

Mapping Health Information

Lecture #10 | GEOG 510
GIS & Spatial Analysis in Public Health
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Overview

- Why map
- Map types (data types)

Why We Create Maps

- Allows for visual interpretation of geographic patterns of phenomena
 - Location of objects/events
 - Themselves (e.g., clustered? where?)
 - Or, in relation to other things
 - Variation of a type or value
 - Categories
 - Quantities

Mapping in a GIS

- Two purposes
 - Mapping for yourself
 - Displaying data in the GIS (or other statistical software)
 - Mapping for others
 - Creating a map to communicate with others

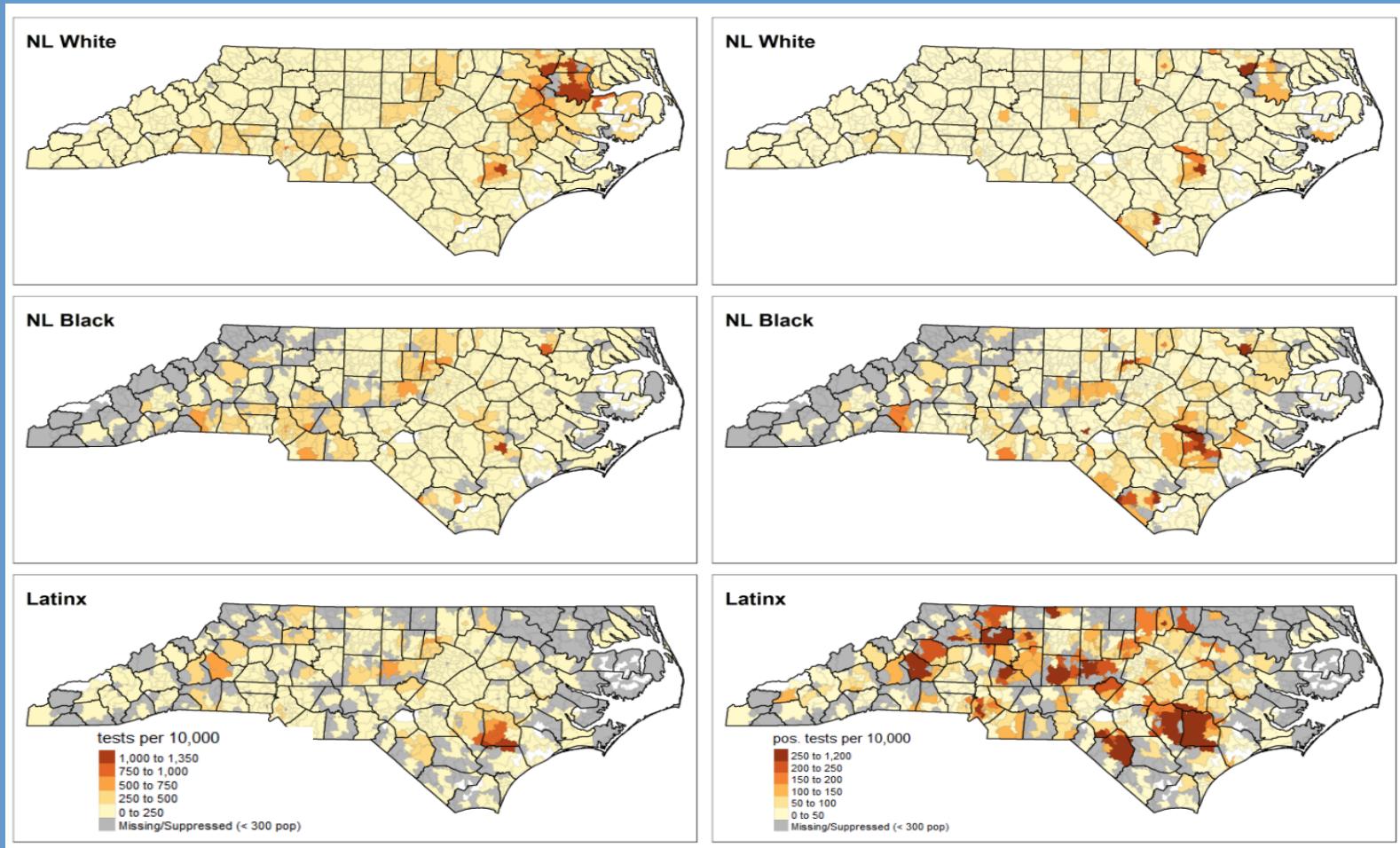
Mapping in a GIS

- Mapping for yourself
 - Displaying spatial data
 - Can be augmented with descriptive statistics or other graphical displays (e.g., histograms), Geovisualization
 - Exploratory or descriptive in nature
 - Visually identify spatial patterns or relationships
 - Hypothesis generation

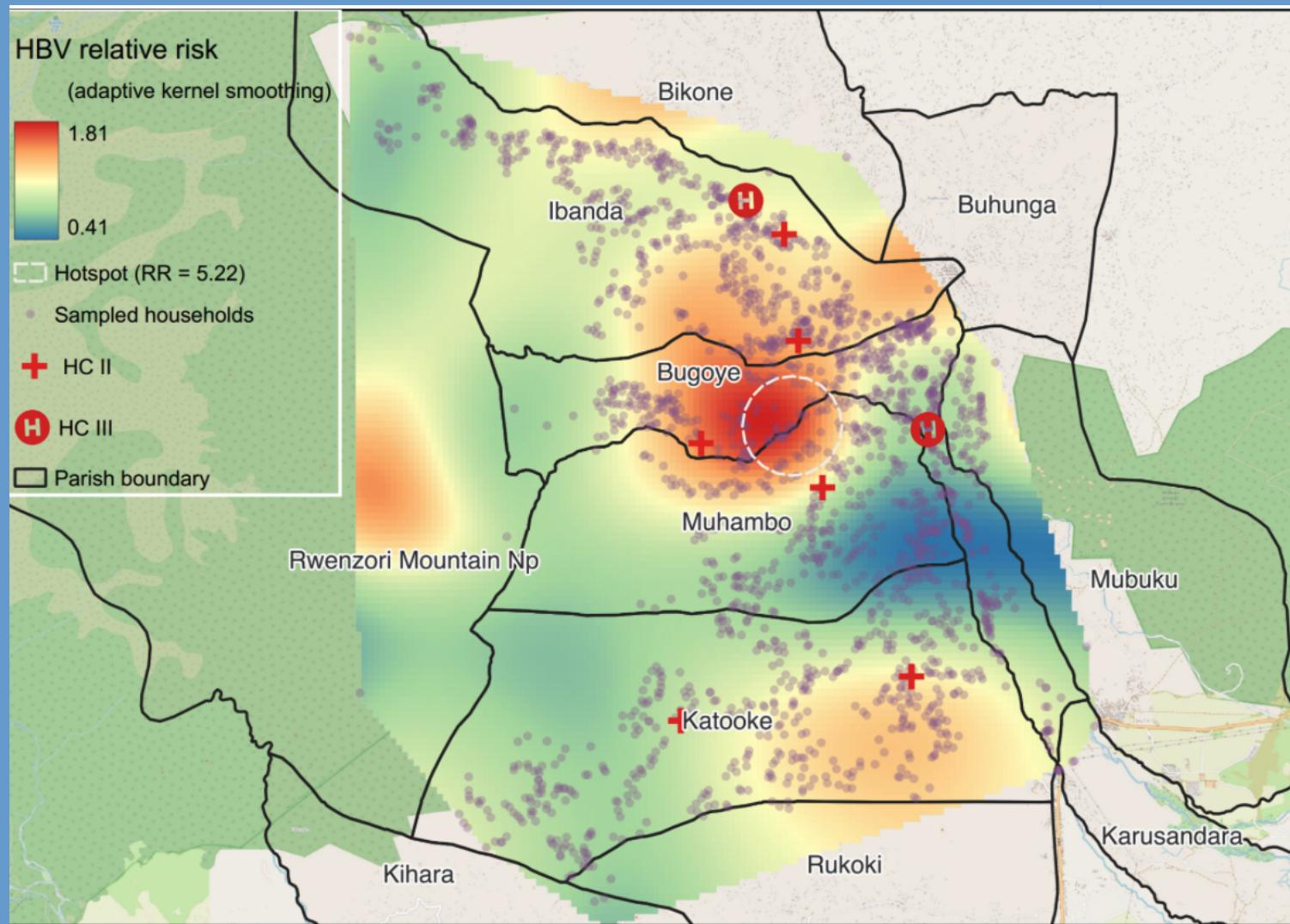
Pattern vs. Process

- A spatial pattern is generally the result of some spatial process
 - We map patterns (observe, describe)
 - We model processes (understand, explain, predict)
 - **Key question:** What is the underlying process that may be generating the observed health pattern?

Description

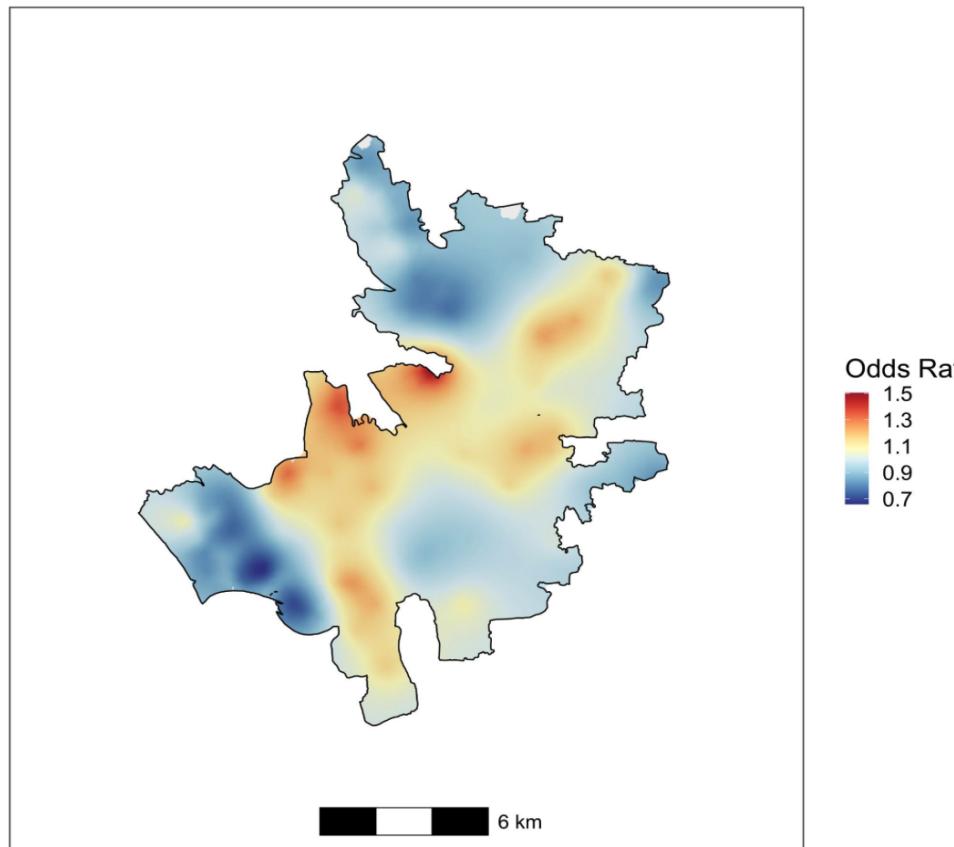


Description

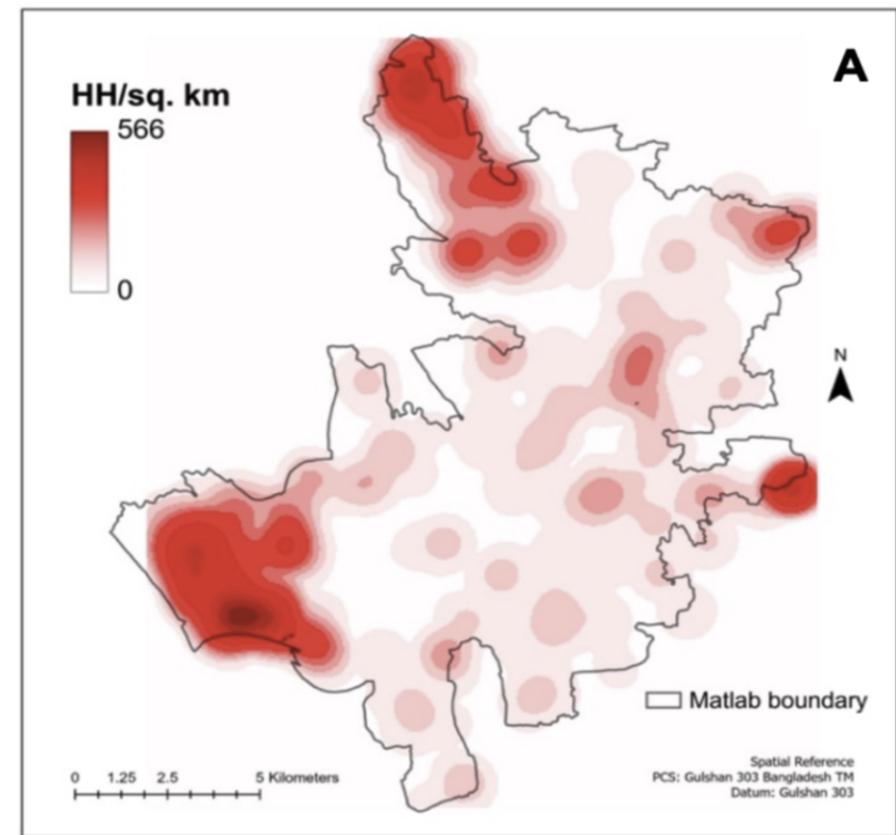


Explanation

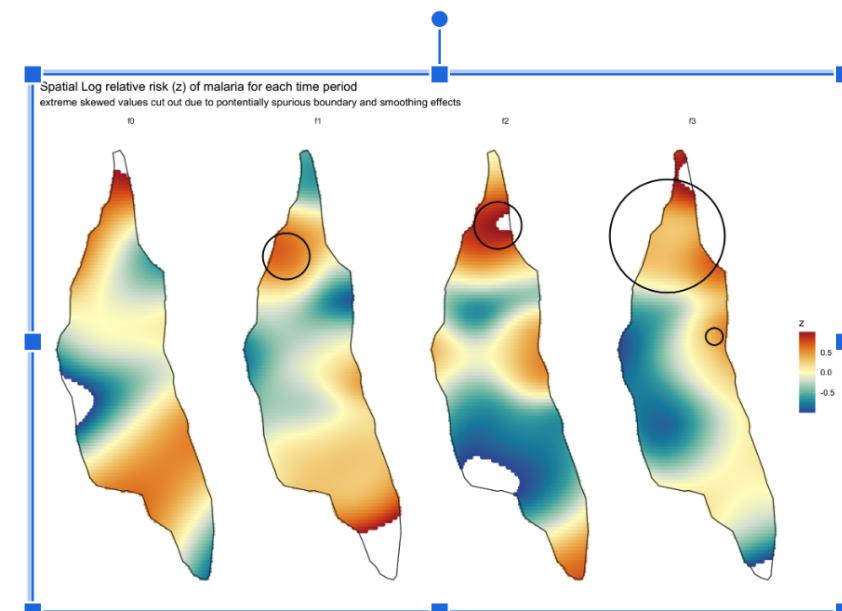
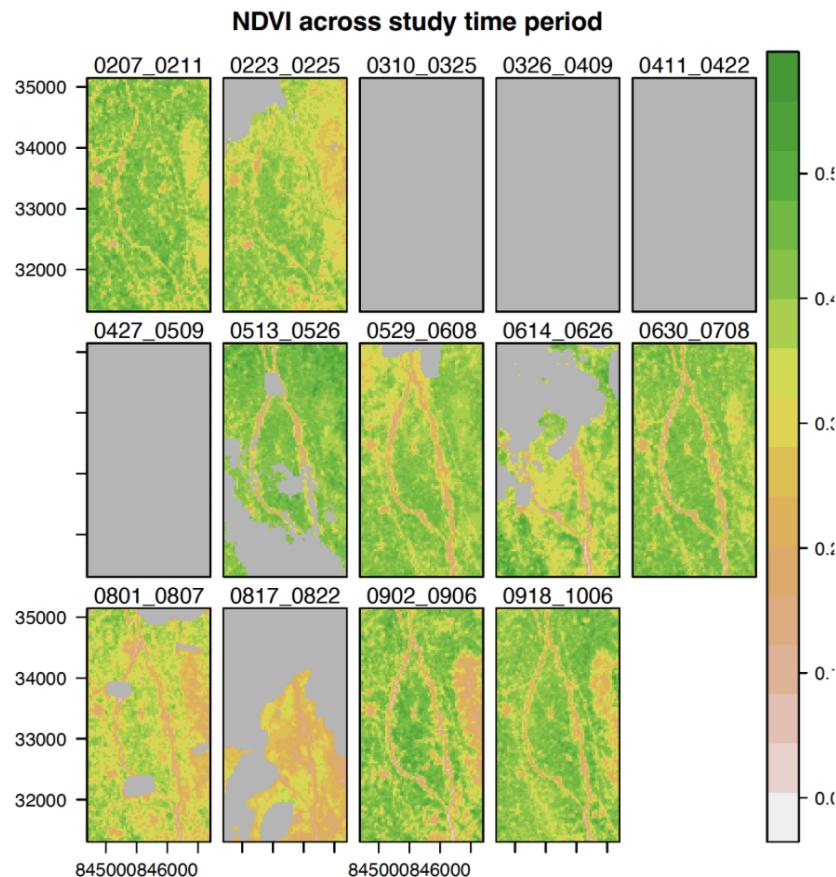
Odds of Diarrheal Disease Incidence



Density of deep tubewell use



Explanation



GIS and Maps

- Point
 - The map is a universal communication tool that has proved to be one of the strengths of GIS
- Counterpoint
 - The map metaphor is probably the greatest hindrance to further advancement in GIS analysis and applications

Mapping in a GIS

- Mapping for others
 - Main purpose is to communicate geographic information
 - Focus on design/presentation in order to create an output that effectively communicates the information

Map Types

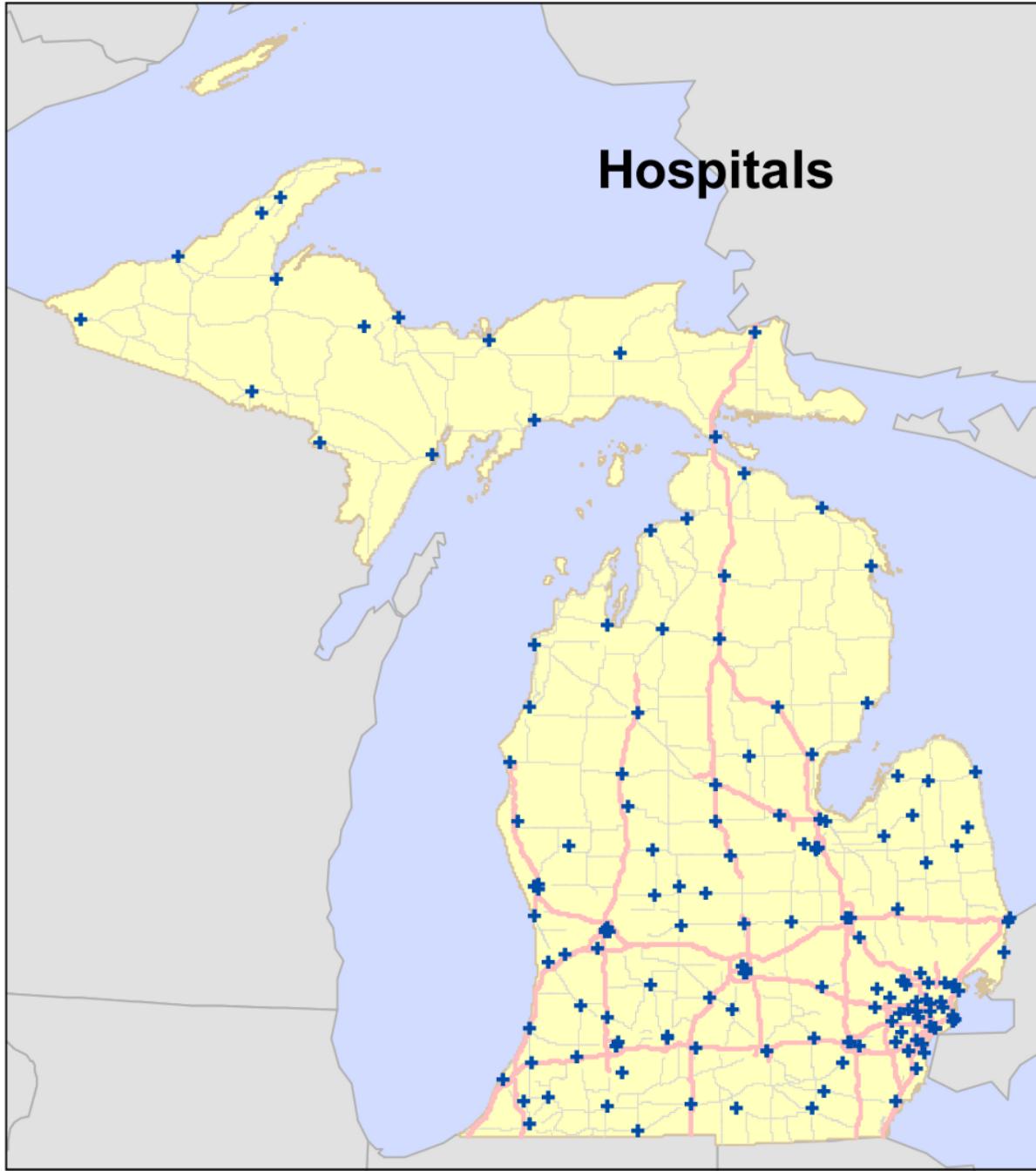
- Reference
 - Goal: communicate spatial association between various phenomena
 - e.g., roads, settlements, administrative boundaries, water bodies, etc.
- Thematic
 - Goal: communicate the distribution of a single property or relationships among several
 - Usually shown at small scale
 - *Small* scale equals *large* areal extent
 - Not restricted to any subject matter

Map Types

- Point map
- Proportional Symbol map
- Dot Density map
- Choropleth map

Point Map

- Variable of interest is represented as set of point features
 - e.g., disease events, facilities, wells
- Symbology is held constant (all points have the same shape, color, and size)
 - Visual interpretation of the density of events (per area) via the locations of points on the map



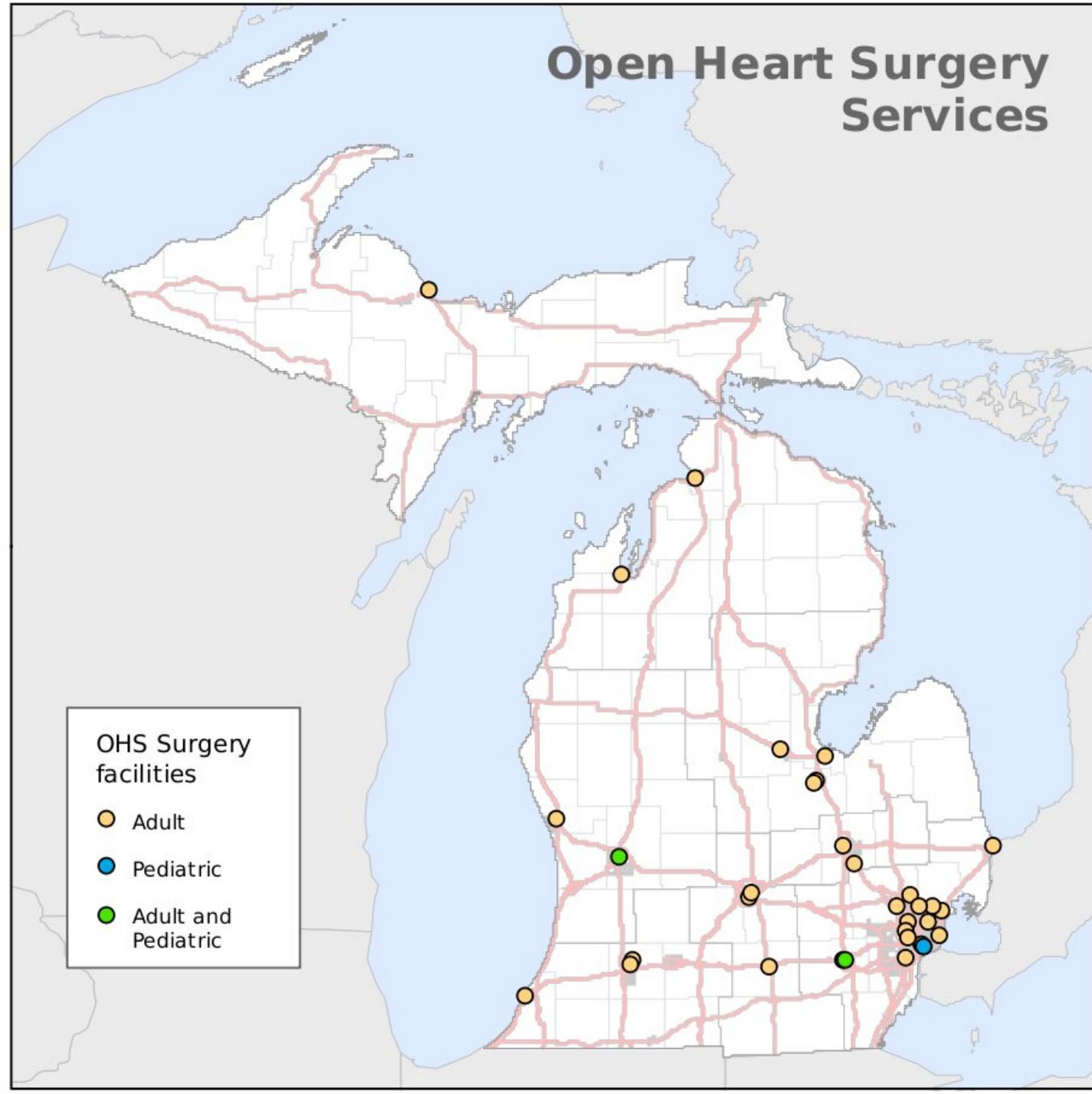
Point Map

- Variable of interest is represented as set of point features
 - e.g., disease events, facilities, wells
- Data integration
 - Compare density to other features
 - e.g., is location and density of events seem to be spatially co-located with other features

Point Map

- Categorical Point Map
 - Variable of interest is represented as set of point features, with categorical differentiation
 - Not quantitative!!
- Symbology is held constant except for shape or color (not size!!)

Open Heart Surgery Services



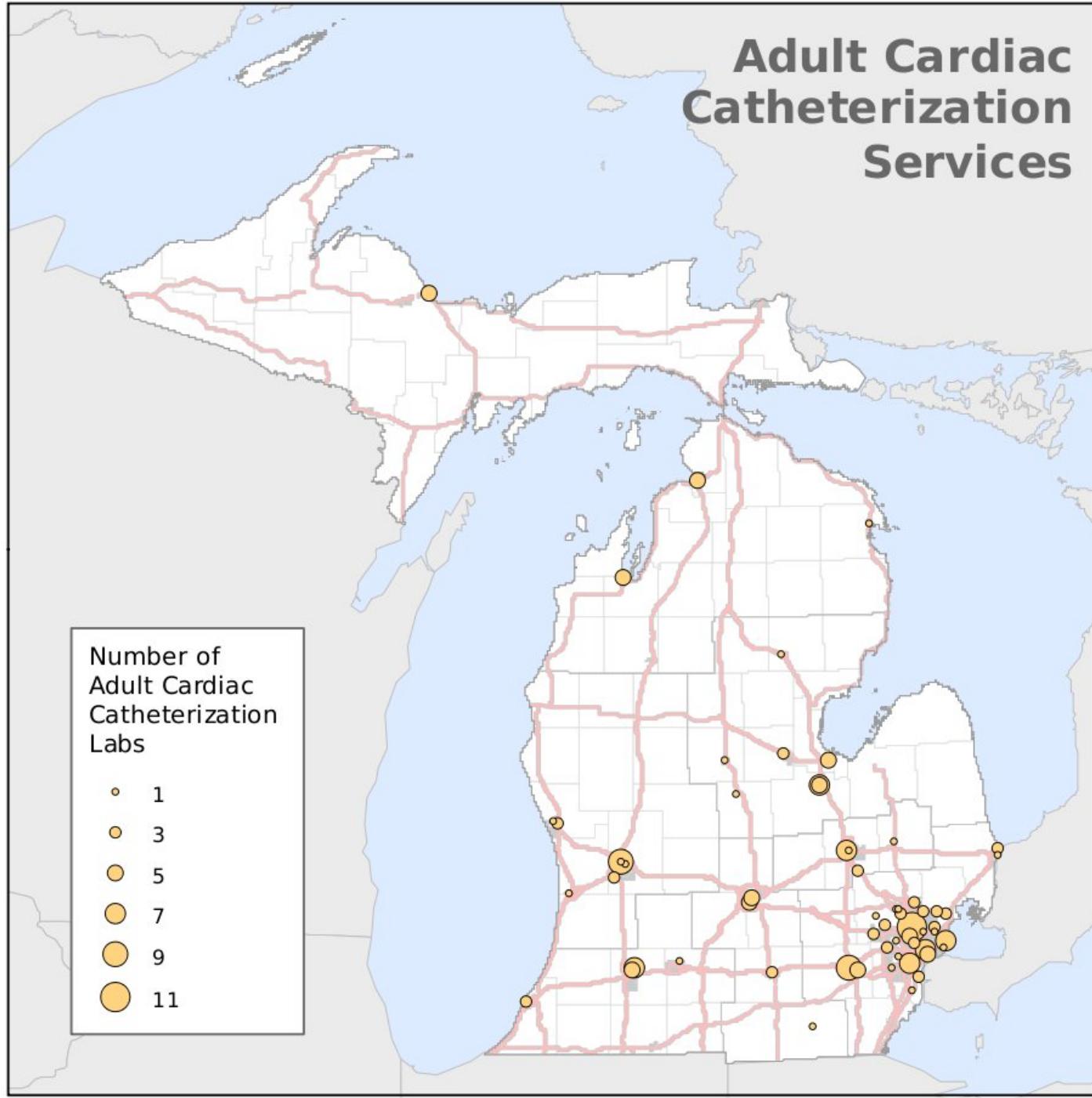
Proportional Symbol Map

- Variable of interest is represented as set of point features, with interval/ratio information
 - e.g., number of disease cases
 - Can also work with line data
- Size of symbol is scaled proportionally to the value of the attribute

Adult Cardiac Catheterization Services

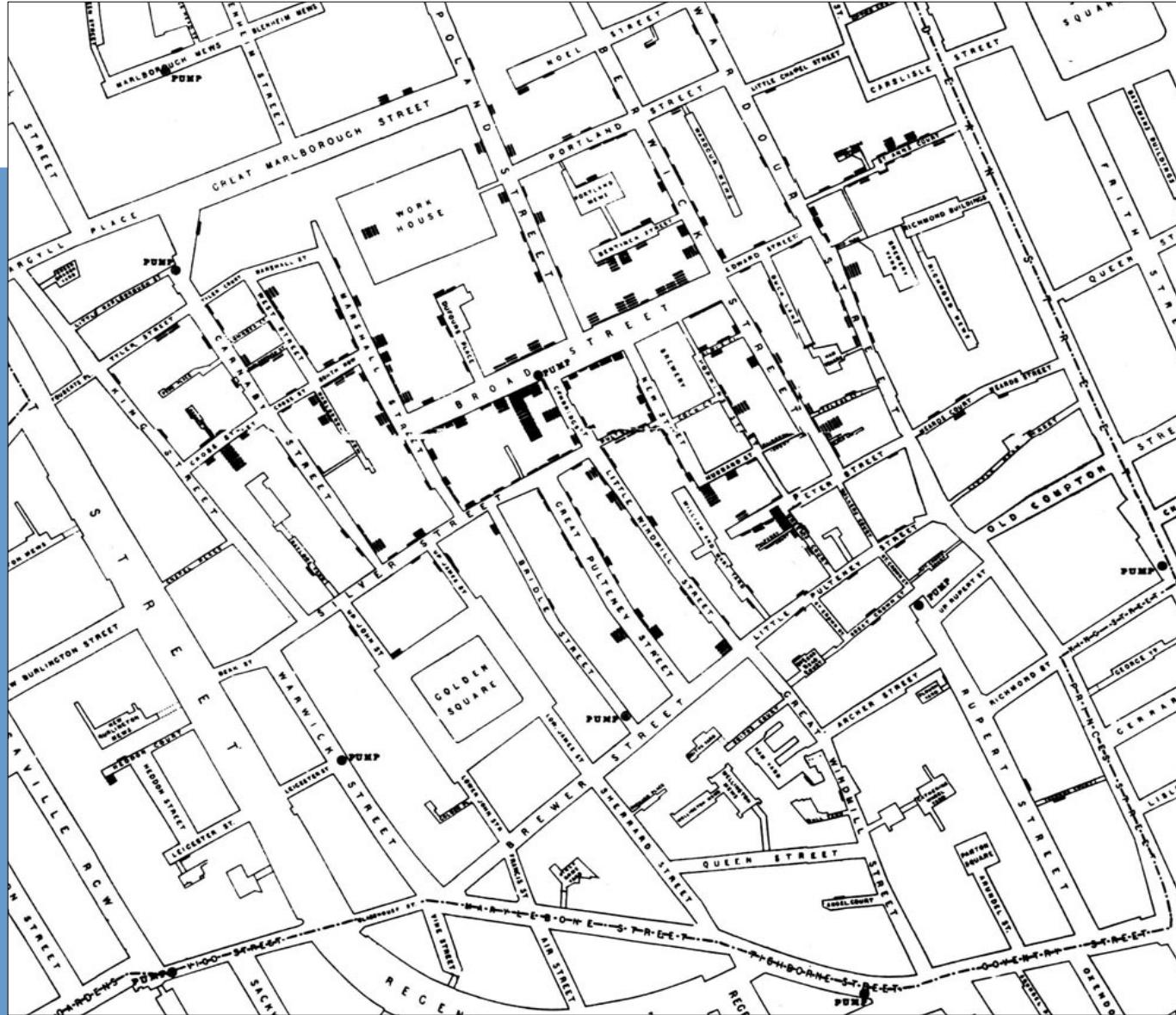
Number of Adult Cardiac Catheterization Labs

- 1
- 3
- 5
- 7
- 9
- 11



Proportional Symbol Map

- Number of disease cases
 - Data integration
 - Compare location and number of cases to other features
 - e.g., is location and density of events seem to be spatially co-located with other features
 - GREATEST EXAMPLE EVER NEXT...



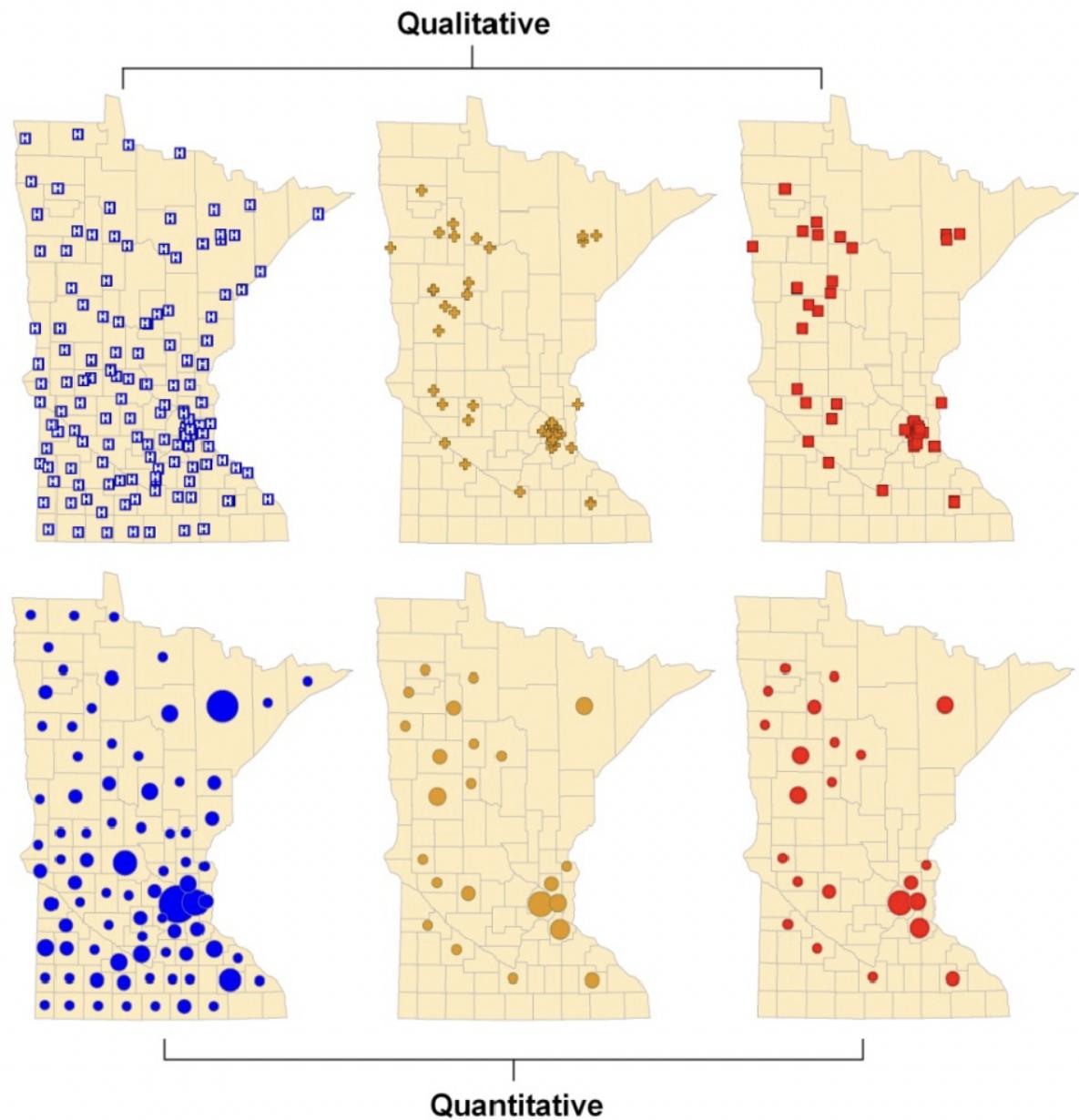
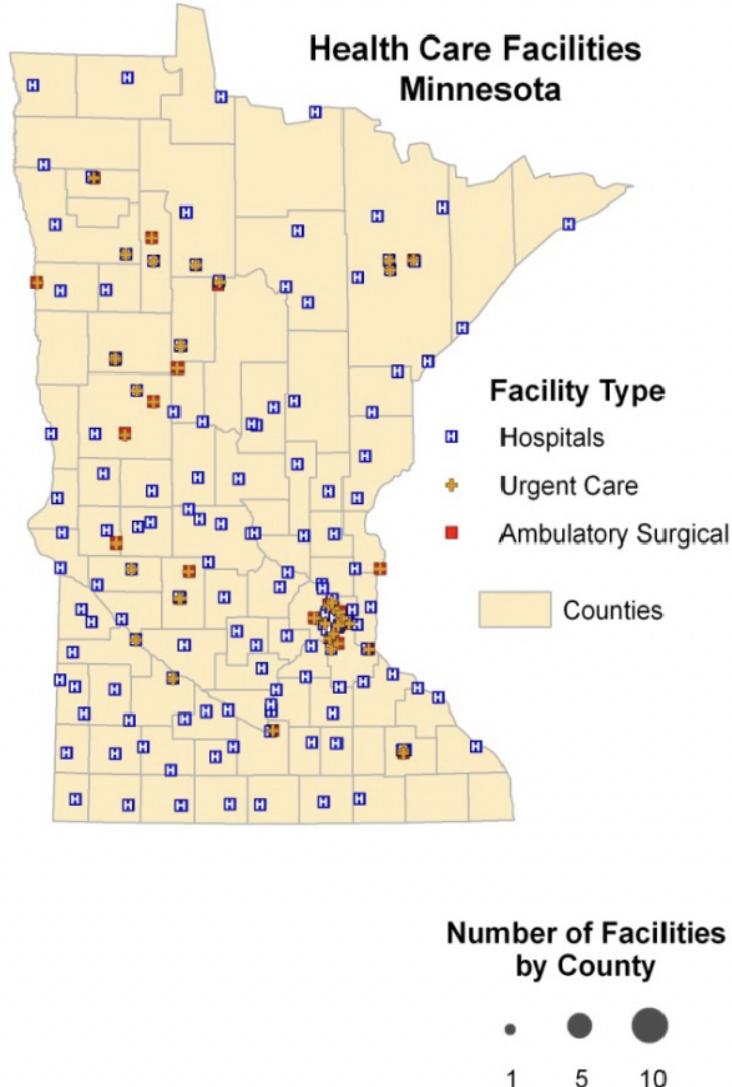
WORST EXAMPLE EVER NEXT...

CORONAVIRUS AROUND THE WORLD

The outbreak began in China and has infected thousands, leaving more than 150 people dead. More than a dozen countries have reported isolated cases.



Qualitative Data vs. Quantitative Data

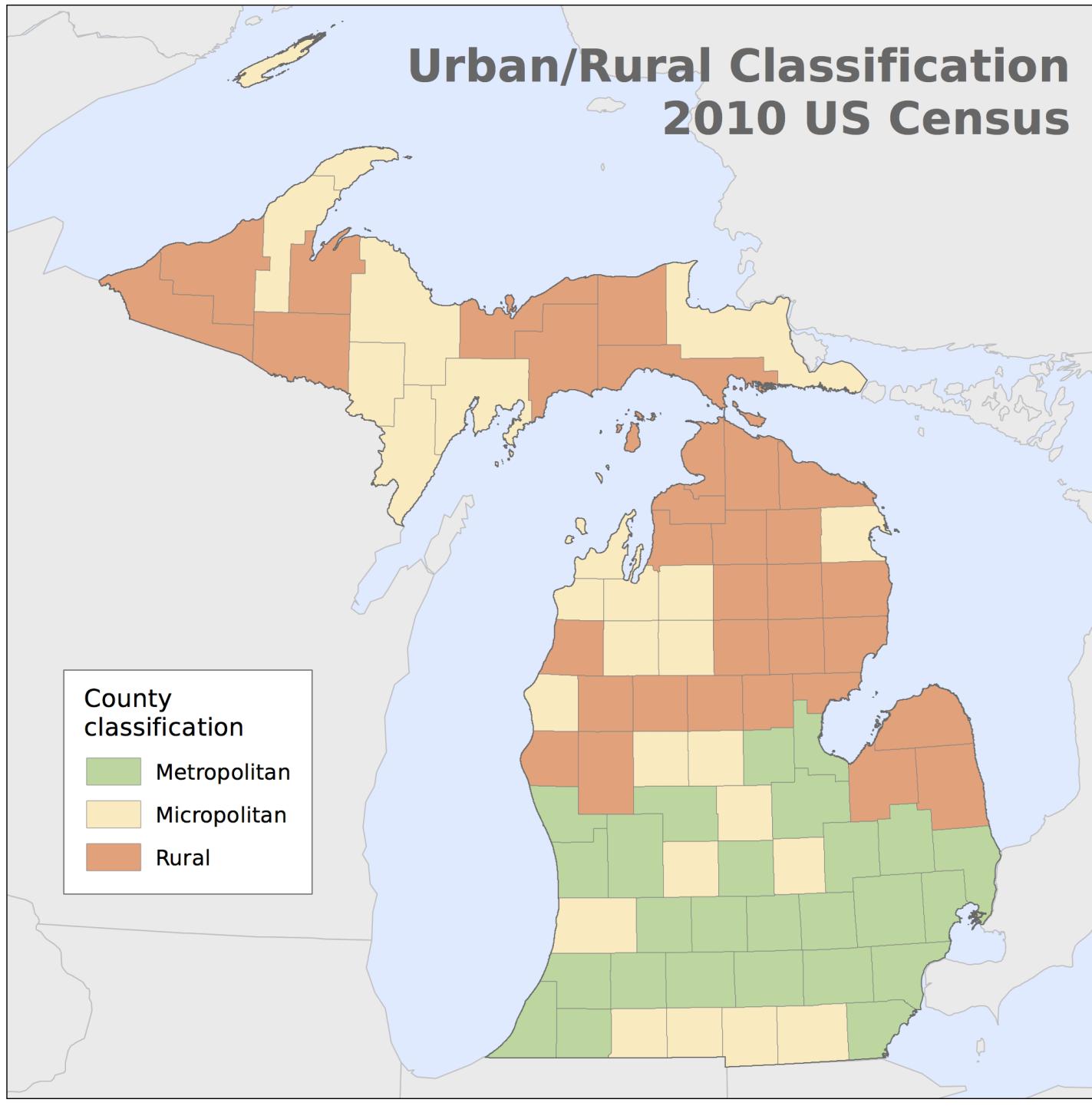


Data Source:
Homeland Security Infrastructure Program, 2010

Categorical Map

- Variable of interest is categorical information for areal data
 - Not quantitative!!
- Vary the color of the symbology to distinguish categories

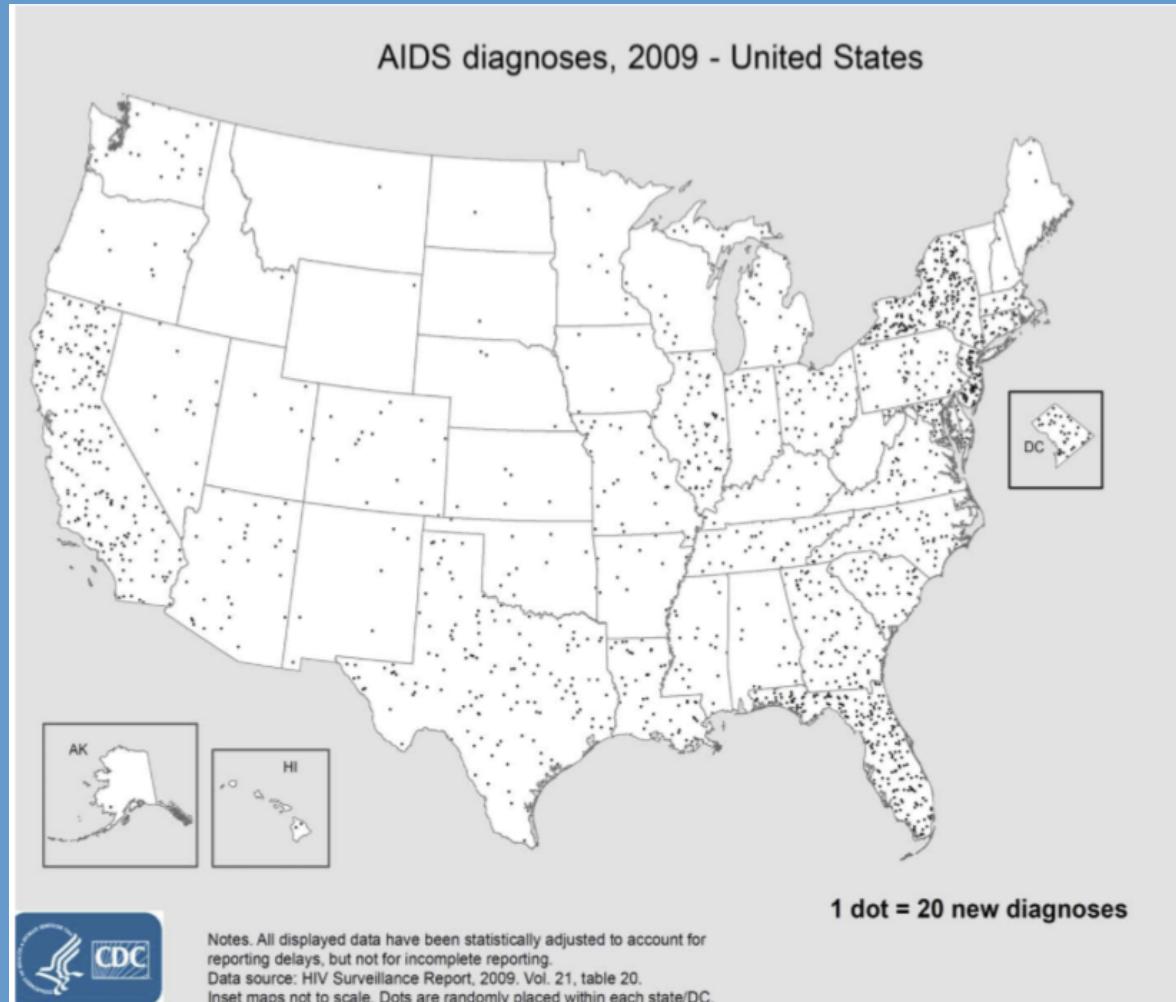
Urban/Rural Classification 2010 US Census



Dot Density Map

- Pseudo Point Map
- Variable of interest represented by counts located within areal features (polygons)
 - Converted to dots (points) via symbology
 - One dot represents X number of events
 - Dots are all the same shape, size, color
 - Visual interpretation of the density of events (per area) via the locations of points on the map

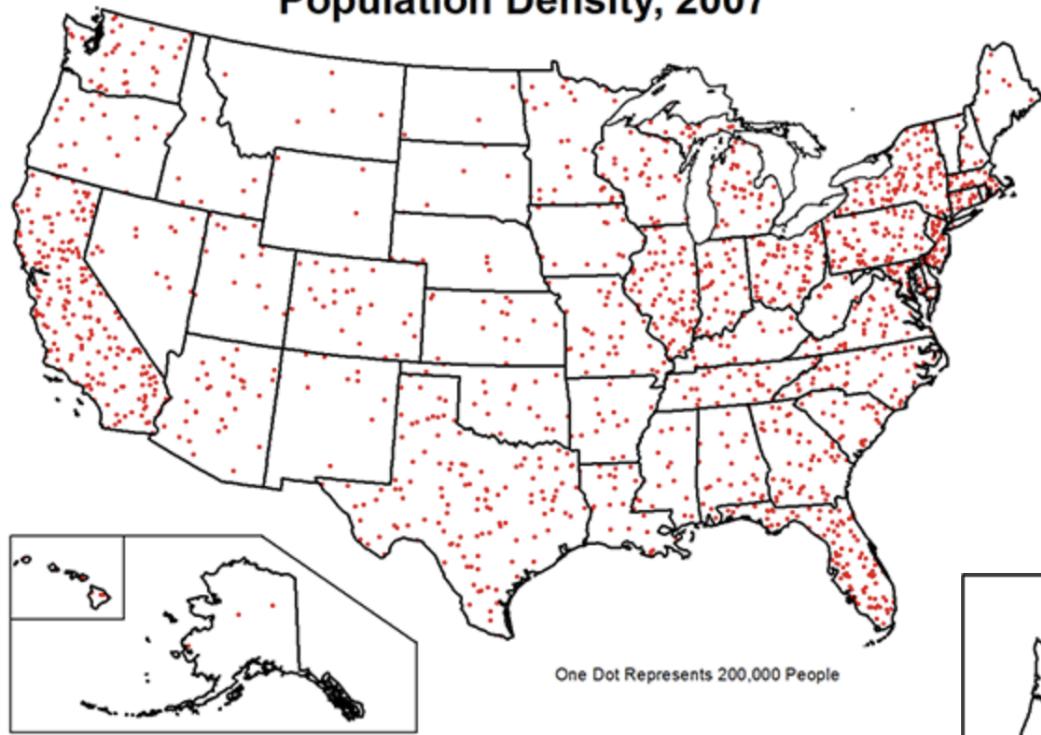
Dot Density Map



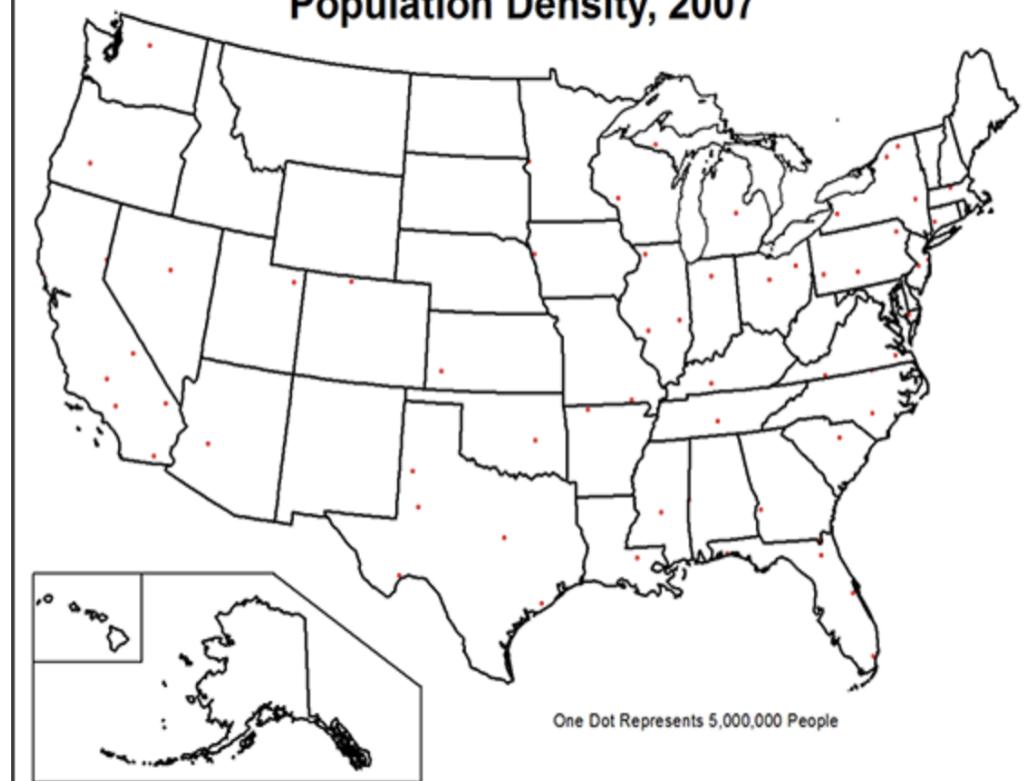
Dot Density Map

- Dot placement is random within the areal unit
 - ArcGIS functionality
 - Allows you to use a masking layer with two options
 - Inclusion: only place dots in areas in this layer
 - Exclusion: do not place dots in areas in this layer
- It is very easy to make a bad dot density map...

Population Density, 2007



Population Density, 2007



Choropleth Map

- Variable of interest represented by ratios/rates/proportions located within areal features (polygons)
 - We generally do not use counts
 - Areas are shaded with different colors, patterns, or intensities
 - Shows geographic variation
 - Requires classifying or binning the data values

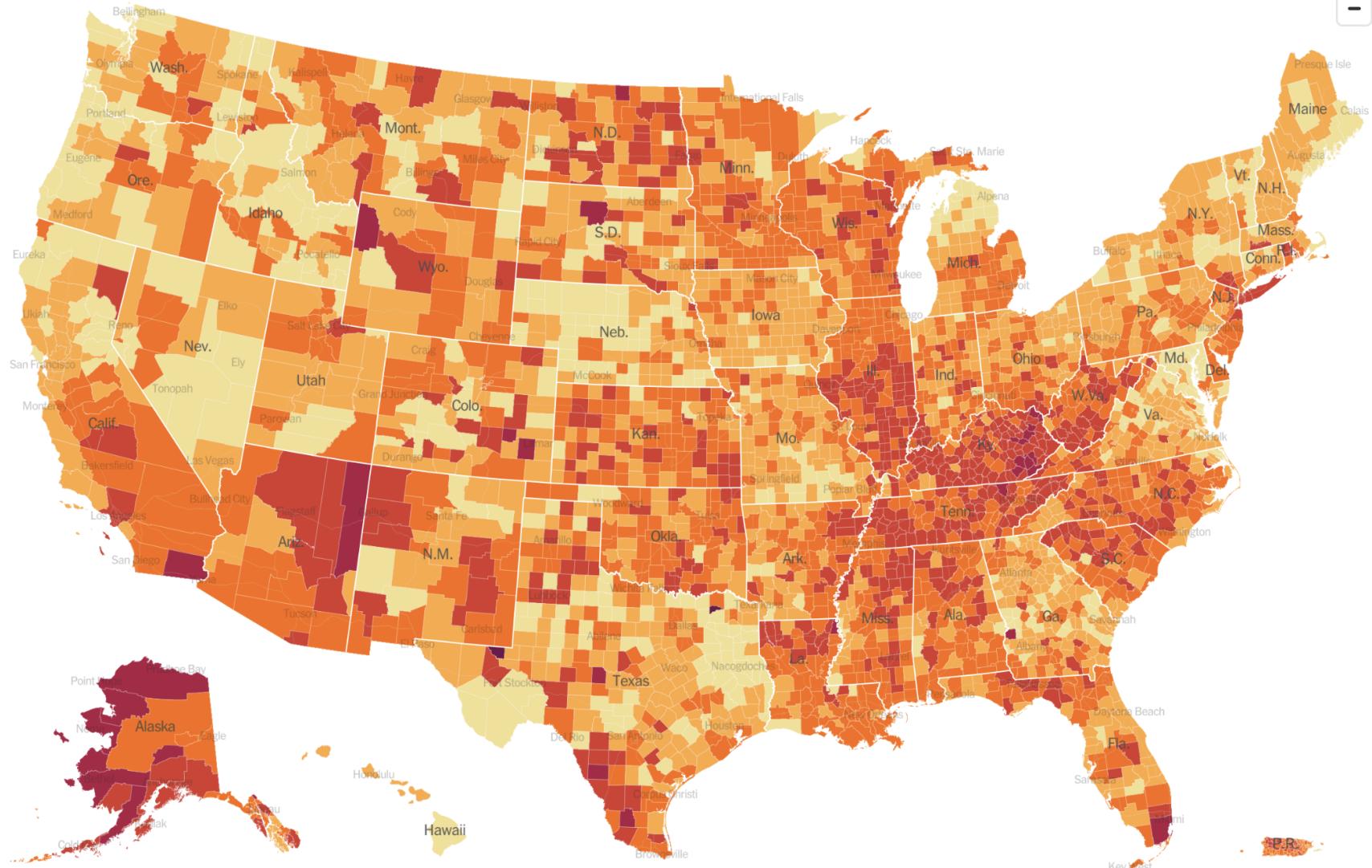
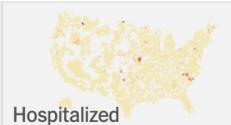
Choropleth Map

- Data Classification
 - Our eyes are not good at discerning more than 6-8 different shades of color in one map
 - Values (attribute that is being mapped) are classified or binned into classes
 - Each class is assigned a specific color along a color ramp
 - Value or Saturation sequence

Cases per capita

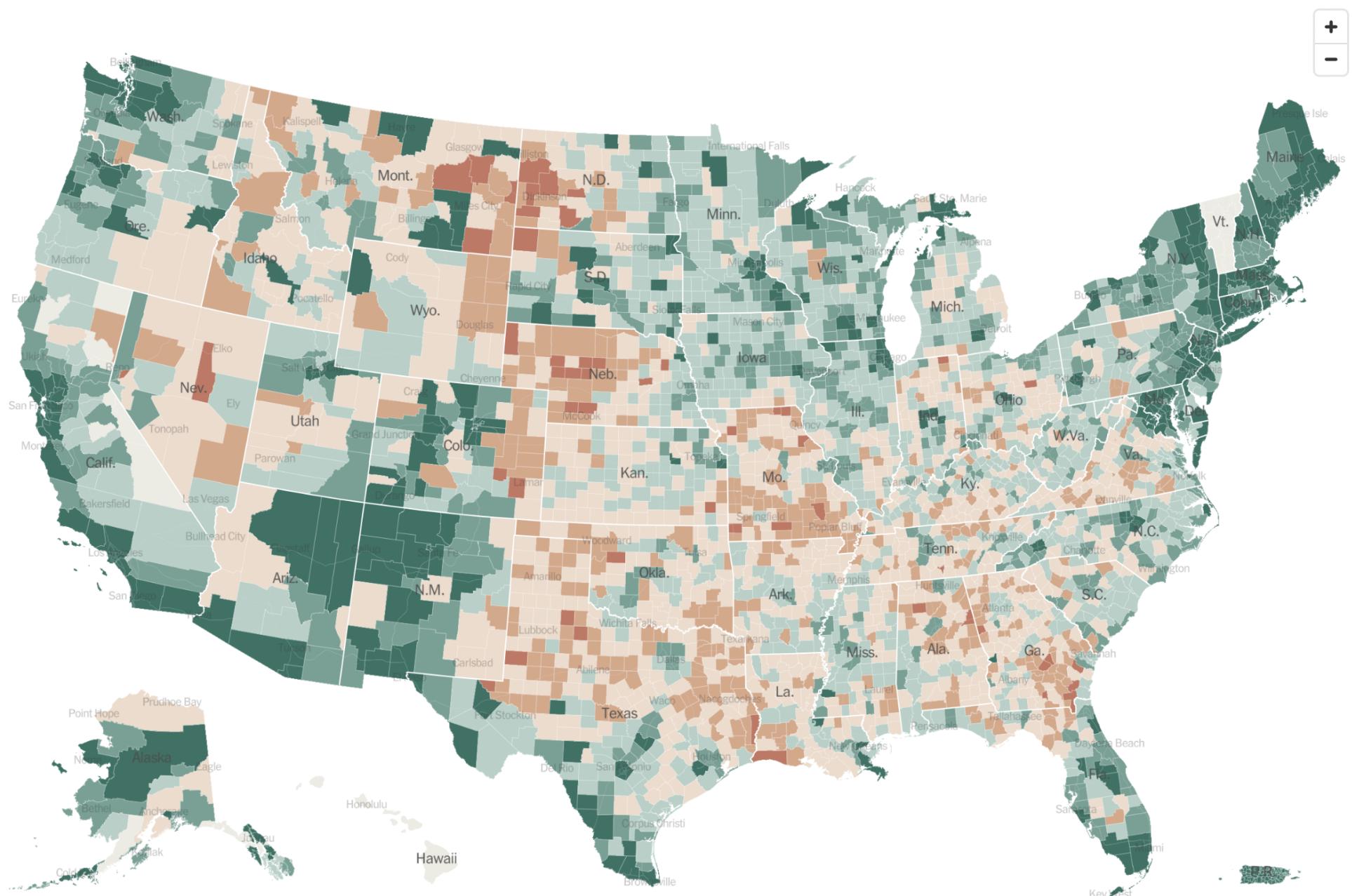
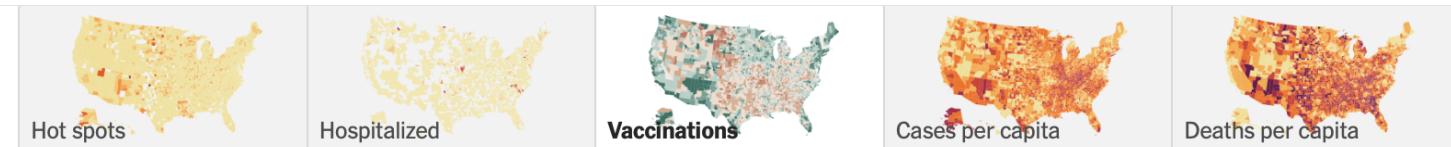
REPORTED CASES PER 100,000 PEOPLE

23,800 36,200 85,600



Vaccinations

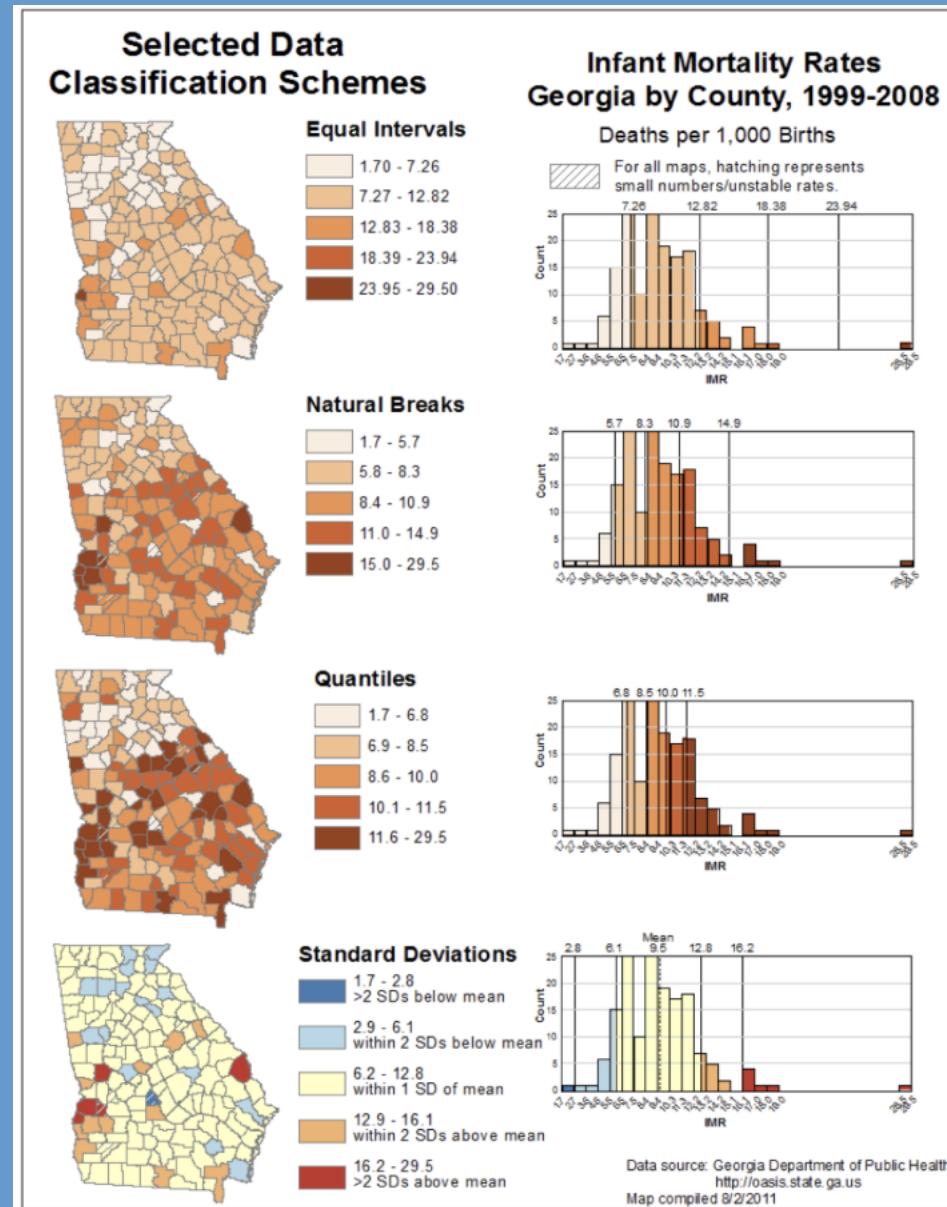
PCT. OF RESIDENTS THAT ARE FULLY VACCINATED



Choropleth Map

- Data Classification methods
 - Use the distribution of values (histogram)
 - Equal Interval
 - Divides range of all data into categories of equal range
 - Quantiles
 - Divides range of all data into n categories such that the same number of features are in each category
 - Natural Breaks
 - Finds natural groupings in the data
 - Result is usually somewhere between equal interval and quantiles

Why this matters...

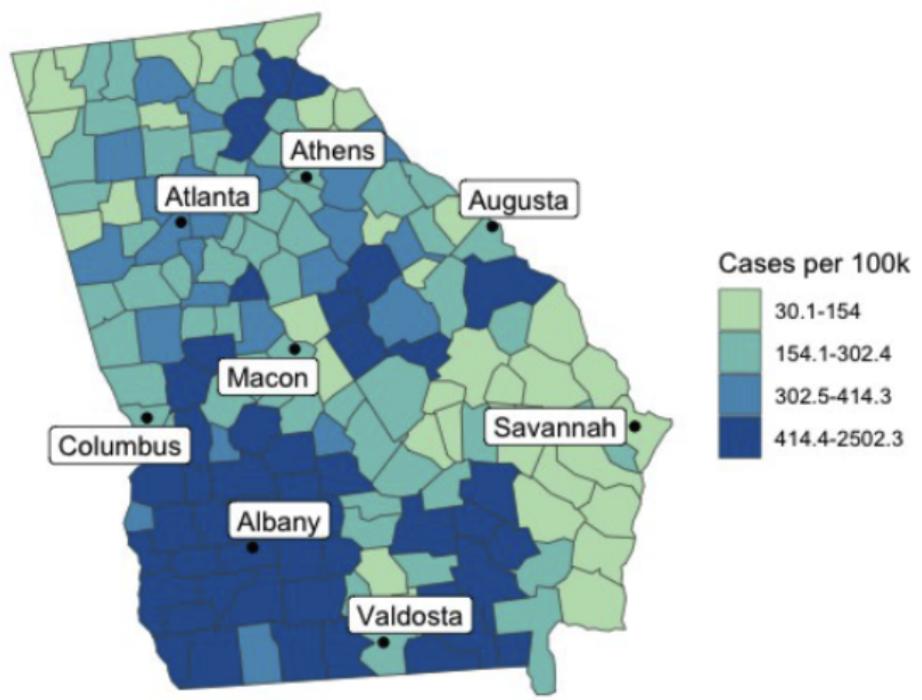


Counts vs Rates

Count of COVID-19 Confirmed Cases
Based on patient county of residence when known

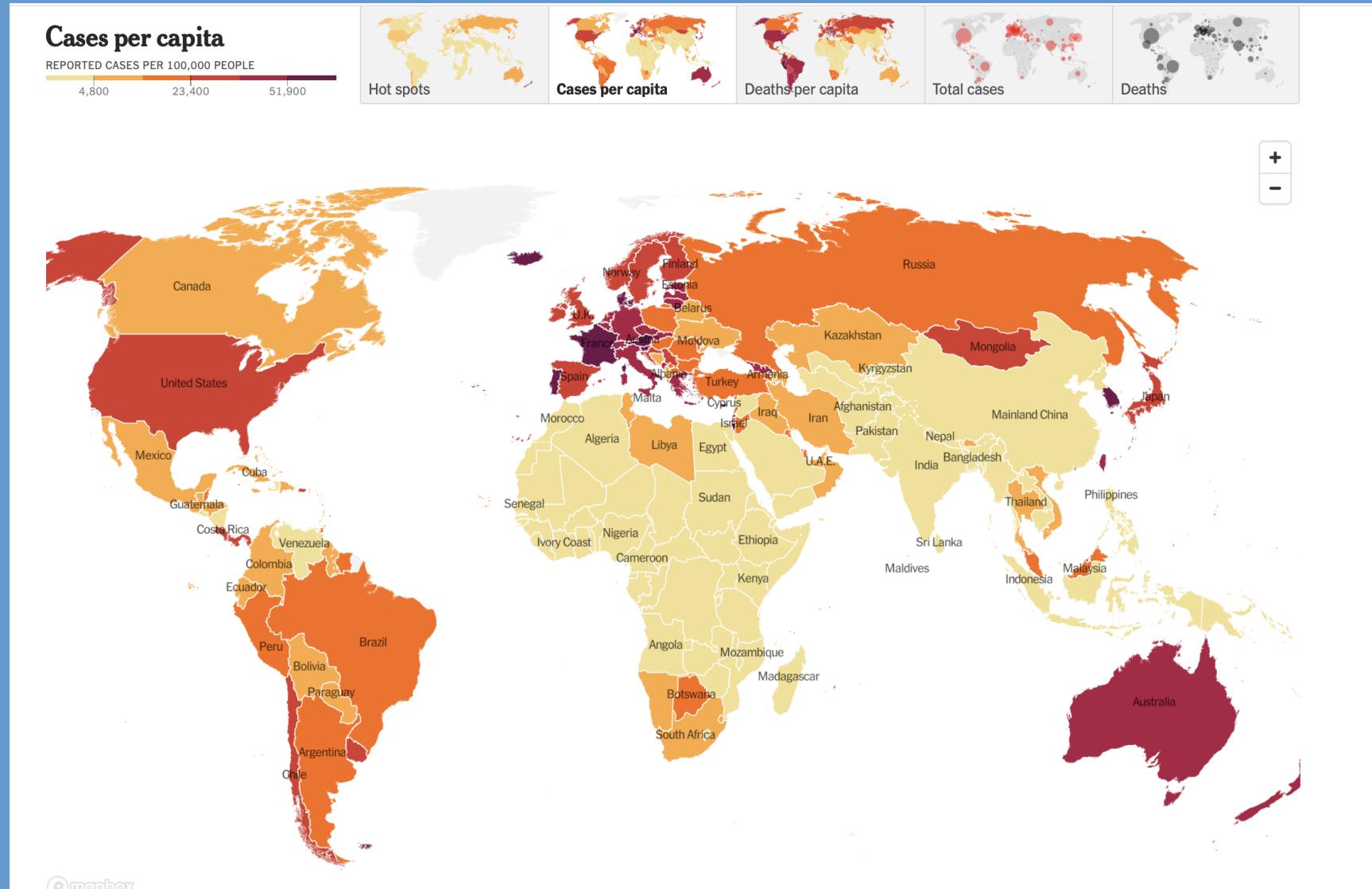


COVID-19 Confirmed Rate per 100,000 Persons
Based on patient county of residence when known

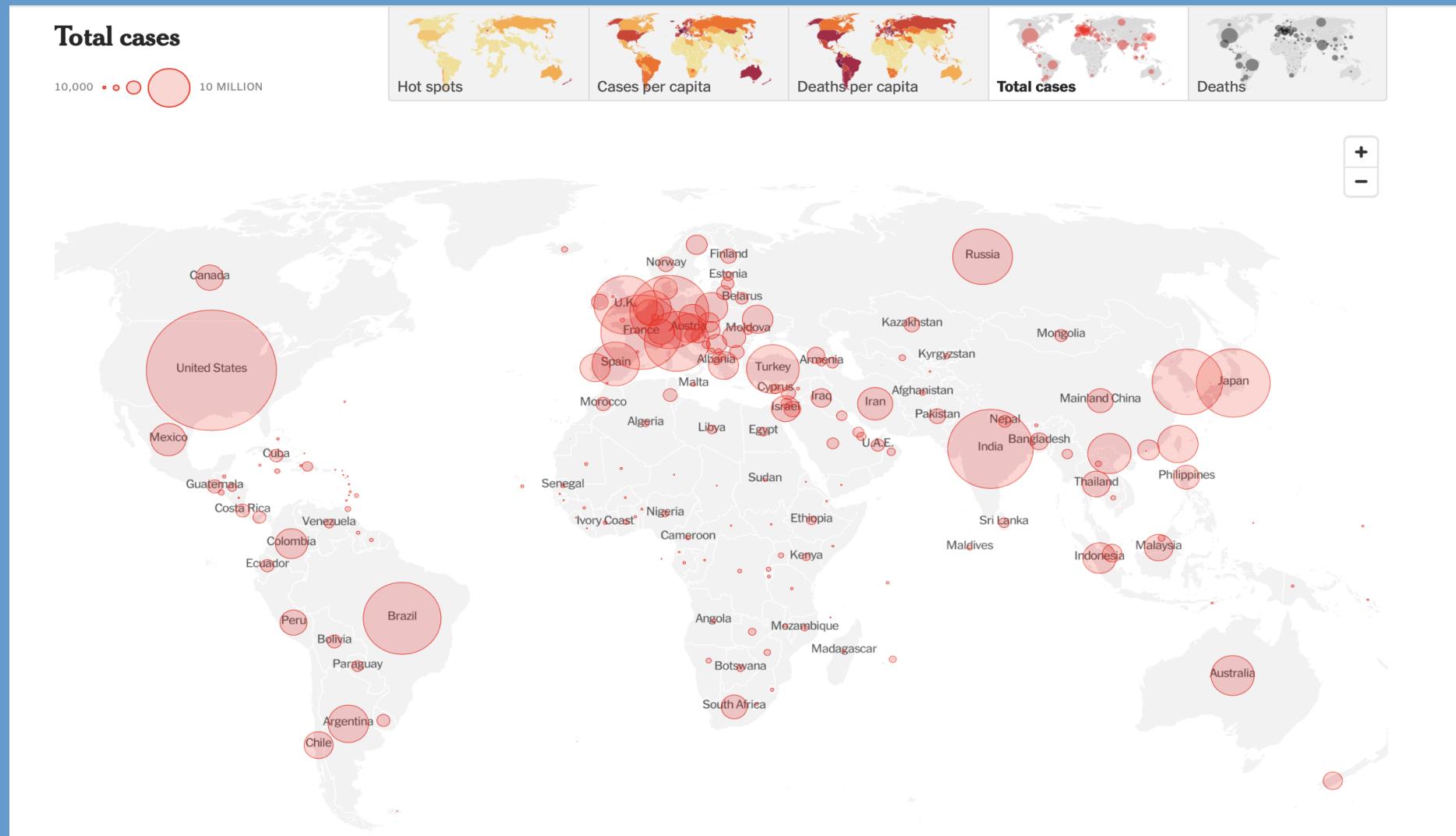


Zhao et al. DOI: [10.1126/sciadv.abe7733](https://doi.org/10.1126/sciadv.abe7733)

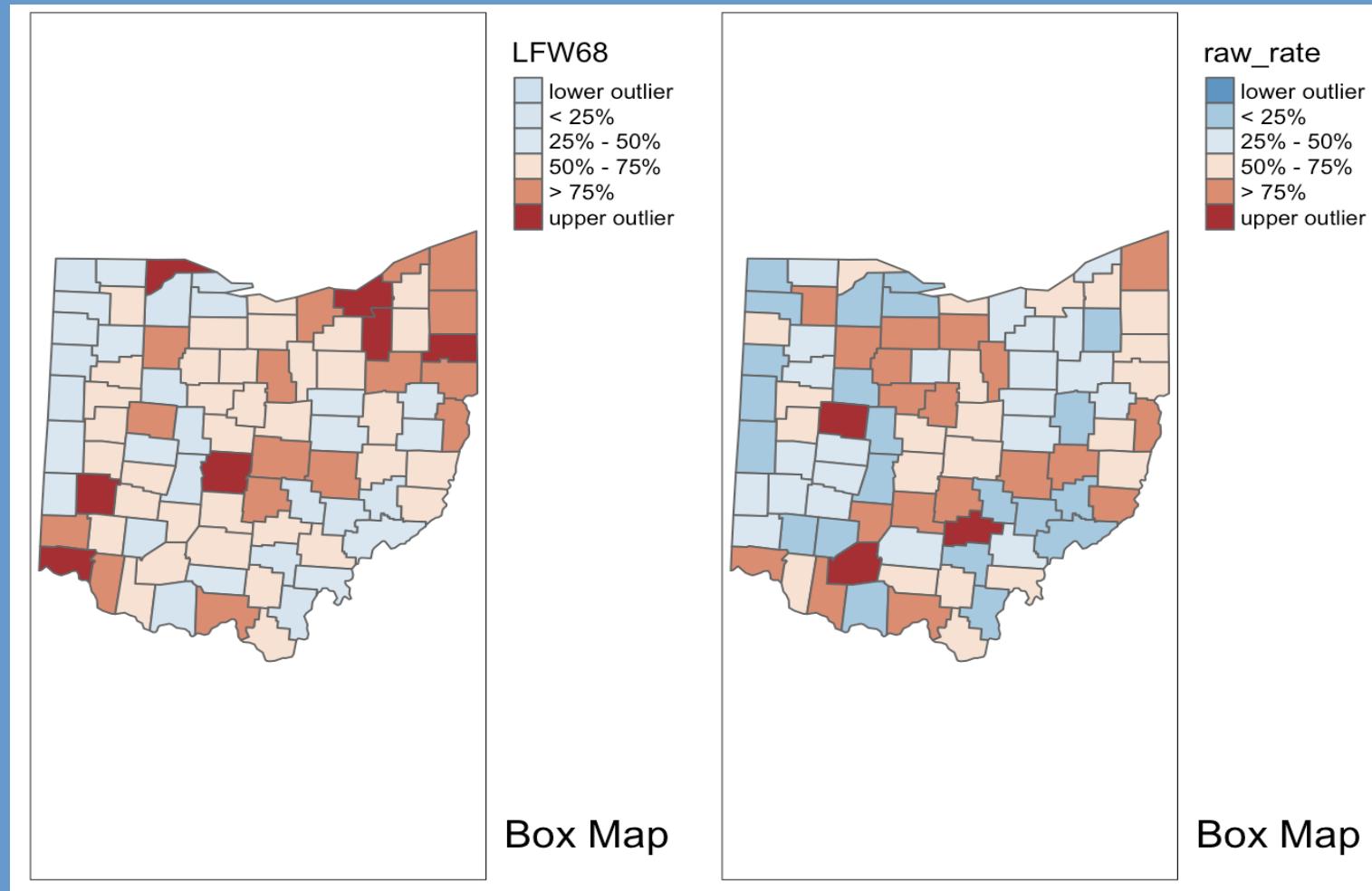
Counts vs Rates



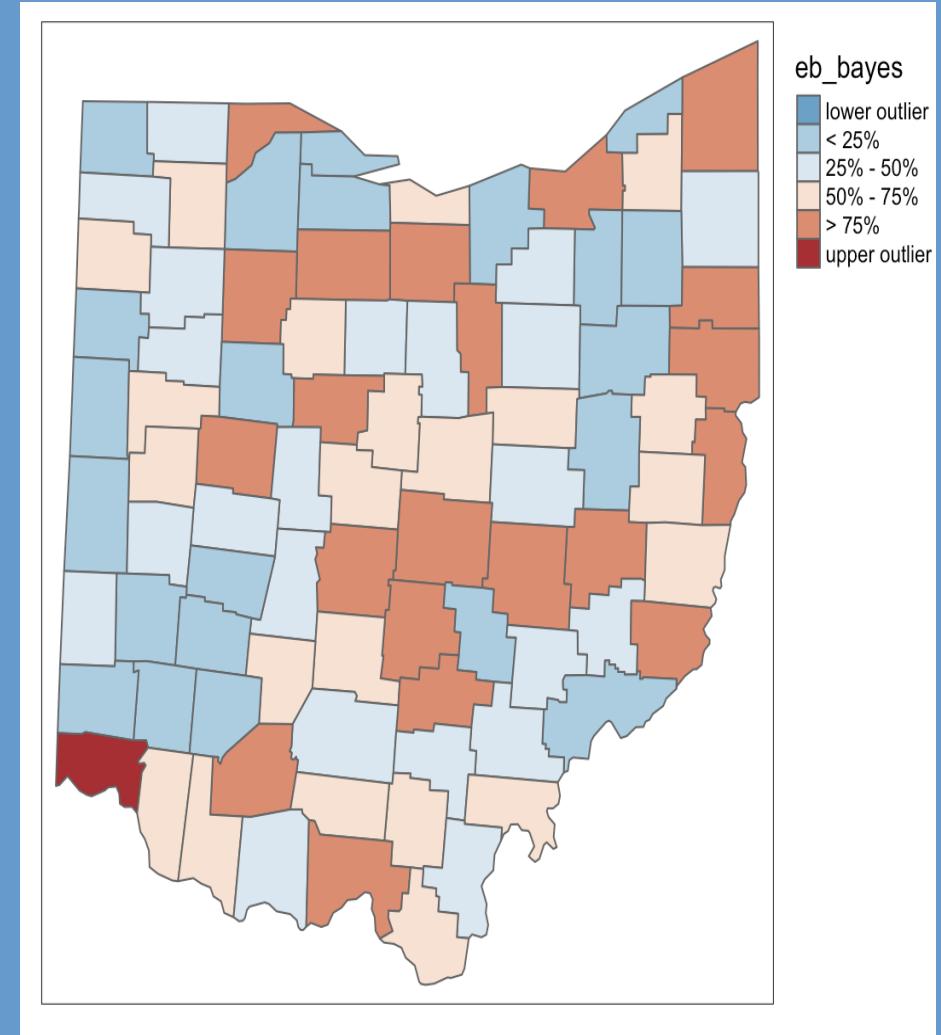
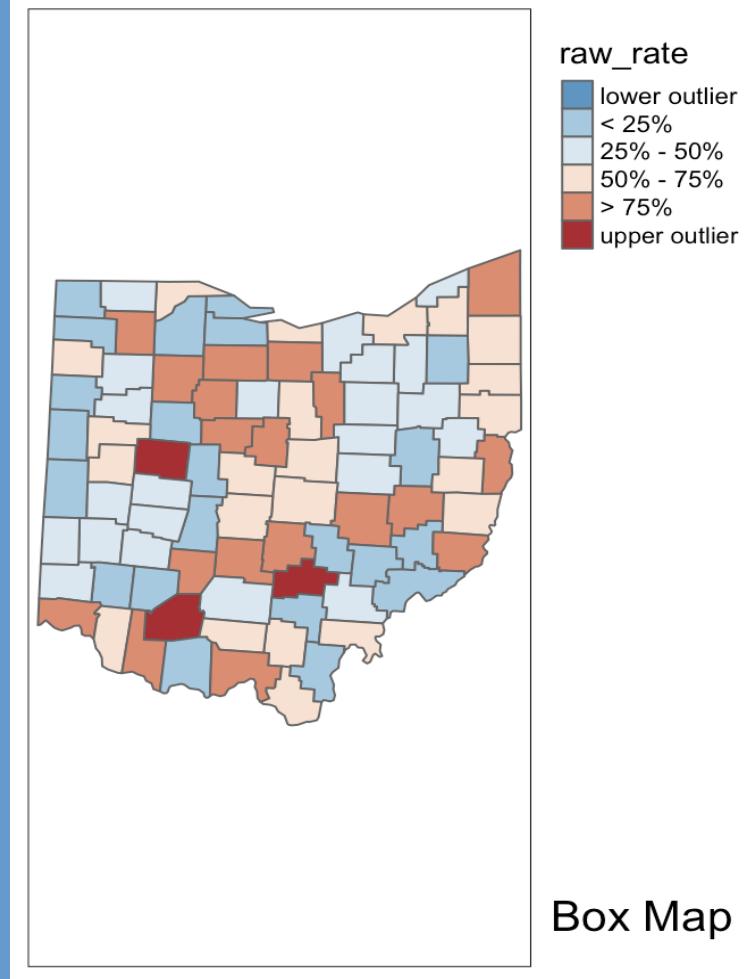
Counts vs Rates



Counts vs Rates

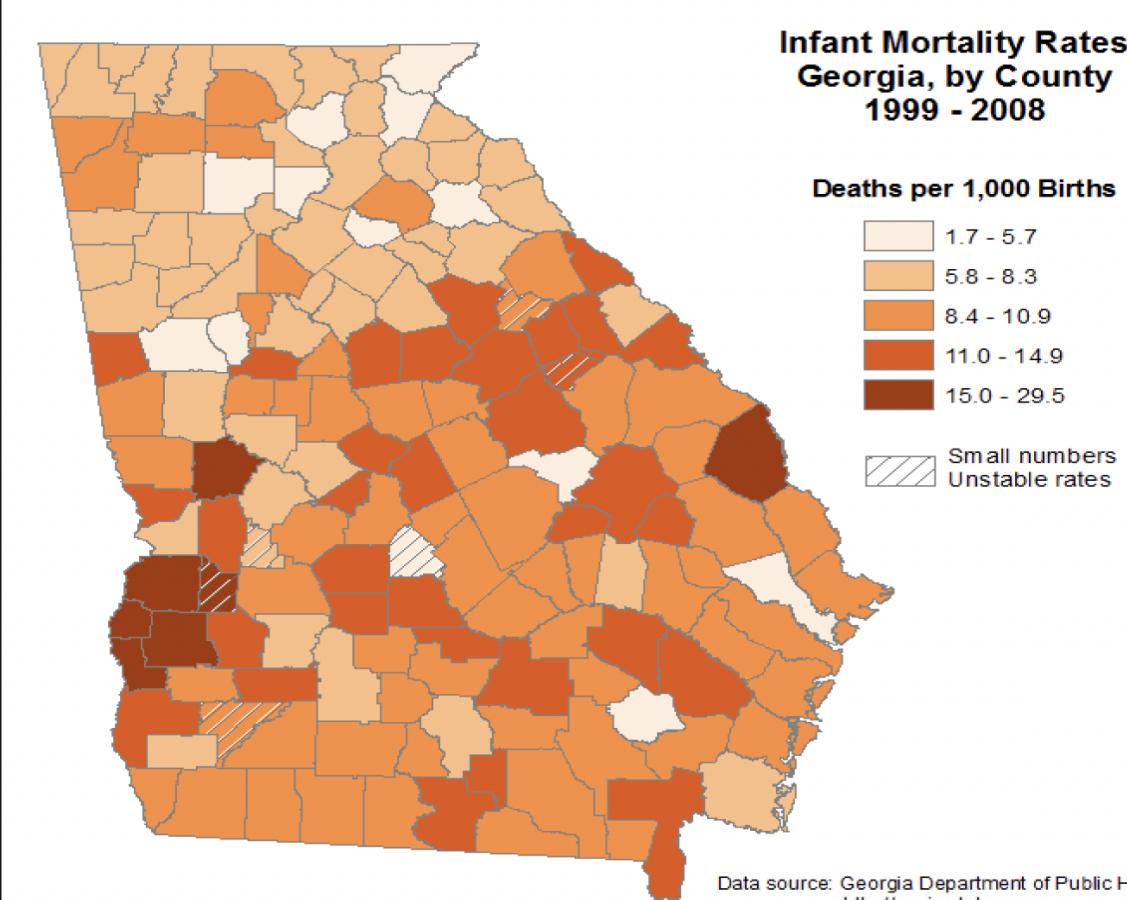


Stable vs Unstable Rates



Communicating Unstable Rates

Hatching to show unstable rates



Light and dark horizontal lines are placed adjacent to one another so the hatch pattern appears on both light and dark choropleth shading.

Choropleth Map

- Classification Guidelines
 - Equal interval is not appropriate for a highly skewed distribution, but value ranges are easier to interpret
 - Quantiles can highlight differences among the features, but can result in large differences in the value ranges
 - Natural breaks (ArcMap default) can balance these concerns and find gaps in the distribution, but value ranges are uneven

Choropleth Map

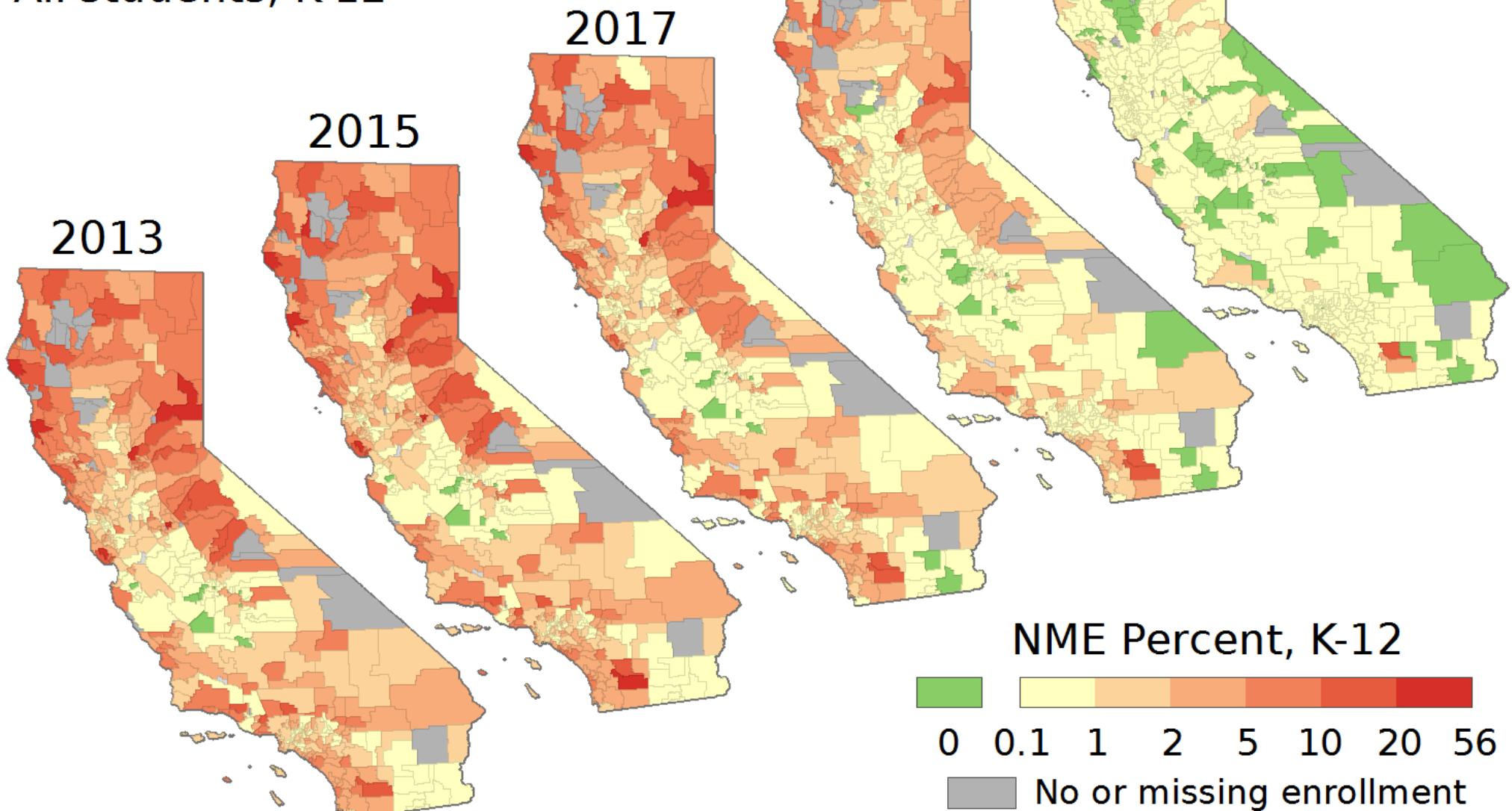
- Multi-panel maps
 - If you want to compare between panels, be sure to keep a consistent classification scheme!
 - Especially if you want to show change over time
 - Will aid in visual interpretation

Non-medical Exemptions

2013 - 2021

California School Districts

All students, K-12



Keywords

- Mapping
- Visual interpretation
- Pattern and Process
- Point map
- Proportional Symbol map
- Dot Density map
- Choropleth map
 - Classification: equal interval, quantile, natural breaks