



Project IV – WNV in Chicago

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Agenda

- High Level Goal & Recommendations
- Mosquitoes Review
- Review of Data
- Feature Selection / Feature Engineering
- Modeling Techniques
- Cost Analysis
- Cost of Doing Nothing
- Questions



Project Goal

- Ciao, West Nile Virus (WNV)!
- Deliver an effective, low-cost plan to spray pesticides throughout the city



Recommendations

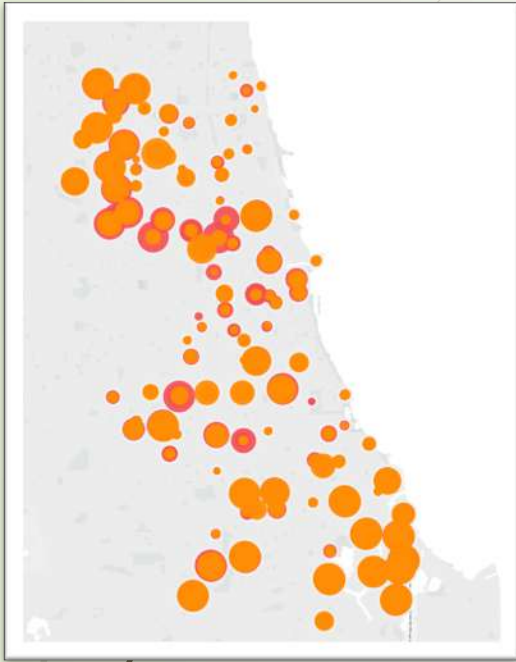
- ➡ # of Spray Locations: 146
 - ➡ Total Cost: \$4,570
 - ➡ Total Time: 2 Days
- 

West Nile Vector Mosquitoes - *Culex*

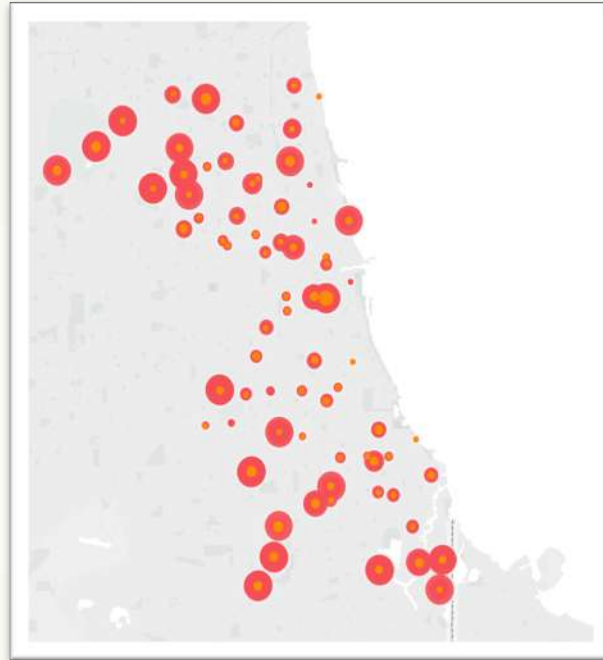
- West Nile Virus in the United States is carried by the *Culex* genus of mosquito. *Culex pipiens*, commonly known as the 'Northern House Mosquito'
- It is found mainly in the Eastern U.S.
- It is a medium-sized mosquito with a brownish or grayish body and brown wings.
- Their larvae thrive in containers of stagnant, polluted water, and thus these mosquitoes are the primary target of the campaign to drain backyard sources of standing water as a way to reduce the incidence of WNV.



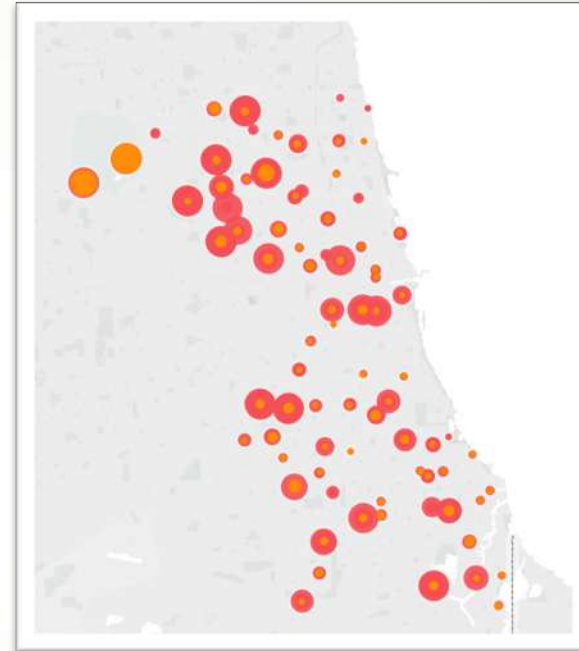
Where Are The Bugs?



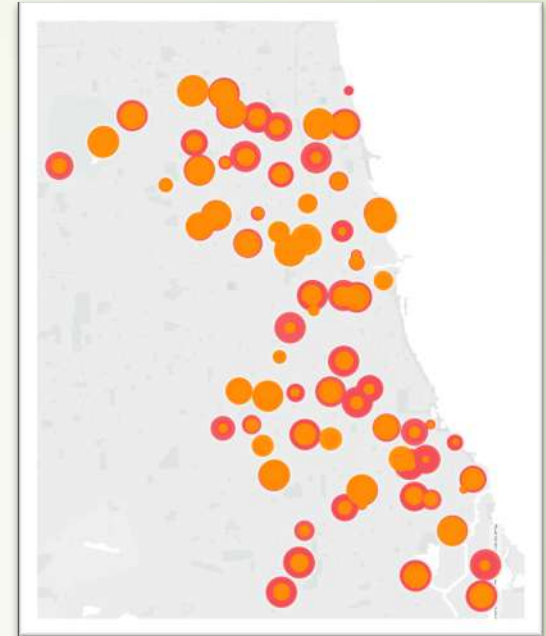
2007



2009



2011



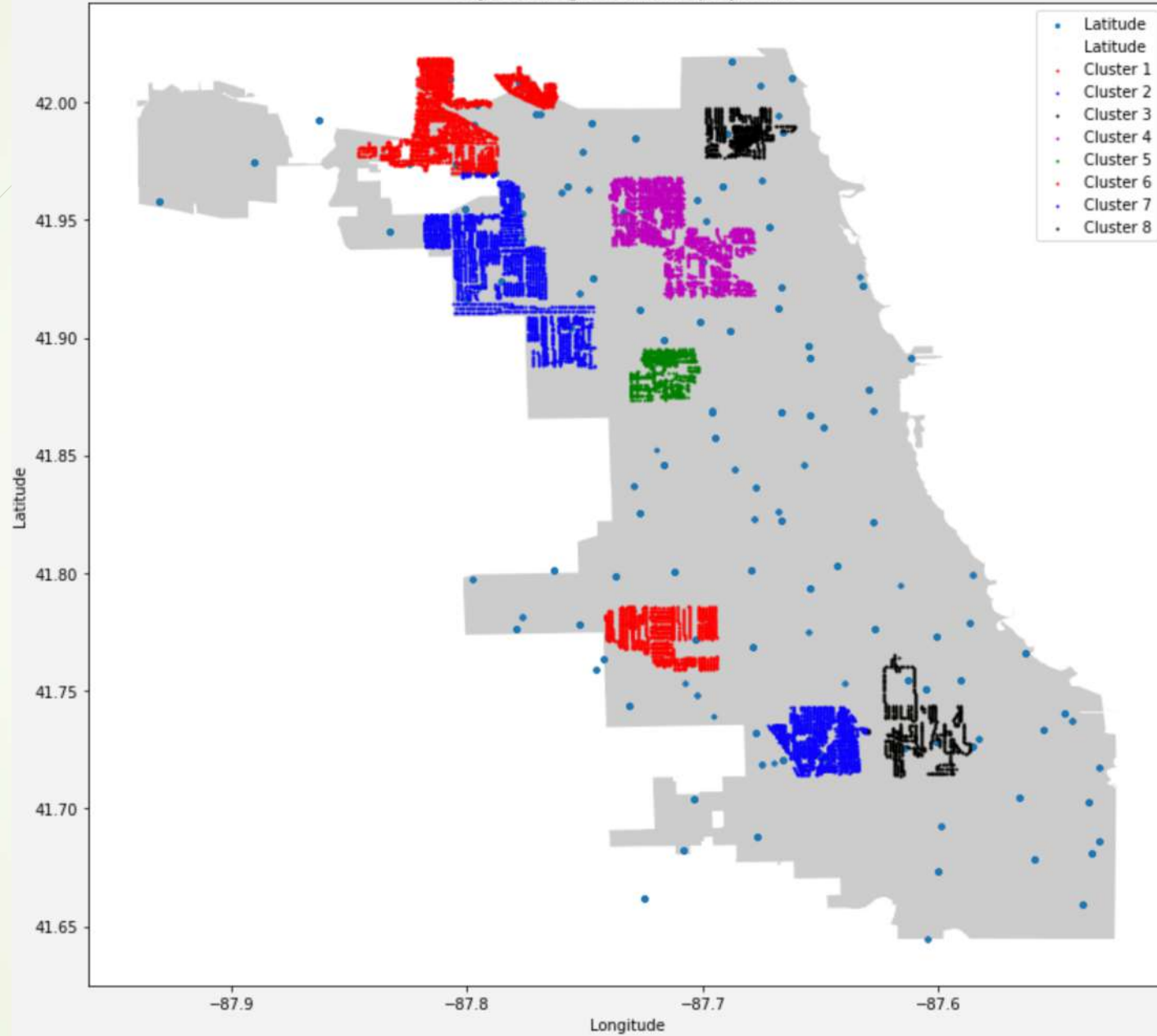
2013

Species

CULEX PAPIENS

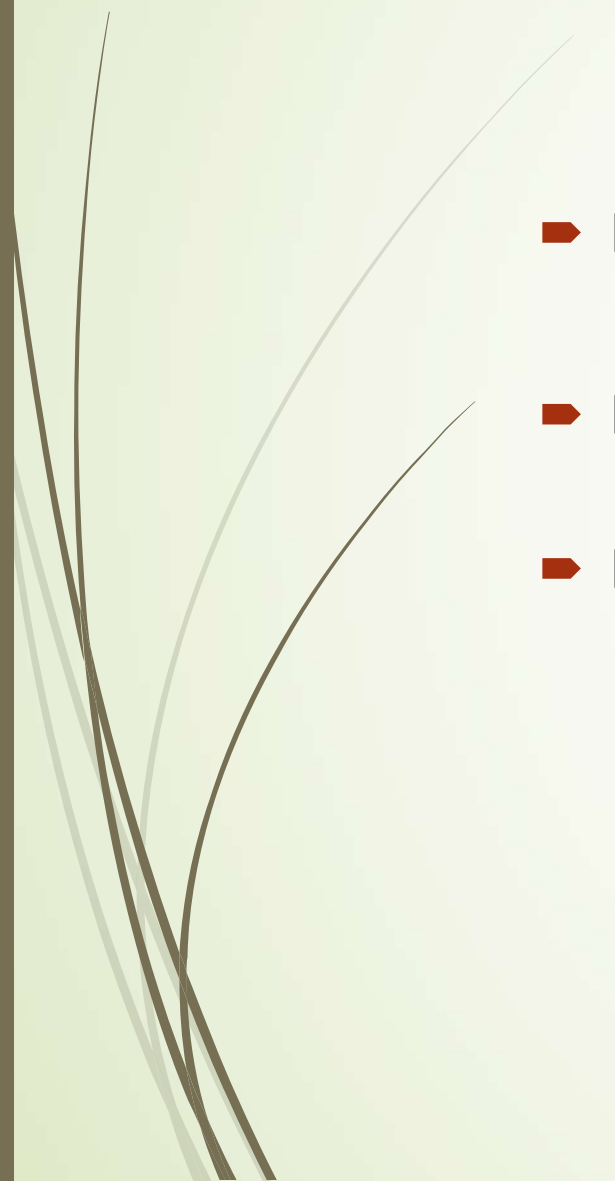
CULEX PAPIENS/RESTUANS

City of Chicago Historical Spray Zones





Feature Selection

- Numerical Data
 - Dummy Variables
 - Let the computer do the heavy lifting...
 - Pipelines & Grid Search
- 



Feature Selection & Model Selection

➤ **Dummied Out Features**

- Random Forest on Dummy Data
- AdaBoost on Dummy Data
- Gradient Boost on Dummy Data

➤ **Numerical Features**

- Random Forest on Numerical Data
- AdaBoost on Numerical Data
- Gradient Boost on Numerical Data
- Logistic Regression on Numerical Data



Optimal Model

- **AdaBoost**
- Hyperparameter Tuning
 - `n_estimators(20, 30, 40, 50 ,60, 80 , 100, 120)`
 - `learning_rate(1.0, 0.8, 0.4, 0.3, 0.1)`
- Best Parameters were...
 - `n_estimators = 100`
 - `learning_rate = 0.8`
- Accuracy Score: 76%



Dramatic Pause

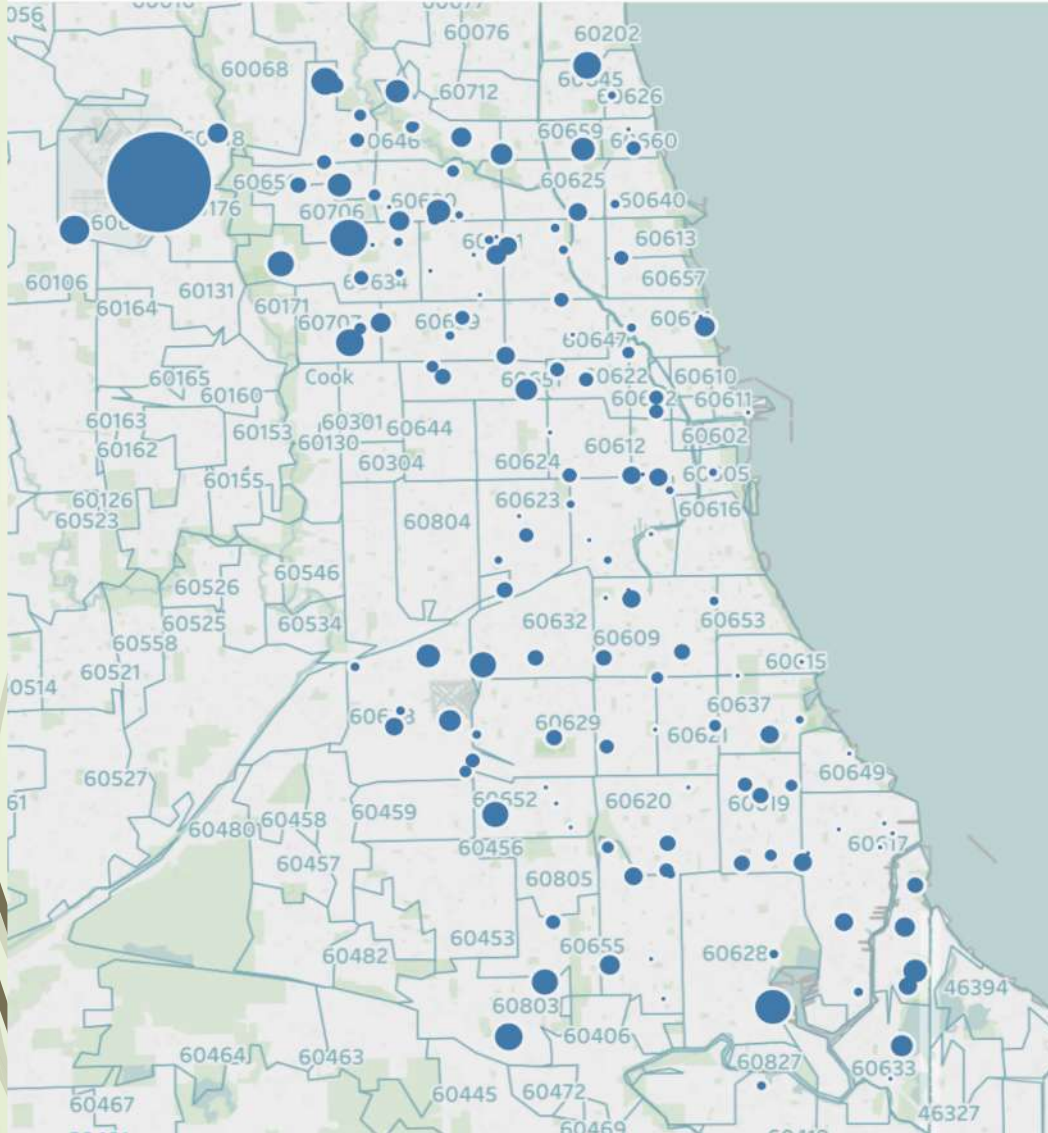
Where To Spray



- Recommendations based off of AdaBoost Model



Where To Spray – Zip Code



- Recommendations based off of AdaBoost Model



How Much Zenifex To Spray

- 146 Spray Locations (city blocks)
- 2.5 Acres Per Block
 - 365 Acres
- \$0.64 per acre
- Raw Cost: \$233.60
- Total Cost (Contingency Planning): **\$250.00 of Zenifex**



Cost of Equipment

- Aerial application covers a larger area faster than the ground application equipment, but it is more expensive than ground application
- Aerial Application: \$250 to \$1000 per hour
- Ground Application: \$150 to \$250 per hour
 - \$200 per hour
 - 2 days
 - 8 hour days
- Total Equipment Cost: **\$3200**



Cost of Labor

- # of Humans Spraying = 2
 - Cost Per Human = \$20 / hour
 - Total Cost = \$640
- # of Humans from Dept of Public Safety = 1
 - Cost Per Human = \$30 / hour
 - Total Cost = \$480
- Total Labor Cost = **\$1120**



Total Cost



\$ 4,570.00



Cost Of Inaction...



Cost of Doing Nothing

- Over \$41 million in healthcare costs nationally since 1999
 - \$866,000 estimated cost for Chicago
- Permanent disability and death

Encephalitis... no, thank you.

- WNV consists of
- Carriers = birds
- Genetic prog
- possible once
- ~ 75% of infect
- are often unan
- ~ 20% deve
- ~ 1% of patient
- the brain area
- 1 in 10 of these patients will die



any copies of itself as

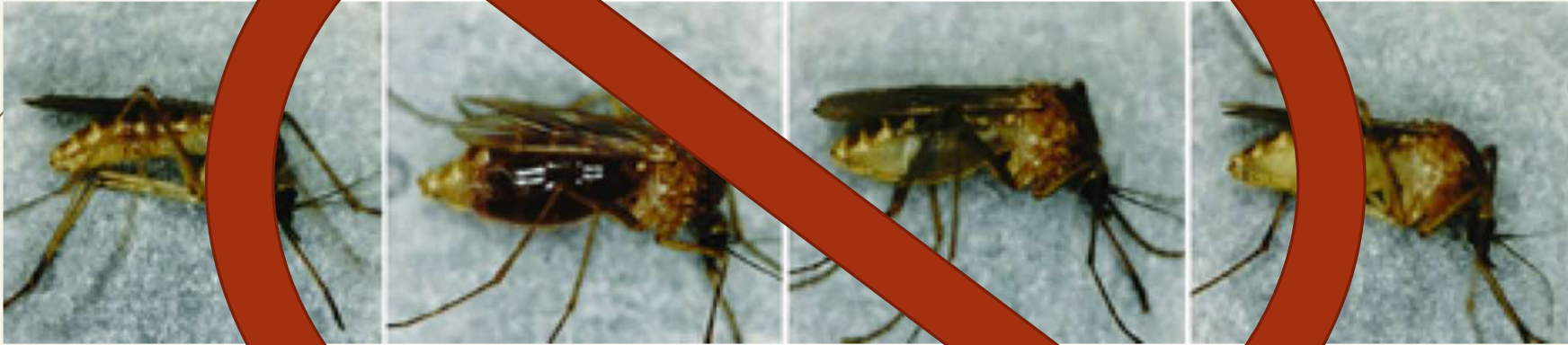
few or no symptoms and
infected

rash

encephalitis - inflammation in



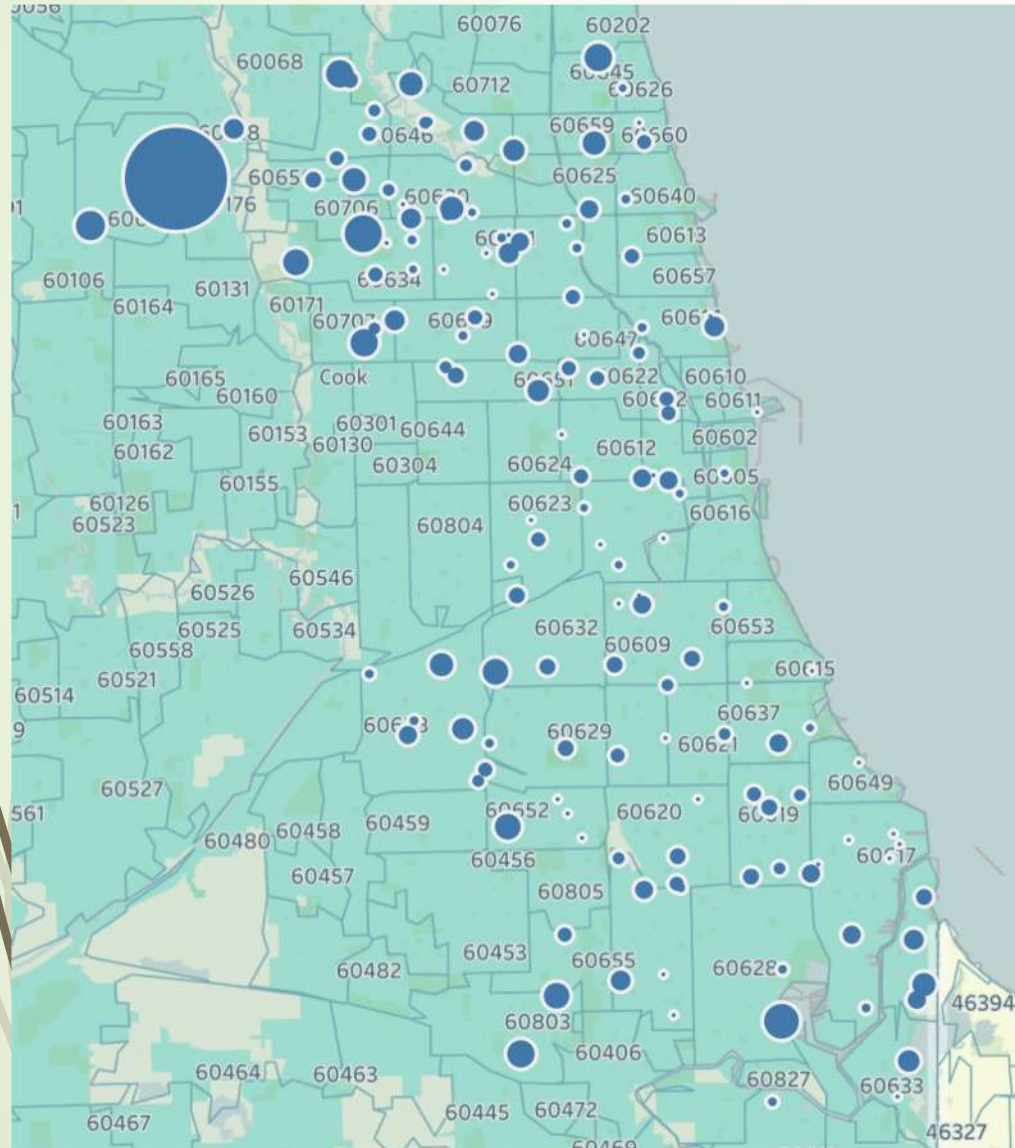
Questions?



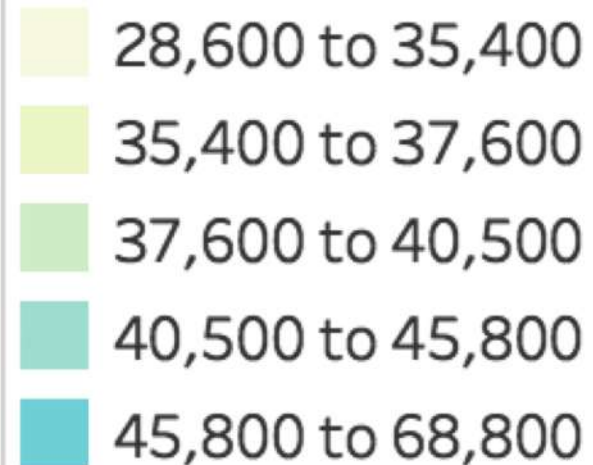
Sources

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- "Protective immune responses against West Nile virus are primed by distinct complement activation pathways": Erin Mehlhop, Michael S. Diamond: *Journal of Experimental Medicine* May 2006, 203 (5) 1371-1381; DOI: 10.1084/jem.20052388
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- <https://www.sciencedaily.com/releases/2014/02/140210184713.htm>
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- <http://lakecountyl.gov/DocumentCenter/View/23494/Summary-of-West-Nile-Virus---2017?bidId=>
- <http://lakecountyl.gov/2371/West-Nile-Virus>

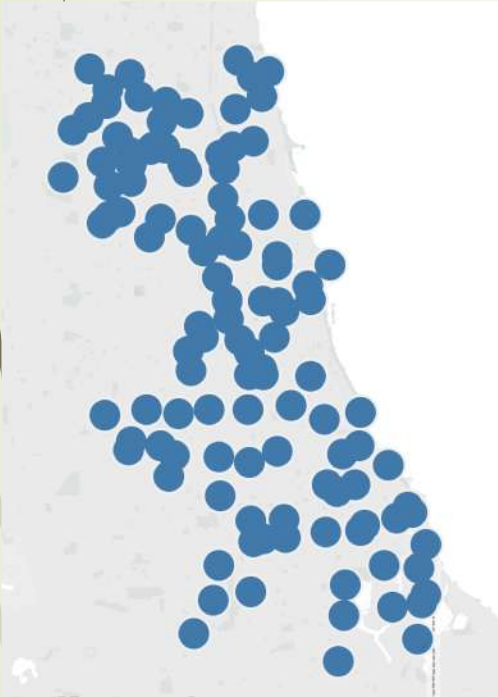
Demographic Deep Dive



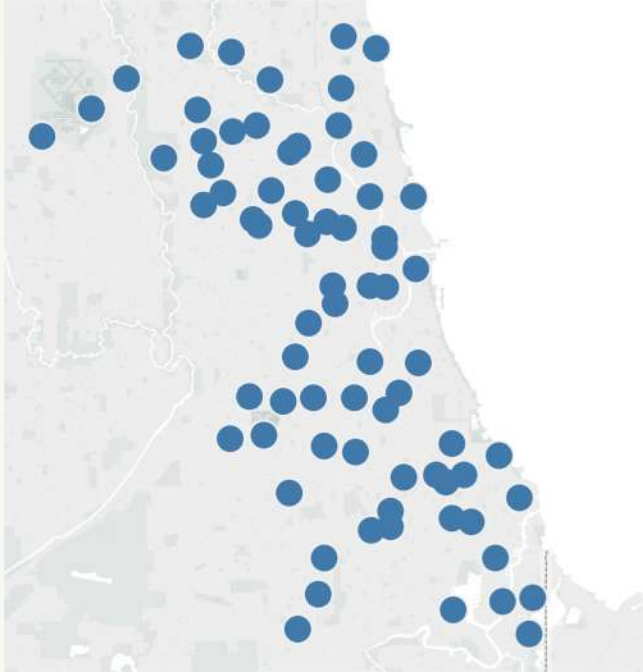
2018 Per Capita Income



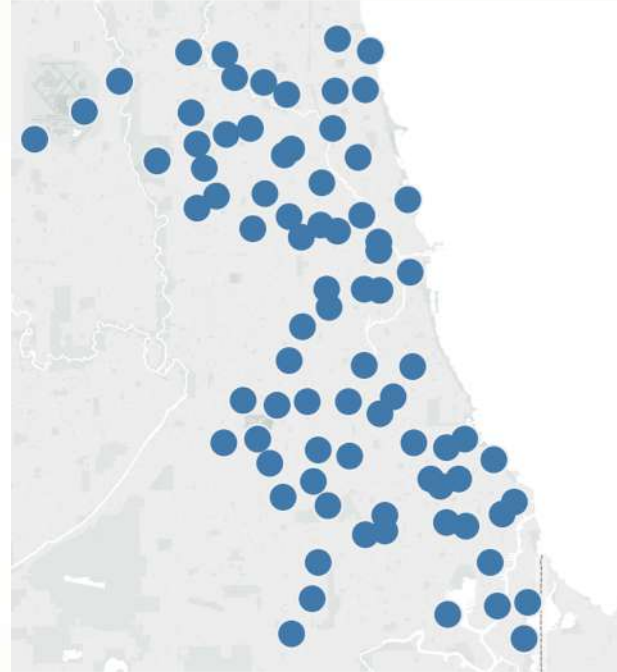
Where was the Spray?



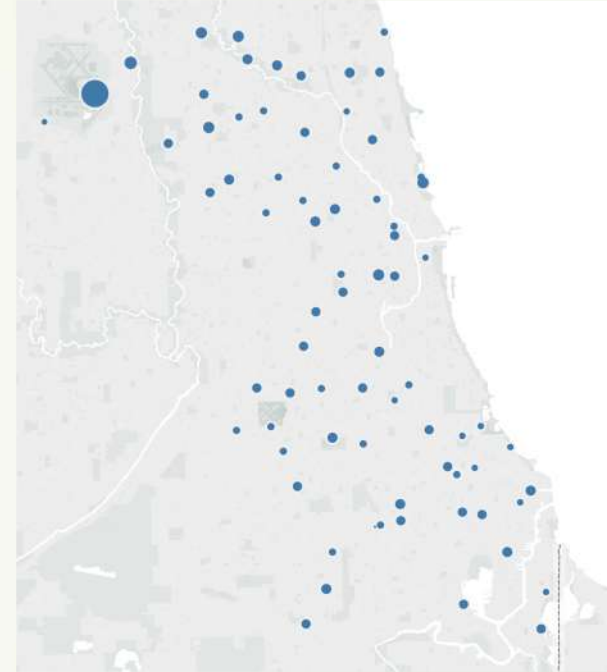
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