



INCORPORATING AREA-LEVEL METRICS:

*Approaches to social
determinants of health-
related research*

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Chief, UW Rheum
1/24/24

INTRODUCTION





Health and health equity are determined by **the conditions in which people are born, grow, live, work, play and age**, as well as biological determinants.

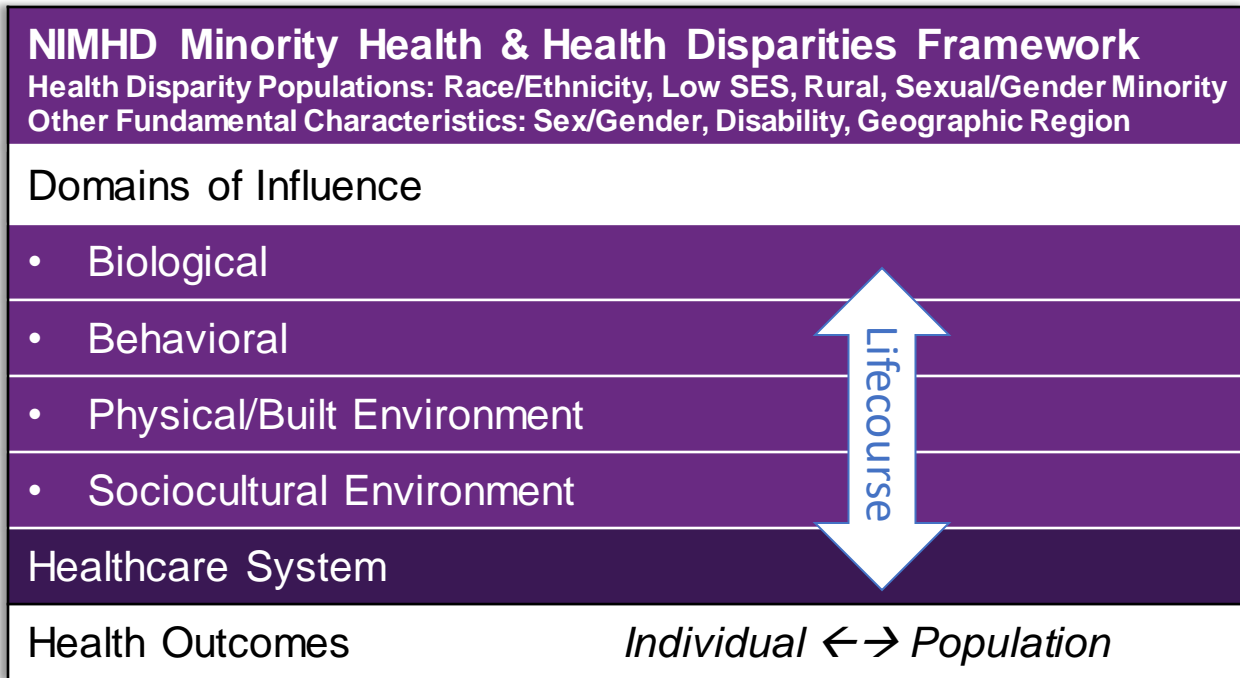
Structural determinants... shape the distribution of power and resources determined by the conditions in which people are born, grow, live, work, play and age.

World Health Organization

OBJECTIVES

1. **Review frameworks and foundational studies on neighborhood context**
2. **Compare-contrast 4 area-level metrics**
 - Medicare Regions & State-level metrics
 - Rural Urban Commuter Area Index
 - Area Deprivation Index
 - Social Vulnerability Index
3. **Select & apply area-level metrics**





VARIABLES

- BIOLOGICAL
 - Number of ACR SLE criteria
- BEHAVIORAL
 - Smoking history
- SOCIOCULTURAL
 - Race, ethnicity
 - Ind. SES
- ENVIRONMENT
 - RUCA (Urban-Rural)
 - Neighborhood - “ADI”
 - CDC SVI

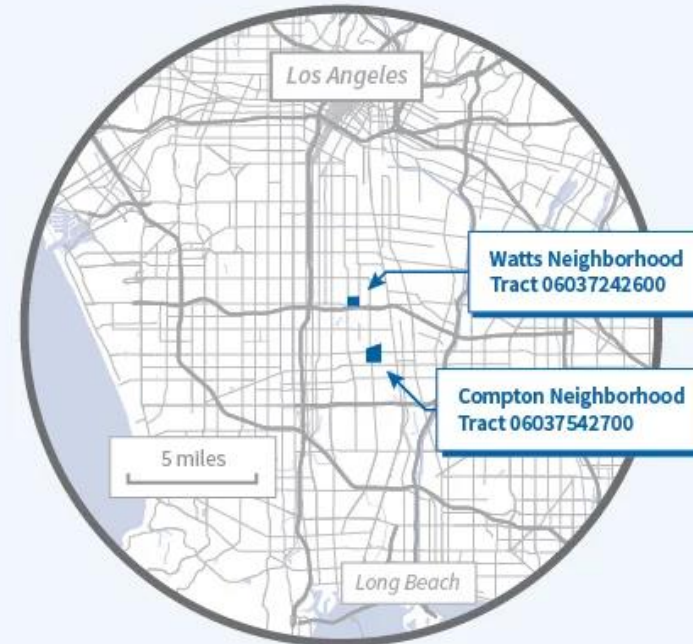
MOVING TO OPPORTUNITY

Moving to Less poor neighborhood before age 13:

1. Increased income by mid-20s by 31%
2. Boosted marriage rates by 2% points
3. Raised college attendance 2.5%
4. Reduced incarceration
5. Reduced Diabetes

Children's Outcomes Vary Dramatically at the Neighborhood Level

Even for children whose parents had similar income levels, later-life outcomes can vary significantly between neighborhoods that are only a few miles apart



Outcomes for black males who grew up in each of the tracts and whose parents' income was at the 25th percentile nationally

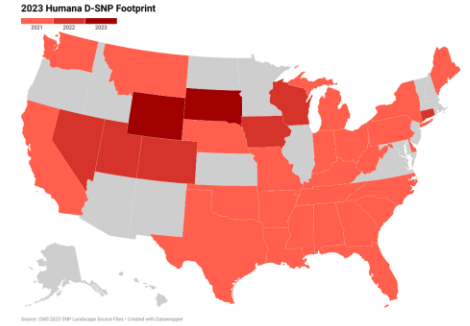
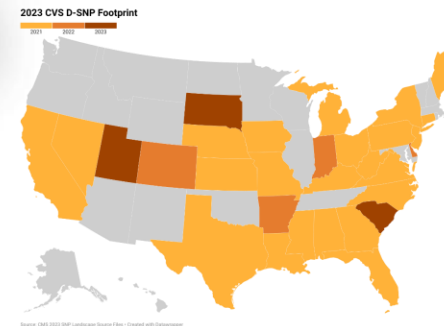
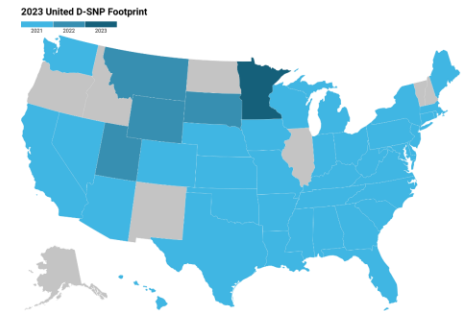
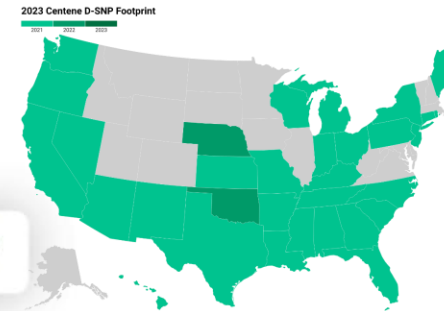
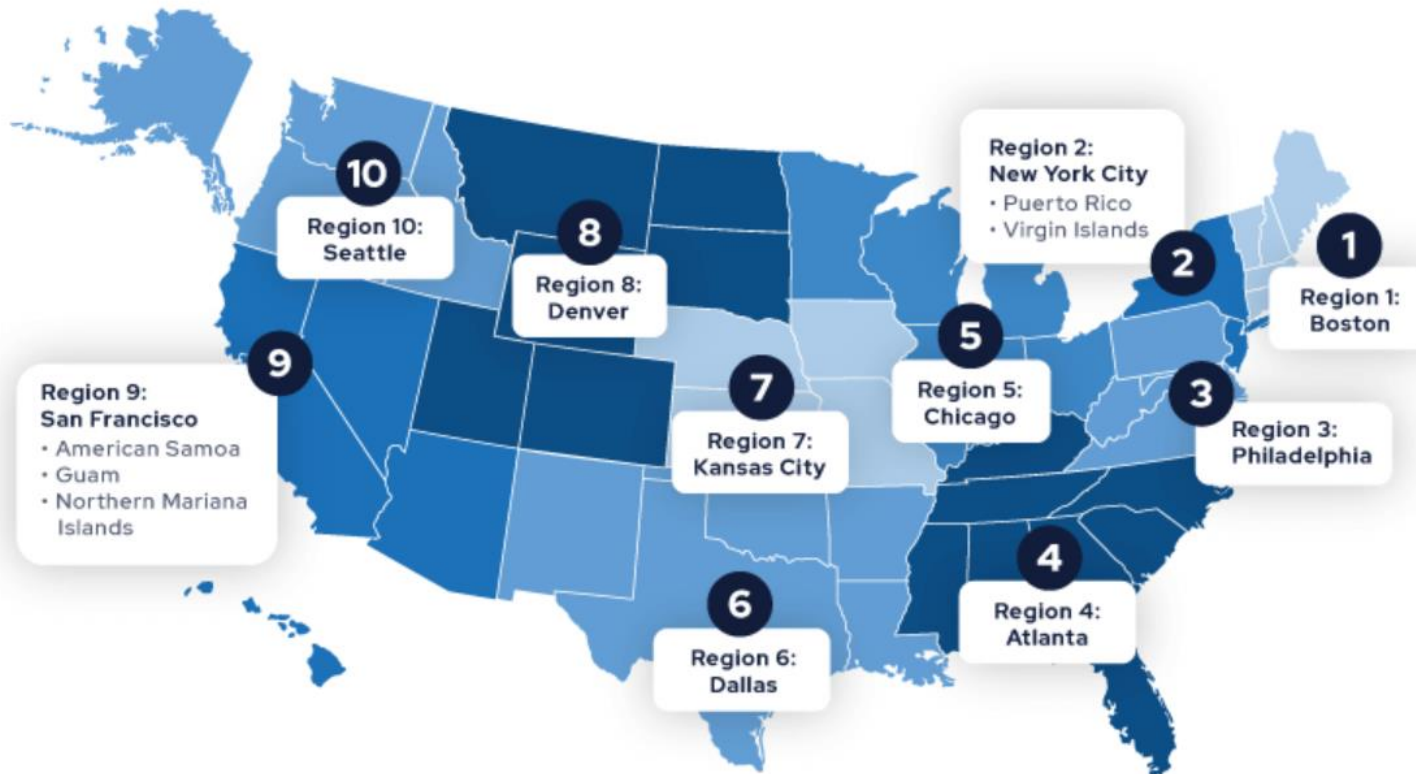


Incarceration rate represents the fraction of adults who grew up in the tract and who were in jail or prison on April 1, 2010
Source: Researchers' calculations using data from the United States Bureau of the Census

CMS
***MEDICARE
REGION CODES
& STATE-LEVEL***



10 TRADITIONAL MEDICARE REGIONS & PART D



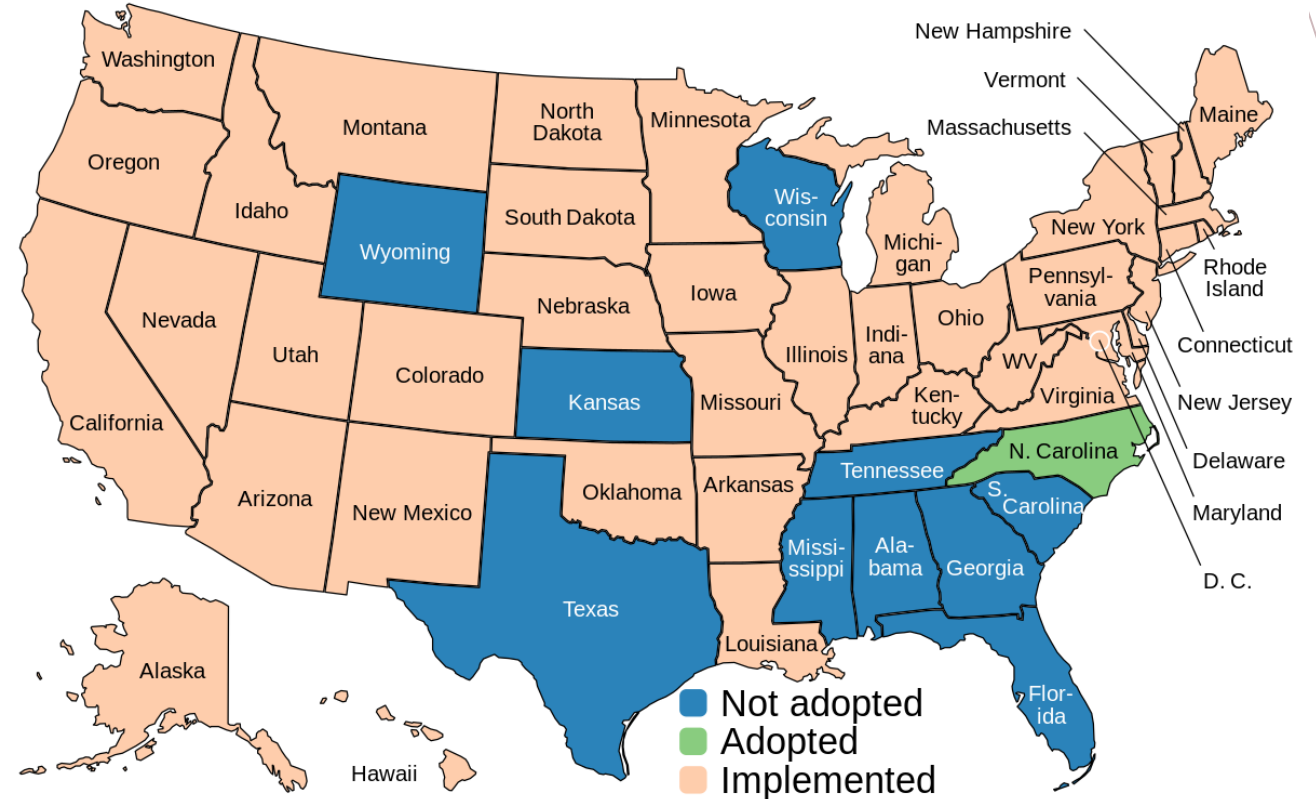
MEDICAID & STATE-LEVEL

Medicaid is state-level

- Policy often state-level
- Again, match time period of analysis

2-digit FIPS codes useful for state level

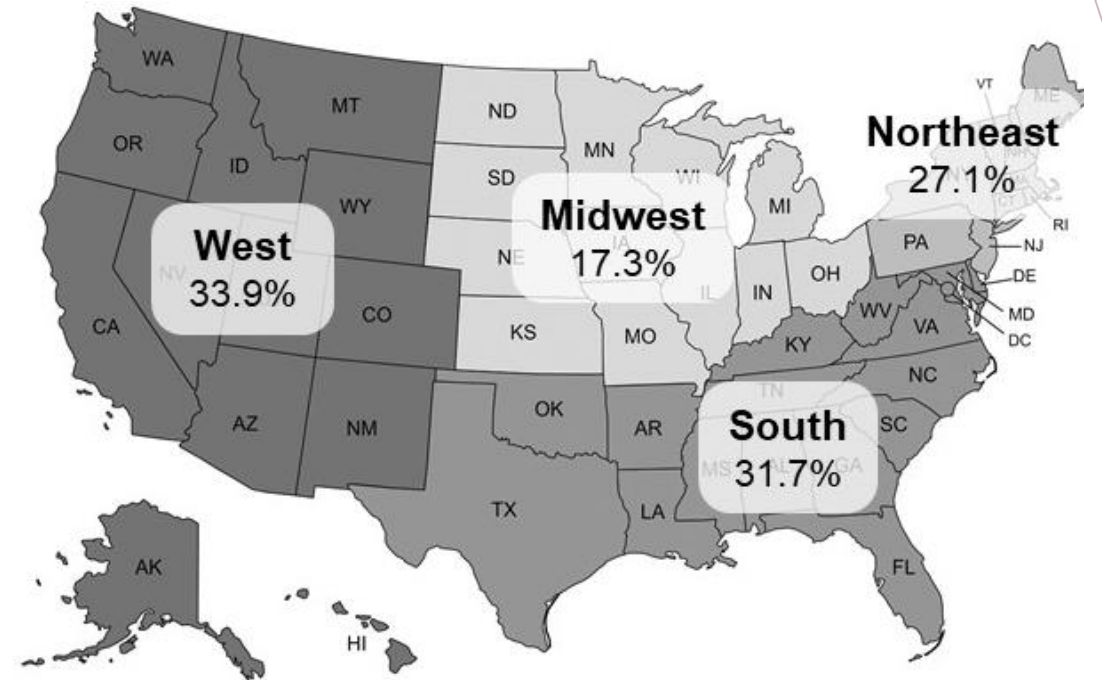
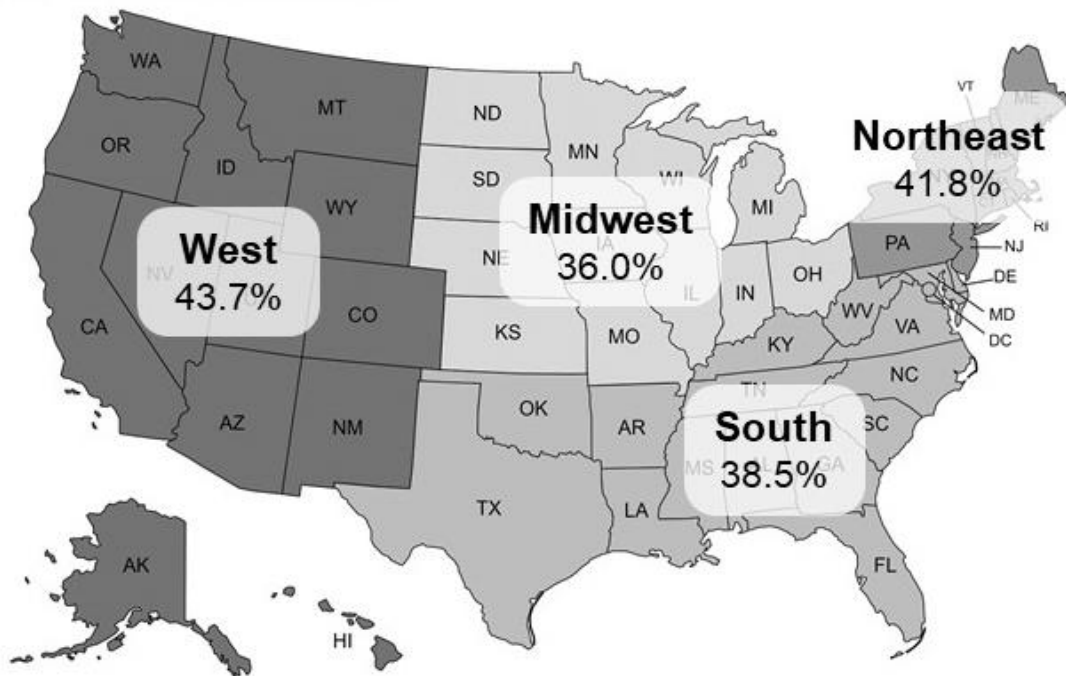
Medicaid expansion. Affordable Care Act



EXAMPLE MEDICARE DUAL YOUNG ADULT SLE STUDY

39.4% of young adults visit retained

28.2% of young adults serologic tested



Rheumatologists Per 100k Patients

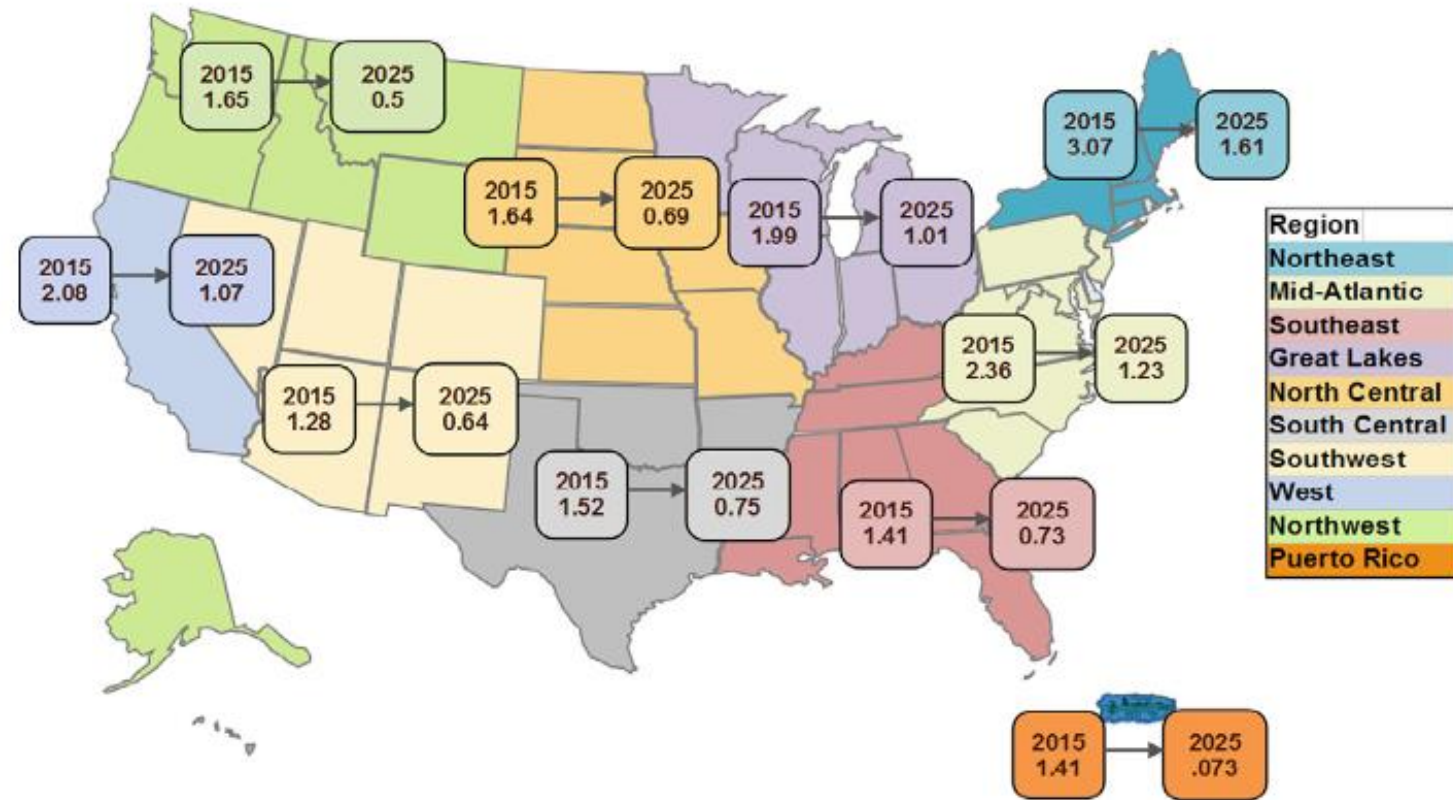


Figure 1. Adult rheumatology provider distribution rate per 100,000 patients in 2015 compared to projections for 2025.

RUCA Codes
***RURAL URBAN
COMMUTER
AREA CODES***



RUCA BASICS

Developed by US Department of Agriculture (USDA) & Dept of Health Human Services (HHS)

By: A) pop. density, B) urbanization, C) commuting

9-10 Code Types

3 Metro

6 Non metro

Census Tract-level

Link using FIPS-2-digits State, 3-digits County or 5-digit zip-code

-watch yr/version-census tracts change in time

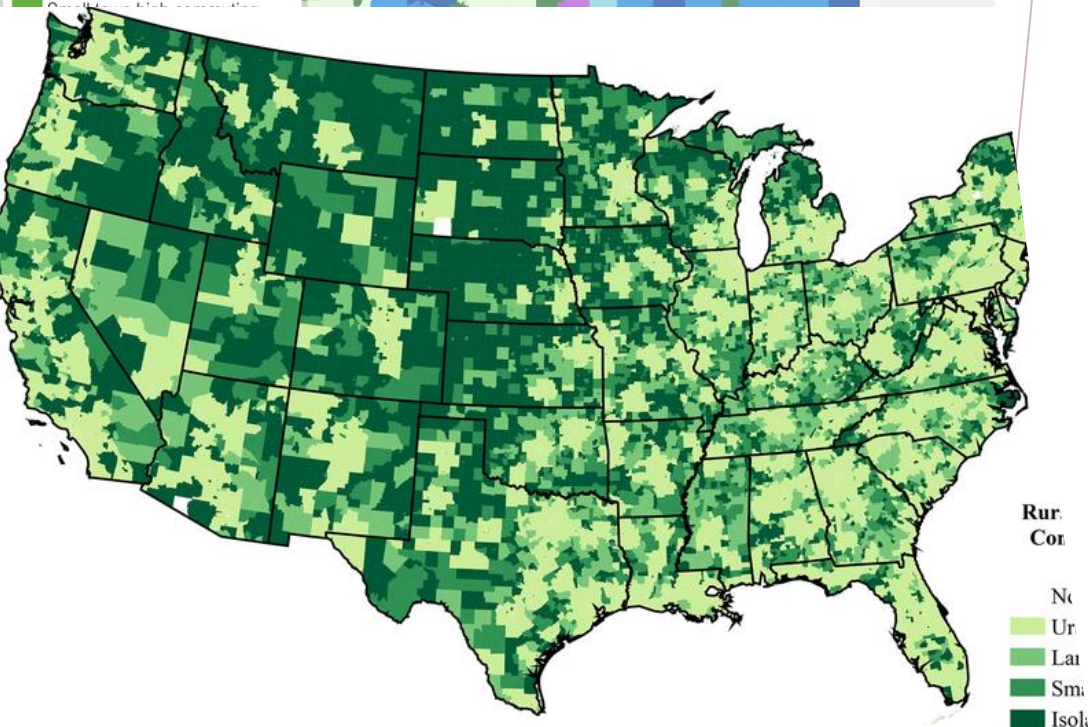
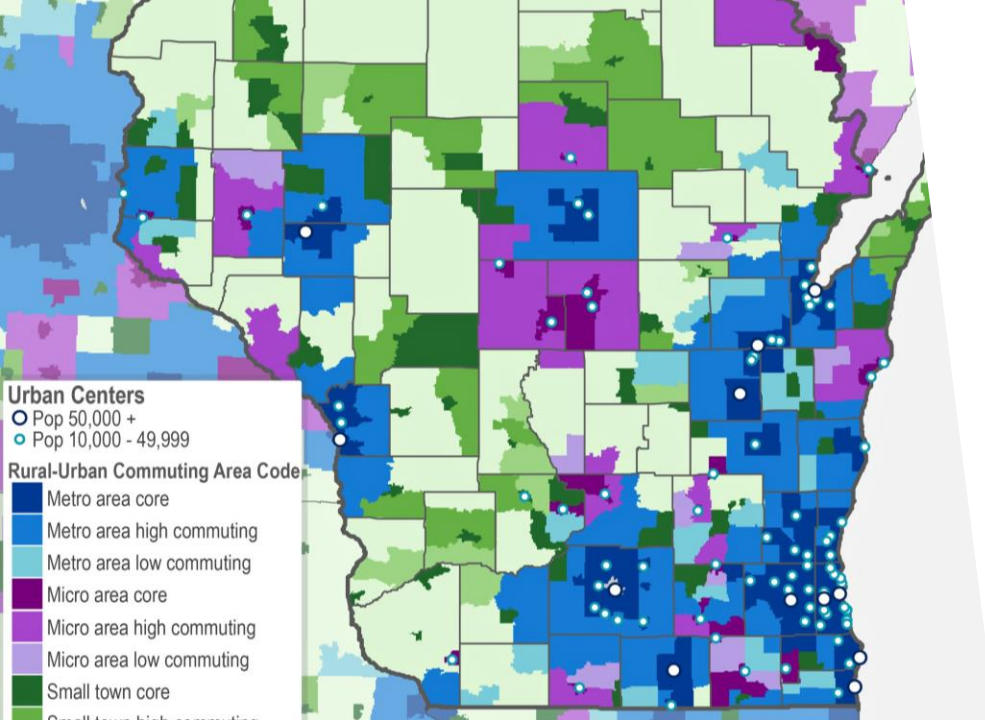


TABLE. RUCA CATEGORIES

Metro	Category		Non-Metro	Category
1	Metro - Counties in metro areas of 1 million population or more		4	Nonmetro - Urban population of 20,000 or more, adjacent to a metro area
2	Metro - Counties in metro areas of 250,000 to 1 million population		5	Nonmetro - Urban population of 20,000 or more, not adjacent to a metro area
3	Metro - Counties in metro areas of fewer than 250,000 population		6	Nonmetro - Urban population of 2,500 to 19,999, adjacent to a metro area
			7	Urban population of 2,500 to 19,999, not adjacent to a metro area
			8	Nonmetro - Completely rural or less than 2,500 urban population, not adjacent to a metro area
			9	Nonmetro - Completely rural or less than 2,500 urban population, not adjacent to a metro area
	<i>*Also 4 and 7 category groupings.</i>		[10-Rural]	

APPLYING RUCA CODES TO PROJECTS

- Select a Time Period to Download

Data Set	Last Updated
2013 Rural-Urban Continuum Codes 	12/10/2020
2003 Rural-Urban Continuum Codes 	7/29/2004
2003 Rural-Urban Continuum Codes codes for Puerto Rico 	10/28/2004
1993 Rural-Urban Continuum Codes 	5/20/2004
1983 and 1993 Rural-Urban Continuum Codes 	5/20/2004
1974 Rural-Urban Continuum Codes 	8/6/2003

*Estimate that 2020 RUCA codes will be released ~Fall 2024

ADI Neighborhood Atlas
**AREA
DEPRIVATION
INDEX (ADI)**



DERIVATION OF ADI

Annals of Internal Medicine

ORIGINAL RESEARCH

Neighborhood Socioeconomic Disadvantage and 30-Day Rehospitalization

A Retrospective Cohort Study

Amy J.H. Kind, MD, PhD; Steve Jencks, MD, MPH; Jane Brock, MD, MSPH; Menggang Yu, PhD; Christie Bartels, MD; William Ehlenbach, MD, MSc; Caprice Greenberg, MD; and Maureen Smith, MD, MPH, PhD

Britain, Sweden, Australia, New Zealand & others use composite area deprivation indices/scores

US weights per Singh et al. 2003

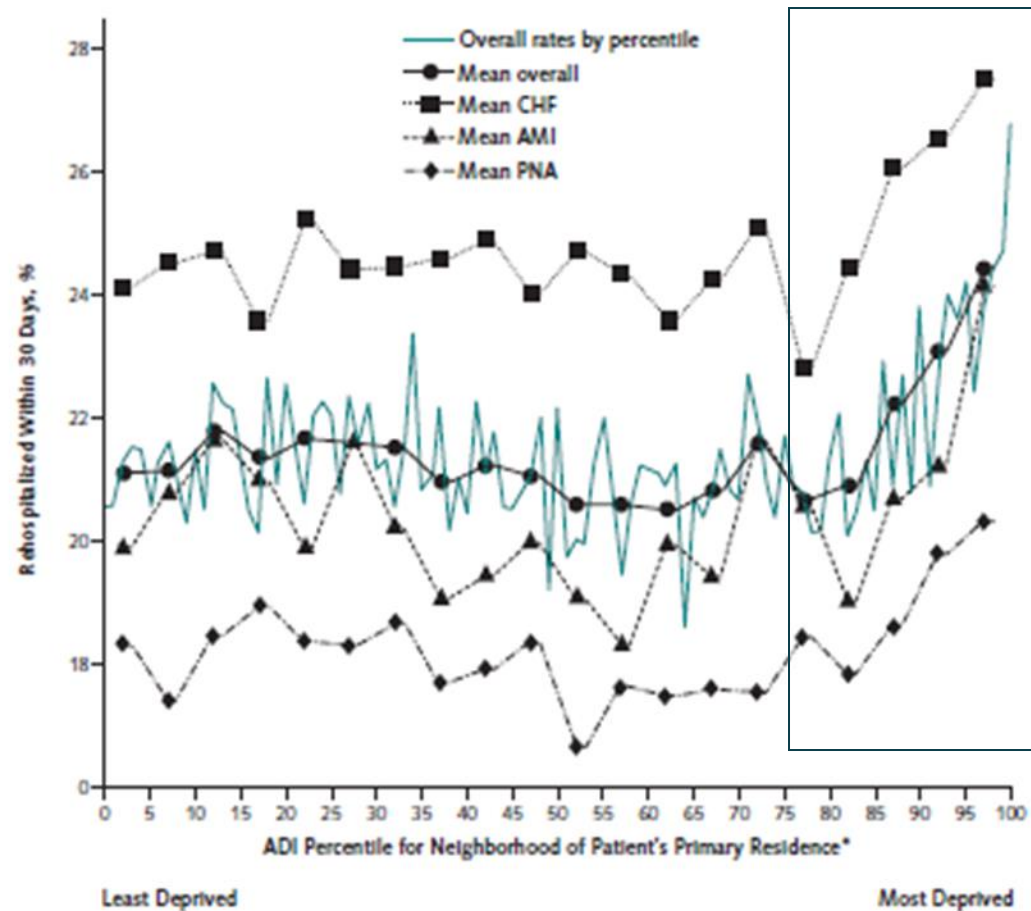
17 Components

- Poverty, Education, Employment, Housing
- Kind updated to census block group by ACS

Table 1. Census Data Block Group Components and Factor Score Coefficients in the Singh ADI*

Census Block Group Component	Factor Score Coefficient
Percentage of population aged ≥ 25 y with < 9 y of education	0.0849
Percentage of population aged ≥ 25 y with at least a high school diploma	-0.0970
Percentage of employed persons aged ≥ 16 y in white collar occupations	-0.0874
Median family income	-0.0977
Income disparity†	0.0936
Median home value	-0.0688
Median gross rent	-0.0781
Median monthly mortgage	-0.0770
Percentage of owner-occupied housing units (home ownership rate)	-0.0615
Percentage of civilian labor force population aged ≥ 16 y unemployed (unemployment rate)	0.0806
Percentage of families below the poverty level	0.0977
Percentage of population below 150% of the poverty threshold	0.1037
Percentage of single-parent households with children aged < 18 y	0.0719
Percentage of occupied housing units without a motor vehicle	0.0694
Percentage of occupied housing units without a telephone	0.0877
Percentage of occupied housing units without complete plumbing (log)	0.0510
Percentage of occupied housing units with > 1 person per room (crowding)	0.0556

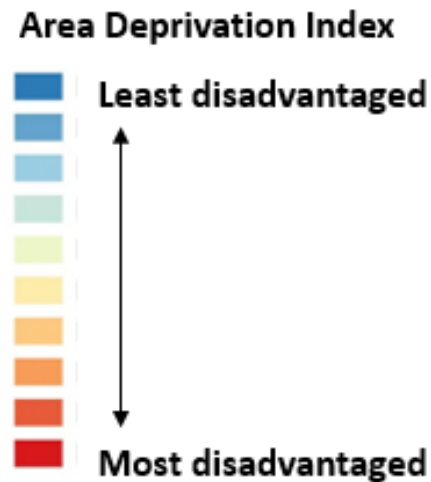
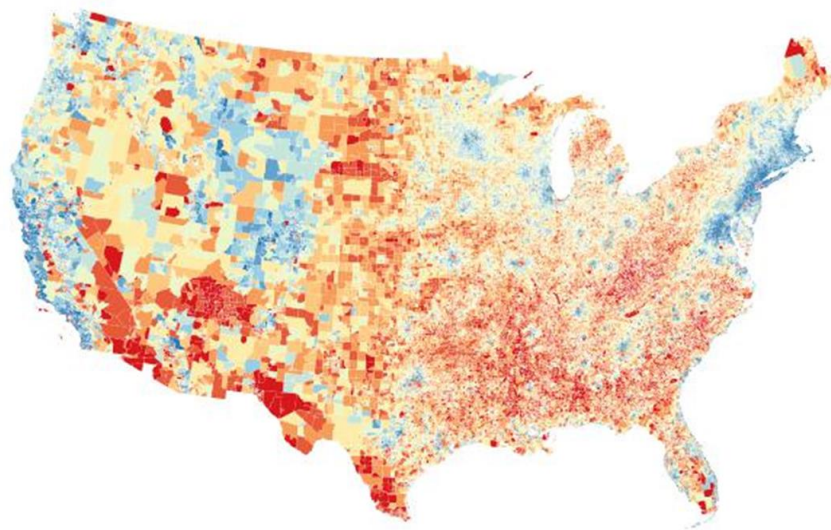
DERIVATION OF ADI



Characteristic	Unadjusted Risk Ratio (95% CI)	Adjusted† Risk Ratio (95% CI)
ADI grouping of the patient's neighborhood of residence		
Least disadvantaged 85% (baseline group) (ADI range, -52.63 to 113.44)	1.00	1.00
Third-most disadvantaged 5% (ADI range, 113.45 to 115.12)	1.05 (1.02 to 1.09)	1.05 (1.01 to 1.08)
Second-most disadvantaged 5% (ADI range, 115.13 to 117.46)	1.09 (1.06 to 1.13)	1.07 (1.03 to 1.1)
Most disadvantaged 5% (ADI range, 117.47 to 129.10)	1.16 (1.12 to 1.19)	1.09 (1.05 to 1.12)

ADI NEIGHBORHOOD ATLAS

- “Neighborhoods” ~1,500
 - Composite of 17 measures
 - **Education, employment, housing & neighborhood poverty**
- Map using **9 digit zip-code census block-group** or Geocoordinates

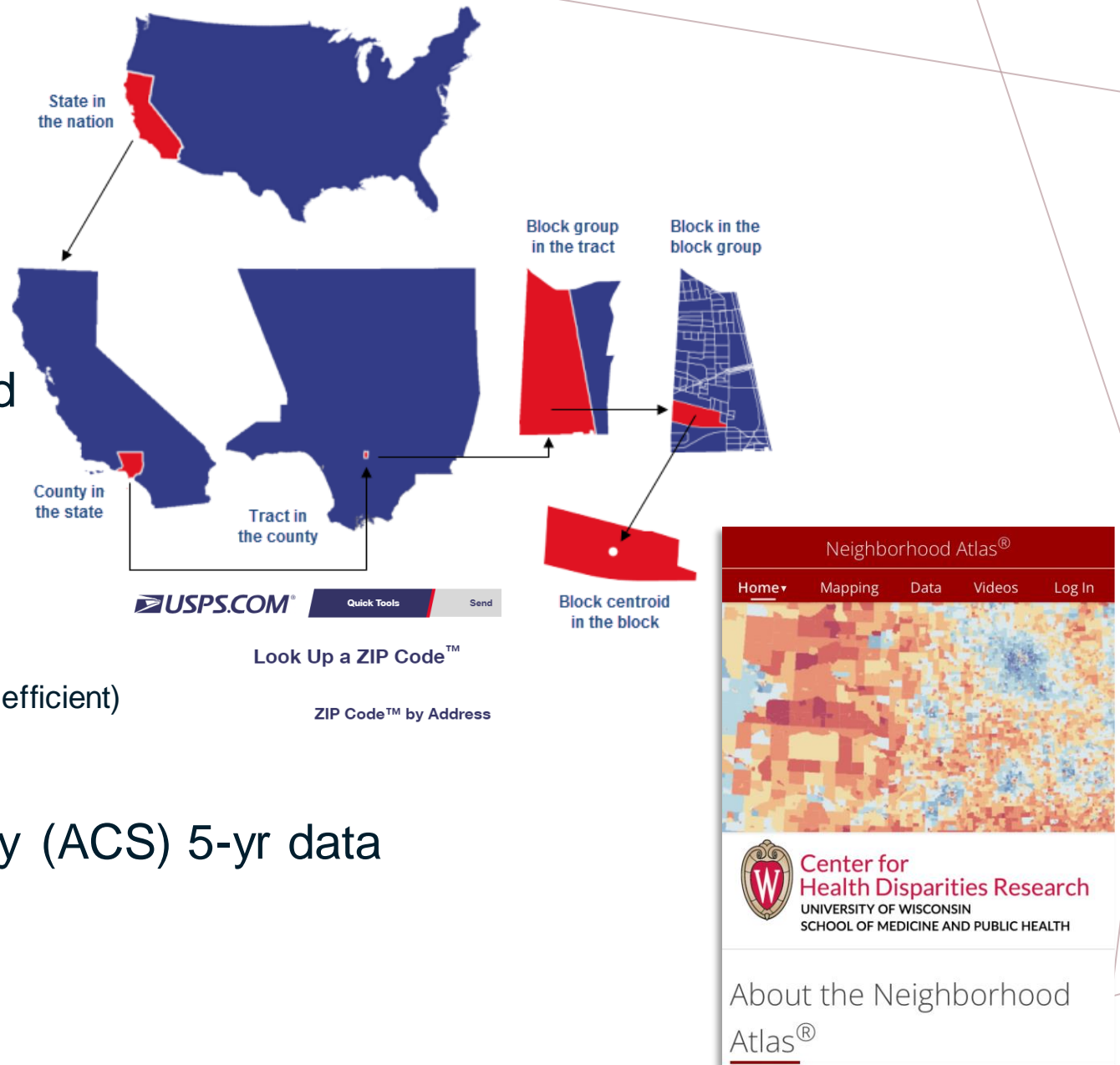


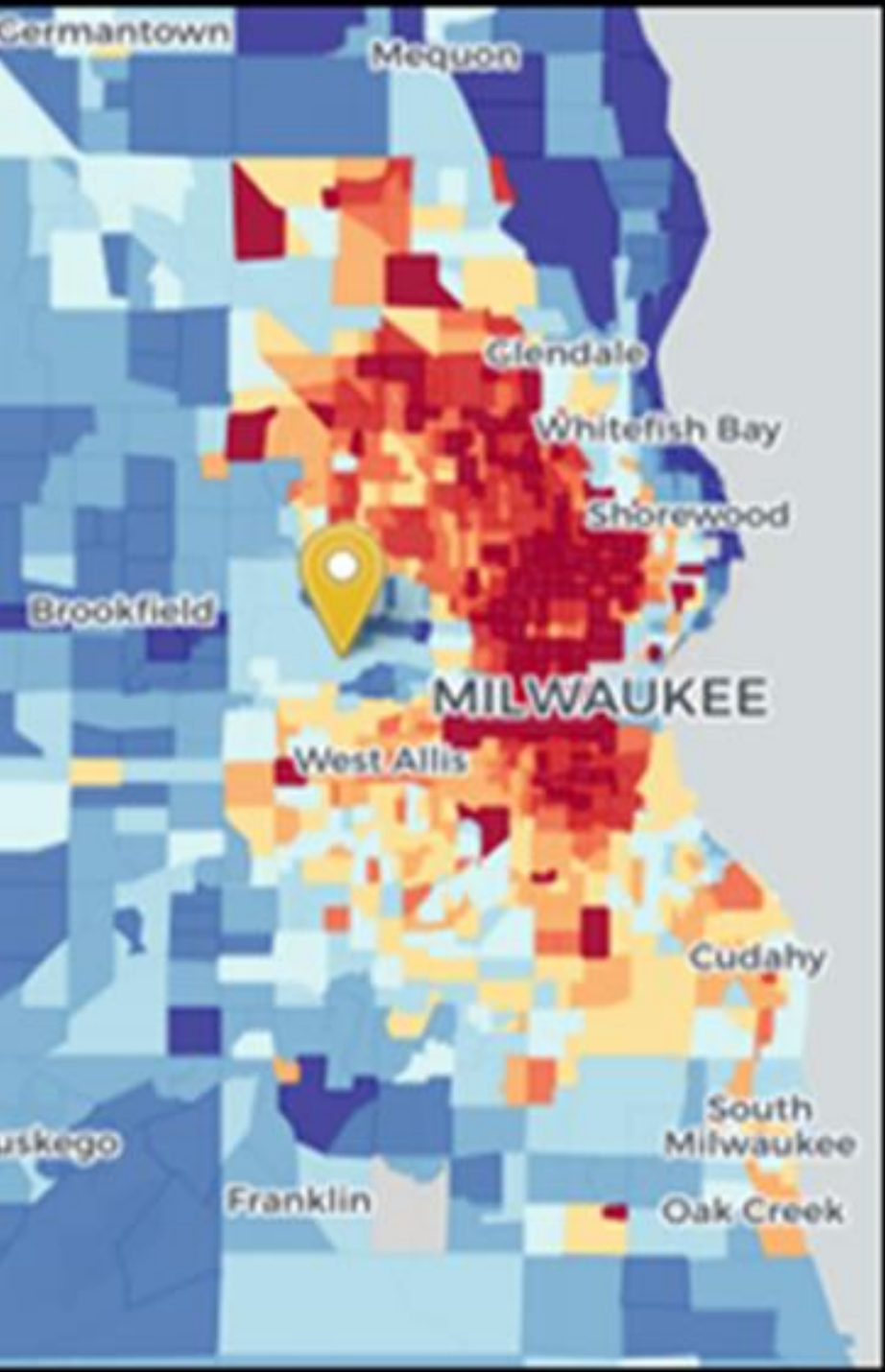
<https://www.neighborhoodatlas.medicine.wisc.edu/>



APPLYING ADI

- **Census Block** defined
- ~250-2500 people—Neighborhood
- 9 digit zip-codes to map
- Or Geocoordinates
- Rankable by state or national
- Use Ranks, Quintiles, Decile (not coefficient)
- Uses American Community Survey (ACS) 5-yr data
 - 2015, 2020, 2021 ADI versions
- Download online*

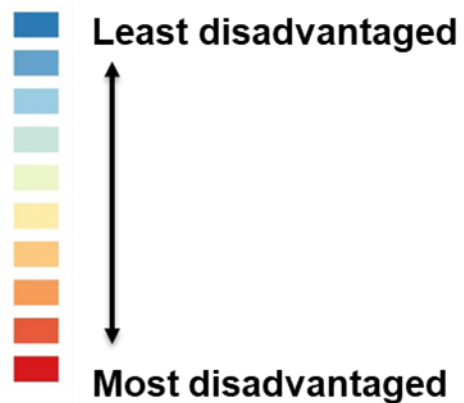




MILWAUKEE

HYPOTHESIS: Patients in disadvantaged neighborhoods (worse ADI) will have lower retention in lupus care.

Area Deprivation Index



EXAMPLE 1: LUPUS RETENTION GAPS IN MILWAUKEE

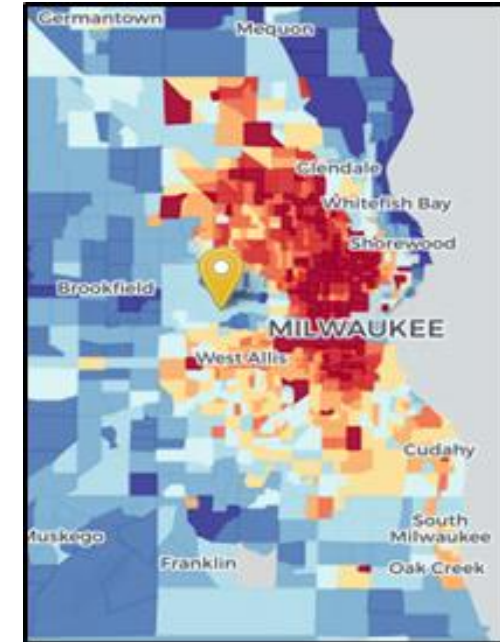
Table. MCW 2015 Observed Retention Rates (n=397)

Definition	Interval	%
Visit Retention	≥ 2 Rheum visits/yr	60%
Lab Retention	≥ 2 Complement tests/yr	27%

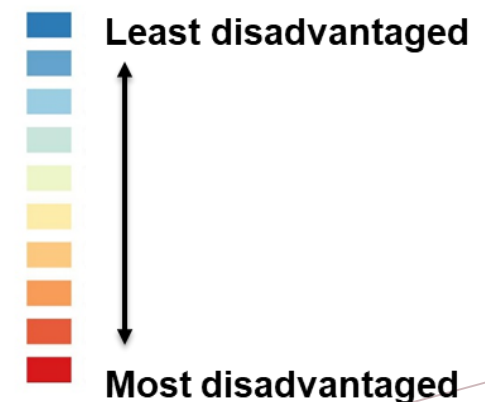
Table 2. Predictors of lupus retention in care visits (n=372)

	Adjusted OR	95% CI
Race (white ref)		
Black	1.69	0.88, 3.22
Other	1.00	0.30, 3.40
Ethnicity Hispanic	0.64	0.18, 2.33
Area Deprivation Index Quartile (1 st quart, least disadvantage ref)		
2 nd Quartile	1.03	0.55, 1.92
3 rd Quartile	1.04	0.53, 2.04
Most disadvantaged Quartile	0.43	0.19, 0.96

Model includes age, gender, race, rurality, comorbidity, lupus factors.



Area Deprivation Index



EXAMPLE 2: US MEDICARE LUPUS CARE BY GROUP

n=15,569 with SLE

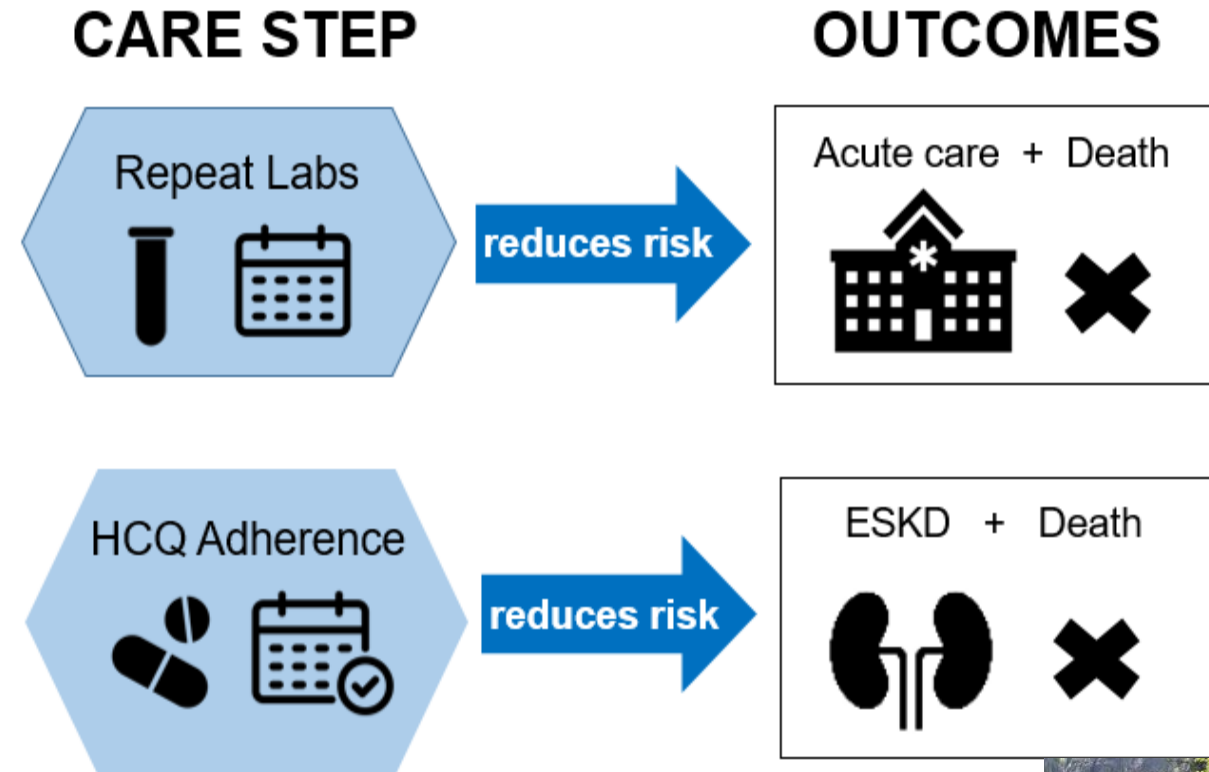
Table 2a. Retention & Treatment Rates by Neighborhood ADI Disadvantage Quintile			
Treatment	Least Disadvantaged	Most Disadvantaged	P-value
Rheum visits	60.3	44.5	<0.001
C3C4 or dsDNA lab	20.0	12.9	<0.001
Hydroxychloroquine (HCQ) any	42.2	39.0	0.033
HCQ 80% med adherence	24.4	19.6	<0.001
Table 2b. Retention & Treatment Rates by Race			
Treatment	White	Black	P-value
Rheum visits	51.1	52.6	0.64
C3C4 or dsDNA lab	14.9	16.4	0.001
HCQ any	39.7	44.4	<0.001
HCQ 80% med adherence	24.2	20.5	<0.001

RISKS OF ACUTE CARE, ESKD, MORTALITY IN LUPUS

Table 3. Hazard ratios of acute care/mortality or ESKD/mortality

	Full Model Hazard Ratio	95% CI	p
Acute care-free survival			
Visit retention	0.84	(0.79, 0.89)	< 0.001
Lab retention	0.70	(0.64, 0.76)	< 0.001
Any HCQ	0.82	(0.77, 0.88)	< 0.001
80% HCQ adherence	0.80	(0.73, 0.87)	< 0.001
ESKD-free survival			
Visit retention	0.78	(0.70, 0.87)	< 0.001
Lab retention	0.81	(0.69, 0.95)	0.009
Any HCQ	0.88	(0.78, 1.00)	0.058
80% HCQ adherence	0.73	(0.63, 0.86)	< 0.001

(n=15,395 for visit and lab, n=10,880 Part D for HCQ)



ADI CORRELATES W/ HEALTH

Race, Ethnicity, Neighborhood Characteristics, and In-Hospital Coronavirus Disease-2019 Mortality

Jianhui Hu, PhD,* Christie M. Bartels, MD, MS,†‡ Richard A. Rovin, MD,§ Laura E. Lamb, PhD,||¶
Amy J.H. Kind, MD, PhD,†#** and David R. Nerenz, PhD*

COVID mortality by ADI national rank

- 31% of deaths in most disadv. quintile
- 52% of Black pts in most disadv. quintile

MOST Disadvantaged ADI Quintile

Death AOR 1.74 (1.13–2.67)

No race effect after ADI added to model



Journal of the American Heart Association

Volume 11, Issue 24, 20 December 2022
<https://doi.org/10.1161/JAHA.122.027093>



ORIGINAL RESEARCH

Race, Sex, and Neighborhood Socioeconomic Disparities in Ablation of Ventricular Tachycardia Within a National Medicare Cohort

Ryan Kipp, MD ; Matthew Kalscheur, MD ; Ann M. Sheehy, MD, MS; Christie M. Bartels, MD, MS ; Amy J. H. Kind, MD, PhD; W. Ryan Powell, PhD, MA 

JAMA Network | **Open.**

Original Investigation | Diversity, Equity, and Inclusion

Association of Race, Ethnicity, and Rurality With Major Leg Amputation or Death Among Medicare Beneficiaries Hospitalized With Diabetic Foot Ulcers

Meghan B. Brennan, MD; W. Ryan Powell, PhD; Farah Kalkow, MD; Joseph Kramer, MA; Yao Liu, MD; Amy J. H. Kind, MD, PhD; Christie M. Bartels, MD

JAMA Network | **Open.**

Original Investigation | Public Health

Association of Neighborhood-Level Disadvantage With Alzheimer Disease Neuropathology



CDC SVI
***CDC SOCIAL
VULNERABILITY
INDEX (SVI)***



The CDC/ATSDR Social Vulnerability Index (CDC/ATSDR SVI) uses 16 U.S. census variables to help local officials identify communities that may need support before, during, or after disasters.



Explore the CDC/ATSDR SVI
Interactive Map

CDC SVI

Used for resource allocation after disasters

- Census tract level ~4000
- Can use state and county to correlate

Built on 15-16 factors of ACS data

- Includes high rents, mortgages, home values
- Race, limited English proficiency, disability
- Also includes crowding



Data & Documentation

SVI

Overall Vulnerability

Socioeconomic Status

Below 150% Poverty

Unemployed

Housing Cost Burden

No High School Diploma

No Health Insurance

Household Characteristics

Aged 65 & Older

Aged 17 & Younger

Civilian with a Disability

Single-Parent Households

English Language Proficiency

Racial & Ethnic Minority Status

Hispanic or Latino (of any race)

Black or African American, Not Hispanic or Latino

Asian, Not Hispanic or Latino

American Indian or Alaska Native, Not Hispanic or Latino

Native Hawaiian or Pacific Islander, Not Hispanic or Latino

Two or More Races, Not Hispanic or Latino

Other Races, Not Hispanic or Latino

Housing Type & Transportation

Multi-Unit Structures

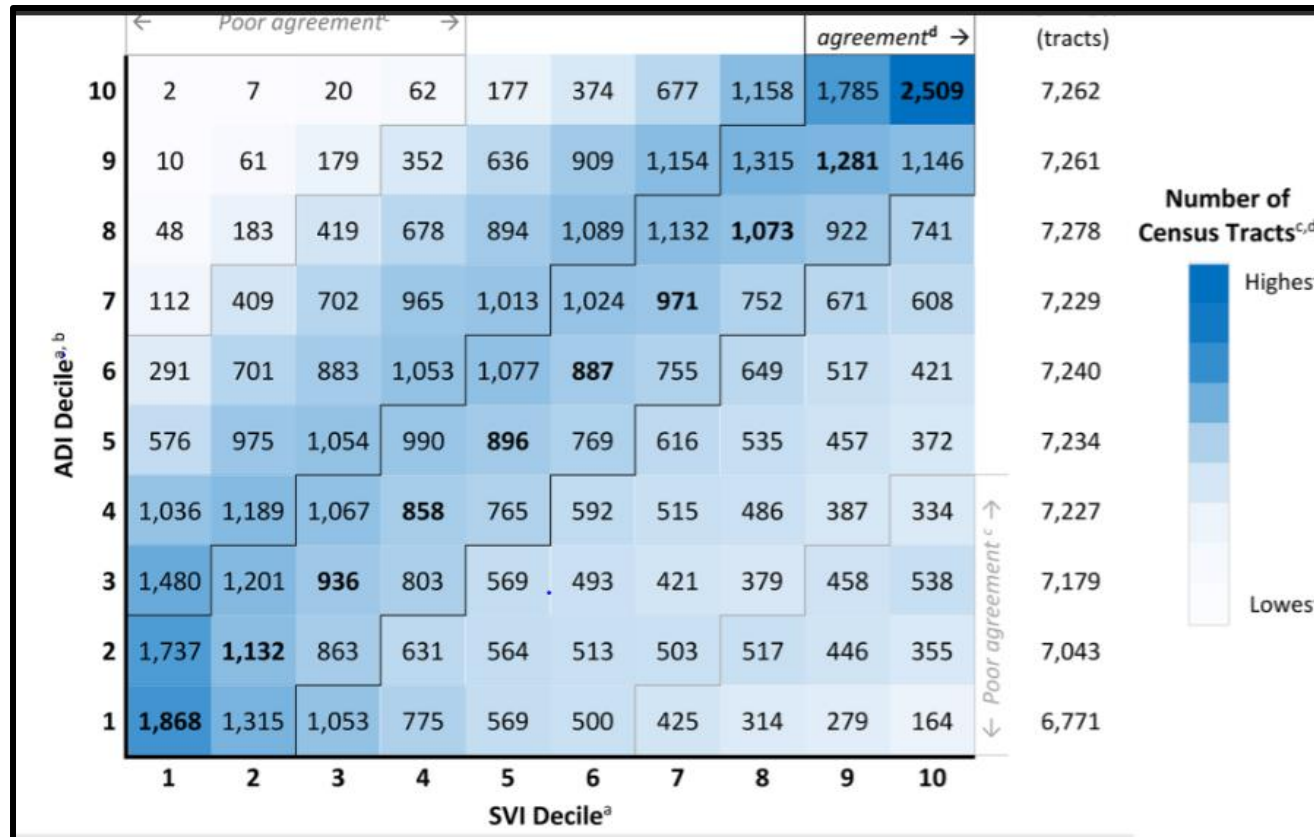
Mobile Homes

Crowding

No Vehicle

Group Quarters

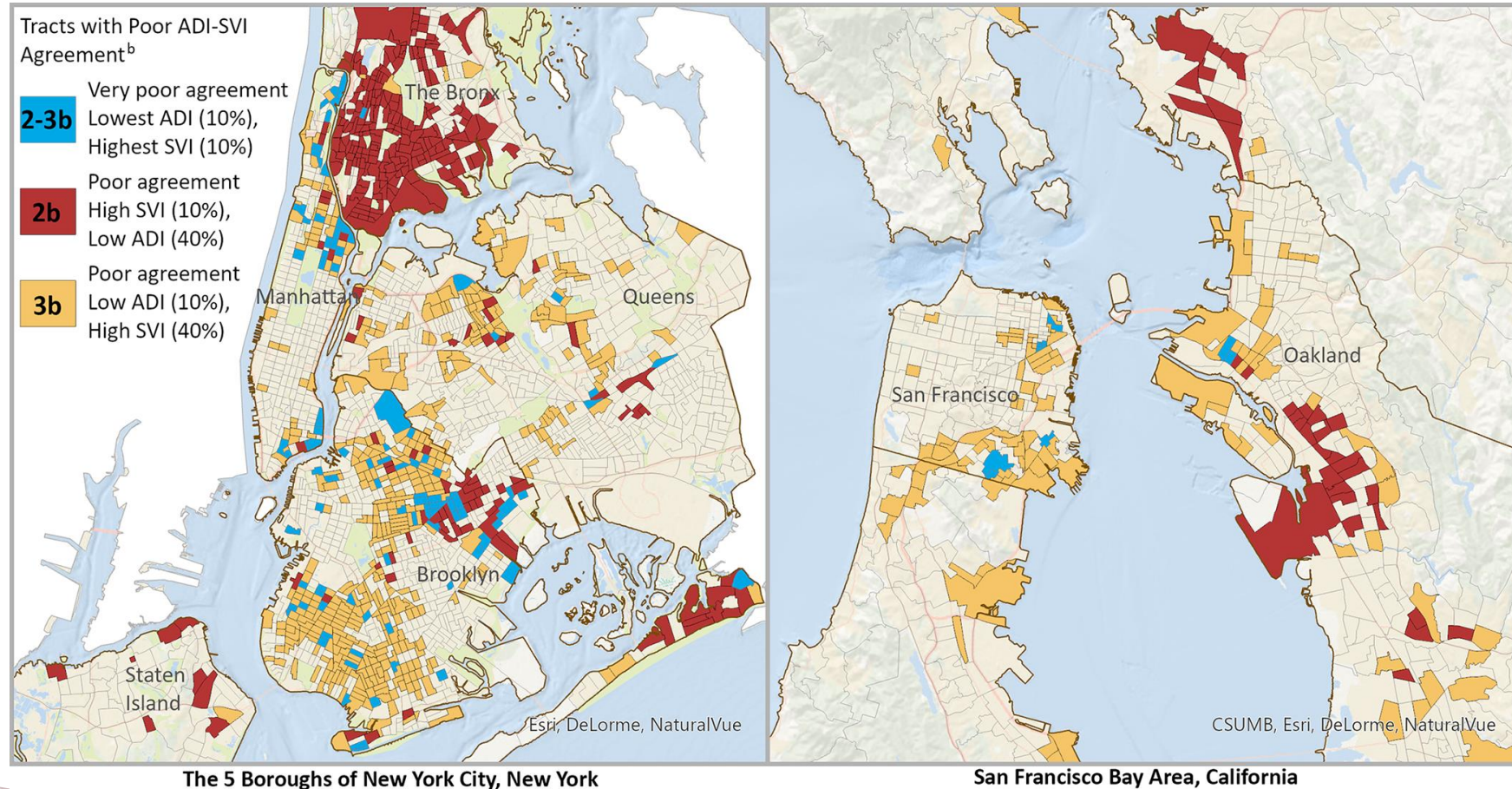
CONTRAST ADI & SVI



6.3% with POOR agreement
 $\Delta > 6$ category

Most often: Hi SVI Low ADI
 Often due to housing costs

HIGH SVI & LOW ADI EXAMPLES



CONTRAST ADI & SVI

Table 1. Comparison of ADI and SVI items.

Domain	Item ^a	Index (# items)	
		ADI (17)	SVI (15)
Income	Below poverty level	•	•
	Below 150% of poverty level	•	
	Income disparity	•	
	Median family income	• ^b	
	Per capita income		•
Employment	Unemployment	•	•
	White collar occupation	• ^b	
Education	High school diploma or higher	• ^b	
	≤ High school diploma		•
	<9 years of education	•	
Housing	Owner-occupied housing	• ^{b c}	
	Median monthly mortgage	• ^{b c}	
	Median gross rent	• ^b	
	Median home value	• ^{b c}	
Household	Single-parent households	•	•
Characteristics	Age 65+ years (older adults)		•
	Age ≤17 years (children)		•
	Persons with a disability		•
	Households w/out a telephone	•	
	Households w/out a motor vehicle	• ^c	•
	Housing w/out complete plumbing	• ^c	
	Housing Type	Multi-unit (10+) structures	
Crowding (>1 person/room)		• ^c	•
Mobile homes			•
Persons in group quarters			•
Minority Status and Language	Non-Hispanic White		•
	Speak English "less than well"		•

ADI V. SVI FOR HEALTH OUTCOMES

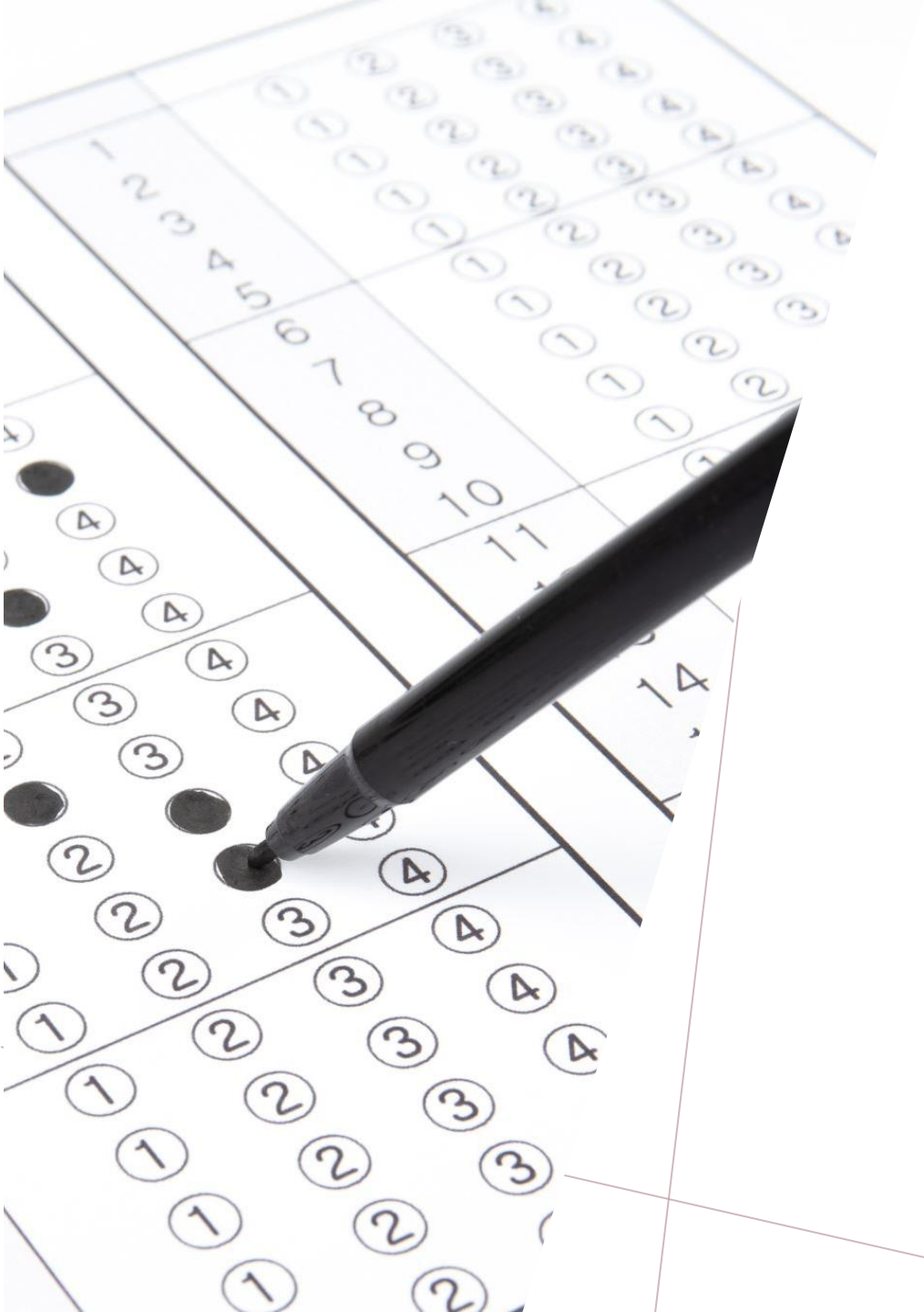
ADI was numerically more strongly associated with certain CV comorbidities such as hypertension, diabetes, and hyperlipidemia, [and ASCVD]...SVI had a stronger association with...CKD and marijuana use.

Jain et al. JAHA 2022

SUMMARY

- 1. NIMHD framework & Moving to Opportunity show that neighborhood context matters**
- 2. Compare-contrast 4 area-level metrics**
 - Medicare Regions & State level
 - Rural Urban Commuter Index
 - Social Vulnerability Index
 - Area Deprivation Index
- 3. Apply area-level metrics**





REVIEW QUIZ

QUICK REVIEW

1. Which area-level metric maps to the most granular clinic block group ~1500 people?
2. Could one use 5-digit zip to map RUCA? SVI? ADI?
3. You have 9-digit zip and want to model how context impacts care utilization, what might you pick?
4. You have 5-digit zip and want to model how inner city crowding and cost of living reduce medication adherence, which metric might you select?

QUICK REVIEW

1. Which area-level metric maps to the most granular clinic block group ~1500 people?

ADI

2. Could one use 5-digit zip to map RUCA? SVI? ADI?

Yes, Yes, No, 9-digit zip for ADI

3. You have 9-digit zip and want to model how context impacts care utilization, what might you pick?

ADI

4. You have 5-digit zip and want to model how inner city crowding and cost of living reduce medication adherence, which metric might you select?

SVI

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ICTR PCOR (PI-Bartels) Engaging Stakeholders in Integration of Preventive Care and Health Promotion in Rheumatology Clinics

NIH-NIAMS AR062381-01 (PI-Bartels) "Impact of Rheumatologist Communication Upon Managing Cardiovascular Risk in RA"

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Something something something by race, 2021

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