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West Nile Virus; History of the Virus and Implications of Public Health for South Dakota in 2004

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West Nile Virus: History of the virus and implications of public health for South Dakota in 2004

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ABSTRACT

West Nile virus is currently affecting human and animal life in North America. This virus has been a popular topic among researchers, health professionals, and state health departments because of its rapid emergence as a threat to human and animal populations. In this article, I will be discussing the symptomology associated with West Nile virus and the disease's pattern of transmission. Furthermore, I will describe procedures for diagnosing and treating West Nile virus and minimizing its future spread into human populations. I will conclude this article by predicting how the West Nile virus will impact South Dakotans in 2004.

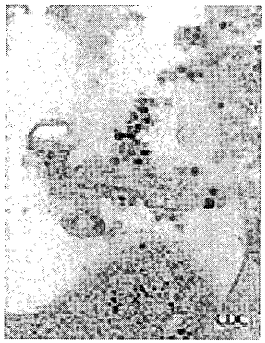
INTRODUCTION

The West Nile virus did not affect North America until 1999 (http://www.cdc.gov/ncidod/dvbid/westnile/). It was brought to the attention of public officials and heath care professionals when severe cases of encephalitis, a severe and sometimes fatal swelling of the brain, occurred in humans as well as horses across the eastern part of the United States.

West Nile has been found in several countries throughout the world. According to the Centers for Disease Control, "...it has been identified in Africa, Europe, the Middle East, central and west Asia, Oceania, and most recently North America (http://www.cdc.gov/ncidod/dvbid/westnile/)."

West Nile virus is in the Flaviviridae family and from the Genus Flavivirus Japanese Encephalitis Antigenic Complex (http://www.cdc.gov/ncidod/dvbid/westnile/). The Flavivirus is an enveloped, non-segmented RNA virus containing approximately 10,000 – 11,000 bases and is about 40 – 60 nm in diameter (8). Upon isolation of the West Nile virus and inspection under an electron microscope, three-dimensional images were obtained by Purdue University, giving scientists the most detailed visual description of the virus to date. Researchers at Purdue University formed the images by freezing the West Nile virus in liquid ethane at –173.3 degrees Centigrade. A stream of electrons was then aimed at the virus particle, one electron at a time. Measurements on how the

electrons bounced off the particle were taken and pieced together to form the image (6). The virus was found to be only 2 millionths of an inch wide (6). The images display how West Nile virus is actually very different from that of influenza, HIV, and measles. Those viruses have protein appendages that grab and infect the host cell. West Nile, however, is shown to be slightly bumpy. The proteins are not appendage-like, but instead folded into each other by interlocking with one another. (6). By understanding the position of the protein, researchers can begin studies on treatments that will disarm the virus. Since the appendages are intertwined, it is very difficult to determine exactly how the virus infects the host cell (6). The image displays an isolate of the West Nile virus at 65,625X provided by the Centers for Disease Control (http://www.cdc.gov/ncidod/dvbid/westnile/).



SYMPTOMS AND DIAGNOSIS

Most people bitten by a mosquito that is carrying West Nile are unaware that they have been infected and experience no symptoms of the virus; however, West Nile virus can produce flu-like illnesses. Patients with compromised immune systems and the elderly are most at risk of becoming chronically ill from the virus (7). According to the Harvard Health Letter, "20% experience mild symptoms, such as fever, headache, swollen lymph nodes, and a rash. Less than 1% develops a more severe illness like encephalitis or meningitis (4)."

The West Nile virus has been isolated from some patients who have fallen ill with encephalitis. Doctors and laboratory specialists use standard reverse transcription-polymerase chain reaction and Taqman reverse transcription-polymerase chain reaction to diagnose the virus from cerebrospinal fluid (5). According to Huang, et al., "the diagnosis of West Nile virus infection was based on the detection and sequence of the West Nile virus genome in cerebrospinal fluid. Although serologic tests can be negative for West Nile, according to the interpretations set forth by the Centers for Disease Control, the detection of the viral genome sequence in cerebrospinal fluid meets the definition of a confirmed case (5)."

An incubation period of 3-14 days is followed by symptoms of drowsiness, severe frontal headache, ocular pain, myalgia, and pain in the abdomen and back. Some patients experience a dry throat, anorexia, and nausea. An examination of the patient will show coating on the tongue, conjunctival injection, and facial flushing. Half of patients may have a rash that will appear on the second to fifth day. The illness is usually gentler in children than adults. More serious infections may occur in humans such as encephalitis, meningitis and sometimes myocarditis, pancreatitis, and hepatitis (8).

According to the Centers for Disease Control, "approximately 1 in 150 infections will result in a severe neurological disease." Age is a common risk factor among

individuals experiencing encephalitis or meningitis after contracting the West Nile virus. West Nile virus should be suspected in patients >50 with unexplainable encephalitis or meningitis that starts in the summer or early fall. Encephalitis tends to be more common than meningitis (http://www.cdc.gov/ncidod/dvbid/westnile/).

Physicians should pay close attention to local occurrences of West Nile viruses as well as the travel history of the patients when diagnosing the cause of an illness. Lab technicians look for the IgM antibody in cerebrospinal fluid using MAC – ELISA (http://www.cdc.gov/ncidod/dvbid/westnile/). Laboratory results are essential in diagnosing whether or not the patient has West Nile virus. Common laboratory results reported by the Centers for Disease Control include normal leukocyte counts in peripheral blood, cerebrospinal fluid containing pleocytosis, elevated protein counts, normal glucose levels, and tomographic scans of the brain showing evidence of acute diseases (http://www.cdc.gov/ncidod/dvbid/westnile/).

TRANSMISSION

West Nile virus is maintained in nature through transmission between a susceptible host and a female mosquito, primarily those in the genus *Culex*. These viruses are called arboviruses because they are arthropod-borne. The virus is carried in the salivary glands of the mosquito (9). Vertebrates are bitten by the arthropod and infected with the virus. The rapid spread of West Nile virus is suspected to be facilitated by the migration of infected bird species. According to the U. S. Geological Survey, "migrations in the spring and fall play an important role in the rapid dissemination of West Nile virus throughout North America and may eventually play a role in the disease's spread throughout much of the Western Hemisphere (9)."

By studying the basic geography of individual states, scientists will have a better idea of the expected human cases that will arise in a given area. Scientists look at the migration patterns of birds, specific landscapes, and the weather conditions in these areas. Time is also an important factor and is being used to predict the distribution of the West Nile virus. Scientists have conducted many experiments on the susceptibility of different species of birds as well as their ability to fight off the viral infection.

Scientists continue to research the effect that the West Nile virus has on the mortality of bird species across America, particularly the Eastern and Midwest states where birds have been most affected (9). Humans and mammals are "dead-end" hosts because they do not develop infectious-level viremias as often as birds (http://www.cdc.gov/ncidod/dvbid/westnile/). A dead-end host means that it will not spread beyond the species after affecting the host.

EPIDEMIOLOGY

West Nile virus has spread across the United States, using the mosquito as its mode of transmission. Human cases have become extremely common. The latest information

was reported in *Morbidity and Mortality Weekly Report* on November 28, 2003. The total human cases (2003) in the United States were 8,567 individuals. In 2003, there were 11,350 birds reported infected and approximately 4,146 horses with West Nile virus (2). Human cases in 2003 showed a dramatic 129.2% increase from 2002; 3,737 human cases were reported on November 26, 2002 (3).

OUTLOOK

The study of the West Nile virus is ever changing. There is not a clear theory on how the West Nile virus will affect infected and non-infected areas in the United States. After studying the data and examining the virus and its patterns since its arrival in the United States, the number of reported human cases is a useful indicator for gauging how West Nile virus will affect a certain area; specifically how South Dakota will be affected in 2004 and 2005, which is 2-3 years after the first confirmed human case. For example, Connecticut, Maryland, and New Jersey all experienced human cases of West Nile virus from 2000-2003 (http://www.cdc.gov/ncidod/dvbid/westnile/). The number of reported human cases for each of these states is indicated in Figure 1.

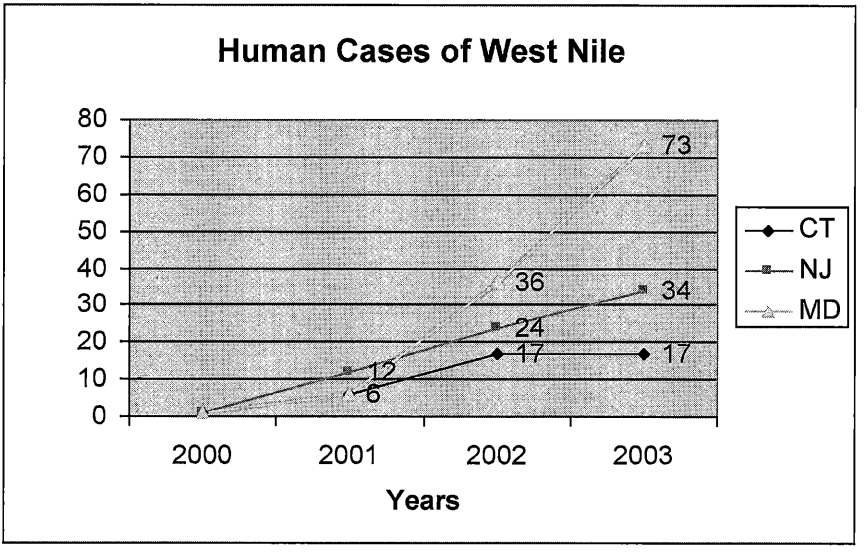


Figure 1. Human Cases of West Nile

After the first confirmed case, each of these states showed a steady increase of West Nile virus cases. From 2001 to 2002 Connecticut marked a 183% increase and from 2002-2003 leveled off with no increase. New Jersey showed a 100% increase from 2001-

2002 and from 2002-2003 indicated a 41.67% increase. From 2001-2002 Maryland marked a 500% increase and in 2002-2003 reported increased cases but the rate of increase had slowed to 102.78%. In each of these states, the percent increase from the second year to the third year decreased. This may have been due to the awareness of the virus and how to prevent being infected with the disease. South Dakota experienced its first human case of West Nile virus in 2002 reporting 37 cases (http://www.cdc.gov/ncidod/dvbid/westnile/).

In 2003, South Dakota reported a dramatic increase of human cases stating 1039 cases within the state (http://www.cdc.gov/ncidod/dvbid/westnile/). The lower number of reported cases in 2002 may have been due to the lack of awareness the public had of the virus. In 2003, however, the public became more aware of West Nile virus and the symptoms associated with the virus prompting more testing. By evaluating the human cases of West Nile virus that the pioneer states reported, South Dakota may see an increase of human West Nile virus cases in 2004 and additional, but smaller percentage increase in 2005.

Several factors need to be considered when predicting how West Nile virus will affect South Dakota in 2004. Continuing loss of susceptible birds (to amplify the virus), the growing natural increasing immunization of humans that have already been exposed to the virus, and the attempts of public health programs to control the mosquito problems will collectively impact the spread of the virus to humans.

SUMMARY

Though most individuals never experience the effects of the virus, some encounter severe encephalitis. The fact that this virus can cross species and cause serious illnesses to humans and horses makes West Nile a very important public health issue. Though taking precautions against the virus is important, it can be very difficult. Mosquitoes are active late summer and early fall which coincides with the time people are most often outdoors. This gives rise to the increase in infected individuals. The public needs to be aware of the complications the virus can cause as well as the steps that can be taken in preventing contraction of the virus. The Centers for Disease Control and Prevention offer information and helpful tips to keep mosquitoes to a minimum and the health of humans and animals alike to a maximum.

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INFORMATION LITERACY

The sources I used to assist in writing this paper are accurate and up to date to the best of my knowledge. All of the authors are credible and have knowledge about the West Nile virus. I chose to use the sources as a guide in explaining the facts about West Nile. I have used the information ethically and have not plagiarized in any way. I have accurately and thoroughly cited all of my sources.