



Summary Report:
**Epidemiological Profile of West Nile Virus
in Kent County, Michigan**

Dedicated to the 2002 Victims of the West Nile Virus in Kent County



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Introduction

The term epidemic is used to describe a period of time when the number of cases of a disease are greater than would be expected. The first human case of West Nile Virus was reported in Kent County, Michigan, in the summer of 2002; therefore, the 57 cases that occurred that summer would be defined as an epidemic. This epidemiologic profile reviews the impact of the West Nile Virus on the people of Kent County, and attempts to explore answers to the questions that were posed during and after the West Nile Virus epidemic of 2002.

Section I: Understanding West Nile Virus

Arboviruses

Arthropod-borne viruses, i.e., arboviruses, are viruses that are transmitted between vertebrate hosts (humans or animals having a spinal column) and blood-feeding arthropods (mosquitoes, flies, and ticks). Arbovirus infections occur when an infected arthropod feeds on the blood of a vertebrate host. These arthropods are referred to as vectors because they transmit disease from one organism to another. Arboviruses such as West Nile Virus that cause human encephalitis (inflammation of the brain) are members of three virus families: *Flaviridae*, *Togaviridae*, and *Bunyaviridae*.

Most humans that acquire arbovirus infections either have no symptoms or have flu-like symptoms. Onset of disease may be sudden with a fever, headache, muscular pain, and general discomfort. In a small percentage of the population, arbovirus infections may lead to encephalitis, permanent neurologic impairment, or to death. Antibiotics are not effective for treatment and no beneficial antiviral drugs have yet been discovered. Treatment for these infections usually focuses on relieving symptoms and managing complications that may arise.

West Nile Virus Background

West Nile Virus is spread by the bite of an infected mosquito, and can infect people, horses, many types of birds, as well as some other animals. WNV was first detected in 1937 in a woman with a fever in the West Nile District of Uganda, Central Africa. Since that time, West Nile Virus has been found in North Africa, West and Central Asia, the Middle East, and Europe. Before arriving in North America in 1999, the most recent outbreak of the virus had occurred in the Democratic Republic of Congo in 1998.

West Nile Virus arrived in the U.S. in New York City in August of 1999. It is still not known when and how it was introduced into North America. It is suspected that infected international travelers to New York, infected mosquitoes, or imported infected birds may have brought it here.

During the 2002 West Nile Virus outbreak of 2002, 3873 cases of WNV resulting in 246 deaths were reported in the U.S. As of December 2002, the virus had been found in 46 different states, with human cases in 41 states (CDC, 2003). In addition, some WNV cases reported in

2002 were thought to have been acquired through organ transplants, breast feeding, blood transfusions, and from mother-to-child during pregnancy; these cases continue to be investigated.

Mosquito Vectors

The mosquito most often associated with WNV in Michigan is the *Culex pipien*, the northern house mosquito. *Culex pipien* breeds rapidly in a variety of containers such as bottles, cans, tanks, gutters, birdbaths, and urns. They are frequently found in water with a high organic content, e.g., containing fertilizer, or rotting or dead material. In addition to *Culex* mosquitoes, the CDC has found that there are 36 mosquito species from which the West Nile Virus was either isolated, antigen was detected, or RNA was detected through a variety of tests.

Clinical Diagnosis

Most WNV infections are mild and often clinically unremarkable. The majority of people infected with West Nile Virus will have no symptoms at all. The U.S. Centers for Disease Control and Prevention (CDC) states that approximately 20% of those infected will develop a mild illness referred to as West Nile Fever (incubation period of three to 14 days with symptoms lasting three to six days). Individuals with West Nile Fever may or may not seek medical care, especially if symptoms dissipate in a matter of days. In addition, West Nile Fever may not be diagnosed among those who do seek medical care, unless symptoms worsen and there is reason to suspect more severe disease. Reports from earlier outbreaks describe the mild form of WNV infection beginning with the sudden onset of a fever, general discomfort, a decreased appetite, nausea, vomiting, eye pain, headache, muscular pain, rash, and enlarged lymph nodes.

Although most WNV infections are mild, approximately one in 150 infections will result in severe neurological disease. The most common complications of WNV infection are meningitis and encephalitis. West Nile **meningitis** (inflammation of the membrane around the brain and spinal cord) is identified by fever, headache, stiff neck, and pleocytosis (the presence of more cells than normal in a particular area). West Nile **encephalitis** (inflammation of the brain) is distinguished by fever, headache, and altered mental status ranging from confusion to coma, with or without additional signs of brain dysfunction (e.g. paralysis, problems with the senses, abnormal reflexes, convulsions, and other abnormal movements). As a complication of West Nile Virus infection, encephalitis is reported more frequently than meningitis.

Laboratory Diagnosis

Laboratory testing for West Nile Virus is somewhat complicated and there is a lag time between specimen collection and final results. The most commonly used WNV laboratory test measures antibodies (immune or protective proteins) that are produced very early in the infected person. These antibodies, called IgM antibodies, can be measured in blood or in cerebrospinal fluid (CSF), the fluid surrounding the brain and spinal cord.

During the WNV outbreak of 2002, the demand for laboratory testing available from the Centers for Disease Control was high nationwide. The Michigan Department of Community Health had to prioritize CSF fluid specimens over blood specimens to ensure that testing for the most severely ill patients was available.

Case Definition

A **probable case** of West Nile Virus is defined as encephalitis (inflammation of the brain) or meningitis (inflammation of the tissues that cover the brain and spinal cord) occurring during a period when arborviral transmission is likely, and with supportive lab tests.

A **confirmed case** of West Nile Virus is defined as encephalitis or meningitis that is laboratory confirmed (e.g. the presence of WNV antibodies in the blood or CSF).

Section II: West Nile Virus in the U.S. 2002

United States

West Nile Virus has migrated westward since it began in New York in 1999 (Figure 1, page 5). By 2002, human cases were found as far West as Montana and California. During the summer and fall of 2002, Louisiana (7.4 cases per 100,000 population) and Nebraska (7.2 cases per 100,000) had the highest case rates, followed by Illinois (6.7 cases per 100,000), Mississippi (6.6 cases per 100,000) and Michigan (5.7 cases per 100,000) followed. These five states ranked the highest for West Nile Virus out of all 41 states that had human cases (Table 1).

Table 1 Leading U.S. States by Rate as of 1/31/03		
Rank	State	Rate
1	Louisiana	7.4
2	Nebraska	7.2
3	Illinois	6.7
4	Mississippi	6.6
5	Michigan	5.7

Michigan and Kent County

In Michigan, Oakland County had the highest West Nile Virus case rate (15 cases per 100,000), followed by Macomb (13 cases per 100,000), Kent (10 cases per 100,000), Wayne (9 cases per 100,000), and Ottawa (4 cases per 100,000). Given the urban nature of the disease and the high case rates of contiguous urban counties, it is unclear why the case rate in Wayne County was so low (Table 2).

Rank of Rate	County	Rate/100,000	Rank of Population	Population
1	Oakland	15	2	1,194,156
2	Macomb	13	3	788,149
3	Kent	10	4	574,335
4	Wayne	9	1	2,061,162
5	Ottawa	4	5	238,314

REGIS (Regional Geographic Information System) was employed to examine the geographic distribution of WNV disease in Kent County. The majority of West Nile cases (39 of 55 cases) occurred within the City of Grand Rapids, consistent with the urban nature of the disease.

In 2002, West Nile Virus was added to the list of diseases that are required to be reported to local public health authorities. The rates from 2002 indicate that West Nile Virus ranked eighth among the ten most frequently reported notifiable diseases in Kent County. The most frequently reported notifiable disease in Kent County continues to be influenza with 20,000-30,000 cases reported annually.

Section III: Epidemiology of 2002 WNV Outbreak in Kent County

Epidemic Curve

There were 57 human cases of West Nile Virus reported in Kent County in 2002, and four deaths. The first case of West Nile Virus in Kent County had a symptom onset date of August 3, 2002, and the number of cases peaked on August 30, 2002. The last symptom onset in a Kent County individual occurred on October 5, 2002. This pattern is defined as a common source outbreak (a group of people is exposed to a particular disease) with an intermittent (alternating) exposure.

Case Demographics

The majority (67%) of WNV cases in Kent County occurred in men; for Michigan as a whole, 55% of WNV cases were male. Ages of WNV cases in Kent County ranged from six to 88 years old, with the average being 50 years old. The most frequently occurring age was 36 years old, and there were four cases in people that age. By race, 27 cases (37%) were white, three (5%) were black, one (1%) was American Indian/Eskimo, and eight (14%) did not identify a race. Of the eight that did not identify a race, five (8%) identified themselves as of Hispanic ancestry, and two (3%) said they were of another ancestry.

Severity of Illness

Almost all of the cases (98%) had a fever, with temperatures ranging from 99° to 107° upon admission. Additionally, 90% had a headache, 72% had muscle weakness, 68% had an altered mental status, 58% had a stiff neck, 46% were nauseated, 40% vomited, and 16% had diarrhea. Regarding specific diagnoses associated with West Nile Virus, 47% of cases were diagnosed with encephalitis, 30% with meningitis, 19% with both encephalitis and meningitis, and 4% with West Nile Fever. Four of 57 cases (7%) resulted in death.

The number of days spent at an acute care hospital for those hospitalized for West Nile Virus ranged from one to 26 days, with an average of six days. Although these patients were released from the acute care hospital, several went on to spend time or visit a rehabilitative hospital for appointments. Nine individuals were never admitted to the hospital.

The long-term health effects of West Nile Virus are not clear. One study conducted in New York (CDC, 2001) found that fewer than 40% of WNV cases recovered fully, however, the number of cases studied was small.

Reported Risk Factors

Although 29 people (51%) could not remember a specific exposure, 28 people (49%) could either remember being bitten by a mosquito or thought they might know how they could have been bitten. Twenty cases said they engaged in some sort of outdoor recreation. The remainder (14%) attributed exposure to having an outdoor job (4%), being bitten while in their home (4%), being bitten while traveling outside of the county (4%), being bitten because of being homeless (1%), and being exposed through a blood transfusion (1%). Of the two individuals that were bitten in their home, one attributed exposure to sleeping on a porch while the other noted sleeping with the window open during hot weather. At least seven people could remember being bitten multiple times.

The severity of West Nile Virus is thought to be influenced by other risk factors such as being immunocompromised, or recently having an organ transplant or blood transfusion. Four individuals identified themselves as being immunocompromised. Of the four, two said they had recently had a transplant, and all four said they had recently had a blood transfusion. To date, only one of the four cases is strongly suspected to have received the West Nile Virus through a blood transfusion.

Bird Surveillance

In Kent County 3,976 reports of dead birds (many reports included multiple birds) were phoned into the Health Department from May 30, 2002 to December 16, 2002. As reported in the *Grand Rapids Press*, a number of birds died at the Kent County Zoo as well.

The number of dead birds reported to the Kent County Health Department increased sharply in the two weeks prior to the first reported human case. Similarly, a study conducted in New York (Eidson et.al, 2001) found a "steep rise in the density of dead crows two weeks prior to the onset of the first human case." A geographic analysis in Kent County found that approximately 75% of all dead crows could be found within a mile radius of a WNV case.

Section IV: Responding to West Nile Virus

Kent County Health Department Response 2002

The Kent County Health Department entered the summer of 2002 aware that West Nile Virus might show up in Kent County; however it was not known how widespread or devastating the disease would become.

With citizens still somewhat aware of the link between dead birds, especially crows and blue jays, and West Nile Virus, the first report of a dead crow came into the Health Department on May 30. This and several subsequent bird specimens were found not to be infected with West Nile Virus. On July 31 a bird submitted to the Michigan Department of Community Health from Kent County was found to be infected with WNV (the bird had been submitted July 16).

Following the identification of a positive WNV bird, the Health Department immediately notified the local news media. The press release issued stated that the Health Department would be conducting enhanced surveillance activities on dead birds and that all dead birds should be reported to the Health Department. A computer database was developed and calls were logged. REGIS was used to map the reported locations of dead birds.

The Kent County Health Department had begun piloting mosquito surveillance – trapping and testing mosquitoes for WNV – in mid-July with traps at various locations in Kent County. Mosquitoes were analyzed by the Kent County Health Department lab, and the presence of West Nile Virus was confirmed in the mosquito samples tested.

The Health Department's Communicable Disease Unit issued health advisories (the first on August 7) to local hospital emergency departments and med centers alerting them that human WNV infection was anticipated, and to rule out WNV in anyone presenting with symptoms of meningitis or encephalitis. The Department's Environmental Health Division kept in close contact with officials at the John Ball Zoo to monitor deaths and illness among the Zoo's bird specimens. An additional health advisory was faxed to local veterinarians suggesting ways that animals' – especially horses -- exposure to mosquitoes could be reduced.

The Health Department continued to monitor dead birds, mosquitoes, and human cases through October, when the last human case in Kent County was reported and mosquito populations were thinning due to cold weather.

Throughout the summer and fall, a key message of the Health Department that featured prominently in all news releases and public information efforts was the need for individuals to reduce their risk of WNV infection by using personal protection measures. Personal protection is a two-pronged responsibility that includes minimizing personal exposure to mosquitoes (by wearing protective clothing, using DEET-containing insect repellent, and staying indoors at dusk and dawn when mosquitoes are most active), and environmental measures to reduce mosquito exposure (eliminating standing water in the yard and other outdoor areas, keeping grass and weeds mowed near the house, and ensuring that screens are in good condition). Additional information on West Nile Virus and reducing personal exposure risk can be found on the web sites of both the Michigan Department of Agriculture (www.michigan.gov/mda) and the U.S. Centers for Disease Control and Prevention (www.cdc.gov).

In order to prepare for the 2003 West Nile Virus season, the Kent County Health Department is currently considering the data and what is known about WNV to develop recommendations for surveillance and control measures. These recommendations will be published in the spring of 2003.

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