

# AVIAN MORTALITY AS AN INDICATOR OF WEST NILE VIRUS

*Avian Mortality as an Indicator of Human Risk for West Nile Virus*

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## Background

In 1999, New York experienced the first outbreak of West Nile virus (WNV) documented in the United States (Nash et al., 2001). Just two years later, this life-threatening zoonotic disease was detected in Michigan birds. The following year, this epidemic resulted in 640 reported cases of human infection and 50 deaths across the state. The virus is capable of leading to a dangerously high fever and an array of neurological problems; for the past 16 years it has time and time again proven to be a significant public health concern. These outbreaks have led to the need for new monitoring practices and health related interventions in order to reduce the risk of human disease caused by this virus.

## Introduction

As any person who has lived in the wetter areas of Michigan can attest too, mosquitos are a particularly pesky part of the food chain. However, in recent years it has come to light that they may be more than just an itch between Memorial Day and deer season. *Culex* mosquitos are believed to be the primary vector responsible for transmitting WNV. While this virus disastrously affects human populations it infects, current literature suggests that we are dead-end hosts. Birds, on the other hand, are especially susceptible to this pathogen and are known to promote further spread of the virus. Since the first reported case of WNV, this virus has been found in over 300 species of dead birds (McLean, 2006 and Kilpatrick et al., 2007). Although many species of birds will experience increased mortality when WNV is present in the environment, members of the family *Corvidae* are known to be a particularly useful indicator. This family of birds includes crows, ravens, magpies, and jays (Eidson et al., 2001 and Komar, 2003). As these birds often fall victim to this virus, public health agencies use the reporting and testing of dead birds as an important indicator of WNV in Michigan and across the United States

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(Center of Disease Control, 2010). This essay will describe what other surveillance strategies exist, methods of measuring avian infection in dead and living birds, and summarize the benefits and drawbacks of using avian mortality as an indicator of human risk for West Nile virus.

### Surveillance Methods

There are two general types of WNV surveillance. The first is an epidemiological measure, which looks at the number of humans infected and uses this data to determine patterns of disease transmission that might be related to season or geography, identify demographic trends, and quantify the burden of this disease (Lindsey et al., 2008). From this epidemiological data, it has been found that 94% of human cases occur from July through September and about 67% of reported cases occur between mid-July and the end of August (Center of Disease Control, 2010). This method of WNV surveillance can be somewhat limited in its predictive ability, but can still be useful for providing information about the disease dynamics.

The second type of surveillance is a type of environmental monitoring, which measures WNV activity in vectors and non-human hosts. This method has shown to be much better for predicting WNV outbreaks. Birds are an incredibly important non-human host to consider in this category. Some species of birds, such as Michigan's own state bird, the American robin (*Turdus migratorius*), are known to amplify WNV once infected. The virus reaches very high levels in the blood of birds for several days after becoming infected, this condition is referred to as viremia. This increases the rate by which WNV is transferred to mosquitos, and eventually to humans. This process of amplification has been shown to occur even in the areas where relatively few hosts are present (Kilpatrick et al., 2006). For this reason, paying specific attention to the number of infection or dead robins in an area could be an important part of the surveillance strategy.

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The main categories of surveillance have now been discussed. The next question to explore is how can we measure the number of dead birds that have been infected with WNV, and which is the more accurate method?

### Measuring Avian Mortality from WNV

Taking biological samples from carcasses and performing laboratory testing on this material in order to find evidence of the virus can measure the extent of avian mortality due to WNV. Less conclusive information about avian mortality can be obtained through obtaining a simple count of dead birds in a given area. This second method is less accurate because there is no way of proving that the birds died from WNV, and not some other incident or pathogen.

Related to this point, researchers have found that at certain times of the year avian mortality may increase for reasons unrelated to WNV (Biology & Control of Michigan Mosquitoes, 2013). In the early spring, birds that migrate north are exposed to a variety of stressful environmental changes that may lead to increased deaths. The warm summer months arrive with large numbers of young birds, which are more vulnerable to trauma, predation, and diseases that develop as a result of underdeveloped immune systems. It is for this reason that it is possible that some birds found dead during these seasons may have died from circumstances unrelated to WNV. It is important that dead-bird surveillance continue in Michigan, and hopefully this data can be used to determine what the normal baseline avian mortality is when WNV is not present.

The benefit in this simple-count method is that it is less time-consuming and less costly than the method involving biological testing. Furthermore, public reporting is a common route of data collection and in these situations obtaining a biological sample is not always feasible.

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Regardless, accumulating information about the timing and location patterns surrounding avian mortality can be a useful way to monitor WNV activity. The main benefit of identifying increased avian mortality in an area is for early detection of a WNV outbreak, and not necessarily a quantitative measure of human risk. After WNV has been confirmed, a general count of avian mortality does not provide very specific information about transmission patterns.

### Testing Live Birds for WNV

Another potential problem with using rates of avian mortality to predict human risk of WNV is resistance. Over time, bird populations are becoming increasingly resistant to mortality from WNV (Reed et al., 2009). To circumvent this issue, measuring the implicated antibodies in living birds is a more accurate approach for monitoring WNV transmission and level of human risk (Komar, 2001). Although several bird species will die from WNV infection, the majority of birds will live but develop a life-long immune response that can be detected through serology. The drawback of this method of sampling is that it is very labor-intensive because it requires the work of veterinarians or other wildlife specialists, but it does provide valuable information about what areas are in greatest risk of WNV infection.

WNV is known to cause death in some bird species, but a limited few studies have addressed WNV-related mortality in species that do not experience a marked population decline since the arrival of WNV. Interestingly, some bird populations (such as Cardinals) do experience mortality but not a decrease in overall population (Beveroth et al., 2010). This suggests that some bird populations can reproductively compensate for their WNV-related mortality rates.

### Conclusion

Understanding how rates of avian mortality can be used as an indicator for human risk of WNV infection is important for government agencies and public health entities. The CDC uses

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this type of surveillance data to determine the risk of human disease, and these figures are then used to inform the decision to use chemical pesticides to kill mosquitoes. Research in this area could help with the implementation of effective and appropriate WNV control programs. Since no WNV vaccines are currently available, the best method of disease prevention is to reduce the overall mosquito count to a more manageable level, so the likelihood of humans contracting a disease is lower. This data can inform mosquito-management programs (Nasci, 2013), as well as healthcare professionals to the incidence and prevalence of this virus so that they may act on best practice.

Several studies have supported the value in using avian mortality to detect WNV activity (Eidson et al., 2001). Collecting samples from living birds that have signs of infection may be valuable, but this process is much more costly and time consuming. Dead birds are much more easily found and utilized for quantifying purposes. By monitoring the numbers of dead birds in a region, public health agencies can determine how much human-risk exists in that area. There is a need for reliable and consistent surveillance programs so that eventually statistics can be used to calculate an index of how great the risk of human disease is based on reported data, and call for a prescribed risk-reduction strategy. Despite the potential drawbacks, the research shows that dead bird surveillance remains a valuable adjunct to mosquito-based surveillance. Public participation in these efforts is vital to obtain the most accurate and widespread information, and should be encouraged through public health education and community outreach.

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