Tech Talk

Build Health Equity with Data Science

MARCH 1, 2022

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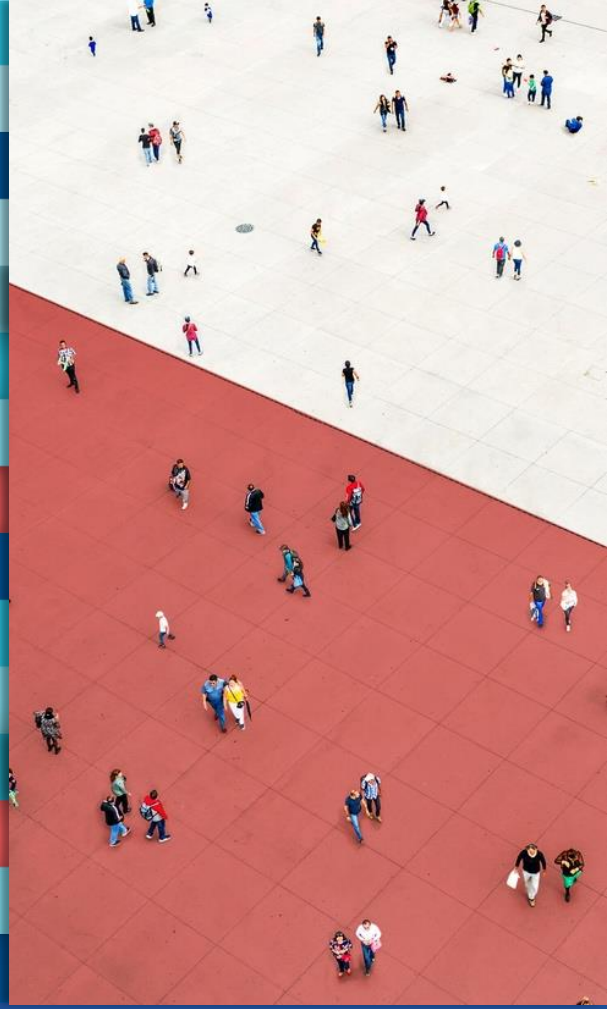
RTI INTERNATIONAL



Determinants of Health

“What are the social determinants of…”

Life Expectancy

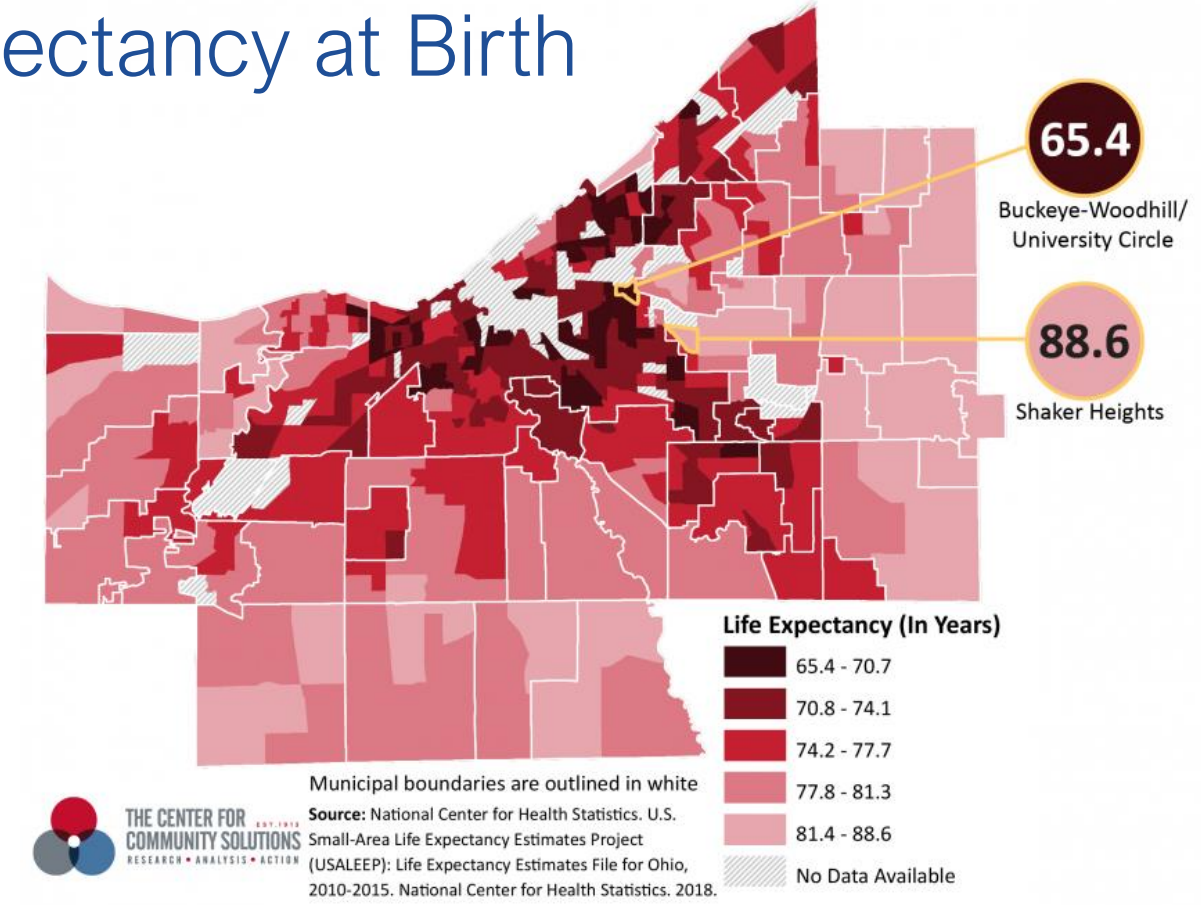
Infant Mortality

Overdose Mortality

Cancer Mortality

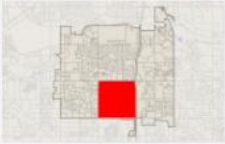
Life Expectancy at Birth

There is a **23 year difference** in life expectancy between these two neighborhoods, **less than 2 miles apart.**



Area-Based Analyses: Selected Geographic Levels

CENSUS BLOCK GROUP – 9-DIGIT ZIP CODES	CENSUS TRACT	ZIP CODE TABULATION AREA – 5-DIGIT ZIP CODES	CITY	COUNTY/PARISH	MSA
n=1,442	n=5,801	n=52,588	n=369,011	n=644,560	
Block group 080050807002	Tract 080700	ZIP Code 80012	Aurora	Arapahoe County	Denver Area
	Colorado	Mountain	West	United States	
	STATE	CENSUS DIVISION	CENSUS REGION		



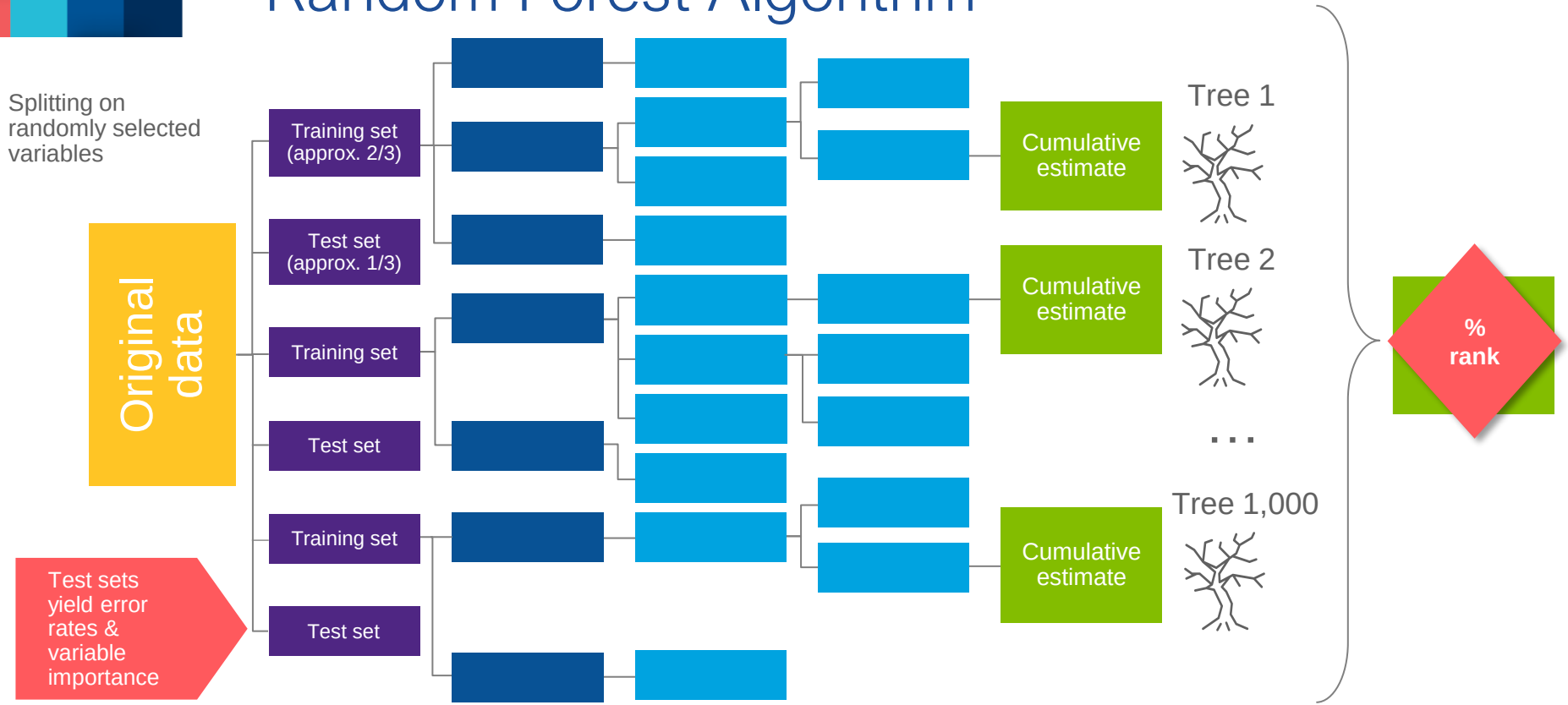
OTHERS:
VOTING DISTRICTS,
SCHOOL DISTRICTS,
POLICE PRECINCTS,
HOSPITAL REFERRAL REGIONS, ETC.

How We Created Local Social Inequity Scores

Conceptual model → Data curation → Random forests → Ranked percentile scores → Validation


Health Outcome
Food Security & Access to Healthy Food
Healthcare Access, Coverage, Costs, Quality
Education Attainment & Quality
Justice, Crime, Incarceration
Environment: Pollution, Heat, Disasters
Community Health, Wellbeing, and Healthy Behaviors
Transportation Access, Safety
Income, Employment, Inequality, Affordability
Housing Adequacy, Crowding, Structural Health
Bias, Stress, & Trauma
Economic stability
Healthcare
Education
Social and community context
Neighborhood/ built environment
Social and community context
Neighborhood/ built environment
Economic stability
Neighborhood/ built environment
Social and community context

Simplified Illustration of Random Forest Algorithm



Social Determinants of Health (SDoH) Data at RTI

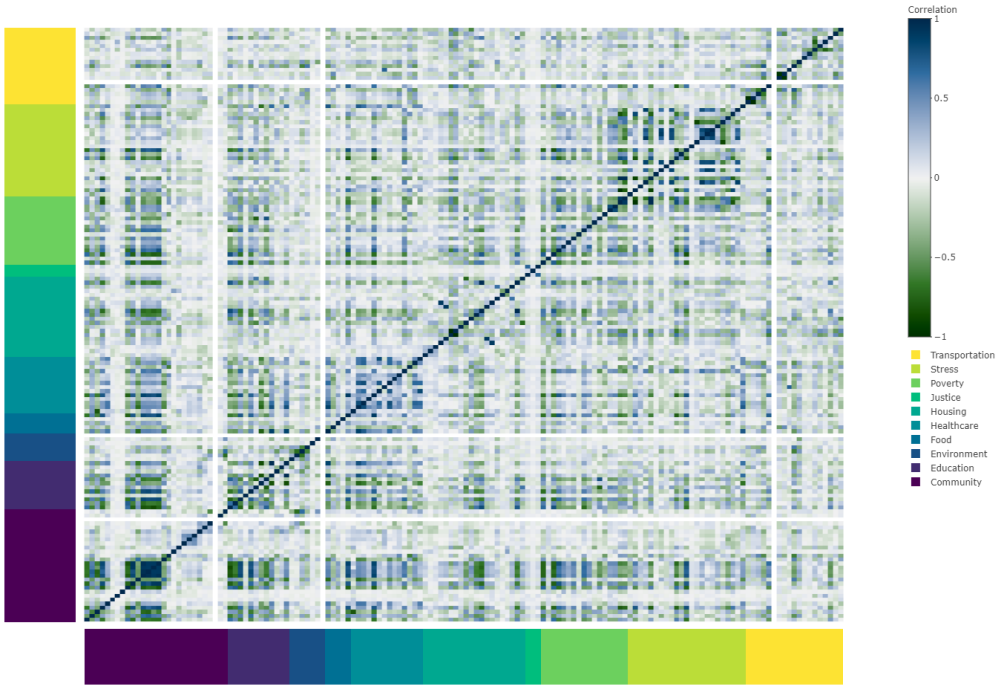
Main Federal Data Sources

- **CDC**:
  - USALEEP project
  - PLACES (21 BRFSS measures for chronic conditions and healthy behaviors)
  - Environmental Public Health Tracking Network
  - Compressed Mortality File
- **TidyCensus**: American Community Survey demographic data
- **US DOT**: Transportation measures
- **USDA**: Food and nutrition data
- **EPA**: Walkability index, air pollution
- **CMS**: HCRIS data
- **FBI**: Uniform Crime Reporting data
- **HUD**: Subsidized housing data
- **HIFLD**: Infrastructure data

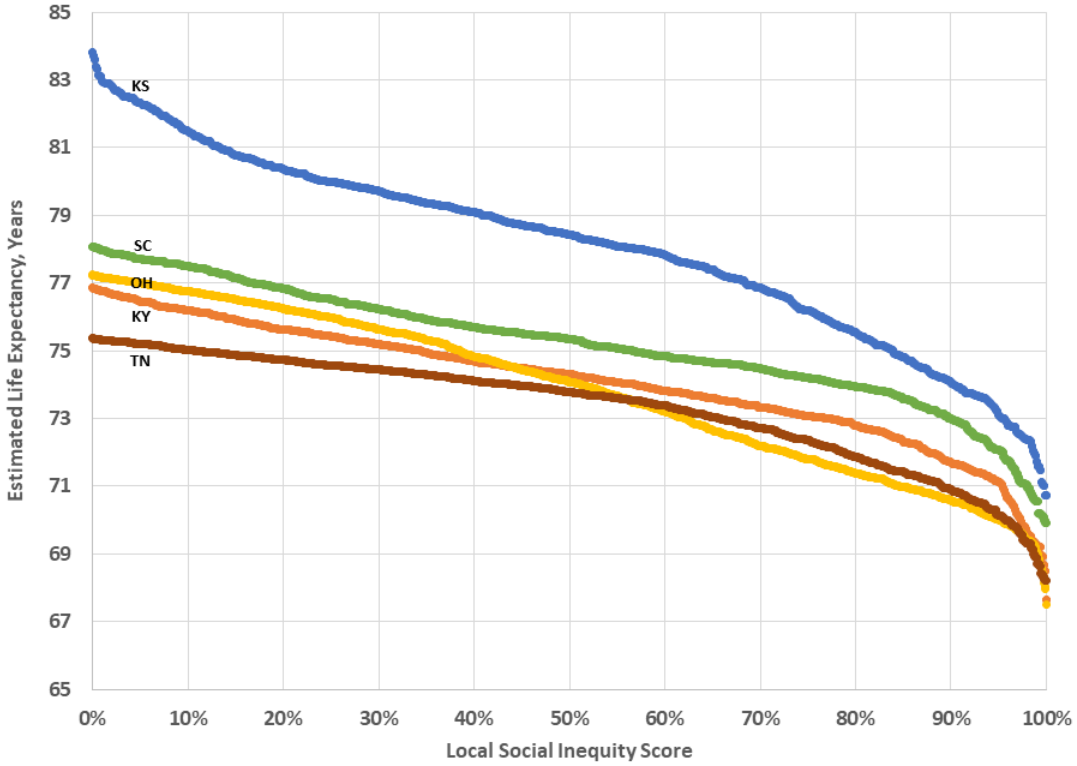
Other Federal and Private Data Sources

- Opportunity Atlas
- Social Capital Project
- Baseline Resilience Indicators for Communities
- United States Drought Monitor
- RWJF County Health Rankings
- Brandeis Diversity Data Kids – Child Opportunity Index
- Brown University's Longitudinal Tract Data Base
- Mapping the Meal Gap
- MIT Election Data and Science Lab

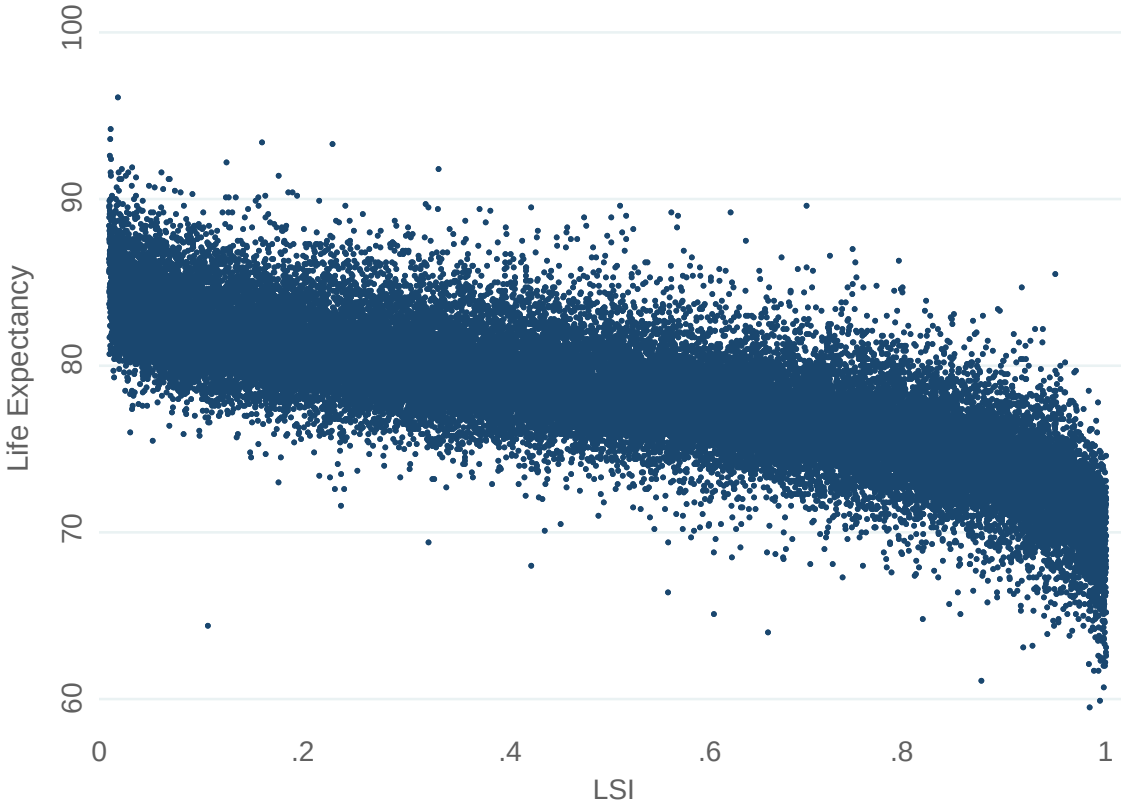
Visualizing Complex Data



Life expectancy by local social inequity: 5 states

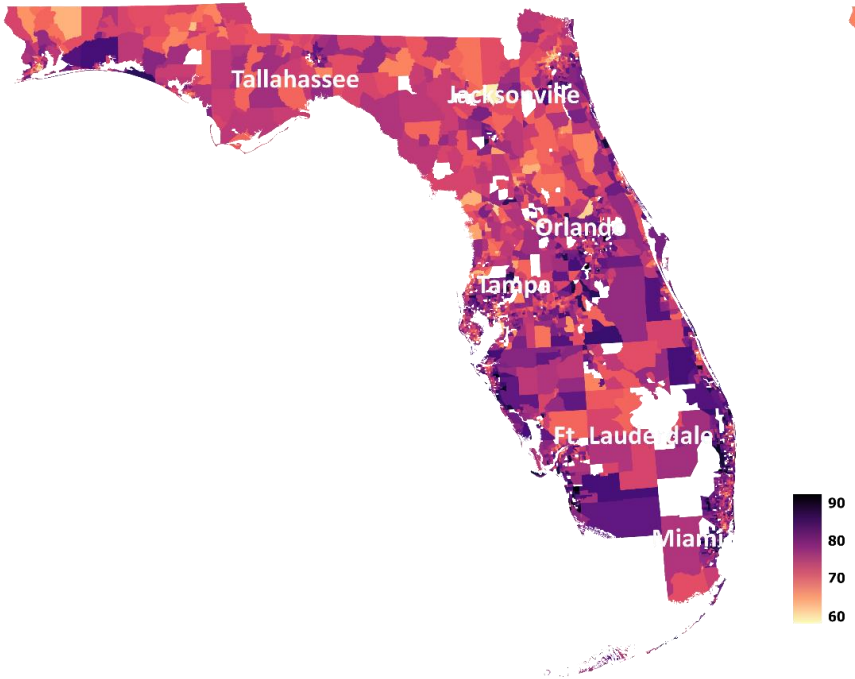


Life expectancy and LSI across the US

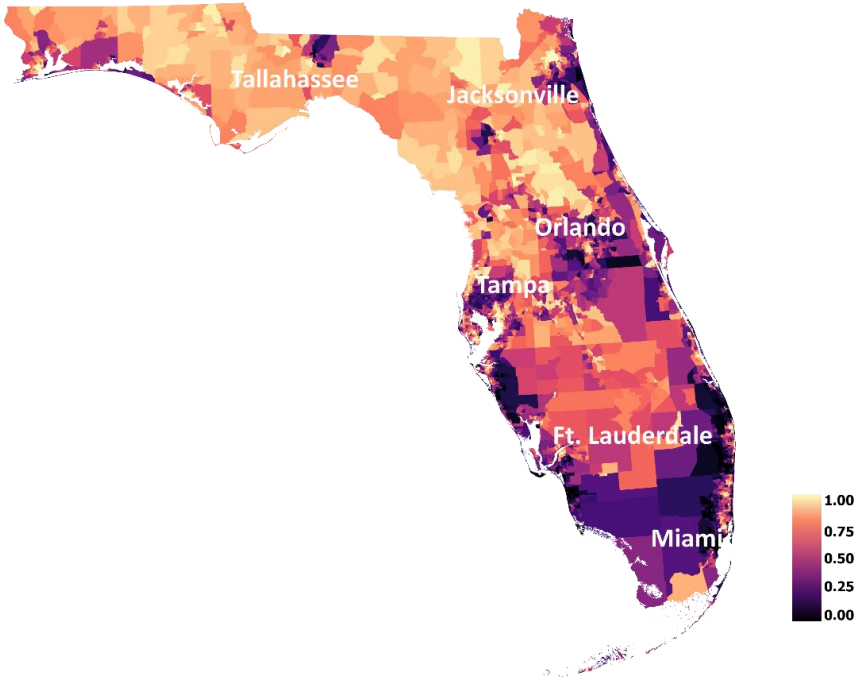


Maps of Life Expectancy and Social Inequity: Florida

Life Expectancy Estimates

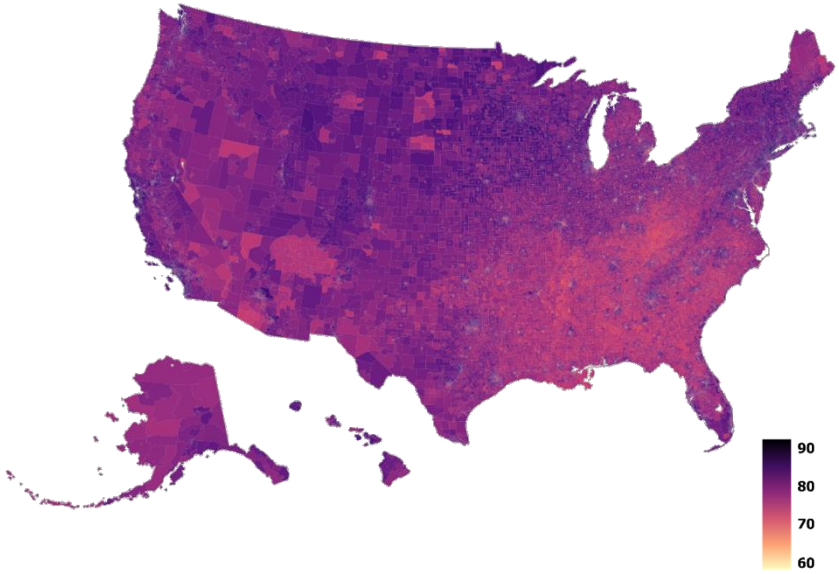


Local Social Inequity Scores

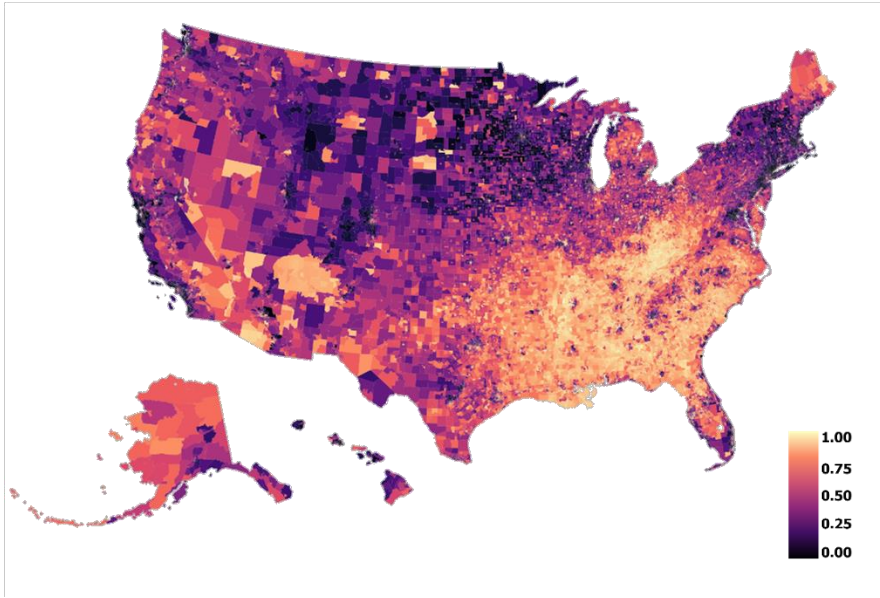


Maps of Life Expectancy and Social Inequity: United States

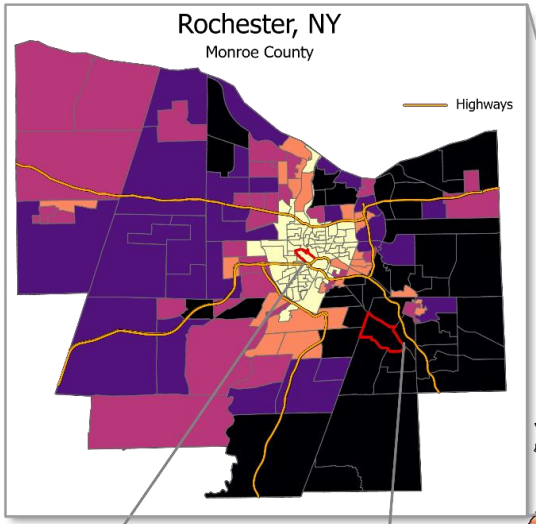
Predicted Life Expectancy

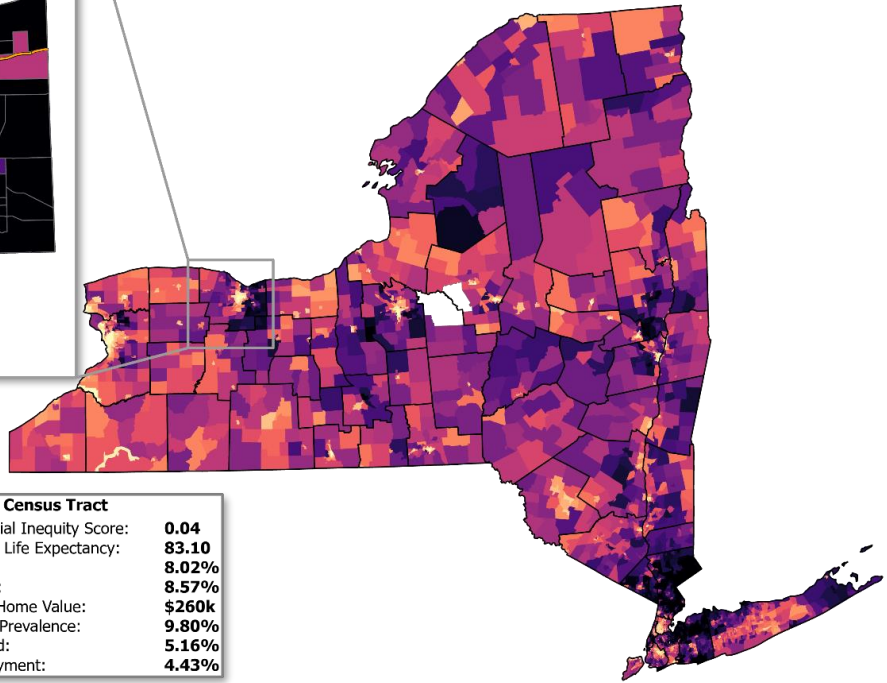


Local Social Inequity Scores



Unpacking the LSI scores – Rochester, NY

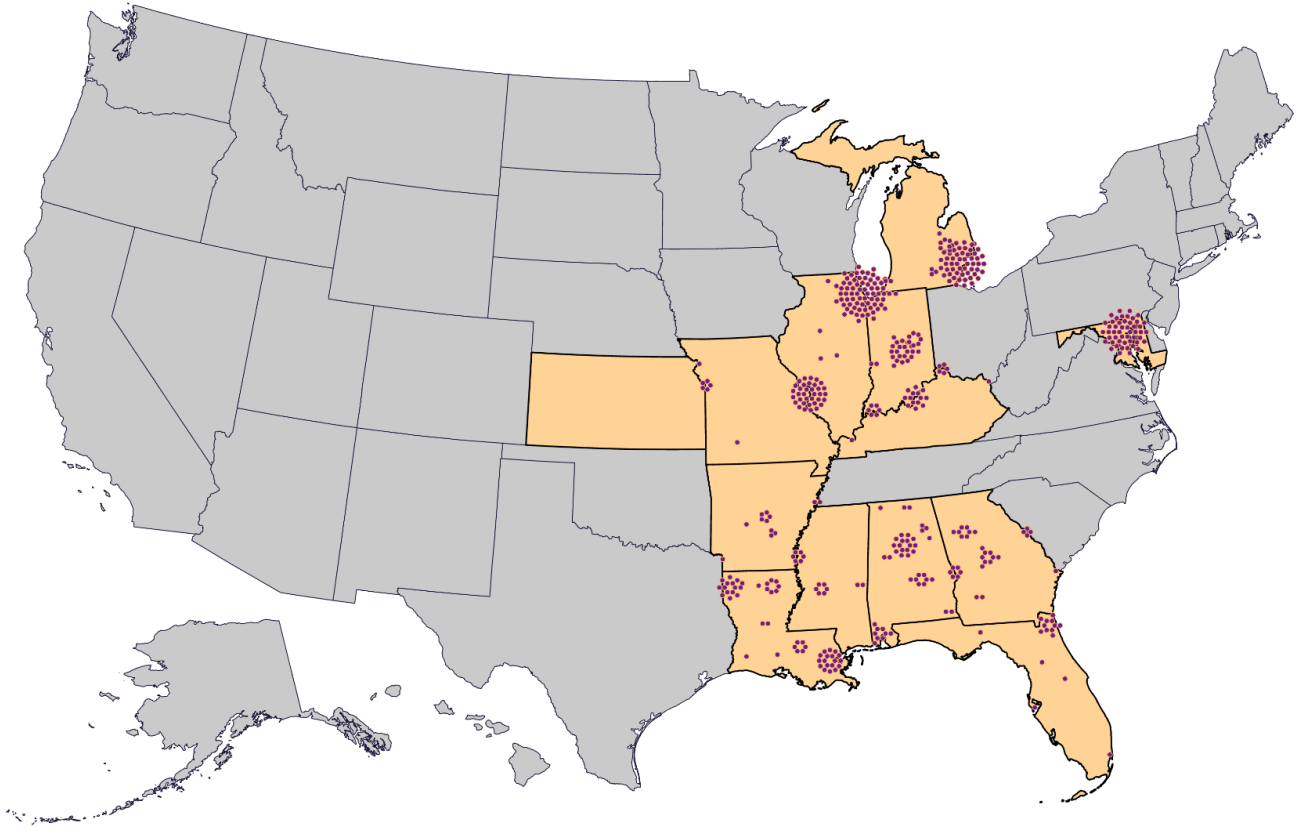




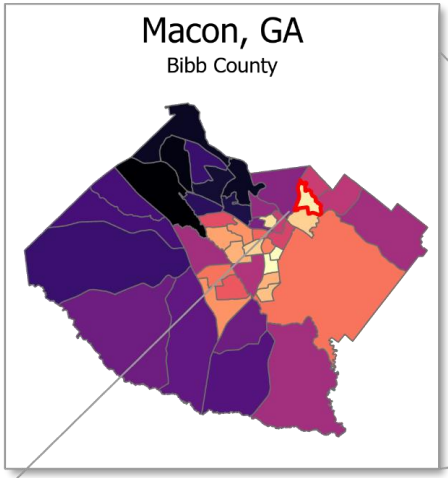
High LSI Census Tract	
Local Social Inequity Score:	**0.98**
Predicted Life Expectancy:	**75.30**
Poverty:	**73.28%**
Disability:	**17.45%**
Average Home Value:	**$43k**
Smoking Prevalence:	**36.80%**
Uninsured:	**8.61%**
Unemployment:	**20.85%**

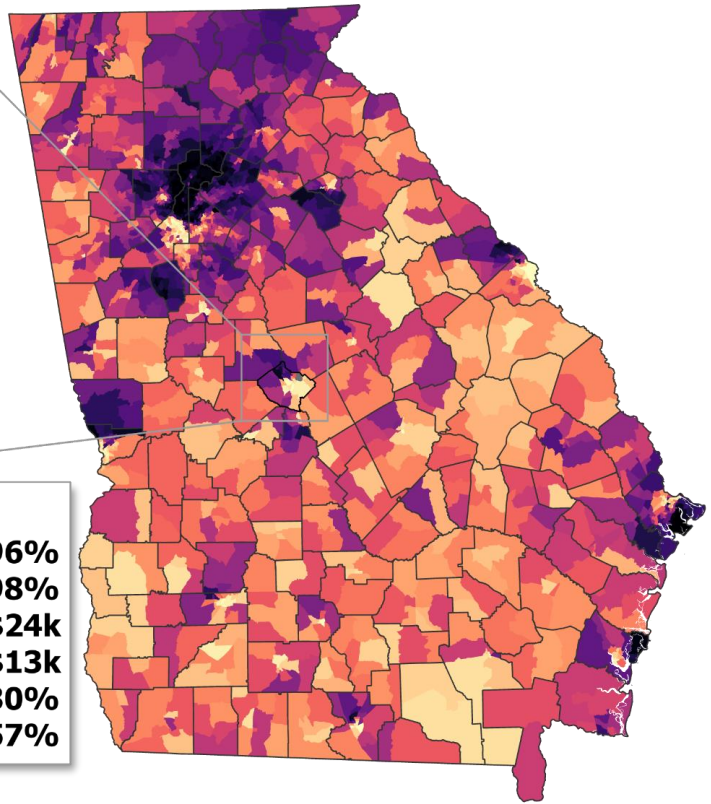
Low LSI Census Tract	
Local Social Inequity Score:	**0.04**
Predicted Life Expectancy:	**83.10**
Poverty:	**8.02%**
Disability:	**8.57%**
Average Home Value:	**$260k**
Smoking Prevalence:	**9.80%**
Uninsured:	**5.16%**
Unemployment:	**4.43%**

Where are the 99th percentile tracts?



Census Tract with Highest LSI Score in US

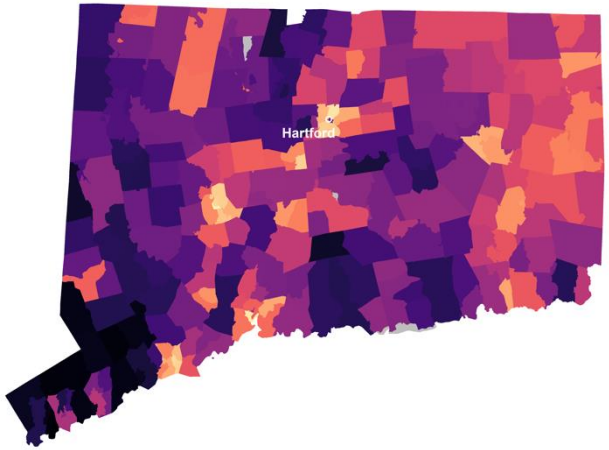




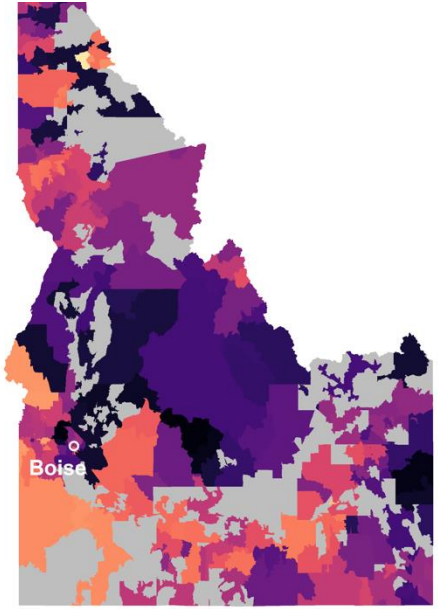
Highest LSI Tract

Non-White:	**96%**
Single Parents:	**98%**
Median Household in 1990:	**$24k**
Median income in 2012-2016:	**$13k**
Unemployment:	**30%**
At or below poverty line:	**57%**

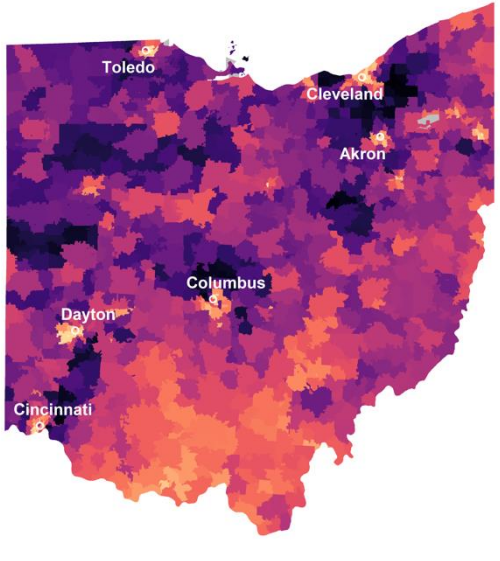
LSI scores by ZIP code across SIM2 states



Connecticut

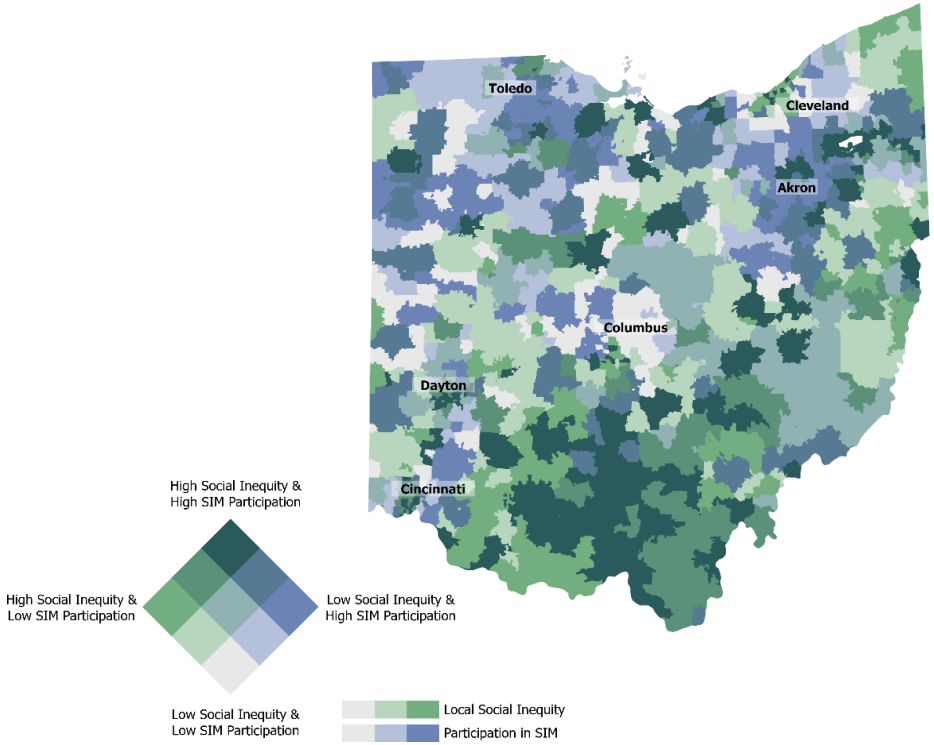


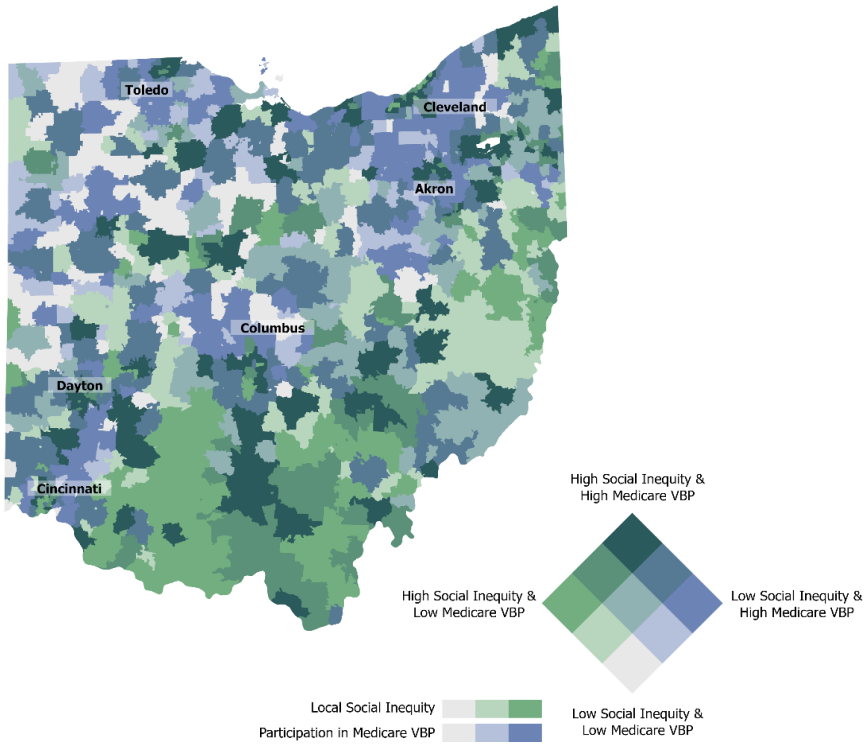
Idaho



Ohio

Bivariate Analysis of LSI vs SIM2 & LSI vs VBP - Ohio

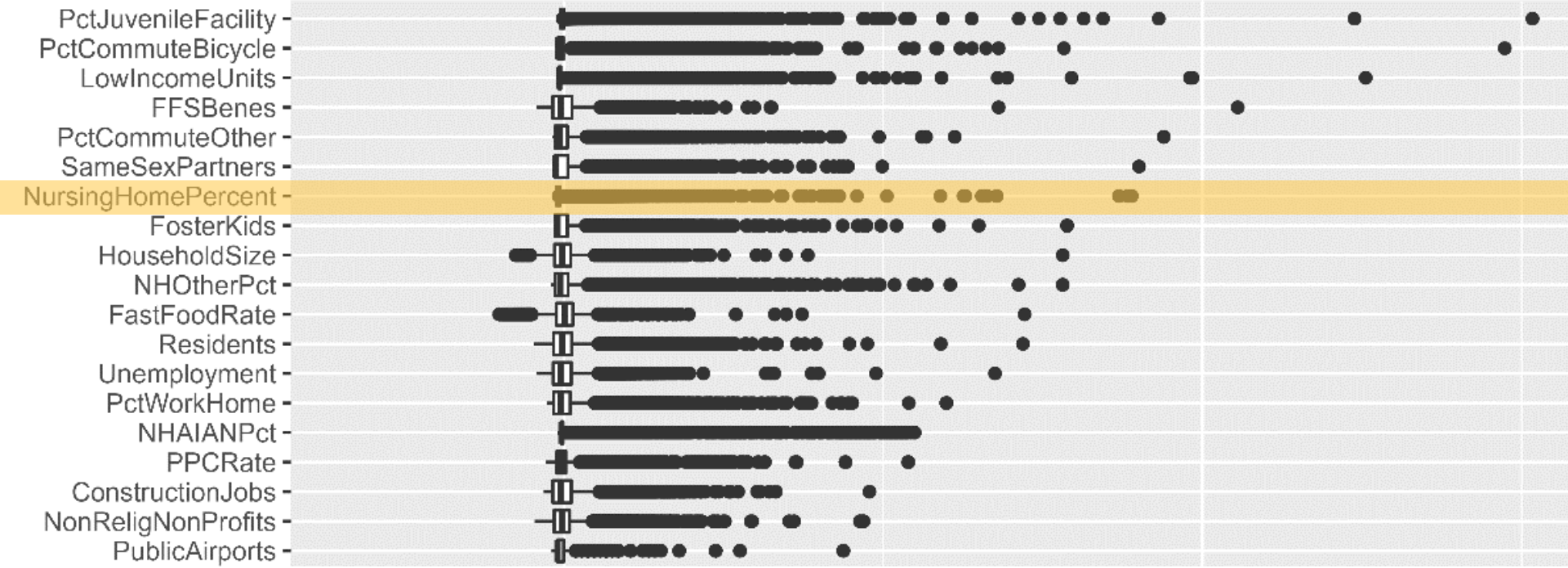




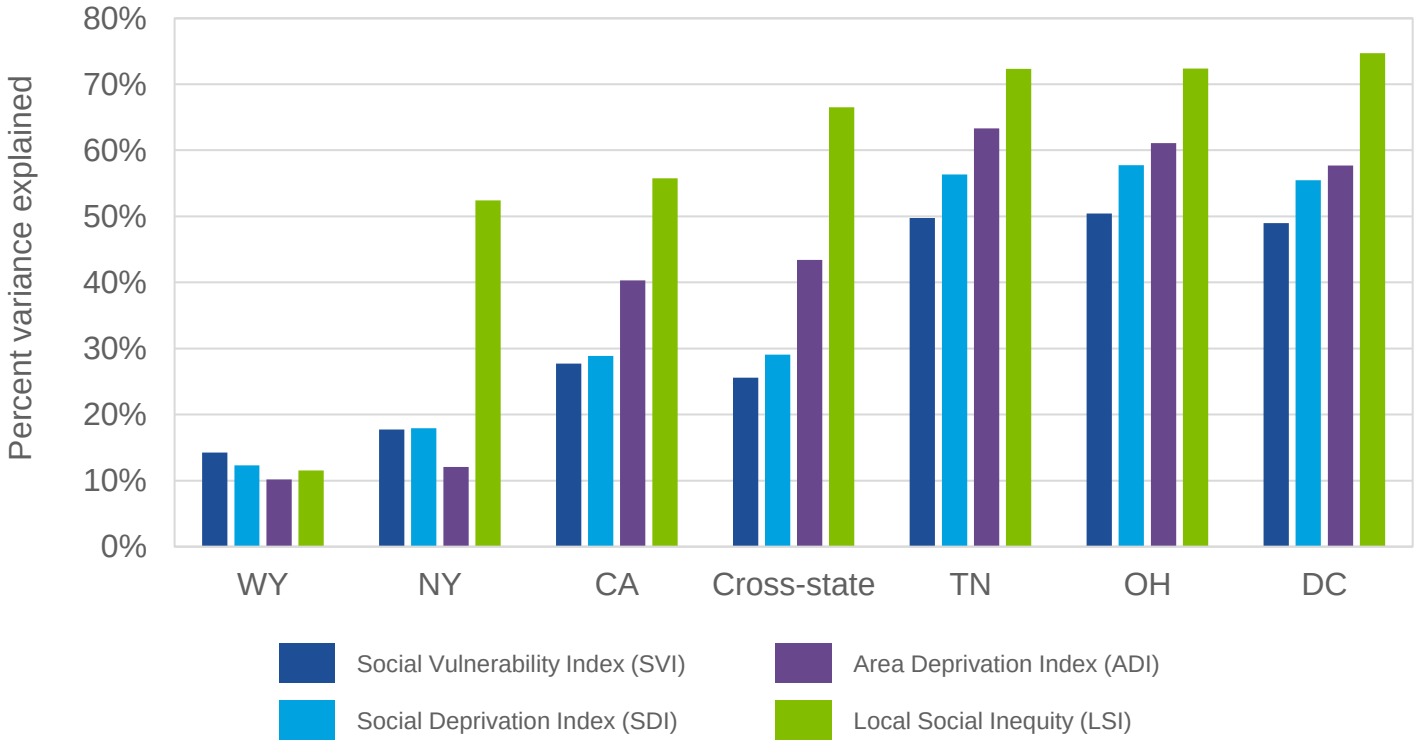
Top Predictors of Life Expectancy Across the US

VI rank	Indicator
1	Nursing home residents, %, 2010
2	Mentally unhealthy >14 days per month, % of adults, 2018
3	Tooth loss prevalence rate, % of adults 65+, 2018
4	Smoking prevalence rate, %, 2018
5	Child Opportunity Index, 2010-2015
6	Probability of reaching the top 20% of income (among children born the same year), 1978-2015
7	Rural/urban commuting area code
8	Foreign-born, %, 2010-14
9	Physically unhealthy > 14 days per month, adults, %, 2018
10	Teen births per 1k females aged < 20 years, 2010-14

What is driving the algorithm?



Comparison with Other SDoH Composite Measures



State Innovation Models, Round 2 (SIM2): Bivariate associations in Ohio – More hospital care, less primary care in highest-risk ZIP codes

Figure 1. Any inpatient admission by quartile and year

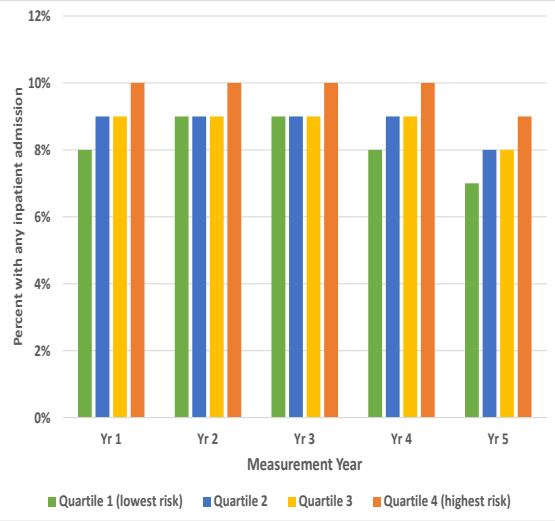


Figure 2. Number of PCP visits by quartile and year

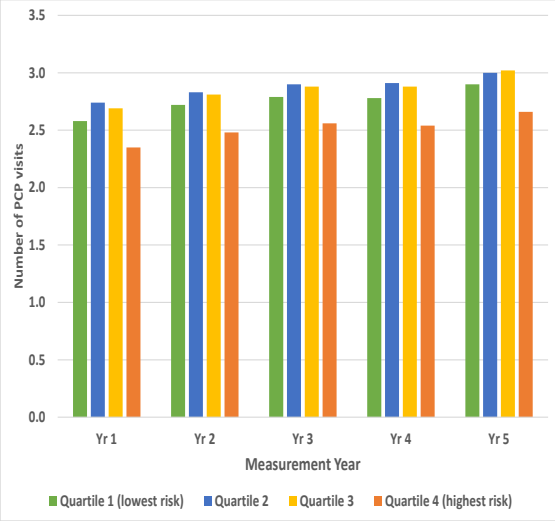
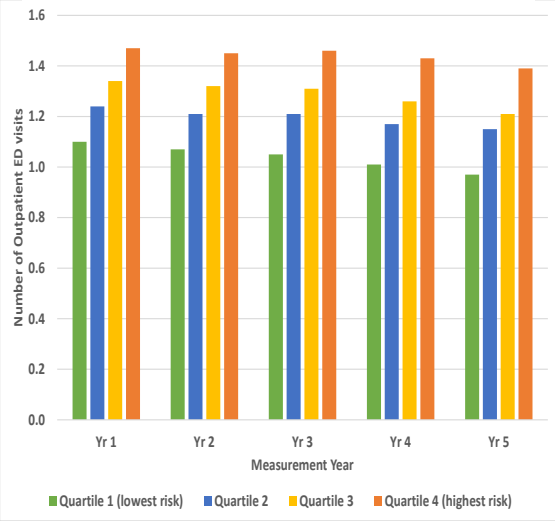


Figure 3. Number of ED visits by quartile and year



n=12.1 million person-years

Validation: Linking LSI Scores with Medicaid Data in Multivariable Triple-Difference Models

Figure 1. Total Spending

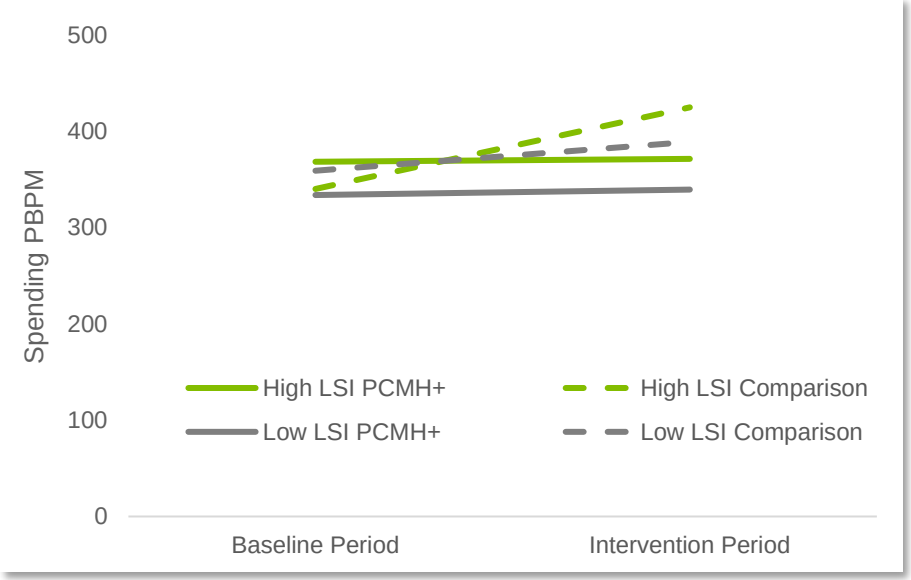
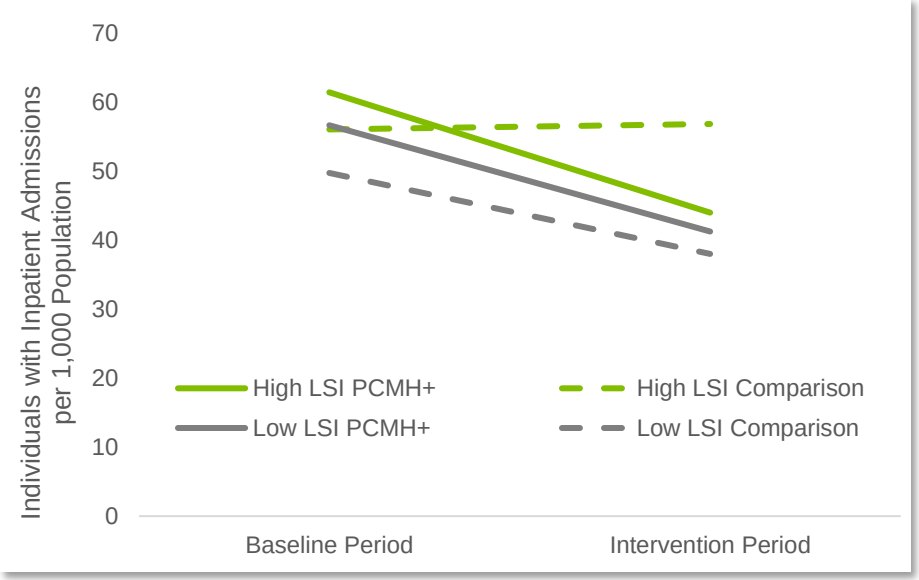


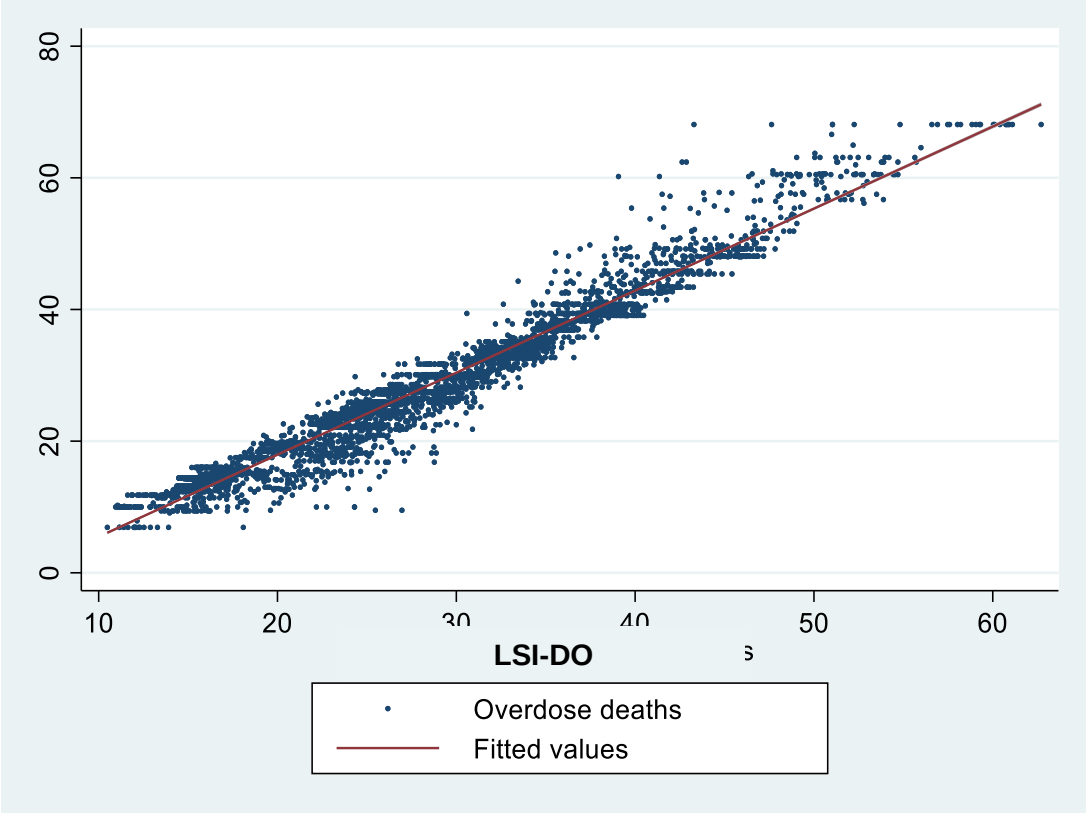
Figure 2. Inpatient Admissions



Modeling Other Outcomes

Observed overdose deaths vs. model-predicted overdose deaths

Age-adjusted drug overdose mortality per 100k



N=4,269
ZIP codes in 4 states

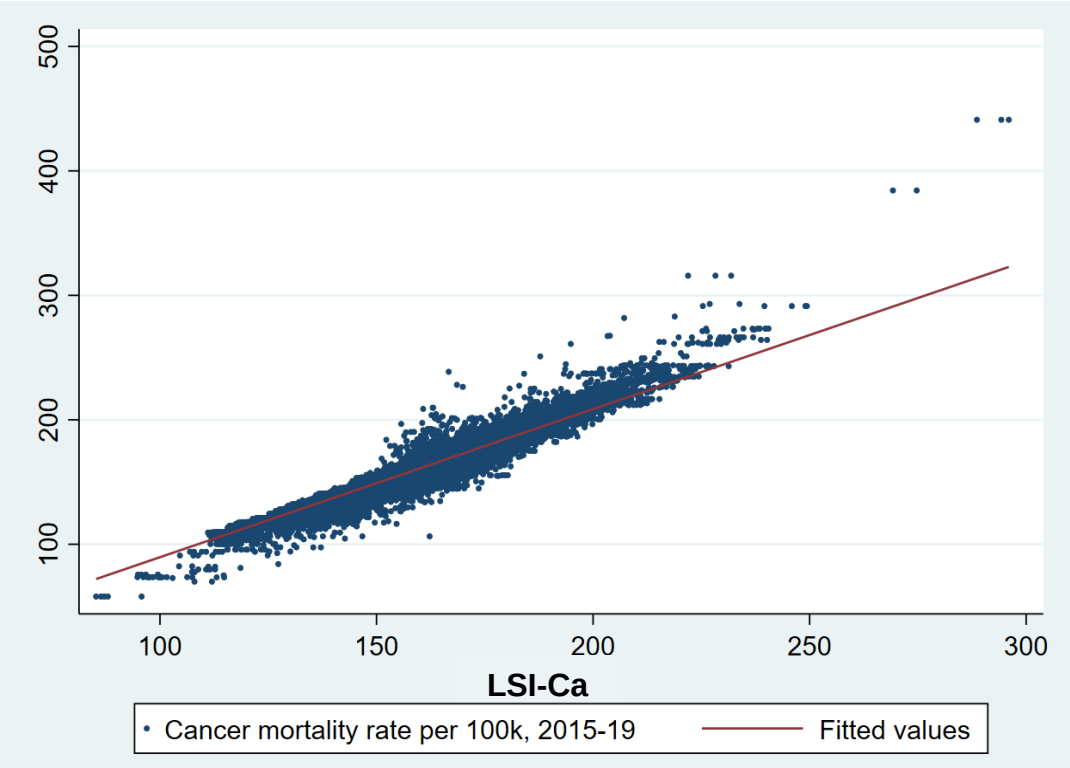
Predictors: 30

RMSE: 3.1

Adj R^2 = 0.9672

Observed cancer deaths vs. model-predicted cancer deaths

Age-adjusted cancer mortality per 100k



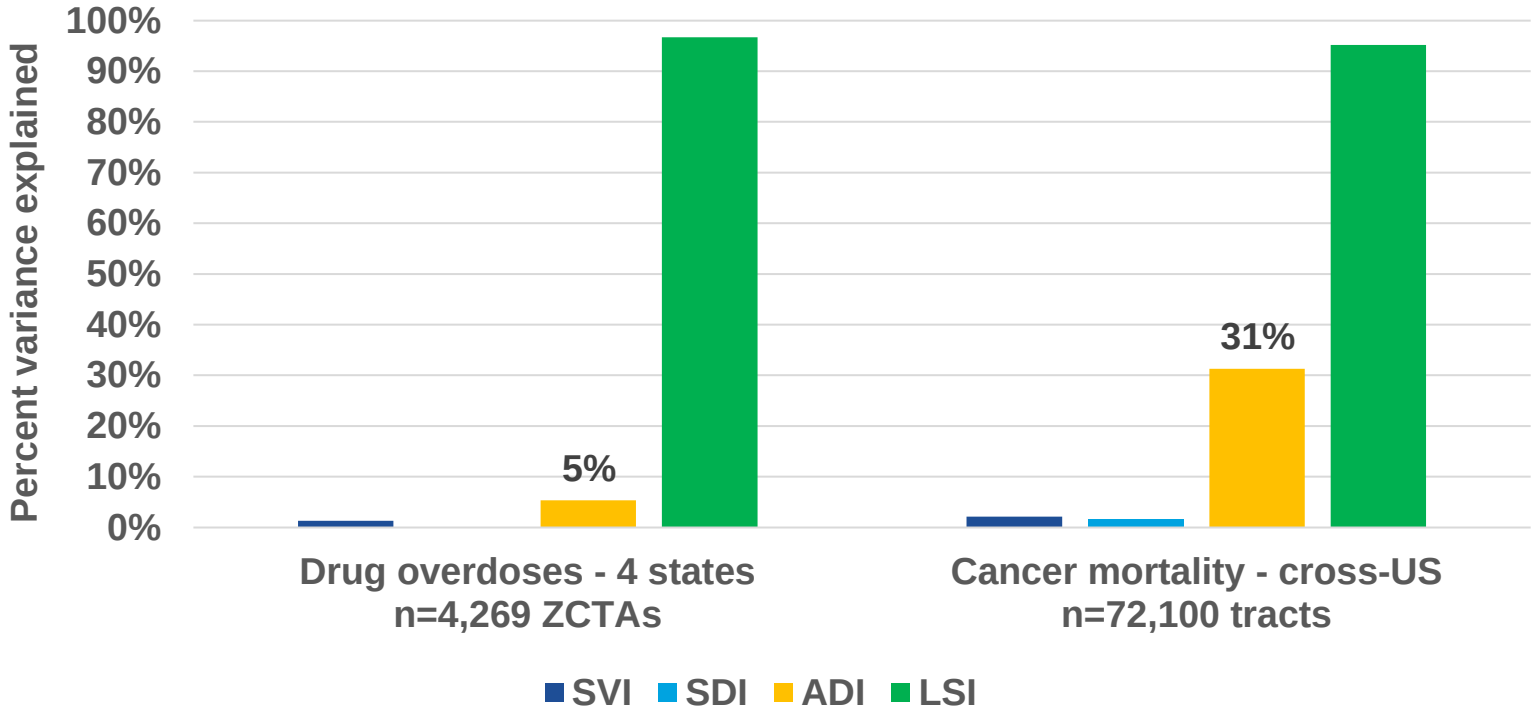
N=72,770
US Census tracts

Predictors: 140

RMSE: 7.8

Adj R^2 = 0.9487

Validation vs Other SDoH Composites – Drug Overdose Mortality and Cancer Mortality



Risk Adjustment for Social Risk Factors

- Does not remove the requirement to address them
- Does not imply lower standards of care are acceptable
- Does not unfairly penalize providers for factors outside of their control
- Does not unfairly reward providers simply for being in better-off/less at-risk communities

Use Cases for RTI Rarity Data and Scores

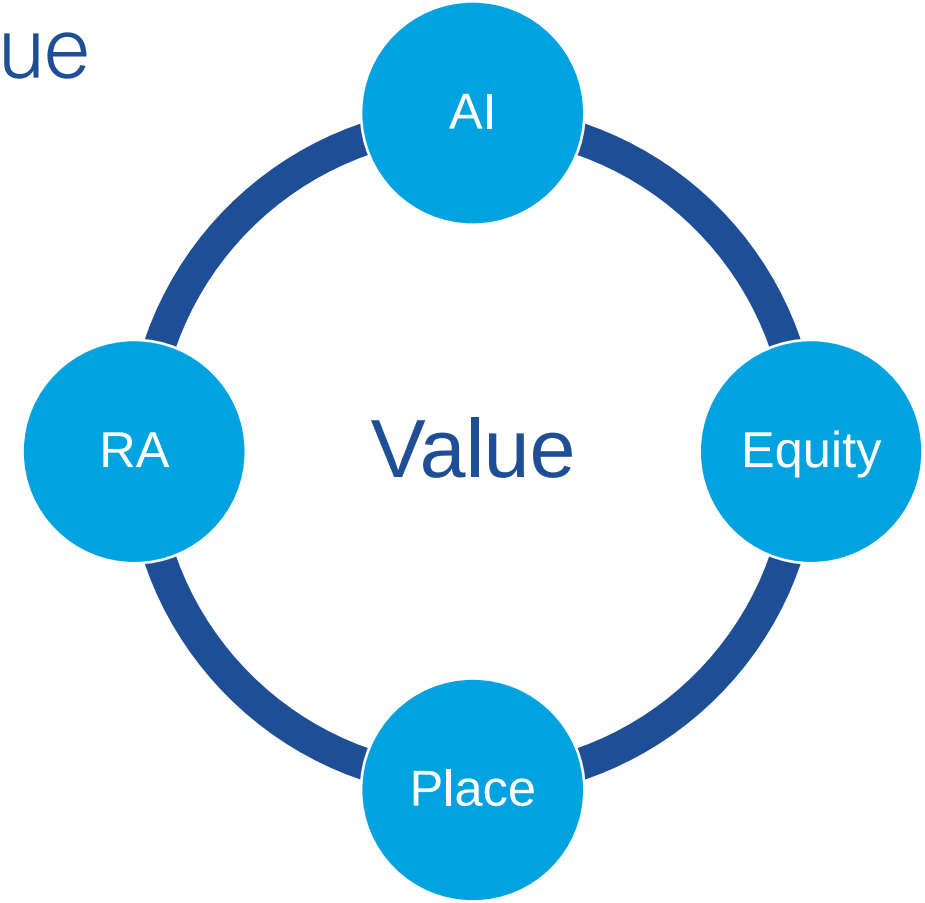
Control for social factors in **analyses of access to care, quality, and cost**

Use in **evaluations** to identify patterns of higher-risk communities

Target interventions to higher-risk populations

Inform policies to address root causes

The Value



Tech Talk

Questions and Discussion

RTI Rarity™
an AI solution of RTI International

Contact **cdannunzio@rti.org** for more on how RTI Rarity can help you meet your project goals

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