Chicago West Nile Virus Cost-Benefit Analysis Report 2007-2014

submitted by

M. Costa, I. Rickman, T. Schendt, T. Plapinger

August 11, 2017

Since the arrival of West Nile Virus (WNV) in the United States in 1999, over 43,000 cases have been reported in the United States. Of those, 2,214 have been in the state of Illinois with the primary state epicenter residing in the city of Chicago. During the study timeframe (2007-2014) there were a total of 350 reported cases in Cook County, or 52% of the total cases in the state during that period .

The Illinois Department of Public Health (IDPH) and the Centers for Disease Control (CDC) both recommend that Adult Mosquito Control (Adulticide) should be one part of an overall Integrated Pest Management (IPM) approach, and should only be considered once Prevention components are in place. The Prevention component of the IPM should consist of the following:

1. Public Information
2. Personal Protection Methods (avoidance, repellants, clothing)
3. Source reduction of mosquito breeding sites
4. Control of mosquito larvae

Once Prevention components are in place, adult mosquito control should be based on surveillance data (e.g., traps, field surveys, multiple WNV positive birds, WNV confirmed human cases). The City of Chicago does use traps as part of it adult mosquito surveillance program. The WNV infection rate of mosquitoes caught in the traps can be used to inform decisions about implementing prevention and control measures such as Adulticide. Environmental surveillance can be summarized as follows:

1. Collect data
2. Provide indicators of the threat to humans and identify geographic areas of high risk
3. Support decision for intervention
4. Monitor effectiveness

One possible approach to determining when and where to spray is the Minimum Infection Rate (MIR). The MIR is the total number of WNV-positive-pools divided by the total number of mosquitoes tests. Determining the appropriate threshold along with other other surveillance data (e.g., infected birds, human cases) can then be used to help decide when to initiate spraying. Based on 2013 spray data, the MIR that triggered spraying is 0.25.

Since the arrival of WNV in Chicago, the city has used Fogging/Adulticide units to spray ultra-low-volume insecticide sprays to combat the spread of the disease by mosquitoes. Ultra-low-volume means that it dispenses very fine aerosol droplets that kill most mosquitoes on contact and stay aloft in the air the longest However, this can be very expensive at $60 or more per linear mile. If the entire city was sprayed it would cost an estimated total of $818,424. However, based on the surveillance data, a focused spray in the areas most at risk of West Nile Virus is appropriate. Based on the spray data provided for 2011 and 2013, the total estimated costs were $45,112 and $520,051, respectively. The adulticide kills insects about the size of a mosquito and is low risk to vertebrate animals. It may bother individuals with asthma. Recent studies have shown that the risk of illness from West Nile virus is greater than the small risk associated with adulticiding.

One approach to quantifying the cost/benefit of spraying is to consider the medical and societal costs of illness from WNV. In 2003, a study was conducted on 80 patients as a result of an outbreak in Colorado. The initial hospitalization costs, cost of additional medical care, and absence from work during the five years after the initial infection were considered. The researchers extrapolated these costs and estimated that on a national scale, the costs associated with the virus are approximately $56 million per year in the United States.

Since the disease has varying levels of severity, the individual cost per person can vary as well. The most severe cases where patients suffered from acute flaccid paralysis, a neuroinvasive disease, had the longest hospital stays and incurred a median medical cost of $25,000. The costs later increase as they would need long term care for rehabilitation. Hospitalized patients who suffered from the more common side effects of the disease like fever or Meningitis had short term hospital stays, but still incurred a median cost of $7,500 per person. Those hospitalized also missed a median of 42 days of work due to illness, which not only has personal impacts on income, but also general productivity loss to the employer.

Of those infected between 1999 and 2014, over 18,000 patients, or almost half of those infected with WNV, required hospitalization. Assuming Illinois had a similar hospitalization rate during the study timeframe of 2007-2014, approximately 175 people may have been hospitalized. At a minimum, if those hospitalized only incurred short-term stays it would be a total cost of $1.31 million, but if they suffered the most severe effects, the medical costs are estimated at $4.38 million dollars.

In 2013, Cook County had 60 reported cases of WNV and 7 deaths associated with WNV. Assuming the 7 deaths had median medical costs of $25,000 each and the remaining 53 cases had median medical costs of $7,500, the total medical costs can be estimated as $572,500 on the low end and up to $1.5M on the high end. Comparing these costs to the approximate cost of spraying, which we estimated at $520,051 for 2013, suggests that the benefits of spraying most likely prevented more severe human cases of WNV and possible death from the disease.

Based on a study of 2005 WNV outbreak in Sacramento, California, the analysis showed that there were no new human cases of WNV 14 days after spraying which is the disease incubation period. In comparison 18 new cases were detected in the untreated areas. While there are obvious differences between environmental factors in Chicago and Sacramento, this shows the effectiveness of spraying in preventing human cases.

As part of an overall Integrated Pest Management program, adult mosquito control should be considered when informed by environmental surveillance data such as traps, field surveys, multiple WNV positive birds, WNV confirmed human cases.

Articles Used:

<https://wwwnc.cdc.gov/eid/article/14/5/07-1347-t1>

<https://wwwnc.cdc.gov/eid/article/14/5/07-1347_article>

<https://www.sciencedaily.com/releases/2014/02/140210184713.htm>

<https://www.cdc.gov/westnile/resources/pdfs/data/2-West-Nile-virus-disease-cases-reported-to-CDC-by-state_1999-2015_07072016.pdf>

<https://www.cdc.gov/westnile/resources/pdfs/wnvGuidelines.pdf>

<http://www.dph.illinois.gov/>

<http://www.idph.state.il.us/envhealth/wnvgenpublic.htm>

IPM Control of Adult Mosquitos provided by Linn David Haramis, Ph.D., Entomologist/Vector Control Program -Retired

IL, Dept. Public Health, Div. Environmental Health

212.785.2365

<http://www.dph.illinois.gov/topics-services/environmental-health-protection/structural-pest-control/mosquito-spray-faqs>

<http://www.dph.illinois.gov/topics-services/diseases-and-conditions/west-nile-virus>

<http://www.cmmcp.org/faqmos.pdf>