

The background features a stylized graphic of the Maryland state flag. It consists of four horizontal stripes of equal width. The top and bottom stripes are yellow, and the middle two are red. A white cross-shaped pattern is centered on the red stripes. The left side of the slide has a vertical black border, and the right side is a solid dark brown.

Exploratory Data Analysis

Countywise Air and Radiation Analysis for Maryland

BUDT758W

Our Team

Akshay Subramaniam



Emil George Mathew



Lexy Lichtenberg



Megan O'Brien



Bei-Yu Xing



Background - Moving to Maryland

162,674 People moved to Maryland in 2023

7% Growth in the Maryland resident population over each decade

Many people move to Maryland every year, it's a great state to live in. This presents a critical choice: which of the 23 counties offers the best quality of life?

Beyond housing costs and commute times, how do counties perform on public health and government responsiveness?



Data Sources



Violations: Code enforcement violations across Maryland sites; 140 rows



Enforcement Actions: Enforcement actions by date and site; 111 rows



Complaints: Environmental complaints by type and site; 2,354 rows



Compliance: Maryland site compliance check results; 124,082 rows



Disease Registry: Airborne disease incidence counts, including respiratory and infectious conditions; 121 rows

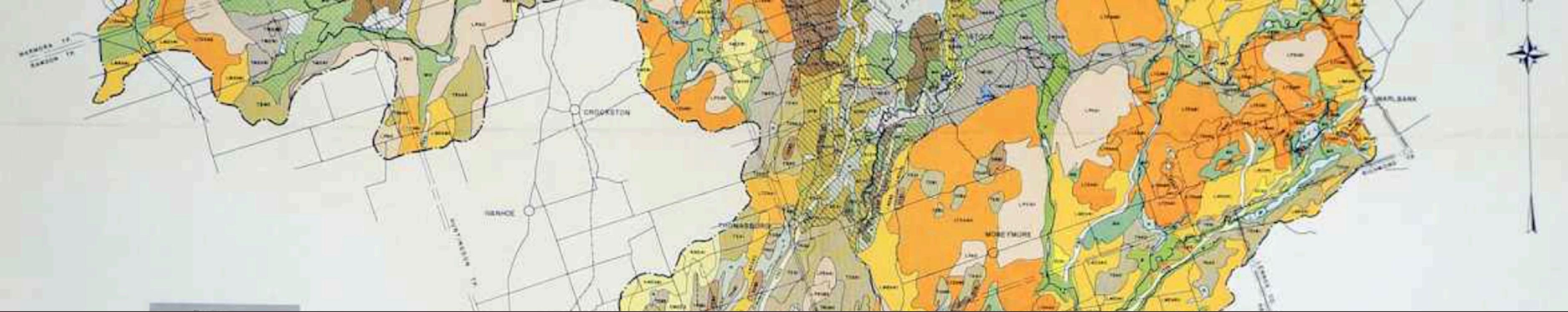


Population Census: Demographic data enabling population-adjusted analysis of county performance metrics; 25 rows



Air Quality Index: Daily AQI metrics by county; 59,232 rows

** Datasets joined on the county-level using Python



Key Insights



Average violation resolution takes 201 days across Maryland counties

Significant variation exists between jurisdictions in government responsiveness



Air quality index and disease metrics shows a connection with Air and Radiation

Traditional assumptions about air quality and health outcomes hold up in Maryland data.

Hypothesis 1: More Populated Counties
Resolve Violations Quicker

Population vs. Government Response

Do larger counties resolve violations faster due to greater resources and capacity?

Initial Hypothesis

Larger populations should correlate with shorter resolution times through economies of scale

Statistical Testing

Applied correlation analysis between population size and average resolution duration

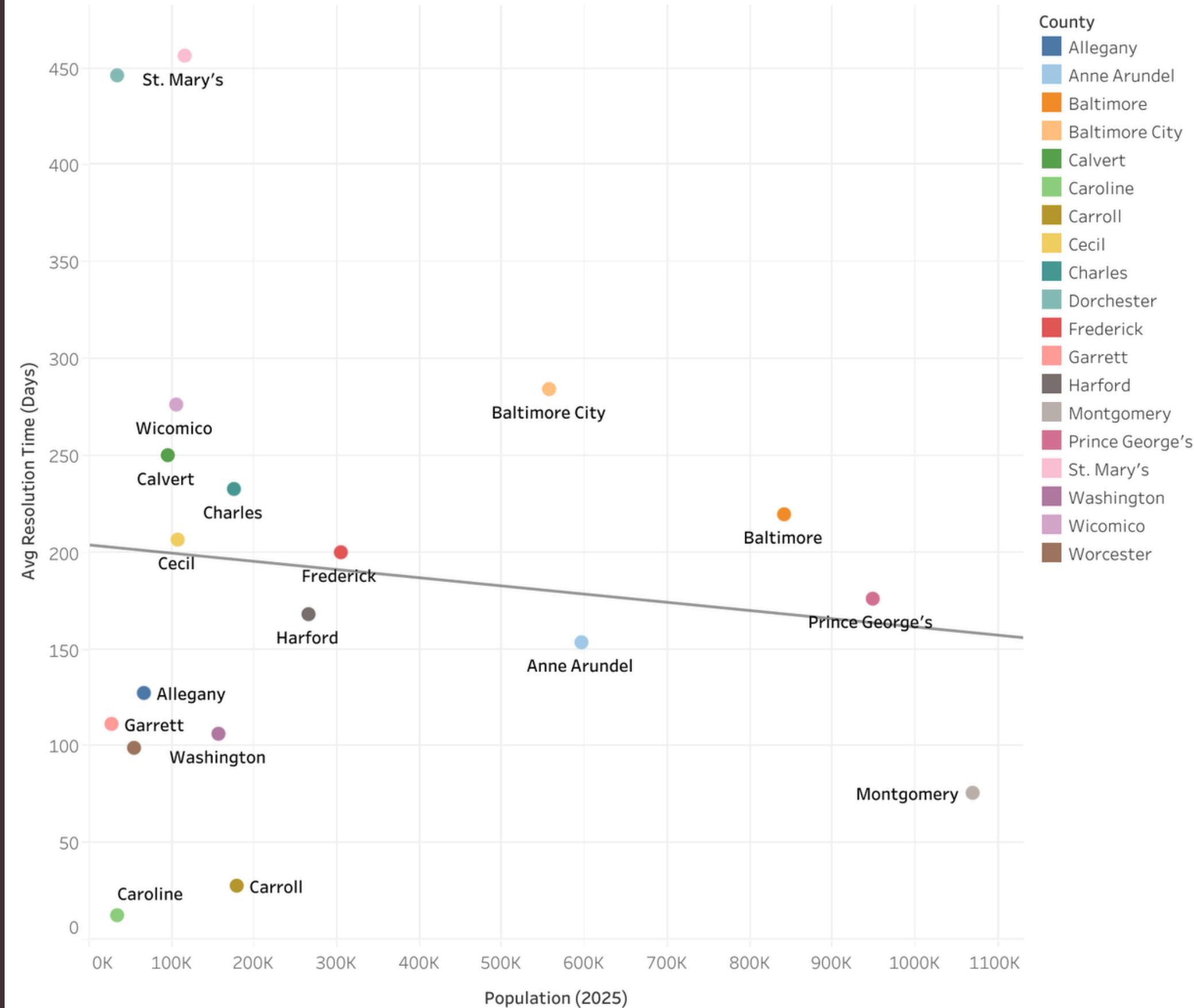
Data Analysis

- Calculated violation resolution times
- Normalized violation resolution times by county population to control for size effects



Population vs. Government Response

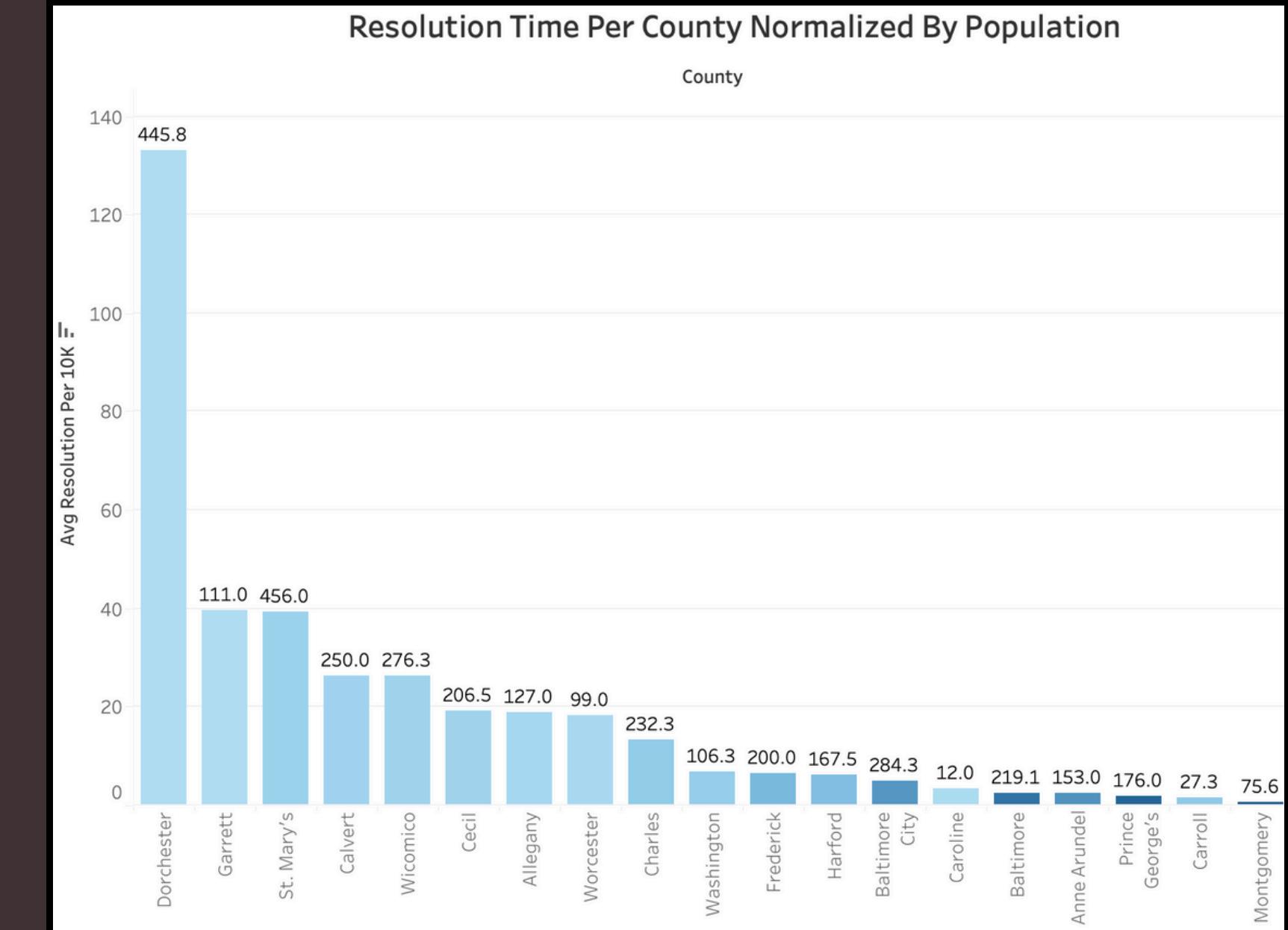
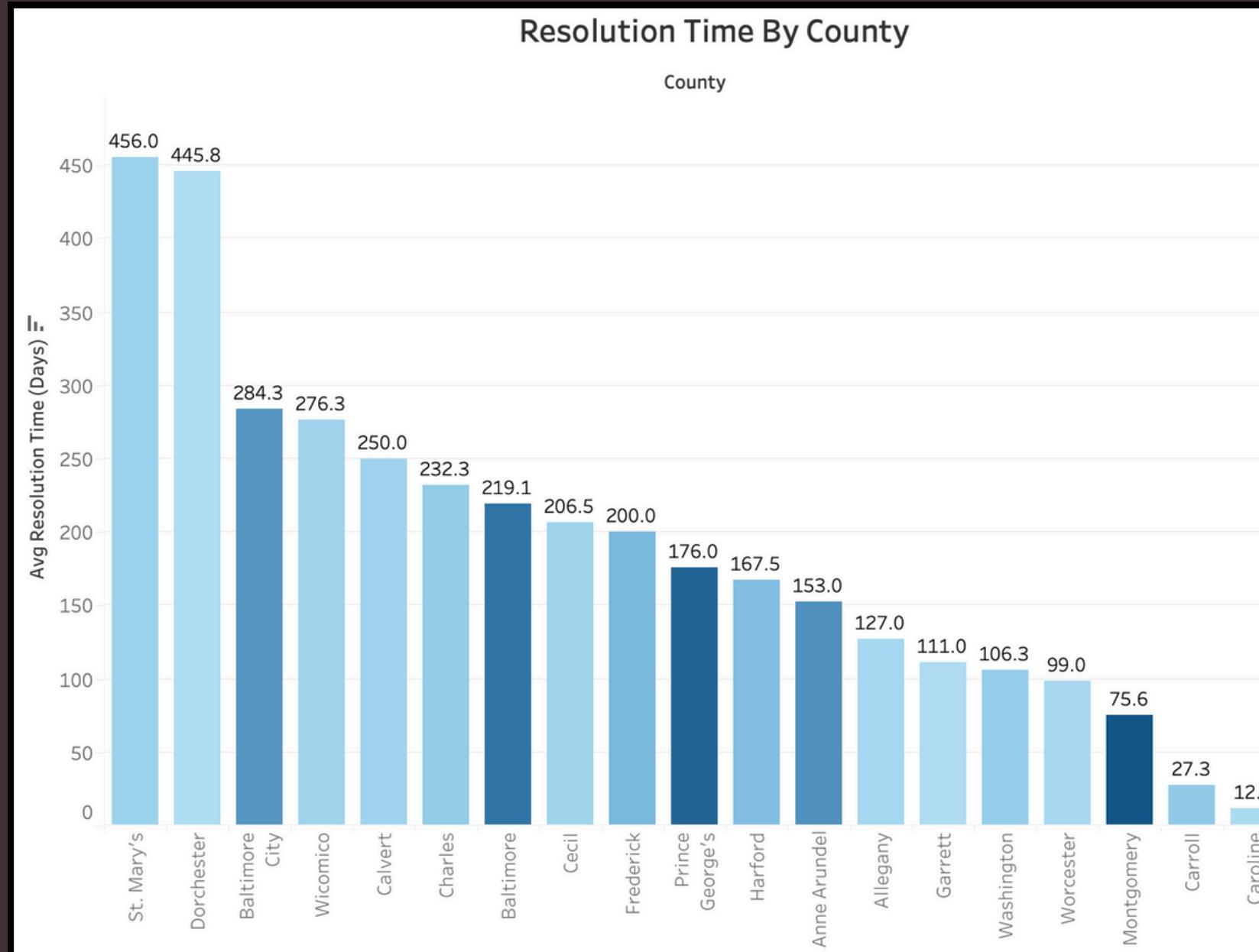
County Population vs. Resolution Time



Very weak negative relationship between county population and average violation resolution time.

Government Responsiveness Reality

2025 Population	
28,093	1,069,288



When looking only at raw wait times, population size doesn't appear to have an effect. However, when resolution times are normalized by county population, more populous counties generally resolve violations more efficiently, suggesting economies of scale.

Hypothesis 2: AQI, Airborne diseases and ARA are related

ARA Metrics

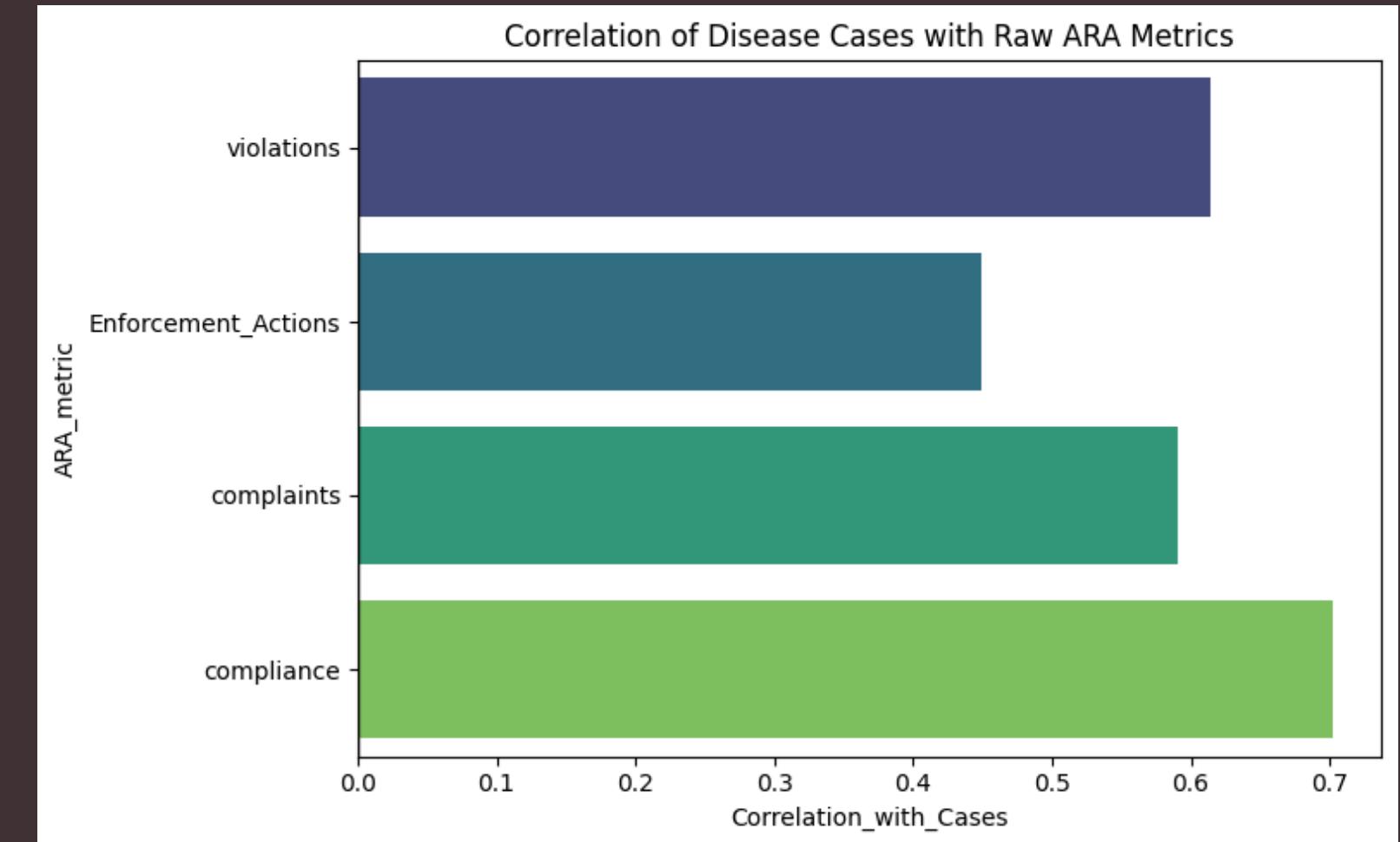
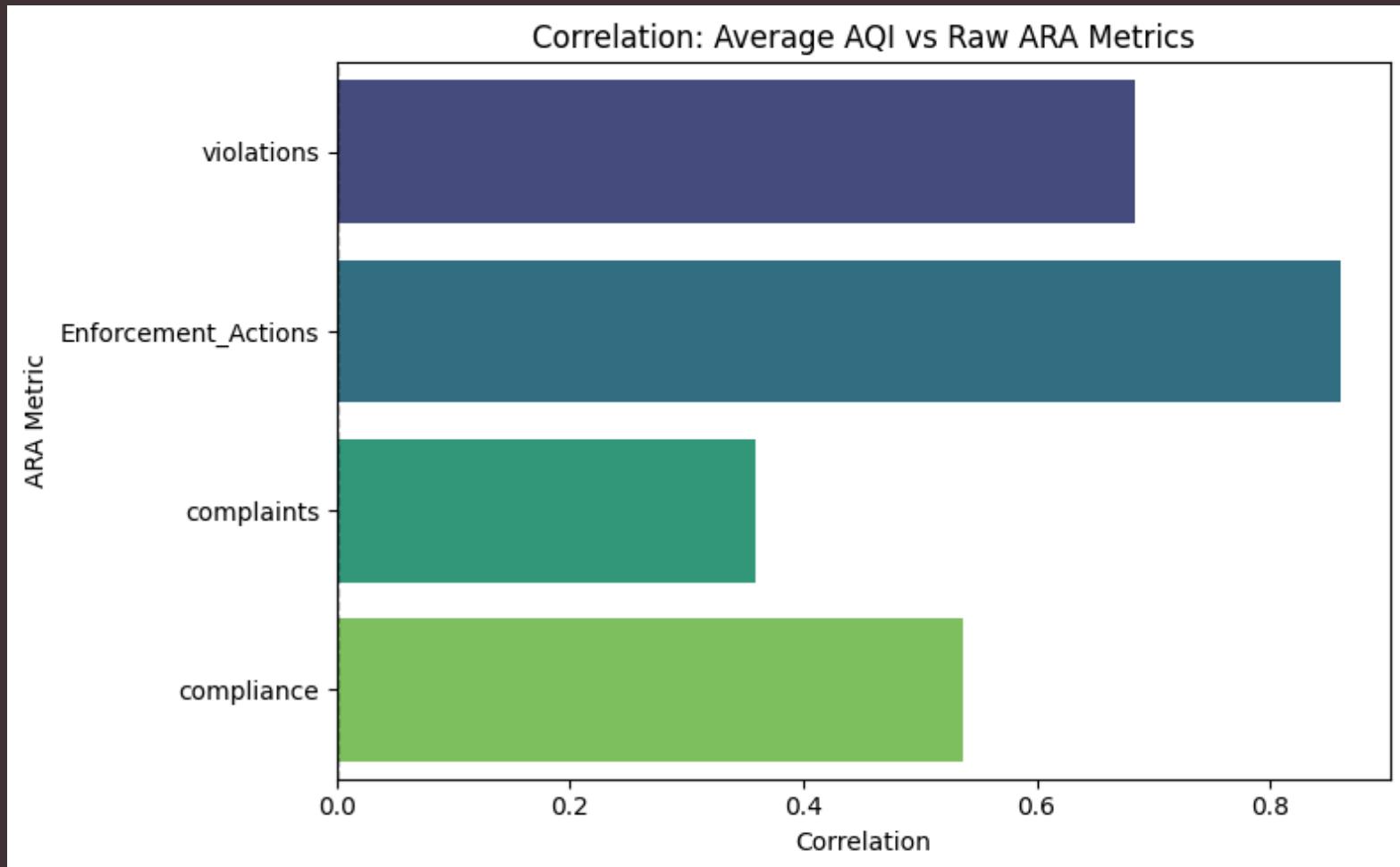
County-level violations, enforcement actions, complaints, and compliance

AQI & Airborne Diseases

Air Quality Index and Airborne illness incidence data



Correlation Between Air Quality Index, Diseases vs Air and Radiation



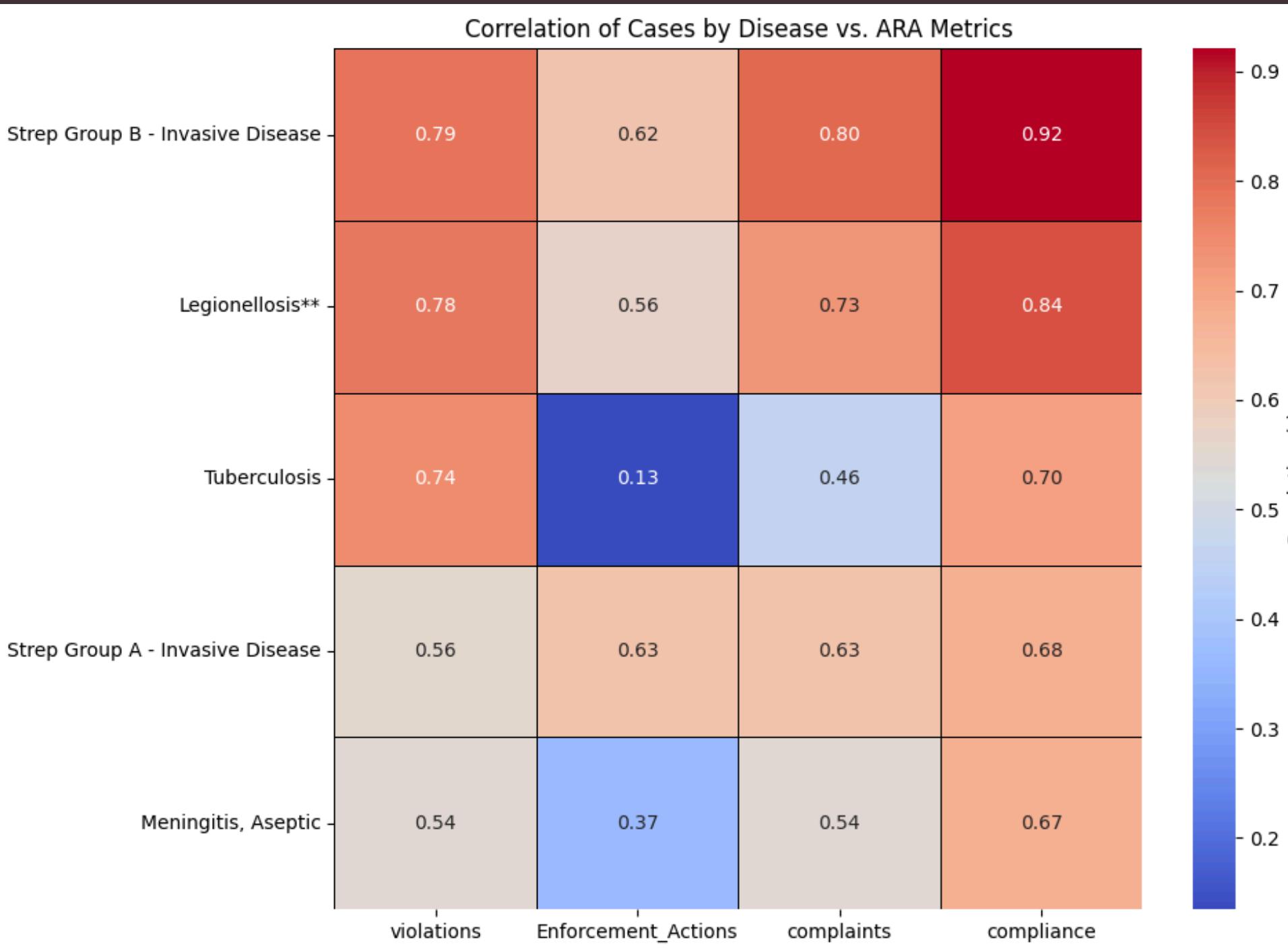
AQI v.s. ARA

- Strong: Enforcement Actions ($r \approx 0.85$), Violations ($r \approx 0.7$).
- Moderate: Compliance ($r \approx 0.5$)
- Weak: Complaints ($r \approx 0.35$)
- Overall: Higher AQI links with more ARA activities.

Airborne Diseases v.s. ARA

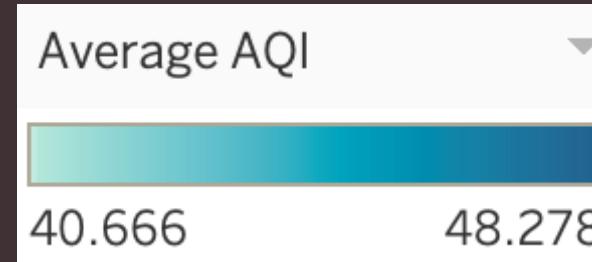
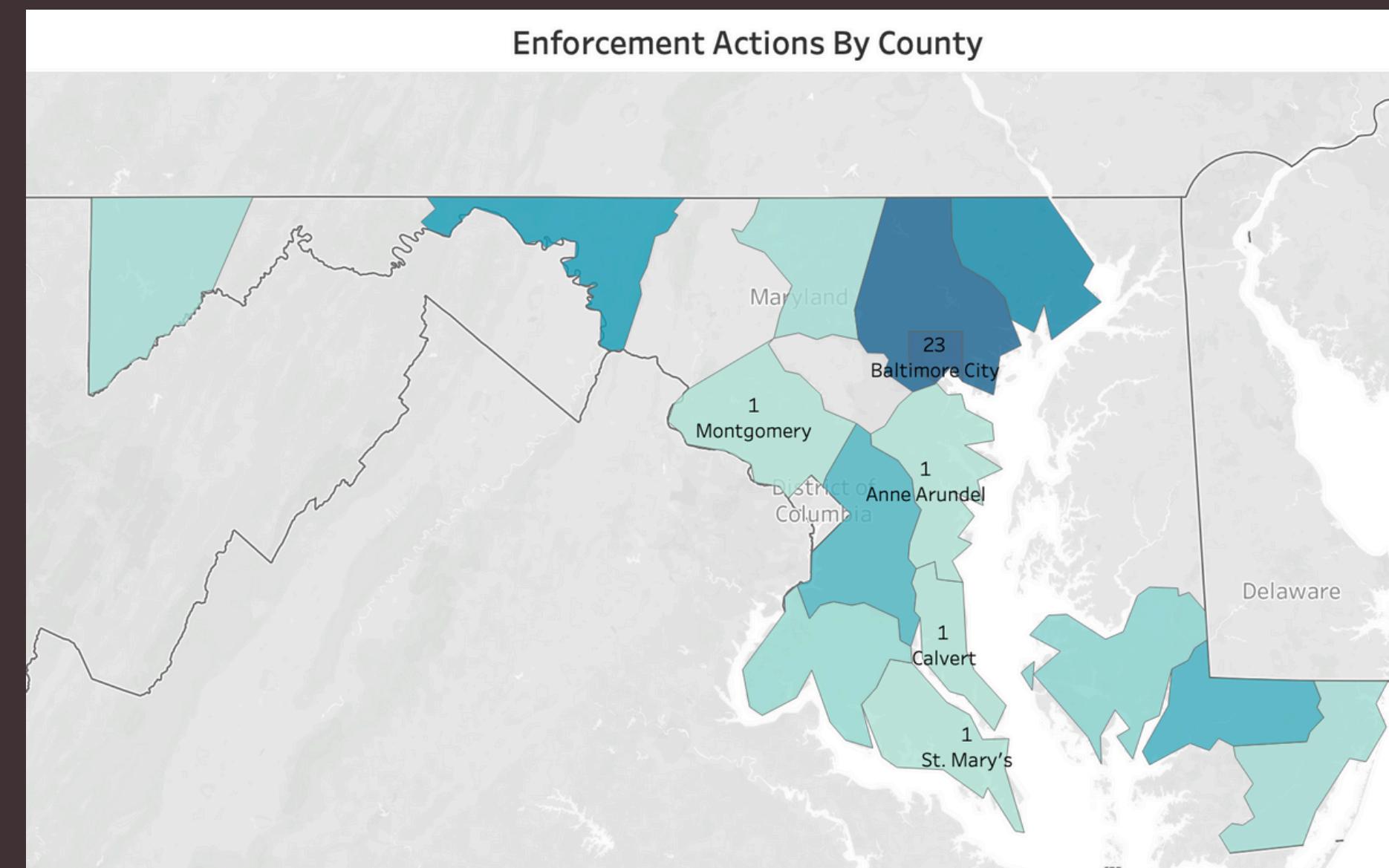
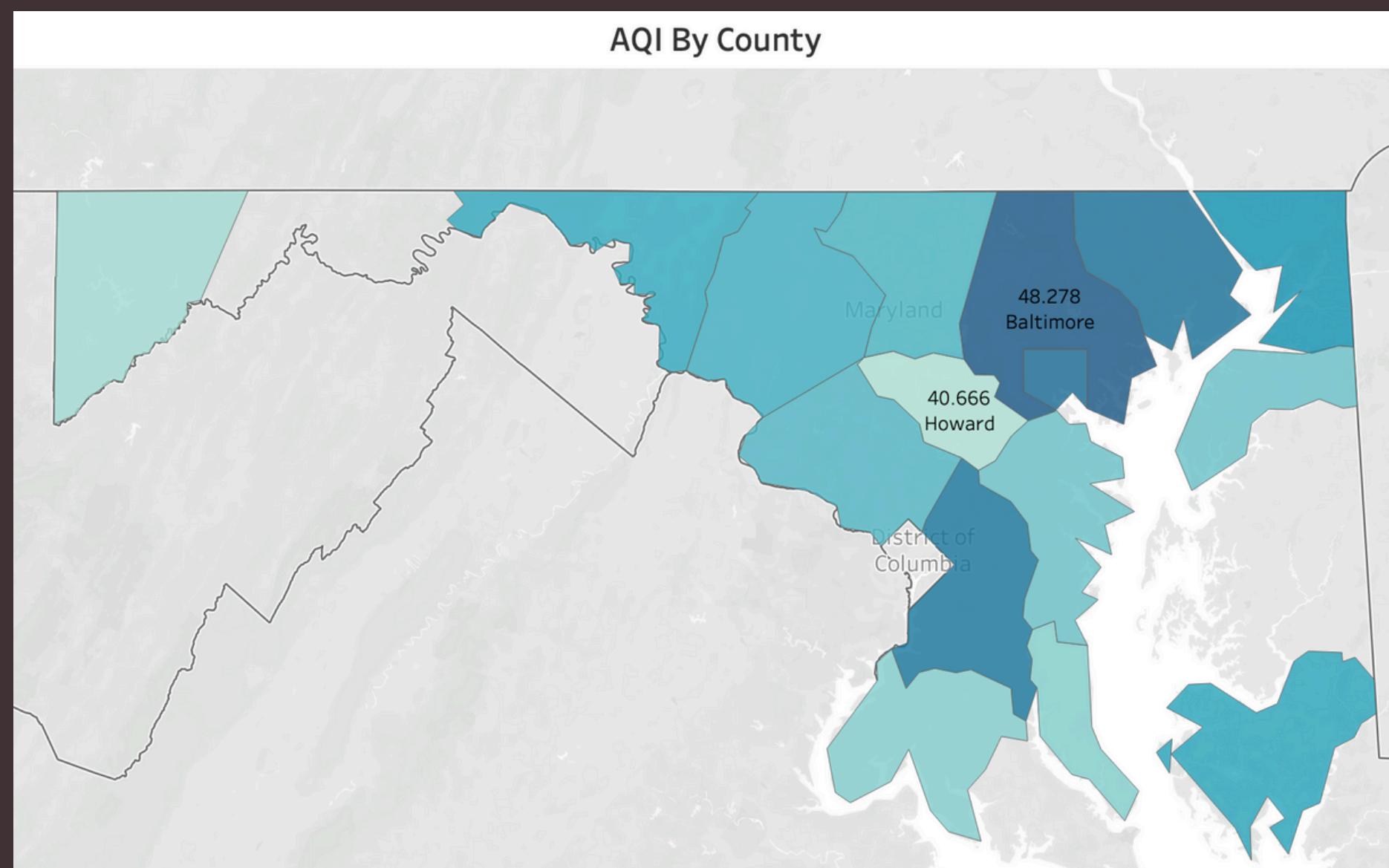
- Strong: Compliance ($r \approx 0.68$ – 0.70), Violations ($r \approx 0.6$) and Complaints ($r \approx 0.58$).
- Weak: Enforcement Actions ($r \approx 0.44$).
- Overall: More disease cases align with higher ARA activity, but strength varies by metric.

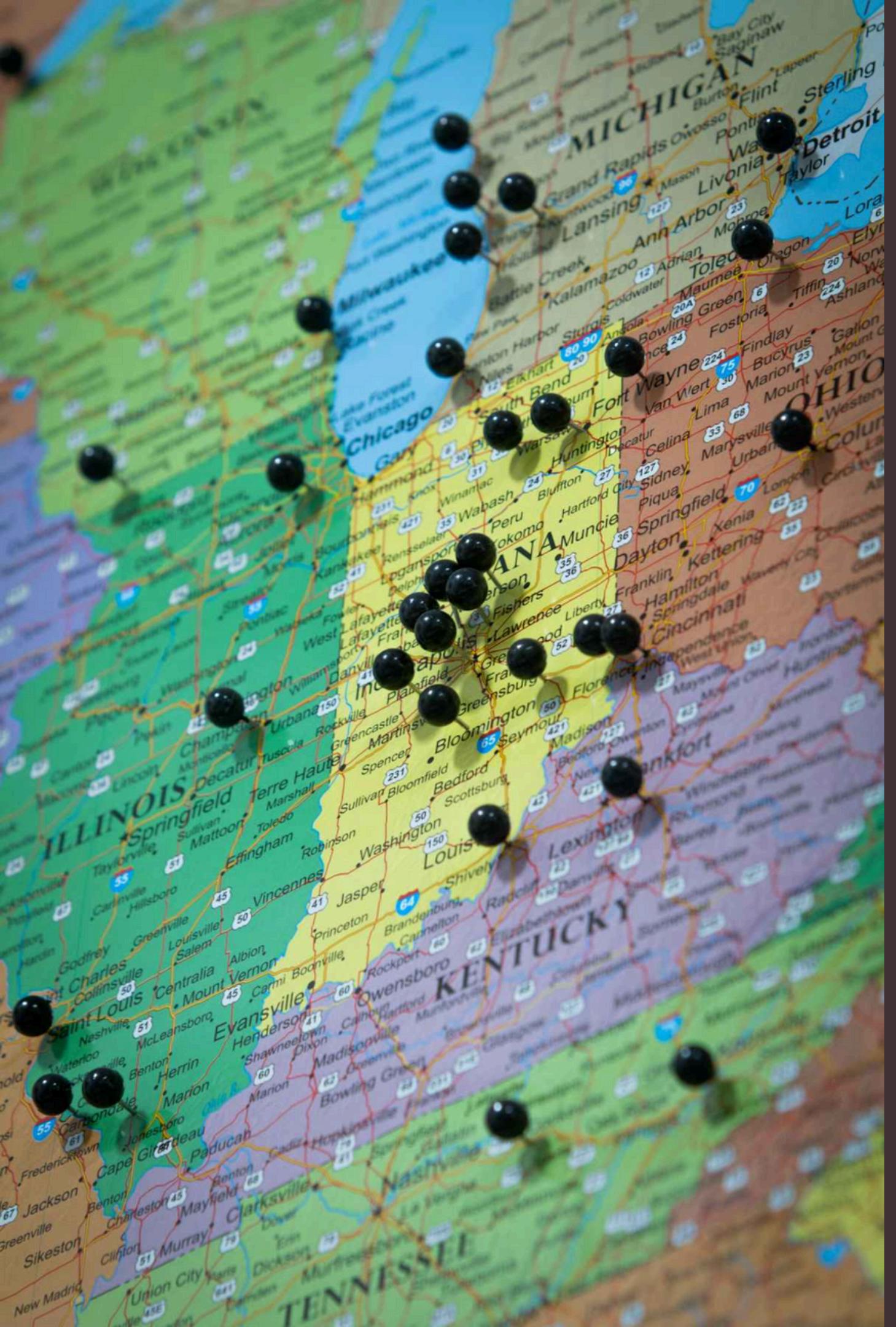
Correlation Matrix: Diseases vs Air and Radiation



- High correlations → suggests scale effects (larger counties = more cases + more inspections).
- Strep Group B & Legionellosis → strongest associations across all.
- Tuberculosis → strong link with violations (0.74), weaker with enforcement (0.13).
- Strep Group A & Meningitis → moderate associations.

AQI vs Enforcement Actions





County Selection

Government Efficiency

- Responsiveness varies widely
- Larger counties resolve violations more efficiently, but not necessarily faster
- In slower counties, unresolved issues could impact property values, quality of life, or business operations

Health Considerations

- Fewer ARA violations and complaints often align with better AQI and lower disease rates
- ARA data not only show regulation but also reflect environment and health conditions

Decision Guidance

- Best choices for responsiveness: Montgomery, Carroll, Caroline
- Counties with potential delays: St. Mary's, Dorchester, Baltimore City
- Fewer ARA violations/complaints align with better AQI and lower airborne disease rates.

Limitations

- Not all data could be reported or reported incorrectly
- Population and violation were matched at county level
- Health effects from poor air quality may appear with delay
- AQI varies in counties and population too

Further Considerations

- Adding income as a factor for county responsiveness
- Looking at allocation of funds per county
- Account for healthcare access and vulnerable populations
- AQI alone may not capture variations, consider political pressures or language barriers

Thank you!

Open for Q/A