 - \$720,000 gross / \$360,000 net

Option 2 increases the frequency of larviciding all of the City's catch basins to twice over the course of the summer. This allows control of the two most significant mosquito breeding cycles of the season and reduces the chance of product failure. This would also improve the probability of significantly reducing the peak number of adult mosquitoes in Toronto at the time of WNV amplification (mid-July to early August).

Option 3 - \$1.08 million gross / \$540,000 net

Option 3 further increases the frequency of larviciding all of the City's catch basins to three times over the course of the summer. This approach would provide greater control of mosquitoes in Toronto. However, there is no convincing data to suggest that this step will necessarily reduce the risk of WNV transmission, and thus it does not warrant the extra expense.

Clearly, the more intensive the larviciding program the greater the reduction in adult mosquito numbers. After reviewing all options and taking into consideration the feasibility and the costs involved, TPH recommends Option 2 as the preferred approach.

Chemical Adult Mosquito Control - \$80,000 gross / \$40,000 net

The recommended product for use in Canada to control adult mosquitoes is malathion. It is applied as an ultra low volume (ULV) formulation through ground-level or aerial spraying. This pesticide is non-specific and can have an impact on other species such as bees, and substantial exposure may induce acute respiratory illness in humans. Consequently, chemical control of adult mosquitoes would be used only if, in the opinion of the Medical Officer of Health, the use of adulticides is necessary to reduce or eliminate a potential health hazard to the residents of Toronto, and when all other measures to prevent this health hazard have failed.

Since there is limited capacity to implement large-scale spraying of adulticides in Ontario, last-minute decisions to implement adulticiding in the face of a crisis could be impeded by a lack of infrastructure to support implementation. To ensure that modest adulticiding is a viable option in the unlikely event it is required on public health grounds, sufficient chemicals, equipment and expertise on adult mosquito control should be acquired by the City, by engaging a licensed pest control company on retainer for this purpose.

The proposed \$80,000 would enable the City to apply adulticide products to approximately 20% of the City's streets and roads in an emergency situation. This assumes that a specific area of the City is at an elevated risk for WNV, and that, in the opinion of the MOH, an adulticide intervention would mitigate that risk. In the unlikely event that surveillance data suggests that there is a city-wide elevation in risk of WNV in humans (e.g. in the case of a city-wide epidemic of human cases), TPH would weigh all of the risk-mitigation options, analyze the potential impacts of these options on human health and the environment, identify the budget implications, and report back to City Council through the Board of Health on required actions.

Any application of chemical controls would be planned and conducted in close co-operation with mosquito control experts, other health units, the MOHLTC and the Ontario Ministry of the Environment (OMOE). Evaluation of the environmental impacts of larviciding is beyond TPH's capacity to do alone, and needs to be done in conjunction with others, including Works and Emergency Services, OMOE, Environment Canada and academic partners. One way of evaluating these impacts would be to measure levels of methoprene in downstream outfalls from the catch basins (e.g. after a large rainfall) and to compare these levels with safe limits for humans and wildlife.

The U.S. experience, especially in Illinois and Ohio (two states with climates similar to Toronto), has shown that substantial WNV morbidity and mortality can occur. New York has the most experience in controlling WNV in North America. Surveillance activities in that jurisdiction indicate that it is difficult to predict the location of human WNV cases from year to year. New York's experience also indicates that the collection of mosquito and bird surveillance data can help direct WNV control activities, by identifying areas of lower and higher risk. It also enables their planners to determine the most effective times of the year in which to conduct larviciding.

Investigations of complaints and enforcement action (under a City by-law with significant fines) has also helped reduce mosquito breeding sites on private properties. New York City health officials believe that their mosquito control efforts over the last 3 years have been effective in reducing the burden of human illness.

Other local medical officers of health in Ontario have indicated that they will continue (and in some cases strengthen) their WNV programs in 2003. In light of this information, it is the opinion of the MOH, that TPH must at least maintain 2002 WNV service levels plus implement some chemical mosquito control in 2003, as described above in Option 2. This would enable the City to respond to WNV-related health risks in a manner that is reasonable and consistent with the advice and actions of other public health professionals.

Conclusions:

2002 was the first year in which WNV caused serious morbidity and mortality in Toronto. As of November 1, 2002 WNV infection had been confirmed in 15 Toronto residents. An additional 30 Toronto residents had initial laboratory evidence of WNV infection and these probable cases await the results of confirmatory testing at Health Canada's National Microbiology Laboratory in Winnipeg.

While the overall population risk of serious illness remains low, the large number of cases in 2002 in Ontario and the United States makes it essential that TPH prepare for the possibility of substantial human illness in 2003 and beyond. TPH must have the capacity to plan and implement a comprehensive and ongoing integrated pest management program for WNV prevention and control that includes source reduction, public education, surveillance and mapping, preventative mosquito control and support for health professionals. This integrated approach to pest management will provide the Medical Officer of Health with the necessary information to make informed decisions regarding prevention and control measures. A proactive approach to mosquito control by using larvicides next spring is also recommended in order to reduce the likelihood that controls against the adult mosquito population will be needed later in the year.

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List of Attachments:

Appendix 1 – Case Definitions for WNV Infection

Appendix 1

Case Definitions for WNV infection

Encephalitis – undetermined – Signs and symptoms of encephalitis including but not limited to altered level of consciousness, weakness and fever, without laboratory evidence of infection with any organism.

Suspect case of WNV – Signs and symptoms of WNV infection such as fever, muscle weakness or altered level of consciousness and a single, elevated titre on a flavivirus laboratory test.

Probable case of WNV – Signs and symptoms of WNV infection and a four-fold or greater rise in flavivirus haemagglutination inhibition or IgG ELISA titres in paired serology.

Confirmed case of WNV – Signs and symptoms of WNV infection and evidence of WNV infection on a WNV-specific laboratory test.