

## Cost Benefit Analysis of Aerial Spraying for West Nile Virus

We will conduct a quick analysis of the benefits and costs to perform aerial spraying in order to control the West Nile Virus outbreak in Chicago. Costs to Chicago include pesticides, plane rental, fuel, and manpower. Benefits are quantified by savings in medical and hospitalisation costs from lower number of WnV cases, and increased productivity as workers take less sick leave. References were obtained from open source research, and appended below.

### Cost Breakdown

Key assumptions are:

- Most effective time interval for aerial spraying is every 3 weeks (Reference B)
- 3 Scenarios will be analysed: spraying 100% of WnV outbreak hotspots, 75% and 50%
- Chicago is 149,800 acres. From 2013 spray data, total area of WnV outbreak hotspots is estimated at about 1/10 of Chicago (14,980 acres)

	Quantity (figures are from Reference A)			Remarks
(A) Pesticide Cost	\$1.30 / acre			Aerial spraying with Naled
(B) Acres to be sprayed	14,980			Assuming spray 100% of hotspots
		11,235		For 75% of hotspots
			7,490	For 50% of hotspots
(C) Plane rental, fuel and pilot cost for 1 trip	\$9,000			
Subtotal: Cost of 1-time aerial spraying (A * B + C)	\$28,474	23,606	17,737	
<b>Total Cost of spraying for the year</b>	<b>\$113,900</b>	<b>\$94,400</b>	<b>\$70,948</b>	Spraying done once every 3 weeks, for 4 months of Jun to Sept, which are the peak months for WnV outbreaks

## Benefit Breakdown

### Key Assumptions:

- From 2013 data (jupyter notebook), spray effectiveness is 50%. i.e. 50% of spray locations had lower to no outbreaks of WnV a month later
- From Chicago research, 57 cases of WnV was reported with flu like symptoms like headache, nausea, muscle pain. Estimated to need 2 days of sick leave. We will refer to them as Patient type A.
- We assume 10% of these cases will develop Meningitis, which may lead to coma, paralysis. They will need an estimated 5 days of hospitalisation. We will refer to them as Patient type B.

	Metric / Cost	Remarks
Median Income for Chicago citizen	\$68,402	
Patient Type A: Number of patients with flu symptoms	57	
Days of sick leave per patient	2	
Productivity loss per patient	\$374	(\$68,402 * (2/365 days))
Patient type A: Total Productivity loss per year	<b>\$21,318</b>	
Patient Type B: Number of patients with Meningitis	5	1% of total infected patients
Days of sick leave per patient	5	
Hospitalisation cost per patient	\$15,000	5 days hospitalisation at \$3,000 per day
Patient type B: Total Hospitalisation Costs and Productivity Loss	<b>\$76,000</b>	
Total medical and productivity loss for all patients due to WnV	<b>\$97,000</b>	

## Conclusion & recommendations

Cost to the city of Chicago is \$1 million a year due to WnV. If spraying is conducted, assuming spray effectiveness of 50%, this would reduce WnV cases by half, leading to savings of \$0.5million.

As spraying 100% of outbreaks is only projected to cost \$117,000, we recommend to conduct aerial spraying every 3 weeks, from Jun to Sep each year.

### References:

- (A) <https://cityoflaramie.org/DocumentCenter/View/7679/05DPesticide?bidId=>
- (B) <https://www.nytimes.com/2002/08/11/nyregion/mosquito-control-weighing-costs-versus-benefits.html>
- (C) <http://www.vdci.net/blog/2018-year-in-review-mosquito-borne-disease>
- (D) <https://www.beckershospitalreview.com/finance/average-cost-per-inpatient-day-across-50-states.html>
- (E) [https://www.chicago.gov/content/dam/city/depts/cdph/food\\_env/general/West\\_Nile\\_Virus/WNV\\_2018databrief\\_FINALJan102019.pdf](https://www.chicago.gov/content/dam/city/depts/cdph/food_env/general/West_Nile_Virus/WNV_2018databrief_FINALJan102019.pdf)