Expect the Unexpected:
The West Nile Virus Wake Up Call

July 24, 2000

Report of the Minority Staff, Senate Governmental Affairs Committee

to Senator Joseph I. Lieberman, Ranking Member

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Introduction

In August 1999, near the end of a hot, dry summer, death and disease came to varied and seemingly unrelated populations of the New York, New Jersey, Connecticut tri-state area. Wild birds, particularly crows, began dying in noticeable numbers. Several residents of Queens came down with encephalitis – an inflammation of the brain – and the human cases of the disease soon spread to other New York City boroughs, Long Island, and Westchester County. By September, horses on Long Island also started falling ill.

Doctors quickly linked the human cases to St. Louis encephalitis, the most prevalent mosquito-borne disease in the United States. Because there is no cure or vaccine for St. Louis encephalitis, the only way to control an epidemic was through public education and mosquito control. New York City, followed by other New York municipalities, Connecticut, and New Jersey launched aggressive campaigns on both fronts.

By the end of September, however, the diagnosis had changed. It became clear that the initially disparate seeming animal and human diseases were in fact related and caused, not by St. Louis encephalitis, but by West Nile virus, a close cousin of the St. Louis encephalitis virus. The identification of West Nile virus was greeted with astonishment. Although West Nile virus was known to have caused epidemics in Africa, the Middle East, and Europe, it had never been seen before in the Western Hemisphere.

By the time Fall's cooler temperatures ended West Nile's spread, 62 people - seven of whom died - developed severe encephalitis, and countless more birds and a number of horses succumbed to the disease. At the same time, the official reaction to the virus – misidentification at the outset, followed by aerial spraying of insecticides, accompanied by announcements that there is no known cure for this potentially fatal disease and the suggestion that the West Nile outbreak could be an act of bioterrorism – left the public confused, angry, and, in many cases, feeling powerless and vulnerable. Events this spring and the recent discoveries in June and July of more than two dozen infected birds and a number of infected mosquitos have revived those feelings and added new urgency to the issue.

In the wake of these events, Senator Joseph Lieberman, the Ranking Minority Member on the Senate Governmental Affairs Committee, asked his staff to review the 1999 West Nile outbreak, with an eye toward determining both what happened and what could be learned from these events. This report is the result of that review.

After conducting hundreds of hours of research, Committee staff has developed a

comprehensive assessment of what went right and what went wrong and recommendations for what should be done to quickly control similar outbreaks in the future. Much of what we found was good. Most importantly, the West Nile experience showed that the United States has unparalleled capabilities to recognize and respond to the outbreak of an emerging infectious disease. But our review found shortcomings as well. The Centers for Disease Control and Prevention (CDC), for example, failed to abide by its very own infectious disease strategy, which states: "Because we do not know what new diseases will arise, we must always be prepared for the unexpected." The cultural and communication divides between the worlds of human disease and animal disease exacerbated the situation, a state of affairs that must be righted, as evidence increasingly shows that emergent diseases in this country may involve infectious agents from animals. Government leadership and accountability could have been stronger during last summer's crisis. Because of the uniqueness of the outbreak, federal labs were overwhelmed with requests to test human and animal tissue for the virus. Staff recommendations include the following:

Federal leadership must continue to be strengthened, and coordination must continue to be improved between federal agencies involved in West Nile and similar infectious disease activities. This will improve the accountability and transparency of governmental actions.

In order to achieve this, federal agencies need to develop a formal, unified West Nile virus response plan, address the organizational and cultural divide between the public health and animal health communities, and assess the states' level of preparedness for mosquito-borne illnesses.

With summer now in full swing, immediate and emergency federal, state, and local needs for controlling West Nile virus should be identified and addressed.

A number of West Nile and West Nile-related issues urgently require longer-term study and sustained attention. A coordinated West Nile research program should be launched that includes research on an effective West Nile vaccine. A web site should be devoted to West Nile Virus to provide quick, accurate and up-to-date information on the disease to the public.

Finally, general and far-reaching improvements to our public health infrastructure at all levels to create a strong and flexible public system offers the best prospect for dealing with West Nile, other emerging infectious diseases, and the threat of bioterrorism that we may face in the future. We need to undertake a comprehensive assessment of our public health system, continue to support plans to improve disease surveillance and reporting networks, and continue to robustly fund infectious disease research.

This report begins with a brief description of the public health threats posed by emerging infectious diseases, whether spread naturally or through bioterrorism. It then provides a narrative of the 1999 New York City outbreak and subsequent and continuing efforts to respond to the West Nile threat. The ongoing response to the West Nile threat is analyzed. The report concludes with a set of recommendations.

I. Emerging Infectious Diseases and Bioterrorism: Be Prepared for the Unexpected

Among the more frightening aspects of the West Nile outbreak was the fact that it was a disease never before seen in the United States, raising fears that it represented the nation's first experience with bioterrorism. Less obvious to the public was that West Nile encephalitis is one of a number of so-called emerging infectious diseases, including those whose incidence in humans has increased within the past two decades or threatens to increase in the near future.[1] From a public health perspective, the threats posed by bioterrorism and by emerging infectious diseases – with their attendant risks of misidentification and the likely absence of a cure – are similar. Both promise to tax the public health system and cause significant death and disease. Indeed, many observers viewed the 1999 West Nile outbreak as an unfortunate, but much-needed wake up call, alerting us to the vulnerabilities in our public health system's capability to deal with both emerging diseases and bioterrorism.

Emerging Infectious Diseases

A 1998 Centers for Disease Control and Prevention (CDC) report, *Preventing Emerging Infectious Diseases: A Strategy for the 21st Century* states that "because we do not know what new diseases will arise, we must always be prepared for the unexpected."[2] The re-emergence of infectious diseases as a major and growing threat to global public health is one of the unexpected legacies of the 20th century. In the United States, after 80 years of steady declines in mortality caused by infectious disease, infectious disease mortality rose 58 percent between 1980 and 1992.[3] Globally, infectious diseases remain the leading cause of death. The World Health Organization has identified respiratory infections, HIV/AIDS, diarrheal diseases, tuberculosis, malaria, measles, and hepatitis as the "seven deadly killers" of infectious diseases.[4] A recent U.S. Army report concluded that "The ability of microbes to adapt and breach our traditional defenses coupled with changes in society, technology, and the environment sustain the likelihood that regional and global epidemics reminiscent of the worst in history will recur."[5] And a

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[1]Lederberg, Joshua, Robert E. Shope, and Stanley C. Oaks, *Emerging Infections: Microbial Threats to Health in the United States*, National Academy Press, Washington, DC, 1992, p. 34.

[2]Centers for Disease Control and Prevention (CDC), *Preventing Emerging Infectious Diseases: A Strategy for the 21st Century*, October 1998, p. vii.

[3]*Ibid*, p. 1.

[4]Cited in National Intelligence Council, *The Global Infectious Disease Threat and its Implications for the United States*, National Intelligence Estimate 99-17D, January 2000, p. 7, http://www.odci.gov/cia/publications/nie/report/nie99-17d.html.

[5]Walter Reed Army Institute of Research, DoD Global Emerging Infections Surveillance and Response System, *Addressing Emerging Infections Disease Threats*, 1998, p. 1.

National Intelligence Estimate published this year predicts that there probably will be only limited and fitful progress in responding to the global threat posed by infectious diseases.[6]

While six of the World Health Organization's "deadly seven" are diseases that have long affected public health, AIDS/HIV, which kills over two million people annually, is an example of an emerging infectious disease that was not recognized until the 1980s.[7] In addition, malaria and tuberculosis are re-emerging as major killers, at least in part because some strains of both diseases have become resistant to standard treatments. Numerous diseases with no known cure, such as Ebola Fever, Hepatitis C, Hantavirus pulmonary syndrome, and Nipah encephalitis, have been discovered in the past 30 years. Other well-known diseases have re-emerged or spread geographically during the same time period, often in more virulent and drug resistant forms.[8] A list of some important emerging and re-emerging infectious diseases is shown in **Figure 1.** Diseases spread by mosquitoes and ticks, such as West Nile and Lyme disease, are known as vector-borne diseases and have figured prominently in this resurgence.[9]

Emerging and Re-emerging Infectious Diseases

Argentine hemorrhagic fever
Bolivian hemorrhagic fever
Campylobacter
Cholera
Creutzfeldt-Jakob disease
Crimean-Congo hemorrhagic fever
Cyclosporiasis
Dengue fevers
Diarrhea caused by numerous viruses
Ebola and Marburg hemorrhagic fevers
Escherichia coli O157:H7
Drug-resistant gonorrhea
Group B and C rotaviruses
Hantavirus Pulmonary Syndrome
Hepatitus C, D, E
HIV1 and HIV2 (AIDS)
Influenza
Japanese encephalitis
Lassa fever
Legionnaire's disease
Malaria
Measles
Nipah encephalitis
Pertussis (whooping cough)
Pneumococcal (multi drug-resistant) disease
Polio
Rabies
Respiratory disease caused by adenoviruses
Rift Valley fever
Roseola
Ross River virus
Salmonella
Scrub typhus
Staphylococcus aureus
Toxic shock syndrome
Tuberculosis
Venezuelan Equine encephalitis
Venezuelan hemorrhagic fever
West Nile fever and encephalitis
Yellow fever

Adapted from Murphy, Frederick A. and Neal Nathanson, "The Emergence of New Virus Diseases: An Overview," *Seminars in Virology*, Volume 5, 1994, pp. 87-102; National Intelligence Council p. 7; Walter Reed Army Institute of Research, pp. 4-15.

Figure 1.

In 1992, an influential Institute of Medicine report noted that serious microbial threats to

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[6]National Intelligence Council, pp. 24-25.

[7]*Ibid*, p. 7.

[8]*Ibid*, p. 2.

[9]A vector-born disease is transmitted from one host to another by a vector. A vector is a carrier, often an arthropod (tick, mosquito) that transfers an infectious agent from one host to another (Lederberg and Shope, p. 279).

health remain and that a number of modern demographic and environmental factors increasingly favor the spread of infectious diseases (**see Figure 2**).[10] The report also noted that the U.S. public health system is a "hodgepodge of fractionated interests and programs, organizational turmoil among new agencies, and well-intended but unbalanced appropriations – without coherent direction by well-qualified professionals" and is not always well equipped to deal with infectious diseases.[11] One of the biggest challenges that emerging infectious diseases pose is the risk that our public health system will not be able to quickly identify and respond to them.

Modern Factors that Favor the Spread of Infectious Disease

- Global travel.
- Globalization of world food supply and centralized processing of food.
- Population growth and increased urbanization and crowding.
- Population movements due to civil wars, famines, and other man-made or natural disasters
- Irrigation, deforestation, and reforestation projects that alter the habitats of disease carrying insects and animals.
- Increased use of antimicrobial agents and pesticides, hastening the development of resistance.
- Increased human contact with tropical rainforests and other wilderness habitats that are reservoirs for insects and animals that harbor unknown infectious agents.

Adapted from CDC, Preventing Emerging Infectious Diseases..., p. 3.

Figure 2.

The Clinton Administration and Congress have responded with a number of programs to revitalize our capacity to protect the public from infectious diseases. In 1994, CDC developed a national emerging infectious disease strategy.[12] In addition, President Clinton issued a Presidential Decision Directive (PDD/NSTC-7) that directed federal agencies to begin a coordinated national response to the growing threat of infectious diseases, and the White House formed a Task Force on Emerging Infectious Diseases, composed of more than 20 federal agencies.[13] A recent National Intelligence Estimate discusses infectious disease as a national and international security threat.[14] Despite these and other efforts, Dr. Michael Osterholm, the former Minnesota state epidemiologist, concludes in a recent *New England Journal of Medicine* editorial that recent events present a ". . . sober reminder that our task is a lot like trying to swim against the current of a raging river. Even with intelligent and extensive efforts by the public and private sectors, the rapidly changing world we live in tends to favor infectious agents."[15]

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[10]*Ibid*, pp. 1-2.

[11]*Ibid*, p. 7.

[12]Centers for Disease Control and Prevention, *Preventing Emerging Infectious Diseases...,* p. 4.

[13]National Science and Technology Council, *Emerging Infectious Disease Task Force Annual Report*, December 19, 1997, p. 2, <http.whitehouse.gov/A-5/textonly/WH/eop/ostp/security/html/eidann_rpt.html>.

[14]National Intelligence Council, pp. 4-5.

[15]Osterholm, Michael T., "Emerging Infections – Another Warning," *The New England Journal of Medicine*, April 27, 2000, p. 1280.

Bioterrorism

The variety of the unexpected diseases we must now be prepared for has increased even further as the threat of bioterrorism by rogue states or terrorists grows. Last year, the Institute of Medicine reported that a number of incidents in the 1990s suggest that terrorists in the United States and abroad may be finding chemical and biological weapons increasingly attractive.[16] U.S. Intelligence agencies report that a growing number of countries and organizations may be seeking to acquire the capability to launch chemical and biological attacks.[17] As recent exercises at the Johns Hopkins's Center for Civilian Bio-Defense Studies revealed, even a small attack with smallpox could produce as many as 15,000 cases in a short time.[18] Colonel Gerald Parker, the head of the U.S. Army's top laboratory for infectious disease research and biological warfare defense, explains that responding to a bioterrorist attack will be, primarily, a public health and medical problem,[19] potentially on a grand scale. And, of course, under many circumstances, it may be difficult, if not impossible, to determine if an outbreak of disease is natural or has been deliberately inflicted.[20]

When viewed against this backdrop, what is surprising is not that there was an outbreak of an emerging infectious disease in New York City in the Summer of 1999, but that such outbreaks did not occur sooner, more frequently, and with more deadly consequences. Indeed, observers have been predicting such epidemics for years. Unfortunately, these same observers question our preparedness for dealing with such outbreaks. As Dr. Osterholm writes, "After almost a decade of battling emerging infections, it seems that the factors supporting their occurrence have only become more common and complicated. I believe that the public health infrastructure cannot and will not keep up with these infections unless we refocus our efforts and reevaluate the resources needed to respond."[21]

The West Nile outbreak put Dr. Osterholm's hypothesis to the test.

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[16]Institute of Medicine, *Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response*, Washington, DC: National Academy Press, 1999, p. 13.

[17]Tucker, Jonathan, "Policy Approaches to Chemical and Biological Terrorism," in Brad Roberts, ed., *Terrorism with Chemical and Biological Weapons,* Alexandria, VA: Chemical and Biological Arms Control Institute, 1997, p. 98.

[18]Goldstein, Steve, "Old Scourge Kindles Fear of Biological Terrorism," *The Philadelphia Inquirer,* April 2, 2000, p. A1.

[19]Potomac Institute For Policy Studies, *Emerging Threats of Biological Terrorism: Proceedings Report*, PIPS-98-3, June 16, 1998, p. 35.

[20]Interview with USAMRIID officials, April 6, 2000.

[21]Osterholm, p. 1281.

II. The Unexpected Happens: West Nile Encephalitis
July-December 1999

Perhaps as early as the beginning of July 1999, a noticeable number of birds, especially crows, began dying in and around the New York, New Jersey, and Connecticut tri-state area, especially in New York City.[22] Human illness soon followed. In mid-August, Dr. Deborah Asnis, an infectious disease specialist at a small northern Queens hospital first noticed a cluster of two, then four patients with symptoms that included fever, headache, mental confusion, and most striking, severe muscle weakness. Symptoms were severe enough for several of the patients to be admitted to the intensive care unit. Initial suspicions focused on botulism, a form of food poisoning and a potential bioterrorism agent, or Guillain-Barre syndrome, an inflammation of the nerves.[23] Analyses of spinal fluid, however, suggested a viral infection.[24]

On August 23, Dr. Asnis contacted the New York City Health Department about this unusual cluster of patients. City officials responded quickly and started an epidemiological investigation of the potential outbreak. On Saturday, August 28, two specialists from the Health Department's communicable diseases section, visited the hospital to review patient charts and interview family members.[25] While they were at the hospital, a fifth patient was brought in, and Health Department officials had the opportunity to view, first hand, the same striking muscle weakness that was present in the other four cases. The other similarity Health Department personnel detected was that most of the patients were older, active adults who spent time outdoors in the evenings. Subsequent Health Department calls to neighboring hospitals revealed three more cases, bringing the total number to eight. On the basis of their investigations, City officials determined the symptoms suggested encephalitis, an inflammation of the brain, possibly from an arbovirus -- a virus spread principally by ticks or mosquitos.[26] **Figure 3** discusses U.S. disease surveillance and reporting.

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[22]Steinhauer, Jennifer and Miller, Judith, "In New York Outbreak, Glimpse of Gaps in Biological Defenses," *The New York Times*, October 10, 1999, p. A-6.

[23]Interview with Dr. Deborah Asnis, March 3, 2000.

[24]Schoch-Spana, Monica, "A West Nile Virus Post-Mortem," *Bio-Defense Quarterly*, Johns Hopkins Center for Civilian Biodefense Studies, December 1999, p. 1.

[25]*Ibid*, p. 1.

[26]Arboviruses are also spread by other arthropods such as sand flies. The study of arboviruses is known as arbovirology (Shope and Lederberg, p. 273).

Disease Surveillance and Reporting in the United States

Disease surveillance is public health officials' most important tool for detecting and monitoring both existing and emerging infectious diseases. States have the principal responsibility for disease surveillance. Each state decides for itself which diseases will be reported through local health departments to the state health department and which information it will then pass on to the CDC. State reporting to the CDC is voluntary.

Infectious disease surveillance in the United States can come in two forms, passive and active. When using passive surveillance methods, public health officials notify lab and hospital staff, physicians, and other relevant sources about disease data they should report. These sources in turn must take the initiative to provide data to the state health department, where officials analyze and interpret the information as it comes in. Under active surveillance, public health officials contact people directly to gather data.

Disease surveillance in the United States depends largely on passive methods of collecting information and has some long-recognized shortcomings. In 1992, the Institute of Medicine noted that, except for food- and water-borne diseases, the United States has no comprehensive national system for detecting outbreaks of infectious disease. The report also noted that emerging infectious diseases are not normally detected and reported through established surveillance activities. Instead, private physicians who see small clusters of unusual cases may report them in the medical literature or to public health authorities.

These words proved prescient in the 1999 West Nile outbreak. Passive surveillance systems did not pick up the outbreak, even though encephalitis is a reportable disease. Instead, an alert physician contacted responsive, well-trained New York City Health Department officials who conducted an active surveillance campaign. City, state and federal public health officials then moved quickly to respond to the outbreak.

To address shortcomings in the U.S. national disease surveillance system, the Clinton Administration is now funding through CDC a $70 million effort to develop an electronic national disease surveillance system that can rapidly detect the infectious disease cases that signal the beginning of an outbreak.

Lederberg and Shope pp. 113-134; U.S. GAO, *Emerging Infectious Diseases: Consensus on Needed Laboratory Capacity Could Strengthen Surveillance*, GAO/HEHS-99-26, February 1999; Dr. Marcelle Layton, New York City Health Department, Institute of Medicine Conference Presentation, June 8, 2000.

Figure 3.

On Sunday, August 29, City officials contacted CDC, which agreed that an arbovirus infection was likely. CDC urged City Health Department officials to collect samples from all the patients for lab analysis at the State pubic health lab and CDC's Division of Vector-Borne Diseases in Ft. Collins, Colorado, which is the World Health Organization's arbovirus reference center for North and South America.[27] In addition, CDC dispatched epidemiologists to New York City to begin investigating an encephalitis outbreak of unknown origin.[28]

Disease Detectives at Work – Round One

[27]A reference laboratory is a specialized laboratory to which clinical specimens can be sent by other laboratories for diagnosis, identification, or confirmation. National Science and Technology Council, *Global Microbial Threats in the 1990s*, 1995, Chapter II, p. 8, http://library.whitehouse.gov/WH/EOP/OSTP/CISET/html/2.html.

[28]Nasci, Roger, CDC, "Statement to the New York State Assembly," December 17, 1999, p. 1, http://cdc.gov/od/wash/na991217.htm.

After receiving the blood samples from their New York City counterparts, New York State's public health lab and CDC-Ft. Collins screened for antibodies to the common American arboviruses that cause encephalitis.[29] These tests pointed to St. Louis encephalitis -- the most widely reported mosquito-borne diseases in the United States -- as the most likely cause for the patients' illnesses, a diagnosis that seemed confirmed by the patients' symptoms and the epidemiology of the outbreak.[30] CDC relayed these results to the New York City Health Department.

Based on these findings, on September 3rd, the New York City Health Department reported in a press release ". . . that the death of one elderly individual and the illness of two other elderly persons in Queens, were confirmed to be associated with St. Louis encephalitis, a viral disease transmitted with mosquitos."[31] As a result, residents of the New York metropolitan area spent the better part of September 1999 thinking there was an ongoing St. Louis encephalitis epidemic.

The available information, however, pointed to St. Louis encephalitis as the *most likely* candidate, given its prevalence in the United States but it could not confirm that St. Louis encephalitis virus was the disease-causing agent.[32] This is because the virus family that St. Louis encephalitis virus is part of – the flaviviruses – cross react in antibody tests, meaning that a positive reading could indicate the presence of several flaviviruses. This phenomenon has been well-understood and extensively documented since the 1950s.[33] In practical terms this means that a positive antibody test could indicate the presence of the viruses that causes St. Louis encephalitis, as well as Japanese encephalitis, West Nile fever/encephalitis, Murray Valley encephalitis, and several other diseases. Making a definitive identification of one of these viruses from antibody tests is notoriously difficult. Dr. Karl Johnson, a leading expert in the study of infectious diseases, likened the task to looking into a hall of mirrors.[34]

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[29]Schoch-Spana, p. 2.

[30]CDC-Ft. Collins knew a lot about St. Louis encephalitis. Not only had CDC been responding to St. Louis encephalitis outbreaks for decades, but the former Director of CDC-Ft. Collins edited the seminal work on St. Louis encephalitis in 1975, and 16 of the book's 23 contributing authors were at the time CDC employees. See Monath, Thomas P., Ed., *St Louis Encephalitis*, American Public Health Association, Washington, DC, 1980.

[31]New York City Department of Health, press release, "City Health Department Reports Three Cases of St. Louis Encephalitis (SLE) in Queens," September 3, 1999.

[32]Schoch-Spana, p. 2.

[33]See Calisher, Charles H. and Poland, Jack D., "Laboratory Diagnosis," in Monath, Thomas P., Ed., *St. Louis Encephalitis*, American Public Health Association, Washington, DC, 1980, pp. 587-592.

[34]Calisher, Charles H., *ProMed Mail*, February 25, 2000, <http: //osi.oracle.com:8070/promed/promed.home>

Understanding these limitations, but still confident in its initial findings, CDC Ft.- Collins sought to demonstrate more definitively that St. Louis encephalitis virus was causing the epidemic. According to CDC Guidelines that were modified in 1999, cases can be confirmed through several methods. The traditional "gold standard" is virus isolation.[35] More recently developed, cutting edge genetic fingerprinting techniques are also being increasingly used for disease identification.[36] CDC employed both traditional and genetic techniques on the New York cases.

CDC was not able to isolate the virus from any of the specimens it received from New York,[37] although this was not surprising, given that St. Louis encephalitis virus is isolated only rarely from human clinical specimens.[38] At this point, CDC opted to confirm the presence of St. Louis encephalitis using a genetic fingerprinting technique that it had used with dramatic success to rapidly identify a previously unknown hantavirus in the American Southwest earlier in the

[35]Virus is isolated from samples and grown in cell cultures and laboratory animals in a process that is analogous to the familiar throat culture used to confirm cases of strep throat.

[36]In this case, the technique employed is known as reverse transcriptase polymerase chain reaction (RT-PCR). RT-PCR is a laboratory method of amplifying low levels of specific microbial DNA or RNA sequences. See Lederberg and Shope, p. 278.

[37]Interview with USAMRIID Officials, April 6, 2000.

[38]See Calisher and Poland, p. 572.

decade.[39] CDC, however, used a general genetic probe for St. Louis encephalitis virus since several strains of the virus, all with slight genetic differences, exist. Because the probe was general, it could only confirm the presence of a flavivirus.[40] CDC apparently believed this would be suitable, however, since the close cousins to St. Louis encephalitis virus (the viruses that cause Japanese encephalitis, West Nile, and Murray Valley encephalitis) had never been seen in this hemisphere.

Mosquito Surveillance and Control

Mosquito surveillance and control programs are important for the detection, prevention, and response to diseases spread by mosquitos. In these programs, the accurate monitoring and sampling of mosquito population (both larvae and adults) levels provides advance warning of disease carrying mosquitos. In some cases, mosquito surveillance is supplemented by the use of sentinel flocks of birds, which are helpful in determining the likelihood of disease transmission in humans. It also allows the appropriate control efforts to be employed that are of least risk to people. Modern mosquito control focuses on integrated pest management (IPM) strategies that call for public education, better sanitation, improved water management, biological and chemical control of mosquito larva, and, when needed, the application of pesticides. Mosquito surveillance and control is labor-intensive, expensive, and requires skilled and trained personnel to operate effectively.

The West Nile outbreak demonstrates the importance of mosquito surveillance and control programs in susceptible areas. In 1999, neither New York City nor many other New York counties operated any type of surveillance program, though efforts were maintained in Nassau and Suffolk counties. Because of this, the City had to resort to aerial spraying of pesticides in all five boroughs.

Connecticut and New Jersey both had active mosquito surveillance and control programs that, while focused on the detection of Eastern Equine encephalitis, allowed them to have the resources and expertise on-hand to rapidly redeploy to combat West Nile virus. Both states did resort to the use of pesticides when positive pools of mosquitos were identified, though spraying was limited and better targeted than in New York. Nevertheless, pesticide use in the tri-state area remains almost as much of a public concern as does West Nile virus.

At national level, about half the states operate some type of mosquito and/or sentinel flock surveillance program. In the aftermath of the West Nile outbreak, many states and communities are improving or establishing their mosquito surveillance and control programs, funded at least in part, by CDC/HHS emergency appropriations.

Connecticut Department of Environmental Protection, "Connecticut's Mosquito Management Program," 1998; Office of Mosquito Control Coordination, "New Jersey State Mosquito Control Commission;" CDC, *Guidelines for Arbovirus Surveillance Programs in the United States*, April 1993.

Figure 4.

Local and State Response to the Epidemic

The news of a possible St. Louis encephalitis outbreak triggered rapid agreement among New York City, State and federal officials to implement an aggressive, multi-component response program. Because there is no known cure for St. Louis Encephalitis, preventing the spread of the disease through education and mosquito control became critical. New York City followed CDC guidelines in implementing an intensive public education campaign and a multi-faceted mosquito control program (see **Figure 4**). CDC epidemiologists assisted with efforts to map the extent of the ongoing outbreak.[41]

Implementing a mosquito control program proved more difficult than starting a public

[39]Marshal, Eliot, "Hantavirus Outbreak Yields to PCR," *Science*, Volume 262, November 5, 1993, p. 836.

[40]Rosen, Marty, "Lab Tests Too General to ID Virus," *New York Daily News*, September 28, 1999, p. 7.

[41]Nasci, p. 1.

education campaign. Because New York City had not had a recognized outbreak of mosquito-borne diseases in the 20th century, it had ceased active mosquito surveillance and control in the late 1980s.[42] As a result, the city had no way to determine where mosquitos were living and breeding. Faced with the need to reduce mosquito populations very quickly, the city immediately began large-scale aerial and ground application of pesticides - an effort that started the very same day that St. Louis encephalitis was implicated as the cause of the outbreak - and which continued through September.[43] At the same time, entomologists and vertebrate ecologists from CDC-Ft. Collins helped New York City establish a mosquito surveillance system.[44]

CDC and New York City officials alerted public health officials in New Jersey and Connecticut to the outbreak over Labor Day weekend. Both states stepped up human disease surveillance and public education and reconfigured their mosquito surveillance and control programs to look for St. Louis encephalitis virus.[45] Throughout the outbreak, officials from the CDC, New York City, New York State, New Jersey and Connecticut participated in daily conference calls to stay up-to-date on events.[46]

The public reacted with alarm to both the disease outbreak and the aerial spraying of insecticides. One newspaper article reported that "the region seemed close to hysteria over the virus. Phones lit up in record numbers at the health department, parents in areas where there was not a single case kept their children indoors. TV reporters talked in stern tones about the plague among us."[47] In Greenwich, CT, for example, town officials announced a temporary ban on "'absolutely all outside activities'" taking place after 5:00 PM.[48]

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[42]Presentation by Dr. Marcelle Layton, New York City Health Department, Institute of Medicine Conference Presentation, June 8, 2000.

[43]Schoch-Spana, pp. 6-7.

[44]Nasci, p. 1.

[45]New Jersey and its counties operate one of the oldest and best established mosquito control programs in the United States (Department of Entomology, Rutgers University, "The Organization of Professional Mosquito Control in New Jersey," http:www-vci.rutgers.edu/insects/mosqorgs.html). Connecticut re-established active mosquito control and surveillance following an outbreak of Eastern Equine Encephalitis in Rhode Island in 1996 (Connecticut Department of Environmental Protection, "Connecticut's Mosquito Management Program, 1998").

[46]Interview with Mr. Kenneth Brudder, New Jersey Office of Mosquito Control Coordination, February 29, 2000.

[47]Steinhauer, Jennifer, "It's Infectious: Fear That's Out of Proportion," *The New York Times*, October 10, 1999, Section 4, p. 16.

[48]Allen, Mike, "Scientists Detect Encephalitis at Two Connecticut Sites," *The New York Times*, September 22, 1999, p. B.1.

Disease Detectives at Work: Round Two

Meanwhile, in events that still seemed unlinked to the human encephalitis epidemic, wild birds continued dying in the Northeast. In early September, New York State started sending dead crows to the National Wildlife Health Center, a U.S. Geological Survey organization which provides information, technical assistance, and research on national and international wildlife. The Center's examinations showed that some of the crows appeared to have died from encephalitis, though screening for the forms of encephalitis that typically kill birds in the United States did not produce positive results. Dr. Robert McLean, the Center's Director and an internationally recognized arbovirus expert, ruled out St. Louis encephalitis, since it had never been known to kill birds.[49]

Separately, Dr. Tracey McNamara, a wildlife pathologist at the Bronx Zoo, also had been collecting dead crows since early August. By September 7, a number of the zoo's exotic birds had died. Examinations revealed tell-tale signs of encephalitis. On September 9, Dr. McNamara, concerned about the zoo's animals, but also suspecting that there could be a link with the ongoing human epidemic of encephalitis, sought help. After initially finding a dead emergency phone line at one United States Department of Agriculture (USDA) lab, Dr. McNamara eventually managed to get Bronx Zoo samples delivered to the USDA National Veterinary Service Lab in Ames, IA, to be examined for animal diseases such as avian influenza and Newcastle disease.[50] Dr. McNamara also contacted the CDC to express concern that there might be a link between the human and bird deaths. Though Dr. McNamara was told that there was little possibility that there was any bird-human link, she sent samples to CDC-Ft. Collins.[51]

By the week of September 14, USDA, the National Wildlife Health Center, and the Connecticut Agricultural Experiment Station[52] had isolated an unidentified virus from dead birds and the Agricultural Experiment Station had isolated a virus in mosquitos.[53] Using an electron

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[49]Interview with Dr. Robert McLean, Director, National Wildlife Health Center (NWHC), February 16, 2000.

[50]USDA's Animal and Plant Health Inspection Service (APHIS) is the lead USDA organization for West Nile issues. The USDA's Agricultural Research Service also plays an important role. USDA laboratories in Ames Iowa and Plum Island, New York, continue to be involved in West Nile activities (USDA-APHIS, "Strategy for APHIS Veterinary Services' Role with West Nile Virus," April 5, 2000).

[51]Interview with Dr. Tracey McNamara, February 1, 2000.

[52]The Connecticut Agricultural Experiment Station is a state-supported scientific research institution. Connecticut founded the station in 1875, as the first Agricultural Experiment Station in the nation (http:www.state.ct.us/A36caes/Directors Welcome/directorswelcome.htm).

[53]Interview with USDA Officials, March 30, 2000; Interview with Dr. Robert McLean, Director, NWHC, February 16, 2000; Anderson, John, et al., "Isolation of West Nile Virus from Mosquitoes, Crows, and a Cooper's Hawk in Connecticut," *Science*, Volume 286, December 17, 1999, pp. 2331-2333.

microscope, USDA believed that its sample from the Bronx Zoo might be a flavivirus. USDA shared this information with CDC and sent the sample to Ft. Collins on September 20.

With more than a dozen dead zoo birds, and more than 100 suspected human cases of encephalitis reported,[54] Dr. McNamara contacted the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) at Ft. Detrick, MD.[55] After receiving samples from the Bronx Zoo on the 21st, USAMRIID scientists were able to rule out other suspect viruses and, on the 23rd, confirmed the presence of a flavivirus. The USDA virus isolate, with additional Bronx Zoo samples, allowed for a variety of confirmation tests to be run, and CDC and USAMRIID were able to confirm on September 24 that a "West Nile-like virus" had been identified in several bird specimens found in New York City and Westchester County (see **Figure 5**).[56] This was a startling finding as West Nile virus had never before been implicated in a disease outbreak in the Western Hemisphere.[57]

[54]New York City Health Department, press release, "Mayor Guiliani Provides St. Louis Encephalitis Update Second Round of Citywide Spraying to be Completed this Week, Weather Permitting," September 21, 1999.

[55]While focused primarily on the military mission, USAMRIID serves as a reference laboratory for the World Health Organization and CDC and collaborates with these agencies in the diagnosis and treatment of unusual diseases wherever they occur (U.S. Army Medical Research and Material Command, *USAMARC*, 2000). A USDA-USAMRIID Memorandum of Understanding, facilitated by New York City government, allows USAMRIID to continue to assist the Zoo (USAMRIID interview, April 6, 2000).

[56]Until further tests could be run, the disease agent was called West Nile-like. Partial sequencing of the genetic code of the virus by three independent teams in December 1999 showed conclusively that the virus in both birds and people was West Nile.

[57]Steinhauer and Miller, p. A-6.

West Nile Virus

Like the virus that causes St. Louis encephalitis, West Nile virus is a flavivirus belonging to the Japanese encephalitis group. West Nile virus was first isolated in Uganda in 1937.

Prior to the 1999 U.S. outbreak, West Nile virus had been isolated in at least 18 countries covering three different geographic regions. This indicates that it is adaptable to a broad range of environmental conditions, and its disease vector, Culex mosquitos, is widely distributed. Periodic epidemics have occurred in Israel, France, South Africa, Romania, and Russia. The 1974 South African outbreak is the largest known epidemic where hundreds of clinical cases were observed. In these epidemics, the disease has generally been mild and characterized by fever, headache, and muscle pain, though more serious cases of encephalitis have been observed, particularly among the young and elderly.

Mosquitos were shown to be the main vector of West Nile virus in the 1950s. Many vertebrate species show evidence of exposure to West Nile virus in nature but wild birds have been most consistently implicated as important hosts in the transmission cycle of the virus. Birds generally were not known to develop clinical signs of the illness naturally, though recent research suggests West Nile virus circulating in the Mediterranean region since 1998 has been associated with increased pathogenicity for birds. In the 1999 outbreak, certain bird species, especially crows, died in very large numbers. As happened in the United States, horses in Italy, Israel, Morocco and France have been susceptible to the disease.

In December 1999, three independent teams established that the strain of the virus circulating in the tri-state area was very closely related to recent Israeli and Romanian strains of West Nile.

Hayes, Curtis G., "West Nile Fever," in Monath, Thomas P., Ed., *The Arboviruses: Epidemiology and Ecology*, Volume V, CRC Press, Boca Raton, Florida, 1988, pp. 59-88; CDC, *Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control*, Spring 2000; Lanciotti, R.S., et al., "Origin of the West Nile Virus Responsible for an Outbreak of Encephalitis in the Northeastern United States," *Science*, Volume 286, December 17, 1999, pp. 2333-2337; Jia, Xi-Yu, et al., "Genetic Analysis of West Nile New York 1999 Encephalitis Virus," *The Lancet*, December 4, 1999; Anderson, John, et al., "Isolation of West Nile Virus From Mosquitoes, Crows, and a Cooper's Hawk in Connecticut," *Science*, Volume 286, December 17, 1999, pp. 2331-2333.

Figure 5.

Disease Detectives at Work: Round Three

CDC issued an official statement on September 24 that implicated a West Nile-like virus in several bird deaths. CDC also announced that it would perform additional lab tests to determine if human patients who were diagnosed with St. Louis encephalitis, or who had encephalitis symptoms but whose illnesses were not confirmed as St. Louis encephalitis, might be suffering from a West Nile-like virus instead. On September 27, CDC formally reclassified the St. Louis encephalitis outbreak as a West Nile virus-like outbreak.[58] This reclassification process for human cases was as circuitous as the bird diagnosis.

There had been some reservations about the St. Louis encephalitis identification almost from the beginning. While most factors pointed to the St. Louis encephalitis as the disease in the human cases, there were signs that something else might have been responsible. As mentioned, the first unusual signal was that large numbers of birds were dying when birds had never been known to show signs of St. Louis encephalitis. Second, a prominent and striking clinical symptom in many of the encephalitis cases was extreme muscle weakness, something past

[58]New York City Health Department, press release, "The U.S. Centers for Disease Control Announces that Birds Collected in New York City Test Positive for West Nile-like Virus," September 24, 1999.

victims of St. Louis encephalitis had not experienced.[59] Third, the outbreak was unique from an epidemiological viewpoint. There had never been a case of St. Louis encephalitis recorded in New York City and only nine cases of St. Louis encephalitis reported in New York State over the past 35 years.[60] In past outbreaks, St. Louis encephalitis had typically advanced northward along the Ohio and Mississippi river valleys and had left a trail of cases in its wake. There was no national outbreak of St. Louis encephalitis in 1999.[61] Finally, laboratory tests on the human cases suggested St. Louis encephalitis in some cases, but in others, results were harder to interpret. Furthermore, the tests that had been run through most of September had not been specific enough to confirm a case of St. Louis encephalitis or to disprove a competing hypothesis.[62]

It was the uncertain lab results that prompted New York State Health Department officials in mid-September to ask Dr. Ian Lipkin, the director of a University of California -Irvine (UC-Irvine) Emerging Diseases Lab, to examine tissue samples from five of the fatal human encephalitis cases. The lab began its studies on September 21st and three days later Dr. Lipkin was virtually certain that the viral genetic material present was not from the St. Louis encephalitis virus but from one of two closely related viruses, either Kunjin or West Nile virus. On the 24th and 25th, the lab communicated these findings to the New York State and City Health Departments, CDC-Atlanta, and CDC-Ft. Collins.[63]

Tipped off by the bird cases, CDC-Ft. Collins used similar genetic fingerprinting techniques to independently confirm that a West Nile-like virus was responsible for at least 25 human cases of encephalitis. CDC officially reported its findings on September 27th.[64] The CDC-Ft. Collins lab director, Dr. Duane Gubler, called the sudden appearance of West Nile virus the most significant development in North American arbovirology in the past 50 years.[65]

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[59]New York City Department of Health, *West Nile Virus: A Briefing*, May 20, 2000, p. 2.

[60]During the same time period, Connecticut reported just one case. New Jersey reported 131 cases, with most of these (124) occurring during national epidemics in 1964 and 1975 (CDC, Arboviral Encephalitis Cases Reported, by Type, United States, http://www.cdc.gov/ncidod/dvbid/arbor/arbocase.htm).

[61]Monath, Thomas M., "Epidemiology," in Monath, Thomas P., Ed., *St. Louis Encephalitis*, American Public Health Association, Washington, DC 1980, pp. 239-245.

[62]Schoch-Spana, pp. 6-7; Rosen, p. 7.

[63]Interview with Dr. Ian Lipkin, January 4, 2000.

[64]New York City Health Department, press release, "The U.S. Centers for Disease Control and Prevention Reclassifies St. Louis Encephalitis Cases as West Nile-like Virus," September 27, 1999.

[65]Duke, Lynne, "A Feverish Career on the Prowl," *The Washington Post*, February 22, 2000, p. A17.

By October, West Nile encephalitis had conclusively killed thousands of wild birds and seven people, though the full extent of the outbreak had yet to be determined. On October 8th, a USDA Emergency Response Team detected 25 cases of West Nile virus infection in horses on Long Island. Horses in Connecticut and New Jersey were also tested for West Nile, but no positive cases were found.[66] During this time, the European Union banned horse and poultry imports from affected areas in New York, New Jersey, and Connecticut.[67]

Disease Detectives At Work: Round Four

While the 1999 West Nile outbreak ended by October, a great deal of scientific work remained to be done in 1999 and into 2000 (see **Figure 6**). The first priority was to continue to map the extent of the outbreak, something that CDC did in conjunction with state and local health departments. CDC eventually confirmed 62 human cases of encephalitis. Seven cases, all involving older patients, resulted in deaths. The onset of most human cases occurred in August. All the cases are thought to have been contracted in the immediate New York City metro area, and the center of the epidemic appears to have been in northern Queens.[68]

Important Federal Activities and Research (October 1999- January 2000)

CDC
Mosquito surveillance in New York City area
Confirmatory West Nile testing in humans and animals
Sequencing of West Nile virus genome
Standardized laboratory testing protocols
Serological survey in northern Queens
Vertebrate serological surveys
Sentinel bird studies
West Nile Workshop
Development of West Nile surveillance, prevention, and control guidelines

USDA
Screening and, later, confirmatory West Nile testing in animals
Pathogenicity studies in domestic poultry
Sequencing of West Nile virus genome
West Nile infection study in horses
Bird serological surveillance in Atlantic region
West Nile Workshop
Development of West Nile surveillance, prevention, and control guidelines

NWHC
Necropsy, screening, and later, confirmatory West Nile testing in birds
Wild bird and small mammal serological survey in New York City
Bird serological surveillance in Atlantic region
Bird vaccine studies

USAMRIID
Vector studies
Pathology studies of Bronx zoo birds
Serological survey of birds and mammals
Sequencing of West Nile virus genome

Complied through a variety of interview and document research

Figure 6.

A New York City Health Department/CDC serological survey conducted in northern Queens during October showed that between 1-4 percent of the population (533-1,903 persons) surveyed had been exposed to West Nile, though over 99 percent of these individuals exhibited

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[66]Brown, Marian Gail, "State Horses Being Tested for Virus," *The Connecticut Post*, October 27, 1999, p. A4.

[67]Interview with USDA Officials, March 30, 2000.

[68]New York City Department of Health, *West Nile Virus...*, p. 1-2.

either no symptoms at all or very mild symptoms.[69] Despite significant fears among the residents and public health communities of New Jersey and Connecticut, those States did not ultimately identify any human cases of West Nile encephalitis.

Though the outbreak's full impact on the bird population will never be known, as many as 10,000 wild birds may have died from West Nile infections. The National Wildlife Health Center estimates that fully one-half of the New York City American Crow population – several thousand birds – died.[70] More than two dozen zoo birds died of encephalitis or were euthanized. While most of these birds were Bronx Zoo specimens, a sandhill crane at the Beardsley Zoo in Bridgeport, CT was also euthanized.[71] Of the 25 Long Island horses that contracted the disease, nine died. Federal, state, and local mosquito surveillance and vector studies implicated the northern house mosquito, Culex Pipiens, as the primary mosquito vector for birds, though field and lab studies showed that other mosquito species could carry and transmit West Nile virus.[72]

In November 1999, CDC and USDA convened a West Nile workshop in Fort Collins that was attended by 100 researchers and officials from government, academia, and the private sector. This workshop developed a useful set of guidelines for surveillance, prevention, and control of West Nile that were later adopted by many states and local jurisdictions.[73]

West Nile Virus and Bioterrorism?

A provocative article in an October 1999 issue of *The New Yorker* held out the possibility that the West Nile virus outbreak could have been an act of bioterrorism. The article focused on a book by an alleged Iraqi defector, who claimed that Saddam Hussein may have developed a lethal strain of West Nile virus to use as a bioterrorist weapon.[74]

U.S. law enforcement, public health, and intelligence officials have investigated the possibility that West Nile virus resulted from a bioterrorist attack but believe that this is very unlikely. All indications point to the natural occurrence of West Nile virus which probably

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[69]A serological survey is a standard epidemiologic tool used to assess infection rates. Blood is drawn from volunteers in a given area and checked for antibodies, which indicate past infections (New York City Health Department, "Health Department Presents Results of West Nile Virus Serosurvey to Queens Residents at Borough Hall," press release, March 20, 2000).

[70]Interview with Dr. Robert McLean, NWHC, February 16, 2000.

[71]Associated Press, "DEP: Crane Dies of Deadly Virus," October 13, 1999.

[72]Interview with USAMRIID Officials, April 6, 2000.

[73]CDC, *Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control*, March 2000.

[74]Preston, Richard, "West Nile Mystery," *The New Yorker*, October 18 and 25, 1999, pp. 90-108.

arrived in New York through international trade and travel.[75] Nevertheless, the West Nile case shows how difficult it can be to successfully distinguish between an emerging infectious disease and a bioterrorist attack.[76]

III. Current Events and Planning for the Future
January 2000 – Present

Planning over the Winter

Accepting the summer 1999 West Nile outbreak as the wake up call that it was – and fearing that summer 2000 could bring a much more widespread epidemic – Federal, State and local governments spent the winter and spring months assessing the 1999 experience and planning for 2000. State and local governments began releasing their West Nile response plans, closely tracking the CDC guidelines, from February and March.[77] New York, Connecticut, New Jersey, Pennsylvania and several municipalities announced and began implementing ambitious plans to provide for disease surveillance and control. States all along the Eastern Seaboard and the Gulf Coast as well as some Midwest and West Coast states also began integrating surveillance for West Nile into existing disease and mosquito surveillance plans. A CDC/HHS emergency supplemental appropriation is providing nearly $7.2 million to the health departments in the 48 continental United States to build epidemiological and laboratory capacity for addressing West Nile and other arboviruses. This funding, which began to be disbursed in late March comes at a critical time for many states since their own fiscal years – and new West Nile dedicated state funding –is just now being made available.[78]

At the Federal level, emergency funding and other federal assistance continues to be provided to the states in a variety of ways, as shown in **Figure 7**.

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[75]Agence France Presse, "No Evidence of Bioterrorism in NY Virus Outbreak," January 6, 2000.

[76]Interview with USAMRIID Officials, April 6, 2000.

[77]Connecticut's plan is representative and focuses on public health surveillance, mosquito management, and communication and public awareness (The State of Connecticut, *West Nile Surveillance and Response Plan*, July 2000, http://dep.state.ct.us/mosquito/index/html).

[78]U.S. Department of Health and Human Services, press release, "Clinton Administration Provides Additional Funding to Prevent the Spread of West Nile Virus,", May 25, 2000.

Disturbing Findings in March

Despite these aggressive steps, four discoveries in March indicated that West Nile had at least the potential to cause further public health problems. On March 8, CDC announced that several pools of mosquitos collected during January and February registered detectable levels West Nile virus RNA.[79] On March 12, the Connecticut Agriculture Experiment Station confirmed that a dead red-tailed hawk was positive for West Nile virus. Less than a week later, on March 17, CDC announced that one of the mosquito pools that had tested positive for West Nile RNA had yielded live West Nile virus.[80] With this information, all questions as to whether West Nile would overwinter in hibernating mosquitos were put to rest. West Nile was back and, as such, would continue to pose a potential threat in 2000. On March 20, the New York City Health Department announced that the serological survey it had conducted in conjunction with CDC during October 1999, indicated that as many as 1,900 people may have been infected by West Nile virus in northern Queens last fall, although only a tiny

Important Federal Activities
(January 2000-July 2000)

CDC
Distribution of West Nile surveillance, prevention, and control guidelines
Award of $7.2 million to states and municipalities
Production and delivery of testing reagents to public health labs
Wide range of ongoing research
Training in laboratory diagnostics
Confirmatory testing
Continued vector surveillance
Development of national West Nile surveillance database
Development of restricted access West Nile website
Initial development of public access West Nile website
Chair West Nile Coordinating Committee

USDA
Confirmatory West Nile testing in animals
Continuing West Nile animal studies, including vaccines
Distribution of West Nile surveillance guidelines to state/university vet labs
Production and delivery of animal-specific reagents to vet labs
Regulation of West Nile virus as a veterinary pathogen
Inspection of labs that use West Nile for diagnostic purposes

NWHC
Confirmatory West Nile testing in wild birds
Bird and wildlife surveillance with federal and state partners
Ongoing West Nile-related research

USAMRIID
Ongoing assistance to Bronx Zoo for West Nile-related research
Other ongoing West Nile-related research

EPA
Ongoing pesticide risk assessments
Investigations into pesticide applications during West Nile outbreak

Compiled through a variety of interview and document research

Figure 7.

[79]New York City Health Department, press release, "West Nile Viral RNA found in Few Hibernating Mosquitoes in New York City," March 9, 2000.

[80]Revkin, Andrew C., "New Findings of Nile Virus Cause Concern," *The New York Times*, March 16, 2000, p. B1.

percentage of these people developed any signs of the illness.[81]

Calls for a West Nile Czar

Concerned there was insufficient federal leadership and coordination, 68 members of the U.S. House of Representatives, most of whom were from the tri-state area, wrote the President and the HHS Secretary to request the appointment of a West Nile Coordinator or "czar" to head an umbrella organization to coordinate the multilevel governmental response and also to request an additional $5 million for research and assistance to combat this virus. The American Public Health Association (APHA), the largest and oldest organization of public health professionals, endorsed this proposal and also recommended the establishment of an advisory committee with representatives from all Eastern Seaboard states.[82]

Towards the Future

On April 12th, Health and Human Services (HHS) Secretary Shalala designated a senior CDC representative, Dr. Steven Ostroff, to serve as the HHS West Nile Coordinator. In addition, HHS announced the formation of a West Nile Virus Coordinating Committee, chaired by CDC and composed of representatives from USDA, the United States Geological Survey's National Wildlife Health Center, the Environmental Protection Agency, and the Defense Department.[83] Though this did not create either the "czar" or the umbrella organization as envisioned by some in Congress, this approach seems to be working. Federal responsiveness and coordination appear to be improving and the states and municipalities that are thought to be most vulnerable to West Nile this summer have dramatically improved their abilities to detect and respond to potential outbreaks. Nevertheless, as mentioned earlier, arboviruses like West Nile are unpredictable. Why and how they periodically jump from their natural cycles in insects and animals into the human population remains poorly understood. West Nile virus' behavior in North America is especially uncertain. The virus could cause another epidemic this summer, or in five years from now.

Recent findings in New York and New Jersey of more than two dozen birds and two pools of mosquitos confirmed to be carrying West Nile virus means that there is the possibility of human cases later this summer. What remains to be seen is whether West Nile virus will spread

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[81]New York City Health Department, press release, "Health Department Presents Results of West Nile Virus Serosurvey to Queens Residents at Borough Hall," March 20, 2000.

[82]The Honorable Joseph Crowley, "West Nile Virus: What the Future Holds for New York City," March 2000; List of Congressional supporters provided by Congressman Crowley's Office; Burke, Cathy, "Bugged Pol Wants Virus Czar," *The New York Post*, March 28, 2000, p. 20; APHA, press release, "Americans Face Potential Resurgence of West Nile Virus: Federal Coordination Needed to Effectively Tackle Problem," April 5, 2000, http://www.apha.org/news/press/2000/virus1.htm.

[83]Letter from HHS Secretary Donna Shalala to Congressman Joseph Crowley, April 12, 2000.

to other parts of the country.

As a result, public concern over another West Nile epidemic remains high throughout the United States and Canada. Because of this level of concern and because of the inherent uncertainties associated with viruses like West Nile, it is particularly important that we take a series of immediate and sustained, long-term measures that will enable us to respond to West Nile in a better fashion in the future.

IV. Responding to the Continuing Threat of West Nile: Important Findings

1. The Importance of Being Prepared for the Unexpected is Underscored

As stated earlier, CDC's emerging infectious disease strategy warns: "Because we do not know what new diseases will arise, we must always be prepared for the unexpected." Unfortunately, CDC did not heed its own advice in the West Nile case. Although a variety of factors may have hindered the ability to quickly identify last summer's outbreak as West Nile, the primary reason for the slow identification may have been, in the words of CDC-Ft. Collins Lab Director, Dr. Duane Gubler, "tunnel vision" within CDC.[84] The initial tests CDC performed, when coupled with the apparent clinical and epidemiological evidence, overwhelmingly suggested St. Louis encephalitis, something that colored CDC's thinking for several weeks. According to a former CDC senior scientist, "[CDC officials] didn't do anything wrong, but they did not do all the right things."[85] Specifically, a more open-minded approach would have called more quickly for additional, more specific lab tests to be undertaken in the face of multiple sources of mounting evidence that something other than St. Louis encephalitis was affecting both people and birds in the tri-state area. More apparent, in hindsight, are clinical (severe muscle weakness) and epidemiological (outbreak in New York in the absence of a national St. Louis encephalitis outbreak, bird and horse illness) signs that are not characteristic of St. Louis encephalitis.

This is not to suggest that CDC's task was an easy one. The nature of CDC's work puts it in the unenviable but inevitable position of having to balance the need to be immediately responsive to requests for assistance from the states and to use its considerable expertise to correctly identify diseases and help control outbreaks. It does this, as was especially the case in the tri-state area, real-time, in a highly charged atmosphere under intense public and media

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[84]Altman, Lawrence K., "Encephalitis Outbreak Teaches Old Lesson," *The New York Times*, September 28, 1999, p. F8.

[85]Quoted in Enserink, Martin, "Groups Race to Sequence and Identify New York Virus," *Science*, October 8, 1999, p. 206.

scrutiny. Moreover, CDC did act quickly to address the technical issues of disease agent identification by revising its working case definition and laboratory diagnostic procedures to ensure that St. Louis encephalitis and West Nile will not be confused again.[86] And, it is absolutely critical to note, responding to West Nile and St. Louis encephalitis outbreaks requires the same prevention and control measures, so the public health consequences likely would have been no different had the virus been correctly identified from the start.

Nevertheless, CDC failed to expect the unexpected. West Nile provided the wake up call. The next outbreak of an infectious disease -- whether naturally occurring or deliberately inflicted -- may not be so forgiving.

2. A Cultural and Organizational Divide Exists Between Public and Animal Health Communities

In the United States, public and animal health communities are divided organizationally and culturally. This has implications for public health. A recent journal article, for example, states, ". . . [West Nile] virus made dramatically clear that the cultural divide between the animal-health and the public-health communities is a dangerous one."[87] West Nile virus can cause a zoonosis – an animal disease that can be transmitted to people. One expert writes, "emergent disease episodes have increased in the United States and globally [and]. . . nearly all of these emergent disease episodes have involved zoonotic infectious agents."[88] Furthermore, "our governmental institutional culture fails, in the long-term, interdisciplinary, interagency strategy development" to address zoonotic diseases. And, we "had better fix this, organizationally and culturally, if we are to deal with the mosquito-borne diseases of the 21st century."[89]

The West Nile case illustrates this problem. Two separate investigations were taking place in late August and early September: one into the human encephalitis cases and one into the bird die-offs. Although the CDC and state and local public health departments worked together on the human cases, the animal investigation was, in many ways, leaderless because of the subdivisions in responsibilities in the animal health world, as well as the relatively low emphasis placed on most wildlife health issues. Livestock is the responsibility of USDA. The tiny National Wildlife Health Center (50 people, $4 million budget) is the only federal governmental agency dedicated to wildlife health issues, and states typically devote very few resources to

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[86]CDC, *Epidemic/Epizootic West Nile...*, pp. 41-43.

[87]Holloway, Marguerite, "Outbreak Not Contained," *Scientific American*, April 2000, p. 20.

[88]Murphy, Frederick A., Emerging Zoonoses, *Emerging Infectious Diseases*, July-September, 1998, p. 1, http://www.cdc.gov/ncidod/eid/vol4no3/murphy.htm.

[89]*Ibid*, p. 3.

wildlife health issues.[90] The health of zoo animals represents a "gray area," that falls within uncertain jurisdictions.[91] Because of limited resources, animal health generally has to focus on major diseases that threaten economically important or endangered species. As a result, federal animal health agencies have generally little capability to identify diseases and disease agents that fall outside of these categories. West Nile virus was a case in point.[92]

CDC, focusing understandably on people, did not immediately see the bird link. USDA and the National Wildlife Health Center were able to isolate -- but not identify -- a virus in birds. Because CDC was grappling with a human encephalitis outbreak in New York City, it could not initially focus much attention on the virus that was killing birds. Ultimately, the common link between the people and bird investigations was Dr. McNamara, the Bronx Zoo pathologist. The initial interagency cooperation also came about more because of personal and professional ties than as the result of existing interagency coordination mechanisms. Often considerable confusion is characteristic of the investigation of epidemics, but this case demonstrates the near absence of interagency and contingency planning for zoonotic diseases.

The recent creation of the multi-agency West Nile Coordinating Committee is a positive step in bridging this gap, as is increased cooperation both informally and through formal mechanisms such as Memoranda of Understanding (MOUs). Nevertheless, some problems remain. For example, mandatory USDA inspections of public health, veterinary, and university laboratories to ensure they have the proper facilities for working with West Nile virus have not been able to keep pace with the number of requests for inspection.[93] As a result, many states cannot do confirmation testing for West Nile without potentially running afoul of federal regulations. This can cause delays in test result returns and also may increase the workload on federal laboratories.

3. The Outbreak Raised Questions of Governmental Leadership, Accountability, and Transparency

The initial misidentification of West Nile virus as St. Louis encephalitis, the organizational and cultural divisions between federal actors, the involvement of a multitude of state and local agencies, the prominent role played by non-governmental actors, the public's fear of both disease and the only known remedy for the disease -- pesticides -- and intense public and media scrutiny all contributed to the perception of a lack of leadership and limited governmental accountability. An October 1999 *New York Times* article stated, "[Scientists and government

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[90]Interview with Dr. Robert McLean, February 16, 2000.

[91]Interview with USDA Officials, March 30, 2000.

[92]Holloway, p. 21.

[93]Information provided by CDC and USDA, May 18, 2000.

officials] . . . saw the New York outbreak as . . . a test of how public health officials could detect and deal with a sudden spread of a disease not typically found in the United States. To them, the missed diagnosis was unnerving."[94]

The concerns culminated in congressional calls for a West Nile virus czar in March 2000. Subsequent actions, such as the appointment of a West Nile coordinator within the Department of Health and Human Services, and the establishment of a West Nile Coordinating Committee, show improved federal leadership, accountability, and transparency. Nevertheless, the recent June and July 2000 discoveries of more than two dozen dead birds and two pools of mosquitos in New York State and New Jersey, all positive with West Nile virus,[95] makes it clear that federal officials will have to continue to focus on efforts to maintain public confidence.

4. Responding to the West Nile Continues to Place a Heavy Workload at Federal Facilities

Because West Nile virus had never been seen before in the United States, no state labs had any capability to confirm a West Nile case. As a result, federal lab facilities were quickly inundated with human, bird, and horse tissue samples for testing for West Nile virus as well as the need to answer important West Nile virus questions. This placed a particularly heavy burden on CDC-Ft. Collins in September and October 1999 because CDC was the only civilian federal facility that could perform the needed tests. CDC-Ft. Collins, the National Wildlife Health Center and USDA's labs all reported that their lab facilities were operating at full capacity, and virtually all available personnel were dedicated to working on West Nile.[96]

Federal, state and New York City officials worried that another, simultaneous outbreak might have been impossible to handle. This heavy workload continues at all the federal labs engaged in testing samples, developing diagnostic tools, producing and delivering lab materials, and preparing for this summer. The National Wildlife Health Center, for example, has been forced to restrict on a state-by-state basis the number of birds it can receive for testing. Many state public health and veterinary labs and local governments are hiring additional personnel and are working diligently to prepare for this summer, but their capabilities, especially at state veterinary labs, are expected to vary widely. In the event of another outbreak, federal officials again expect to be swamped.

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[94]Steinhauer and Miller, p. A-6.

[95]One of the positive mosquito pools contained Aedes Japonicus mosquitos, an introduced Asian mosquito that has spread rapidly through the Tri-State area. Laboratory tests have demonstrated that this mosquito is a very efficient transmitter of West Nile virus (Information provided by Dr. Steve Ostroff, CDC, July 18, 2000).

[96]Interviews with Dr. Steve Ostroff, CDC (April 26, 2000), USDA Officials (March 30, 2000), Dr. Robert McLean, NWHC (February 16, 2000) and USAMRIID officials (April 6, 2000).

Agency and congressional efforts are underway or being considered to improve the capacity of federal and state public health labs, but these will take years to fully implement.[97] Likewise, attracting new talent to the field will also require sustained effort.

5. There Remain Many Unanswered Questions Regarding West Nile Virus

There are many unanswered basic questions regarding arbovirology. Knowledge of how West Nile virus acts in North America – virgin territory for the virus – is especially sparse. For example, the devastating effect that West Nile had on some native American bird species was unexpected. Participants at the CDC/USDA workshop held in November 1999 identified a number of important, broad research priorities (see **Figure 8**).[98]

Important West Nile Virus Research Priorities

1. Current and future geographic distribution of West Nile virus
2. Bird migration as a mechanism of West Nile virus dispersal
3. Vector and Vertebrate host relationships and range
4. Virus persistence mechanisms
5. Mosquito biology, behavior, surveillance, and control
6. Development and evaluation of prevention strategies
7. Laboratory diagnosis
8. Clinical spectrum of disease and long-term prognosis in humans
9. Risk factor studies
10. Viral pathogenesis
11. Genetic relationships and molecular basis of virulence
12. Vaccine development
13. Antiviral therapy
14. Economic costs of the Northeastern West Nile epidemic/epizootic

CDC, *Epidemic/Epizootic West Nile...*, Spring 2000, p. 23-25.

Figure 8.

V. Recommendations

[97]CDC has a multiyear, $1 billion program for improving its laboratory capacity. CDC also funds the Epidemiology and Laboratory Capacity (ELC) program and Emerging Infections Programs (EIP) to improve state capabilities (*Preventing Emerging Infectious Diseases...,* pp. 17-18, 35-41). USDA hopes to spend over $300 million to improves its lab infrastructure over the next 10 years (Interview with USDA officials, March 30, 2000). The American Public Health Laboratory Association (APHL) estimates that $300 million in funding is required over the next five years to modernize state public health labs and additional funding will be required for state vet labs (Information provided by APHL, April 2000). Bipartisan legislation currently under consideration during the 106th Congress may help provide for the public health improvements (Osterholm, p. 1281).

[98]CDC, *Epidemic/Epizootic West Nile...,* pp. 23-25.

The Summer 1999 West Nile outbreak provided a very loud wake up call, one that exposed significant holes in our public health community's ability to respond to emerging infectious diseases, in general, and West Nile, in particular. At the same time, the West Nile experience left us with a blueprint for how we can improve our response next time around. First, though many positive steps have been taken, leadership and coordination among federal agencies needs to continue to be strengthened. Second, efforts to increase the transparency of governmental actions should continue**.** Third, the immediate needs identified by federal, state, and local governments to meet the challenges posed by West Nile this summer need to be addressed. Fourth, the long-term requirements to meet effectively the challenge of West Nile and other arboviruses need to be identified and addressed. Fifth, long-term improvements to U.S. public health infrastructure are required to meet the challenges posed by future emerging and re-emerging infectious diseases and bioterrorism.

Recommendation #1: Continue to Strengthen Federal Leadership and Coordination

The response to the 1999 West Nile outbreak created the perception that federal leadership and coordination were lacking. While state public health departments are on the front lines in fighting infectious diseases in the United States, CDC is the nation's disease control and prevention agency. It is uniquely positioned to coordinate research and response efforts to West Nile virus among federal agencies, state health and environment agencies, and local public health and wildlife officials. As a result, strong, visible federal leadership must come through CDC. CDC, however, cannot carry the burden alone, and other federal agencies – USDA, the National Wildlife Health Center, the Department of Defense, the Environmental Protection Agency, the National Institutes of Health – are important partners in fighting emerging infectious diseases. Coordination among these agencies is vitally important. The recent creation of a federal West Nile Coordinating Committee, chaired by the CDC, is just one of the important and welcome steps agencies have taken to improve federal leadership and coordination. Some additional steps are recommended.

A. Expeditiously Develop a Formal, Unified West Nile Virus Response Plan

CDC, along with the other members of the West Nile Coordinating Committee, should develop a formal West Nile virus federal response plan for this summer and beyond. This report should address the roles and responsibilities of federal actors involved in West Nile activities, ongoing West Nile activities, and potential areas of jurisdictional overlap or gaps that need to be resolved. In addition, it should identify requirements and funding needed to respond to the threat of potential West Nile outbreaks. The report should also develop a set of contingency plans for potential West Nile outbreaks. These plans should contain communications flow charts for emergencies, important agency points of contact, and sources of emergency funding available to federal agencies and states.

B. Expeditiously Develop a Report on the Level of Preparedness for Mosquito-Borne Diseases in the States

Working together, CDC and USDA should expeditiously assess the level of preparedness that the states and large cities have developed to combat mosquito-borne diseases. Attention should first focus on those jurisdictions affected by last year's outbreak. This should cover the level of preparedness in both the public *and* animal health communities. Specific criteria should be developed by CDC and USDA but should include state-by-state public information on public and veterinary laboratory capabilities to identify cases of mosquito-borne illnesses; plans and capabilities to conduct West Nile virus surveillance in humans, livestock, wildlife and mosquitos; information on mosquito control programs; and critical unmet capabilities and funding requirements.

C. Expand the West Nile Coordinating Committee Membership and Responsibilities

Because addressing the threat of West Nile virus requires long-term research on a number of issues, the National Institute of Health's National Institute of Allergies and Infectious Diseases (NIH/NIAID) should be part of this Coordinating Committee. NIAID represents not only another source of expertise, but also as the primary source of governmental funding for research on infectious diseases.

The West Nile Coordinating Committee could also be used as a forum to help mediate jurisdictional disputes between federal agencies and state and local governments.[99]

D. Explore Ways to Bridge the Cultural Divide Between the Public Health and Animal Health Communities

Emerging zoonotic diseases challenge the existing culture and organization of health and research communities. In the future, public health officials will have to better understand the complex relationships between the health of people and animals. In the short-term, programs designed to increase the cross-fertilization of personnel between the different types and governmental levels of health activities – CDC Fellowships, the CDC Epidemic Intelligence Service,[100] agency detailees – might be expanded. For the long-term, additional study on how this gap may best be bridged is needed. A recent Institute of Medicine conference on the "Emergence of Zoonotic Diseases" and forthcoming report on the same topic is a step in the right

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[99]Disputes have arisen between two local governments and the National Park Service over the use of larvicides at National Parks (letter from the National Park Service to the New York City Health Department, April 18, 2000).

[100]Three agency representatives on the West Nile Coordinating Committee – Dr. Steve Ostroff (CDC), Dr. Randy Crom (USDA), and Dr. Robert McLean (NWHS) – are Epidemic Intelligence Service Alumni.

direction.[101]

E. Clarify USDA's Inspection and Permitting Process

USDA's inspection and permitting process to use West Nile virus for diagnostic purposes has not been able to keep pace with CDC's delivery of testing materials to state labs and the need for state labs to begin to do confirmatory testing for West Nile virus.[102] USDA's inspection and permitting process is likely to fall even further behind now that CDC is committed to provide assistance (and reagents) to all 48 continental states. USDA, CDC, and representatives from public health, veterinary, and university laboratories need to enter into discussions to find the best way for the states to follow federal regulations and safely and expeditiously perform West Nile testing.

Recommendation # 2: Increase Transparency of Governmental Actions

Public concern about West Nile remains very high. A great deal of public information on West Nile virus has been made available through the media, press conferences, agency websites, other internet sources such as *ProMED Mail*, official documents, public service announcements, hotlines, and other means. Nevertheless, at a conference sponsored by the New York State General Assembly, some participants raised the issue of inadequate public communications and registered complaints about the lack of governmental transparency and the need for a "one-stop-shop" for authoritative information.[103] This situation has been much improved, however, since the creation of the West Nile Coordinating Committee.

A. Continue to Deliver Regular Press and Congressional Briefings

The recent practice of regular press and congressional briefings and question and answer sessions instituted by the West Nile Coordinating Committee is a welcome and positive development.[104] The demand for information from the press, the public, and Congress will only increase as the summer progresses.

B. Develop a Dedicated, Publicly Accessible West Nile Virus Website

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[101]The Institute of Medicine held this conference on June 7-8, 2000 at the National Academy of Sciences, Washington, DC..

[102]Information provided by CDC and USDA on May 18, 2000. Documents provided by APHL on June 8, 2000.

[103]Wildlife Conservation Society, *Proceedings of the West Nile Virus Action Workshop*, January 19-21, 2000, pp. 79-81.

[104]Representatives from the West Nile Coordinating Committee have held four such briefings during April-July 2000.

Currently, all the relevant federal agencies maintain very good, but separate web sites on West Nile issues, as do a number of states and many municipalities. A comprehensive, regularly updated West Nile virus website should be established that would fuse information coming in from the federal governments and the states. Ongoing CDC and U.S. Geological Survey efforts to develop such a site should be supported.

Recommendation #3: Continue to Address Immediate and Emergency Needs to Combat West Nile Virus

Federal, state, and local governments are implementing plans to combat West Nile this summer. Agencies are spending millions of dollars on research, public and health provider education campaigns, disease surveillance, mosquito control, enhancing laboratory capabilities, training personnel, stockpiling supplies, and other measures. HHS and CDC are in the process of supplying over $7 million in emergency funding this summer for state programs.[105] CDC and USDA have also made additional funds available for their own and other federal agencies' efforts. Nevertheless, additional federal assistance may have to be provided later in the summer, especially if another epidemic occurs. In addition, the needs of the veterinary community appear to be acute.[106]

A. Identify Immediate Needs and Emergency Funding Sources

The Federal West Nile Response Plan described in Recommendation #1A asks federal agencies to identify existing requirements and the funding needed to address these requirements. It also asks federal agencies to identify sources of emergency funding that they can utilize both for themselves and for transfer to the states in case of another epidemic. The needs of the states can be identified by both their written requests for the existing $7 million federal emergency allocation as well as by the State Preparedness report described under Recommendation #1 B.

B. Explore Creative Ways to Temporarily Increase Capabilities This Summer

Federal agencies should be encouraged to look for creative ways to recruit personnel on a temporary basis through the use of federal employee details, fellowships, and other mechanisms that could attract personnel from academic institutions and other research organizations to meet the demands likely to be placed on federal labs this summer. Contracting for services and developing cooperative agreements with state and university labs may also be considered as potential ways to increase capacity and capability.

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[105]U.S. Department of Health and Human Services, press release, "Clinton Administration Provides Additional Funding to Prevent the Spread of the West Nile Virus," May 25, 2000.

[106]Meeting with representatives from the American Horse Council, May 8, 2000.

Recommendation #4: Address Long-Term Requirements to Meet the Challenge of West Nile and Other Arboviruses

The 1999 outbreak revealed our vulnerability to emerging infectious diseases, particularly mosquito-borne viral diseases such as West Nile. The very nature of these kinds of diseases, which unpredictably erupt into epidemics, makes it difficult in our public policy environment and annual budgetary system to sustain attention. Many experts believe the field of arbovirology has been in a state of decline for the past 20 years with some of the field's most experienced researchers having either retired or nearing retirement and with an absence of younger researchers to take their places. This decline has occurred, unhappily, while the country is increasingly threatened by emerging and re-emerging arboviruses such as West Nile, Dengue fever, and even yellow fever, the first arbovirus ever identified, and last seen in the United States in 1905. The West Nile outbreak, according to CDC's West Nile Coordinator, represents the "chickens coming home to roost" after two decades of inattention.[107]

To help arrest this decline, there is a strong need to update, archive and preserve existing knowledge. There is also the need to robustly fund research that helps to answer many of the basic, long-standing unanswered questions regarding arbovirology, as well as direct specific research on West Nile virus.

A. Take Steps to Update and Preserve Knowledge on the Arboviruses

CDC and NIH should coordinate and support the update and transfer to computer files of the *International Catalogue of Arboviruses and Certain Other Viruses of Vertebrates*, which was last updated in 1985. There has been widespread agreement that such an update should take place, but previous efforts have failed due to lack of funding.[108] In addition, CDC and NIH should also support the update of the seminal work on arboviruses, *Arboviruses: Epidemiology and Ecology*, which was published in 1988.[109] This multi-volume report is no longer in print, but remains in high demand and was widely use as a source of information on West Nile during last year's outbreak.

C. Develop a Multi-disciplinary, Coordinated West Nile and other Arbovirus Research Program

CDC has already identified a number of important West Nile research questions (see **Figure 8**). West Nile-related research is ongoing in all the federal agencies that are members of the West Nile Coordinating Committee and at some universities. As of April 2000, however,

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[107]Interview with Dr. Stephen Ostroff, CDC, April 26, 2000.

[108]Interview with Dr. Charles H. Calisher, April 12, 2000.

[109]Monath, Thomas P., Ed., *The Arboviruses: Epidemiology and Ecology*, Volumes I-V, CRC Press, Boca Raton, Florida, 1988.

NIH's National Institute of Allergies and Infectious Diseases, the largest source of civilian funding for research on infectious diseases, had funded only one dedicated West Nile project. Increased support is vital. The new NIH administered multi-agency research program for the Ecology of Infectious Diseases, started last year, shows real promise and is especially valuable in helping understand arboviruses and other vector-borne illnesses such as Lyme disease.[110] The West Nile Coordinating Committee should help coordinate research efforts and proposals.

D. Accelerate Research on a West Nile Vaccine

Given the enormous costs and long time periods to develop vaccines, work on a West Nile vaccine, probably for veterinary purposes, deserves special emphasis. USDA has begun some vaccine-related research and the Army's Walter Reed Institute of Infectious Diseases conducted some preliminary research on a West Nile virus vaccine during the early 1990s.[111]

Recommendation #5: Take Other Steps to Improve Our Public Health System

Many experts agree that improving the general public health infrastructure in the United States at all levels offers the best prospect for effectively dealing with future outbreaks of West Nile virus and other emerging infectious diseases. The West Nile case revealed some troubling and long-standing problems within our public health infrastructure. Long-identified problem areas at the federal level include shortages of key personnel, aging facilities, antiquated and inadequate disease reporting and surveillance systems, and insufficient research funding.[112]

In addition, state public health and veterinary labs have very little capability to deal with most non-routine disease outbreaks. The American Public Health Laboratory Association estimates that $300 million in funding – for information technologies, facilities, training, and capital equipment – is required over the next five years to modernize state public health labs. Additional funding is required to modernize state veterinary labs. Strong federal support will be required to enhance these capabilities.[113]

A. Undertake a Comprehensive Assessment of Our Public Health Infrastructure

Numerous shortcomings in our public health infrastructure have been recognized for over

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[110]Information provided by NIH/NIAID, April 13, 2000.

[111]West Nile poses a threat to the $25 billion per year U.S. horse industry as well as to endangered bird species such as whooping cranes (meeting with the American Horse Council, May 8, 2000, and interview with Dr. Robert McLean, Director, National Wildlife Health Center, February 16, 2000).

[112]Lederberg and Shope, pp. 2-15.

[113]Information provided by APHL, April 20, 2000.

a decade. While a number of valuable programs are underway that are making improvements at both the federal and state level, a comprehensive assessment of our public health infrastructure – personnel, facilities, research efforts, and policies – should be undertaken. The Public Health Threats and Emergencies Act of 2000, recently introduced in the Senate, would enable such an assessment to be undertaken.

B. Support Administration Plans to Improve Disease Surveillance Efforts

The West Nile case and numerous other studies have shown that our existing disease surveillance networks are inadequate. Recently, the Clinton Administration began to fund multimillion dollar efforts to build a nationwide electronic surveillance network.[114] International surveillance is also very important and cooperative infectious disease surveillance, prevention, and control efforts with the World Health Organization make important contributions in this area. The five Armed Services overseas labs – down from seven several years ago -- serve as important emerging infectious disease sentinels.[115] In addition, DoD's funding for comprehensive military disease surveillance network is an important contribution at both the national and international level.[116]

C. Continue to Robustly Fund Infectious Disease Research

Continued robust funding from NIH for infectious disease research, which now totals more than $475 million annually in non-AIDS/HIV research, is needed.[117] Areas of emphasis particularly relevant to West Nile and other emerging infectious diseases include studies on disease agents and their biology, pathogenesis and evolution; vectors and their controls; vaccines and antimicrobial drugs; and rapid methods of laboratory diagnosis and pathogen detection.[118]

VI. Conclusion

The 1999 West Nile encephalitis outbreak and the potential for another outbreak this summer provided a clear signal – to many "a wake up" call – of our growing vulnerability to emerging infectious diseases and the increasing threat of bioterrorism. These twin threats are

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[114]The White House, press release, "White House Announces New Multi-million Dollar Investment to Combat Emerging Infectious Diseases,"January 10, 2000.

[115]Lederberg and Shope, pp. 5-6, 9-10.

[116]Walter Reed Army Institute of Research, pp. 19-20.

[117]Documents provided by NIH/NIAID, April 13, 2000.

[118]Lederberg and Shope, p. 146.

arguably among the most pressing and personal national and international security threats that face us. Infectious diseases remain the world's leading killer.

There is widespread agreement that the next emerging or re-emerging disease that lands on our shores may be even more challenging than West Nile has proved to be, especially if it can readily be spread from person to person, as diseases like flu and small pox are. When – not if – such an event occurs, there will be little margin for error in identifying and responding to the disease.

Although our national capabilities to respond to such a future certainty are good, areas for improvement -- some highlighted in the West Nile case -- have been long recognized, as this report documents. This situation can and must be addressed. Public health is a classic public good and an area where government investments reap some of the highest dividends. As such, we must have the best facilities, the best and most experienced people, and the best research in our efforts to combat infectious diseases. In tandem with these investments, we need to have in place the leadership and perspective that can bridge evident organizational, jurisdictional, and cultural differences within our public health and animal health communities.

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