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Monitoring and Controlling West Nile Virus: Are Your Prevention Practices in Place?

Editor's Note: NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, we feature a column from the Environmental Health Services Branch (EHSB) of the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In this column, EHSB and guest authors from across CDC will highlight a variety of concerns, opportunities, challenges, and successes that we all share in environmental public health. EHSB's objective is to strengthen the role of state, local, and national environmental health programs and professionals to anticipate, identify, and respond to adverse environmental exposures and the consequences of these exposures for human health. The services being developed through EHSB include access to topical, relevant, and scientific information; consultation; and assistance to environmental health specialists, sanitarians, and environmental health professionals and practitioners.

The conclusions in this article are those of the author(s) and do not necessarily represent the views of CDC.

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In a remarkable demonstration of the potential for invasive organisms to spread and establish in new, permissive habitats, West Nile virus (WNV) expanded from a small area in New York City in 1999 and is now found across much of the western hemisphere from central Canada to southern Argentina. Enzootic WNV transmission and human WNV disease have been reported from all 48 of the continental United States. The disease burden imposed by this new addition to the U.S. public health scene has been equally remarkable. During 1999–2012, more than 36,000 cases of human disease were reported to the Centers for Disease Control and Prevention (CDC), including approximately 16,000 cases of neuroinvasive disease and 1,500 deaths (Petersen & Fischer, 2012). Some models estimate that between two million and four million people have been infected with WNV since 1999, and 400,000 to 1 million people may have experienced some degree of illness due to the infection (Petersen et al., 2012).

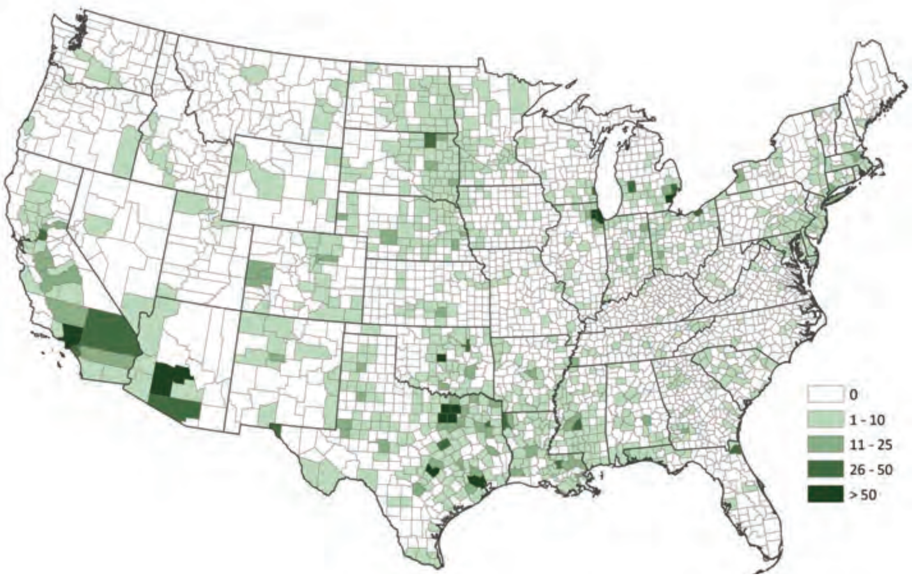
WNV cases peaked during 2002 and 2003 when large, regional outbreaks occurred as the virus expanded across the midsection of the country (Hayes et al., 2004). In recent years, the number of reported cases declined (Lindsey, Staples, Lehman, & Fischer, 2010) and outbreaks became more focal and sporadic, leading to speculation that WNV transmission was subsiding in the U.S.

The WNV epidemic of 2012 demonstrated that WNV remains an important zoonotic disease. During 2012, WNV transmission remained widespread with 48 states reporting infections in people, birds, or mosquitoes. As of November 27, 2012, a total of 5,245 cases of WNV disease in people, including 236 deaths, have been reported to CDC. Of these, 2,663 (51%) were classified as neuroinvasive disease (i.e., meningitis or encephalitis) and 2,582 (49%) were classified as non-neuroinvasive disease. This is the highest annual number of WNV disease cases reported to CDC since 2003. The 2012 outbreaks remained focal and spatially restricted rather than regional, with almost 75% of the reported cases coming from 10 states (Texas, California, Louisiana, Mississippi, Illinois, South Dakota, Michigan, Oklahoma, Nebraska, and Colorado) and one-third of all reported cases coming from Texas (Figure 1). Just over half of the 1,714 cases in Texas occurred in just four counties located in the Fort Worth-Dallas region (Dallas, Tarrant, Denton, and Collin counties).

Though several potential WNV vaccines have completed phase I or phase II human clinical trials and results suggested good safety and immunogenicity, none of the vaccine candidates has progressed to phase III trials (Beasley, 2011). Thus, preventing WNV depends on measures to keep infected mosquitoes from biting people. This can be accomplished through personal protection activities and integrated mosquito manage-

FIGURE **1**

Distribution of the 5,245 West Nile Virus Human Disease Cases Reported to ArboNET, by County, 2012



As of November 27, 2012.

ment programs targeting vector mosquitoes. Numerous personal mosquito repellent products are commercially available, and some are quite effective at preventing mosquito biting for long periods (Centers for Disease Control and Prevention [CDC], 2012). Repellent use has been associated with reduced risk of WNV infection (Mostashari et al., 2001). Unfortunately, even during WNV outbreaks, relatively few people actually use repellents (McCarthy et al., 2001) despite aggressive promotion of personal protection by health departments. This leaves community-based, integrated mosquito management programs as the best WNV prevention tool available (CDC, 2003).

The integrated mosquito management concept currently employed by many mosquito abatement districts is an evidence-based decision support system anchored by a monitoring program providing data that describe

- the conditions and habitats that produce vector mosquitoes,
- the abundance of those mosquitoes over the course of a season,
- the infection rate of WNV in mosquito vectors, and
- other parameters that influence local mosquito populations and WNV transmission.

These data inform decisions about implementing mosquito control activities appropriate to the situation, such as

- source reduction through habitat modification where feasible;
- larval mosquito control using predators, biologicals, or pesticides; and
- adult mosquito control using pesticides applied from trucks or aircraft.

The objective is to use source reduction and larval control to maintain vector mosquito populations below levels at which they support intense WNV transmission, and to respond with effective adult mosquito control efforts when adult mosquito abundance, and particularly the incidence of WNV-infected mosquitoes increases in an area (CDC, 2003).

Maintaining these monitoring systems is costly, but essential. Predicting where and when WNV outbreaks will occur is difficult. While much has been discovered about the vector mosquitoes, birds, and environmental components of the WNV transmission ecology, the interplay among the many biotic and abiotic elements that drive WNV amplification is a complex, stochastic process that makes long-term prediction of where and when outbreaks will occur quite difficult (Kilpatrick et al., 2005). The best WNV indicators currently available provide 2–4 weeks lead time in advance of human cases (Carney et al., 2011; Jones et al., 2011; Kwan et al., 2012). Where adequate surveillance is maintained, this is sufficient lead time to implement adult mosquito control efforts that have demonstrated success in reducing human risk, resulting in fewer WNV cases (Carney, 2008).

CDC has collaborated with the Association of State and Territorial Health Officials (ASTHO) to provide guidance to communities wishing to establish or expand integrated mosquito control programs (ASTHO, 2005) and is currently working with state health departments and local mosquito control agencies to evaluate monitoring systems to improve the ability to detect and prevent WNV outbreaks. State and local environmental health programs can reduce the risk of WNV in their communities by including integrated mosquito management as part of their core public health services.

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Did You Know?

You can access an updated West Nile virus (WNV) fact sheet, access the 2012 WNV data and maps online, as well as view archived information on WNV from 1999 to 2011 at cdc.gov/ncidod/dvbid/westnile/index.htm.

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