

# VACCINATION CLINIC LOCATION OPTIMIZATION

## RTI-DUKE DATA+ PRACTICUM

### PROBLEM STATEMENT

What are the best locations for immunization and vaccination clinics in Durham County if there is a Zika virus outbreak?

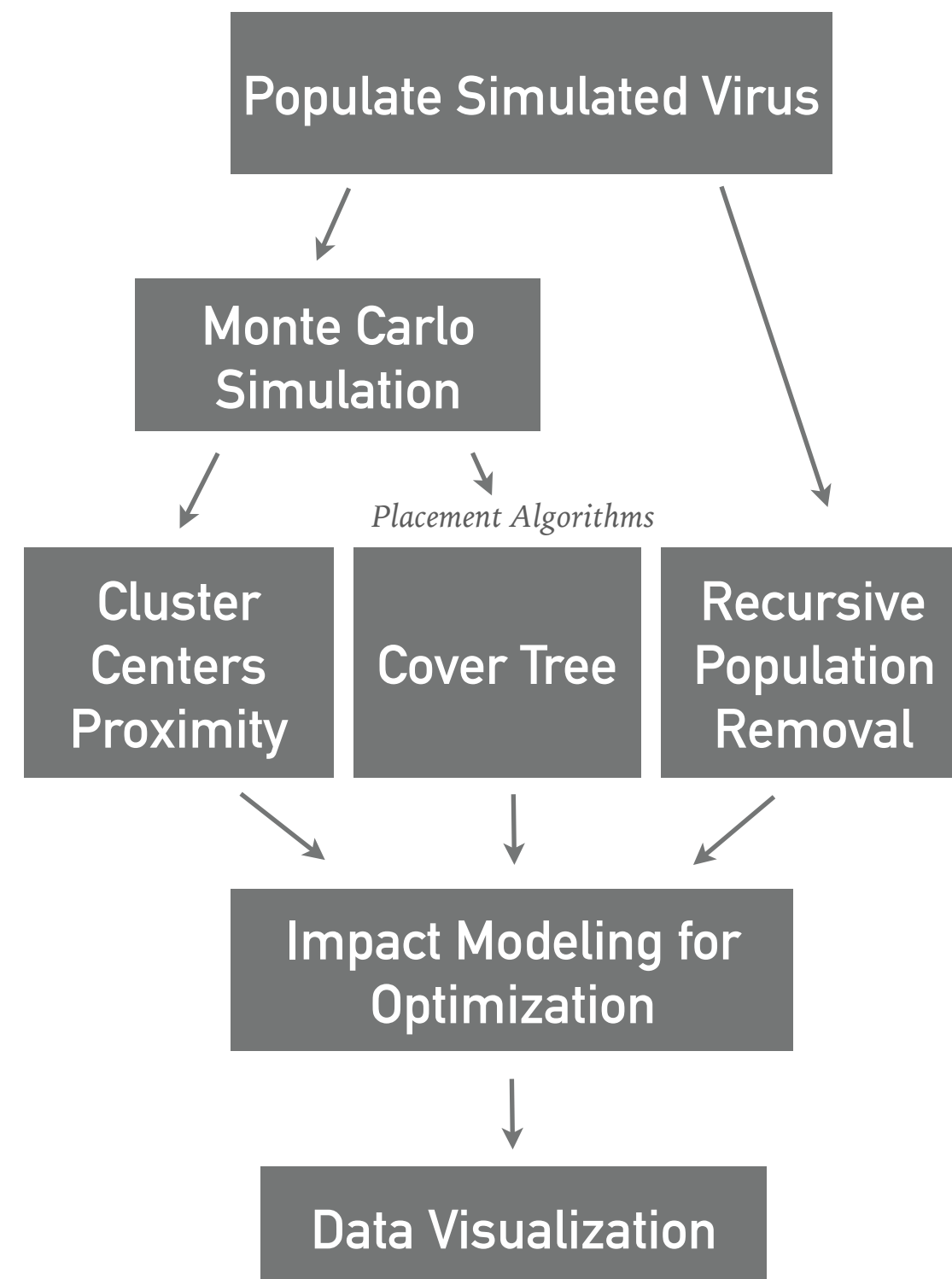
### ZIKA VIRUS BACKGROUND

- Zika Virus Genus: *Flavivirus*
- Transmission Routes: Vector-borne (*Aedes aegypti* mosquito), Vertical, and Sexual
- Symptoms: Rash, joint pain, conjunctivitis, and fever
- Problem: If a pregnant woman is infected, can cause microcephaly and other birth defects in the child

### SYNTHETIC POPULATION DATA

- Synthetic Population: Computer-generated projections of distribution of households based on household income, number of occupants in household, and race and age of head of household
- Data prepared from 2010 US Decennial Census by RTI International

### METHODS



# ANALYSIS & RESULTS

## PLACEMENT ALGORITHMS

*Clinics must only be placed in schools that Durham County Residents attend*

**Cluster Centers Proximity:** Find schools within 1 mile sq. radius of natural cluster centers (k-means) that serve most people within a 3.5 mile sq. radius

**Cover Tree:** Use basic cover tree data structure concepts to place clinics for maximum coverage of population

**Recursive Population Removal:** Find school that serves the most people within a 3.5 mile sq. radius, remove those people from the population, recurse

## IMPACT MODEL OPTIMIZATION

*Used 4 clinic sites for initial model because 4 natural population clusters*

Ross-McDonald Model used for disease spread analysis with simultaneous vaccination spread

Cover Tree clinic set determined as most efficient in vaccinating and limiting disease within the population

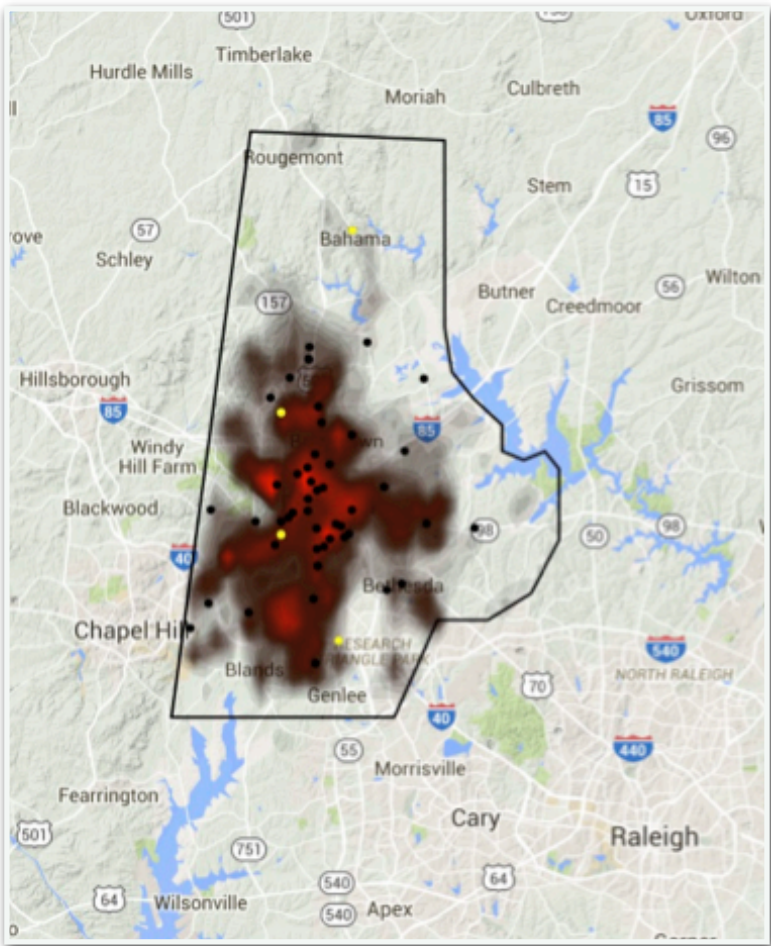
## CLINIC SITES

- Mangum Elementary School
- Hillandale Elementary School
- Rogers-Herr Middle School
- Lowes Grove Middle School

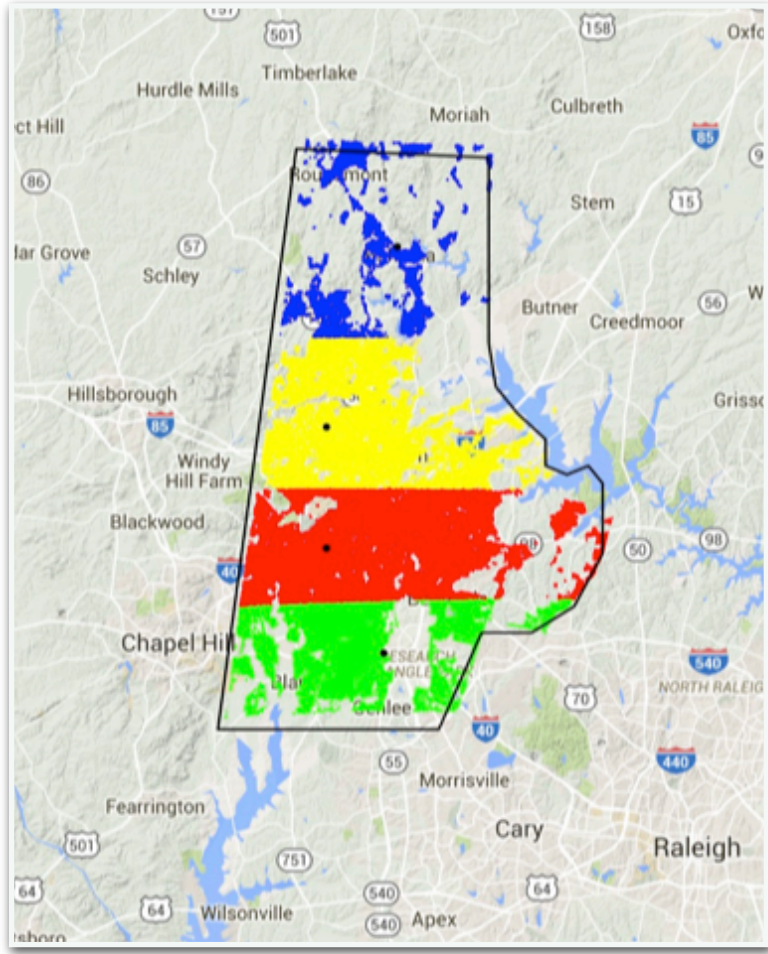
## IMPACT MODELING RESULTS

	Cluster Center Proximity	Cover Tree	Recursive Population Removal
Time to Herd Immunity	50 Days	29 Days	41 Days
Total Vaccinated	202,085 (76.1%)	205,394 (77.3%)	204,687 (77.0%)
Total Infected	5,830 (2.2%)	3,445 (1.3%)	4,240 (1.6%)

## COVER TREE CLINIC PLACEMENT RESULTS



Durham County Population Density, Schools and Selected Clinic Sites  
U.S Synthetic Population 2010 Version 1.0, RTI International. Maps made in R.



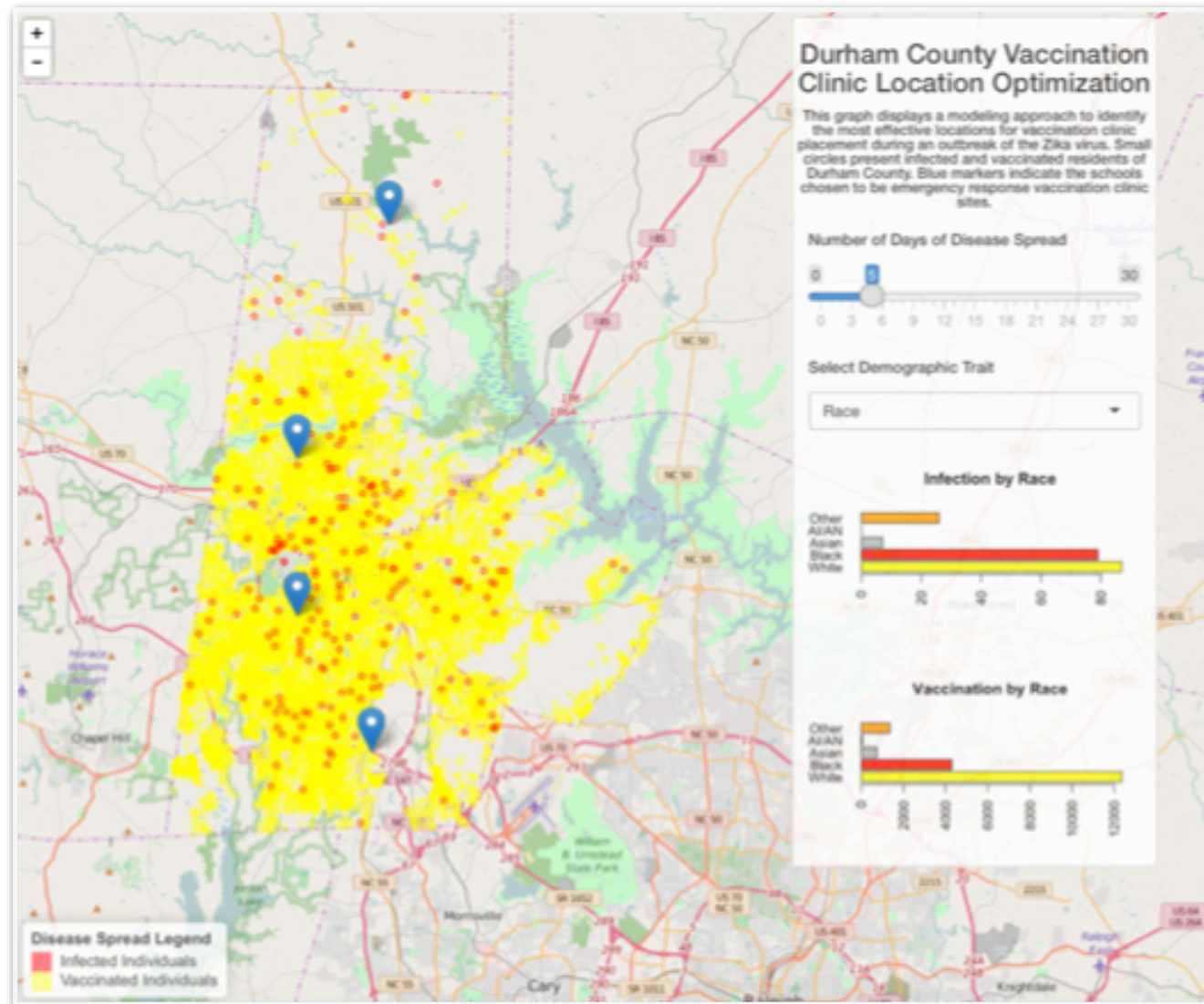
Durham County Population Segmented by Closest Chosen Clinic  
U.S Synthetic Population 2010 Version 1.0, RTI International. Maps made in R.



# FINAL PRODUCT & CONCLUSIONS

## R/SHINY IMPACT MODEL VISUALIZATION APPLICATION

*Interactive application to explore impact model and demographic break downs*



## PLACEMENT ALGORITHM CHOICE

- Cover Tree provides the best model in selecting schools that will reach the most people in Durham County in the shortest amount of time, limiting the number of people infected
- Does not distribute population evenly among clinics, but instead provides closer access to entire population
- Can select different model for more even distributions if the desired clinic specifications change

## IMPACT MODELING ADAPTION

- Adaptable model can easily select any number of schools in Durham County to use as vaccination clinic sites
- Model can also be adapted for other diseases by replacing Ross-McDonald Model for appropriate disease spread model and disease-specific parameters

## OPPORTUNITIES FOR FURTHER RESEARCH

- Expand placement algorithms to include more advanced spatial scanning statistics
- Inclusion of traffic patterns
- Analysis of clinic capacities and vaccination scheduling
- Account for budget constraints