The Resurgence of West Nile Virus
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Over the past several decades, public health officials have worked to alert the public to the threat of emerging infections, and the idea has captured the imagination of the American public. Consider *The Andromeda Strain*, *Outbreak*, and *Contagion*. However, these theatrical portrayals—in which a scary, mysterious disease emerges but is investigated and controlled by the time the credits roll—fail to reveal the true drama, the ecological complexity of the world where real and deadly diseases occur. Over the years, public health professionals and the public alike have gotten excited about such pathogens as hantavirus, H5N1 avian influenza, the severe acute respiratory syndrome (SARS), monkeypox, and West Nile virus (WNV). Whereas H5N1, SARS, coronavirus, and monkeypox are only vague memories for most Americans because the ecosystem that fosters disease transmission exists overseas and not in our own backyard, WNV and hantavirus are different. Although the public and professionals may have become somewhat complacent about both diseases, 2012 is reminding us that perhaps we shouldn’t have.

West Nile virus has become endemic in North America. It is here to stay because we have the right combination of birds and mosquitoes. But this very endemicity has been driving complacency. After all, up to 80% of infected persons have few or no symptoms. However, WNV still causes life-threatening encephalitis and meningoencephalitis in some patients, and we are learning more about long-term sequelae (1), including flaccid paralysis (2). Although no vaccine or effective treatment is available, clinicians must maintain clinical suspicion of infection under the right circumstances of season and mosquito exposure to arrive at the correct diagnosis in a presenting patient. In addition, WNV remains a significant concern for blood collection organizations and transfusion services, requiring screening of donors, either individually or in pooled samples, on the basis of virus activity indicators.

Cases of WNV infection in 2012 in the United States have already exceeded that of any other year to date—with 1590 cases, 65 deaths, and 303 viremic blood donors as of 28 August 2012 (3)—including the earliest years after the introduction of WNV in 1999 when the U.S. population, both bird and human, was immunologically naïve to the virus. The problem this year is so dramatic that cities, such as Dallas (4), have resorted to aerial pesticide application to kill adult mosquitoes (adulticiding) for the first time in 45 years. Texas, South Dakota, Mississippi, Oklahoma, Louisiana, and Michigan have been particularly hard hit. Could this be a new strain of the virus, a reintroduction, or a mutation? Is a long-term temporal cycle of WNV infection emerging? Or, is this year’s experience related to unusual weather patterns? Temperature does have a role in WNV amplification.

This year we have been hearing from local health departments, wildlife rehabilitators, and other observers about an increase in dead bird sightings compared with recent years; somewhat similar to what had been seen earlier in the WNV experience. This might suggest a new WNV strain, either by natural selection or introduction. A new strain could also account for a change in human epidemiology. Alternatively, the reservoir of infection in birds might be substantial—some species experienced considerable mortality when the virus first arrived, but studies indicate that most populations have at least stabilized, if not recovered (5). But we cannot discount the possibility of increased numbers of the *Culex* species of mosquitoes that are the prime vectors. *Culex pipiens*, *C. restuans*, and *C. tarsalis* are abundant and ubiquitous puddle- and container-breeding mosquitoes broadly distributed geographically in overlapping ranges in urban, suburban, and rural settings. These mosquitoes thrive and reproduce in stagnant, dirty, putrid collections of water in puddles and containers, sewers, storm drains, and catch basins, all of which are part of our residential infrastructure. The drought that has gripped much of the country this year has caused contraction of water sources, creating excellent breeding conditions for these mosquitoes. The record-breaking heat is known to accelerate both the reproductive rate of mosquitoes and the rate of virus replication within them (6). The interplay of heat, drought, human habitats, increased mosquito populations, and enhanced viral development all act in concert to increase the force of transmission. At least, that’s the theory. The truth of what lies behind the resurgence of WNV activity this year will take time to uncover.

A frequently cited publication states that three quarters of emerging infections are zoonotic, that is, shared in nature by humans and animals (7). West Nile virus is first and foremost a bird virus. But it is spread within the avian reservoir by mosquitoes. And humans live in the same ecosystem as both birds and mosquitoes. So, to truly understand WNV and its manifestations, including the causes of increased incidence, we need to understand the virus and its cycle in nature; the reservoir and the vector; and how the human-built environment contributes. Similar questions about hantavirus may eventually help explain the concerns about that disease that have also arisen this year (8). This integration of environmental science and veterinary medicine with human medicine is the essence of
the One Health Initiative (www.onehealthinitiative.com), an international effort toward inclusive collaboration across disciplines. Fully understanding WNV disease, with its strong environmental component, will require work on all 3 fronts.

In the meantime, mosquito-prevention messages must be unrelenting, directed at personal protective behaviors (avoidance, repellents, and clothing) and reduction of breeding sites. The public must be constantly prodded, with a balance of sensible precautions and awareness of the possibility for severe disease. Reduction of mosquitoes requires an integrated pest-management approach, and we must also come to grips with the sometimes controversial issue of pesticide application to kill adult mosquitoes, when benefit outweighs risk, and objectively determine efficacy under various conditions. For the long term, perhaps modifying the way we create our own environment will be an important part of reducing the impact of the disease.

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