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# CDC research finds West Nile virus hospitalizations cost nearly $800 million in US since 1999

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In a study of the economic impact of West Nile virus (WNV) in the United States, a research team from the Centers for Disease Control and Prevention (CDC) reports that in the 14 years since the virus was first detected in New York, hospitalized cases of WNV disease have cost a cumulative $778 million in health care expenditures and lost productivity. The findings are the result of an analysis published online today in the *American Journal of Tropical Medicine and Hygiene* (*AJTMH*).

West Nile virus became a familiar phrase to Americans in 1999 when news reports of serious infection and deaths from the virus first emerged. Until then, West Nile virus—which is spread to humans by the bite of an infected mosquito—had not been detected outside of the Eastern Hemisphere. Annual outbreaks have continued to occur across the United States, such as the large outbreak in Dallas in 2012. Over 37,000 WNV disease cases have been reported to CDC since 1999, and this number likely underestimates the total number of infections that occurred in the United States.

About 1 in 5 people who are infected with the virus will develop a fever with other symptoms such as headache and joint pains, but about one in 150 of those infected develop a serious nervous system illness such as encephalitis or meningitis that typically requires hospitalization.

Little is known about the longer-term health needs of individuals affected by WNV disease or the economic cost of the disease to the nation. The study looked at the costs of initial hospitalization of WNV patients and long-term direct and indirect costs in the five years following their hospitalization—from follow-up doctor visits and medications to how much job or school time was missed.

"We believe that previous costs associated with West Nile virus disease have been underestimated because they've predominantly focused on the costs of the initial illness," said J. Erin Staples, MD, PhD, a medical epidemiologist at CDC in Fort Collins, Colorado, and the study's lead author. "Many hospitalized patients will incur additional medical and indirect costs, and these need to be figured into the burden of WNV disease. Only with accurate figures can public health, academic, and industry officials determine the cost effectiveness of local mosquito control measures or of developing new drugs and vaccines."

To address this area, the research team determined the cost of initial hospitalization for 80 patients during a 2003 outbreak in Colorado. For a subset of these patients, they then calculated costs of additional related medical care and missed work incurred in the 5 years after the initial infection. To estimate the total cost of WNV disease to the nation, the research team extrapolated those costs to the total number of hospitalized cases of WNV disease reported to CDC since 1999. Those findings suggest an annual burden of $56 million in the United States.

## Economic impact for the four major clinical syndromes of WNV

This is the first published study to calculate these costs for the four specific "clinical syndromes" of the disease: fever, meningitis, encephalitis and acute flaccid paralysis, the more severe of which can

lead to death or long-term disability.

The 37,088 WNV disease cases reported to CDC from 1999 through 2012 included more than 16,000 patients with neurologic disease, over 18,000 patients who required hospitalization, and over 1,500 deaths. According to the CDC, individuals over 50 years of age are more likely to develop severe neurologic disease if infected.

The researchers found that short-term and long-term costs for individuals hospitalized with WNV disease varied widely and depended on the clinical syndrome encountered.

"We broke down costs by clinical syndrome and were surprised by what we found. While patients with meningitis had shorter hospital stays than others with neurological syndromes, they were also younger and more likely to miss work, which translated to a higher economic cost in lost productivity," Staples said. "Encephalitis patients tended to be older, with many of them retired, so the cost associated with lost productivity was lower."

Patients who were hospitalized with acute flaccid paralysis, a partial- to whole-body paralysis caused by WNV infection, had the largest initial and long-term medical costs (median $25,000 and $22,000 respectively). All of them required long-term care to help regain lost function, which increased costs. Patients who were hospitalized for meningitis and those hospitalized for fever incurred similar costs of initial hospitalization (median $7,500). Most meningitis and fever patients did not require long-term care.

Among patients in the study, the average age at initial diagnosis was 55 years, and one-fourth of patients were over 65 years of age. Hospitalized patients were absent from work or school for a median 42 days due to their illness.

## Data from CDC national disease surveillance system

Researchers were able to make national cost estimates due to the efforts of physicians and state public health officials who report confirmed WNV disease cases to the CDC ArboNET surveillance system. CDC uses ArboNET to track the incidence of WNV disease as well as other diseases caused by arthropod-borne viruses (arboviruses) transmitted by mosquitoes or ticks such as dengue, La Crosse, eastern equine encephalitis, and Powassan viruses.

"National surveillance efforts are critical to determining where and when outbreaks of mosquito or tick-borne diseases occur," Staples said. "Being able to react quickly to an outbreak and put in place preventive measures such as emptying outdoor water containers, wearing insect repellant and potentially beginning community-wide insecticide spraying is essential to limiting both the public health threat and the long-term economic cost of vector-borne infectious diseases."

In an accompanying *AJTMH* editorial, Alan D. T. Barrett, PhD, a tropical viral disease specialist at the University of Texas Medical Branch, Galveston, Texas, writes that studies such as this "are critical to assessing cost-effectiveness of prevention and therapeutic countermeasures and various intervention strategies, and are important in helping guide public health decisions."

"There are a number of candidate vaccines and antiviral drugs in development, and the figures for economic burden reported in this paper will aid policy makers and pharma to assess the economics of vaccine and drug development," he adds.

West Nile virus most likely entered the United States inadvertently through animals or mosquitoes imported from Europe or the Middle East. Human infections were first identified in New York City in late

summer 1999. The virus then quickly spread across the entire continental United States in less than 5 years. As recent outbreaks confirm, WNV is firmly entrenched in the United States and seasonal outbreaks can be expected to recur annually. Several potential vaccines for WNV are being tested, but none are yet available to vaccinate the general public.

"Understanding the economic impact of disease is an increasingly important data point for the public health community and policy makers," said Alan J. Magill, MD, FASTMH, president of the American Society of Tropical Medicine and Hygiene, which publishes the journal. "As we all strive for the most efficient and effective use of scarce resources, studies like this offer decision makers facts that will help them make sound funding and policy decisions."

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