West Nile virus (WNV), a mosquitoborne arbovirus identified in New York in 1999, has become enzootic in the northeastern United States, affecting humans, birds, horses, and other mammals. Although no human WNV infection was identified in Connecticut or New Jersey in 1999, 62 persons with WNV illness, including seven deaths, were detected in New York City (NYC) and nearby New York counties (1). In 2000, these jurisdictions implemented active surveillance (AS) and enhanced passive surveillance (EPS)* to detect human illness; 21 persons were identified with acute WNV infection (14 in New York, six in New Jersey, and one in Connecticut), including two deaths (one each in New York and New Jersey) (2). This report summarizes the human WNV surveillance systems in Connecticut, New Jersey, New York, and NYC and recommends EPS for hospitalized patients with encephalitis of unknown etiology for the continental United States.

Connecticut

The Connecticut Department of Public Health (CTDPH) implemented EPS statewide during April 1--October 31, and AS in two southwestern counties during July 1--October 31. Surveillance criteria included all hospitalized patients with encephalitis, meningoencephalitis, or Guillain-Barre syndrome (GBS) with fever; in August, criteria were expanded to include hospitalized aseptic meningitis patients aged ≥18 years. EPS consisted of monthly mailings to physicians and all acute-care hospitals to solicit reports of patients meeting surveillance criteria. In counties participating in AS, infection-control practitioners (ICPs) were asked to review emergency department and hospital admissions and report patients meeting surveillance criteria. ICPs were contacted weekly by CTDPH staff for follow-up on all reported patients. Serum and cerebrospinal fluid (CSF) specimens from all reported patients were tested for WNV-reactive IgM by enzyme-linked immunosorbent assays (ELISA) at the CTDPH laboratory.

During April 1--October 31, 235 patients were tested: 46 (20%) with encephalitis or meningoencephalitis, 44 (19%) with aseptic meningitis, and one (<1%) with GBS; 144 (61%) patients did not meet surveillance criteria but were tested at their physicians' requests. Of these 235 patients, one mildly symptomatic outpatient tested positive for WNV. Tested patients were not categorized by surveillance method.

New Jersey
The New Jersey Department of Health and Senior Services implemented EPS statewide during June 1--November 30, and AS in six counties near NYC during July 15--October 31. Surveillance criteria included all patients hospitalized for viral encephalitis, meningoencephalitis, or GBS and patients aged ≥17 years with aseptic meningitis. For EPS, public health staff distributed WNV fact sheets, surveillance criteria, and reporting instructions to health-care providers. For AS, ICPs in six counties reviewed emergency department and hospital admissions, surveyed physicians, and provided weekly fax reports of patients meeting surveillance criteria. ICPs and physicians were contacted weekly for follow-up on all reported patients. Serum and CSF specimens from patients who met the surveillance criteria were tested for WNV-reactive IgM and IgG by ELISA at the state's Public Health and Environmental Laboratory.

Of 55 patients tested, 18 (33%) had encephalitis, 15 (27%) had meningoencephalitis, 19 (35%) had aseptic meningitis, and three (6%) had GBS. Six patients had laboratory evidence of WNV infection; five (83%) were identified through EPS and one (17%) through AS.

**New York City**

The New York City Department of Health (NYCDOH) implemented EPS citywide during May 1--November 25, active physician-based surveillance (APS) during June 1--September 30, and active laboratory-based surveillance (ALS) during July 1--September 30. Surveillance criteria included all hospitalized patients with encephalitis, meningoencephalitis, or GBS with fever or altered mental status and patients aged ≥17 years with aseptic meningitis. For EPS, public health staff provided surveillance criteria and laboratory testing information to health-care providers through medical rounds, biweekly alerts, and a special issue of the NYCDOH's medical bulletin. APS was conducted at 18 sentinel sites; infectious disease and critical-care specialists and neurologists and chief medical residents were contacted biweekly for reports of patients meeting surveillance criteria. Twelve sites participated in ALS; hospital microbiology laboratories submitted CSF specimen results with parameters suggesting viral etiology for testing on a weekly basis. APS and ALS sites were selected initially on the basis of 1999 WNV activity; additional sites were added during the season as increasing WNV activity in birds and mosquitoes was detected in Staten Island and south Brooklyn. All serum and CSF specimens were tested for WNV-reactive IgM by ELISA at the NYC Public Health Laboratory.

Of 512 patients tested, 205 (40%) had encephalitis or meningoencephalitis, 236 (46%) aseptic meningitis, 22 (4%) GBS, 41 (8%) other diagnoses, and eight (2%) unknown diagnoses; 56 (11%) did not meet surveillance criteria but were tested at their physicians' request. Fourteen NYC residents had WNV infection diagnosed; 11 (79%) infections were detected at APS hospitals and three (21%) at hospitals where only EPS was conducted. Two patients with WNV infection reported by physicians were identified simultaneously through ALS.

**New York State (excluding NYC)**

During May 1--October 31, the New York State Department of Health (NYSDOH) and local units conducted EPS statewide and AS in counties with WNV activity in humans, birds, mosquitoes, or horses in 1999 or 2000; in April, NYSDOH implemented commercial laboratory surveillance. Surveillance criteria included all patients with viral encephalitis or meningoencephalitis and patients aged ≥2 years with aseptic meningitis. EPS included distributing alerts that encouraged physician reporting and specimen submission instructions to all local health units. Suggested activities for local health units conducting AS included weekly contact with medical staff at sentinel acute-care hospitals about patients
meeting surveillance criteria. Commercial laboratories licensed by NYSDOH to perform arbovirus testing participated in surveillance by reporting patients who tested positive for antibodies to arboviral panels. Serum and CSF specimens from reported patients were tested for WNV infection at the New York Wadsworth Laboratory; testing included WNV-reactive IgM and IgG by ELISA, polymerase chain reaction, and plaque-reduction neutralization.

Of 589 patients tested, 230 (39%) had encephalitis or meningoencephalitis, 191 (32%) had aseptic meningitis, 89 (15%) did not meet surveillance criteria, and 79 (13%) were missing data to determine clinical status. Tested patients were not categorized by surveillance method. Commercial laboratory surveillance identified four patients who had flavivirus antibodies; investigation by local health units for travel and vaccination history and additional WNV testing indicated that none had a current or nontravel-related flavivirus infection. No human WNV infection was identified in New York outside of NYC.

Reported by: M Cartter, MD, D Mayo, PhD, R Nelson, DVM, L Wilcox, MPH, J Hadler, MD, State Epidemiologist, Connecticut Dept of Public Health. F Sorhage, VMD, B Wolf, MS, E Bresnitz, MD, State Epidemiologist, New Jersey Dept of Health and Senior Svcs. J Greenko, MPH, J Kellachan, MPH, B Edwin, I Poshni, PhD, M Layton, MD, New York City Dept of Health; G Johnson, G Lukacik, B Wallace, MD, C Huang, PhD, L Kramer, PhD, S Wong, PhD, P Smith, MD, State Epidemiologist, New York State Dept of Health. Arbovirus Diseases Br, Div of Vector Borne Infectious Diseases, National Center for Infectious Diseases; State Br, Div of Applied Public Health Training, Epidemiology Program Office; and EIS officers, CDC.

Editorial Note:

In 2000, public health jurisdictions used active and passive surveillance approaches based on staff and laboratory resources and degree of WNV activity identified by bird, mosquito, and mammalian surveillance. AS fostered ongoing communication between health departments and health-care providers but had variable yield. Eleven of 14 WNV-confirmed patients from NYC but only one of six in New Jersey were identified at AS hospitals. AS could have identified a higher proportion of WNV illnesses in NYC because the location of AS coincided with the epicenter of the outbreak (Staten Island). In comparison with AS, EPS was less labor intensive for health-care providers and health department staff, and intense public awareness of WNV in the northeast United States may have improved EPS effectiveness, resulting in increased reporting. However, EPS did not provide direct education about WNV to health-care providers, and in the absence of media and public interest, EPS may have missed reports of suspect illnesses. To plan future surveillance strategies, jurisdictions should evaluate the costs and yields of active and passive WNV surveillance efforts in upcoming transmission seasons.

All jurisdictions focused surveillance on severe WNV manifestations. Serologic studies suggest that approximately one in 150 infected persons develop neurologic disease requiring hospitalization (2,3). By monitoring patients with severe disease, the number of infected persons can be estimated; however, jurisdictions with few nonhospitalized human WNV infections may not be identified. Surveillance among patients with mild and nonspecific symptoms (e.g., fever and headache) probably would exhaust laboratory and staff resources.

Most states did not conduct WNV testing on pediatric patients with meningitis in summer months because they most likely represented enteroviral infections (4). In addition, most 1999 human infections
were identified in older hospitalized patients. Therefore, studies during outbreaks should be considered to
determine the spectrum of clinical illness and the extent to which children are affected.

In 2001, EPS for hospitalized patients with encephalitis of unknown etiology is recommended for the
continental United States (5). All suspect WNV illnesses should be screened by testing CSF and
appropriately timed acute and convalescent serum specimens for IgM ELISA antibody. Appropriately
timed acute and convalescent serum samples should be tested for a four-fold or greater rise in
WNV-specific neutralizing antibody. With the availability of commercial laboratory testing for WNV,
jurisdictions are encouraged to identify patients with commercial laboratory reports indicative of recent
WNV infection and to verify these results by viral-specific neutralizing antibody testing. Monitoring of
milder illnesses (e.g., aseptic meningitis or GBS) depends on jurisdictions' resources and should be a
lower priority. AS should be considered in areas with known WNV activity on the basis of bird and
mosquito surveillance data. Jurisdictions in the northeastern, central, and western United States should
begin human surveillance by June 2001 or earlier if other surveillance activities, such as avian mortality
surveillance, demonstrate WNV activity. WNV could circulate throughout the year in some areas,
especially the Gulf States; therefore, human surveillance should be considered year round in southern
states. Because the ELISA and hemagglutination-inhibition test can be cross-reactive between WNV, St.
Louis encephalitis, yellow fever, dengue, and Powassan viruses, patients who test positive for antibodies
to these viruses should be tested for specific neutralizing antibody.

References

5. CDC. Revised guidelines for surveillance, prevention, and control of West Nile virus
infection---United States, 2001. Available at
April 2001.

*AS=Health department-initiated contact with health-care providers to solicit reports; EPS=passive surveillance (i.e.,
health-care provider-initiated reports) enhanced by general alerts to key health-care personnel (e.g., primary-care
providers, infectious disease physicians, and hospital infection-control personnel).

Disclaimer All MMWR HTML versions of articles are electronic conversions from ASCII text into HTML. This
conversion may have resulted in character translation or format errors in the HTML version. Users should not rely on this
HTML document, but are referred to the electronic PDF version and/or the original MMWR paper copy for the official
text, figures, and tables. An original paper copy of this issue can be obtained from the Superintendent of Documents, U.S.
prices.