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The Synergistic Effects of Social Determinants of Health and Race-Ethnicity on 30-Day Readmission Disparities in an Inpatient Population

S03: Social Determinants and Health Assessment

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Disclosure

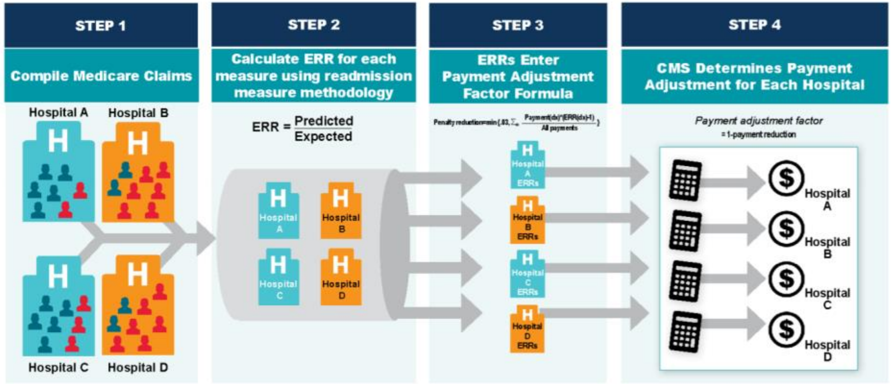
I have no relevant financial relationships with commercial interests to disclose

Learning Objectives

After participating in this session, the audience should be better able to understand:

- how the combination of social determinants of health (SDOH) and race-ethnicity impact disparities in 30-day readmission
- how multiple analytic methods can be applied and how risk factors can be used to identify groups of patients with varying levels of readmission risk

Introduction



CMS Hospital Readmissions Reduction Program & Financial Penalties

Sources: CMS (2017) HRRP User Guide; Edward Hunt (2016), Ponce Research Institute

- Hospital readmission rates are often used as quality metrics for hospital reimbursements or penalties
- Reduction in hospital readmission rates has been a priority for improvement of healthcare quality and patient clinical outcomes
  - Identifying risk factors of readmission is critical for intervention

Motivation

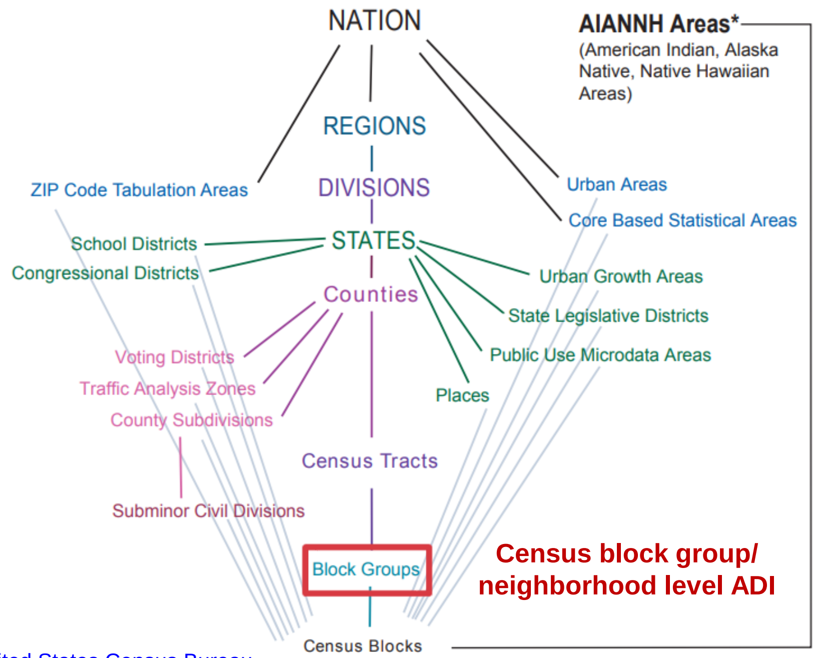
- Previous studies showed that race-ethnicity and the nonclinical conditions, SDOH,—including Area Deprivation Index (ADI)—were important factors that influence the likelihood of readmission

  - SDOH: Centers for Disease Control and Prevention (CDC) defined as "The conditions in which people live, learn, work, and play affect a wide range of health risks and outcomes"

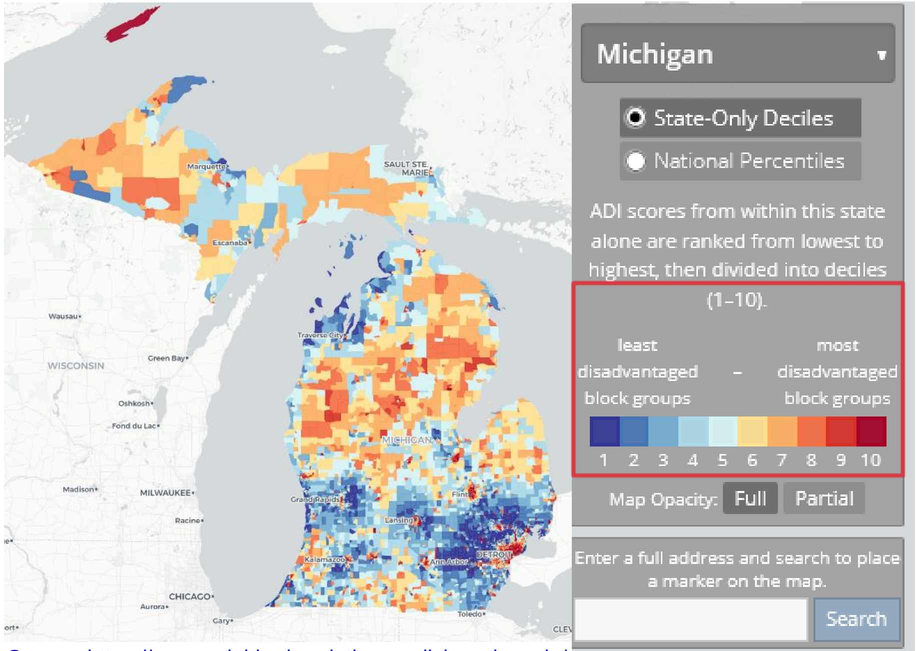
Sources: https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health

Area Deprivation Index (ADI)

- A ranking measure of socioeconomic status disadvantage (income, education, employment, and housing quality)



Source: United States Census Bureau



Source: https://www.neighborhoodatlas.medicine.wisc.edu/

Research Gap

- There is a lack of research studying
  - the impact of SDOH and race-ethnicity on readmission risk in the broader population setting
  - how the effects of SDOH on readmission may depend upon race-ethnicity

Objectives

- Examine the effects of SDOH and race-ethnicity on readmission separately for all inpatient populations across a large health care system
- Investigate the racial-ethnicity specific effect of SDOH on readmission
- Identify groups of patients with differing readmission risk based on SDOH, race-ethnicity, and other covariates
- Locate potential geographical hotspots for high readmission risk

Data: HFHS Inpatient Registry

- A retrospective study from 11/2015 - 12/2018

Data Source

Primary Dataset

- Readmission Dataset from Epic EMR

Other Sources

- Flowsheet
- GIS Geocoding Software for ADI Mapping (ZIP+4)
- Diagnosis Table

Key Variable

Race-Ethnicity[1]

SDOH

- Drug Use
- Lives Alone
- Depression
- ADI
- Primary Insurance Type
- Dual Eligible Coverage

Outcome

- 30-day Readmission

Covariate Variable

- Age
- Gender
- AHRQ CCSR Diagnosis Category[2]
- Charlson Comorbidity Index (CCI)
- 17 Chronic Diseases

[1]: Black, White, Hispanic & Latino, Others; [2]: AHRQ Clinical Classifications Software Refined (CCSR) Categories

Analytical Workflow

Encounter-level Dataset

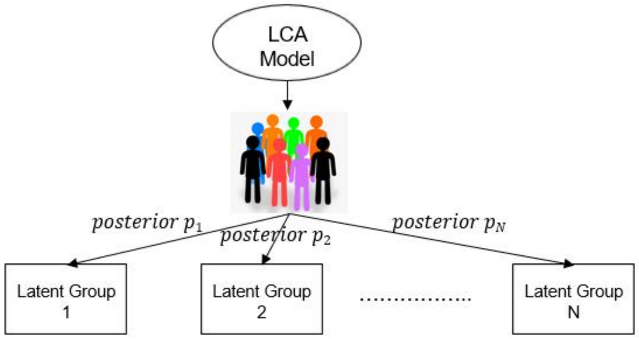
- 30-day Readmission Flag
- Race-Ethnicity
- Six SDOH
- Covariates

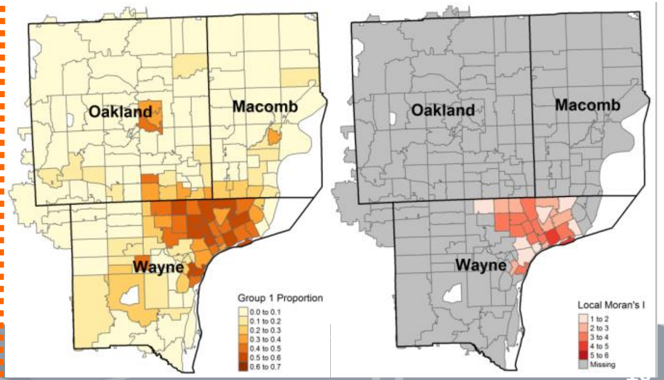
Q: What are the important SDOH?
Q: How does the racial-ethnicity effect of SDOH affect readmission?

Univariate Analysis & Multivariable Logistic Regression

Q: How to identify groups of patients with varying levels of readmission risk and target on the high-risk group?
Q: How to detect the geographical hotspots for the high-risk group?

Latent Class Analysis (LCA) & Spatial Autocorrelation Analysis





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Descriptive & Univariate Analysis

Overall: <0.001

- Race-Ethnicity and all SDOH were significantly associated with 30-day readmission

Total inpatient admissions:
256,077

Primary outcome:
30-day readmission

158,574 unique patients

34,901 readmissions (13.6%)

Mean age 60 years old with SD:19.7

57.7% female

63.0% White

27.0% Black

3.2% Hispanic

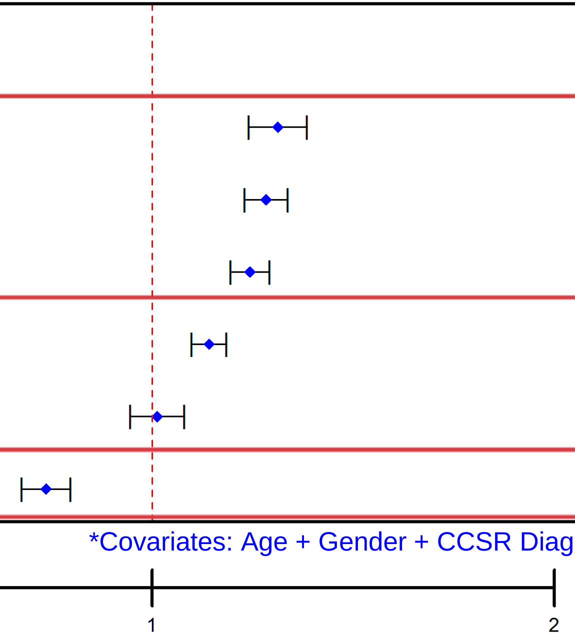
Variable ***P<0.001	Readmission-Yes	Readmission-No
Race-ethnicity, row%***		
White	0.13	0.87
African American	**0.15**	0.85
Hispanic	0.10	0.90
ADI Nat'l. Ranking, Mean***	**67.68**	65.08
Depression, row%***		
Depression History - Yes	**0.17**	0.83
Depression History - No	0.13	0.87
Insurance Type, row%***		
Medicare	**0.17**	0.83
Medicaid	0.11	0.89
Commercial	0.08	0.92

The Effect of SDOH on Readmission

- Each SDOH was associated with readmission, except Medicaid insurance (vs. Medicare)

Model A: **Readmission Y/N ~ SDOH** + Race-Ethnicity + Covariates*

Pairwise Comparison	OR (95% CI)	P value
Whole System		
Drug Use	1.24 (1.18 - 1.31)	**<.001**
Dual Eligible	1.22 (1.17 - 1.26)	**<.001**
Depression	1.18 (1.14 - 1.22)	**<.001**
Lives Alone	1.10 (1.07 - 1.14)	**<.001**
Medicaid Insurance (vs. Medicare)	1.01 (0.96 - 1.06)	0.710
Commercial Insurance (vs. Medicare)	0.83 (0.80 - 0.87)	**<.001**



*Covariates: Age + Gender + CCSR Diagnosis Category + Charlson CCI + Chronic Disease

The Effects of Continuous & Categorical ADI on Readmission

- The patients living in more deprived areas (higher ADI) were more likely to be readmitted in 30 days

Model A: **Readmission Y/N ~ ADI (continuous/categorical)** + other SDOH + Race-Ethnicity + Covariates*

	Odds Ratio	95% CI	*P*-value
ADI (continuous)	1.002	1.000-1.002	$P < 0.001$
ADI (categorical)	**Reference: ADI percentile Q1 (1-45)**		
ADI Q2 (46-69)	1.07	1.03-1.11	$P < 0.001$
ADI Q3 (70-90)	1.07	1.03-1.10	$P < 0.001$
ADI Q4 (91-100)	**1.13**	1.08-1.17	$P < 0.001$

*Age + Gender + CCSR Diagnosis Category + Charlson CCI + Chronic Diseases

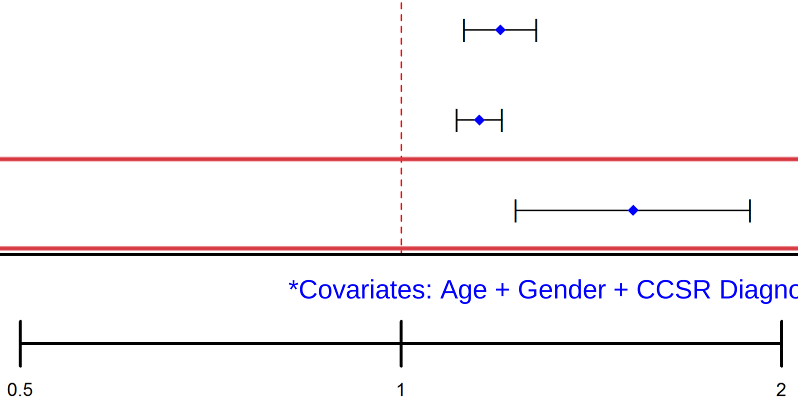
The Racial-Ethnicity Specific Effect of SODH on Readmission

Model B: **Readmission Y/N ~ SDOH + Race-Ethnicity + SDOH x Race-Ethnicity** + Covariates*

- The effect of depression on readmission was dependent upon race-ethnicity (Depression x Race-Ethnicity: $p = 0.012$)
  - The patients who had depression history were more likely to be readmitted in 30 days, especially for the Hispanic patients

Pairwise Comparison	OR (95% CI)	P value
Depression		
Black	1.20 (1.12 - 1.28)	**<.001**
White	1.15 (1.11 - 1.20)	**<.001**
Hispanic	1.53 (1.23 - 1.89)	**<.001**

“OR” are from three Race-Ethnicity stratified models



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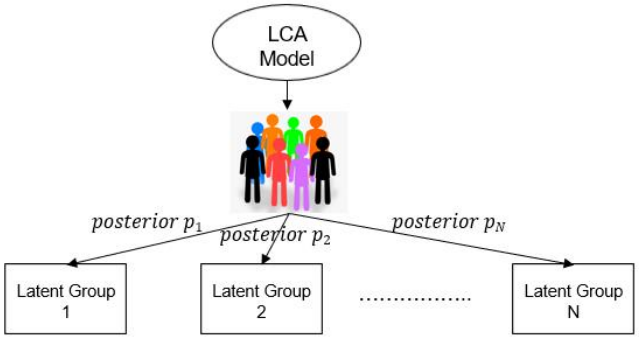
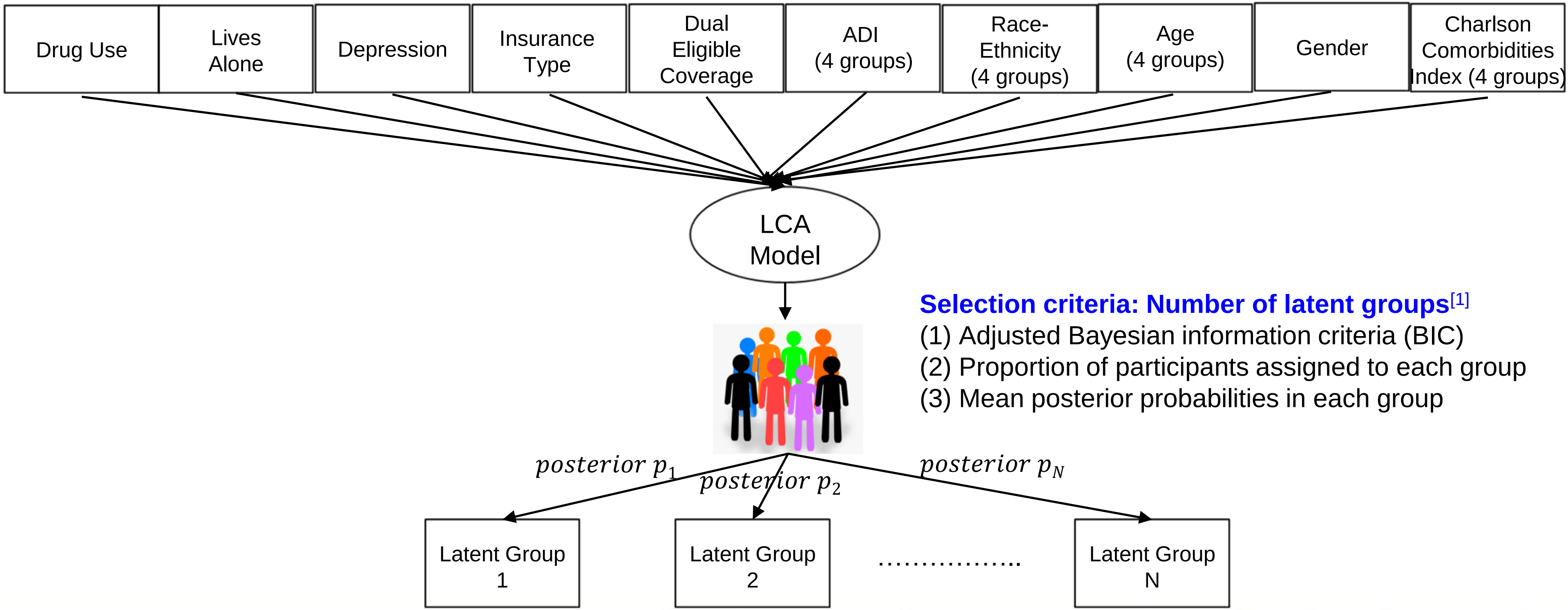


LCA Diagram

Observed Variables



Selection criteria: Number of latent groups[1]

(1) Adjusted Bayesian information criteria (BIC)
(2) Proportion of participants assigned to each group
(3) Mean posterior probabilities in each group

[1]: Muthén B, Muthén LK. Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. Alcohol Clin Exp Res. 2000;24(6):882–891

LCA – Overall Summary

Total Patient Encounters: 256,077

20% of Encounters

Group 1: High Readmission (19.5%)

High proportions of
- African American
- High ADI
- Drug use
- Living alone
- Depression
- Dual Eligibility
- Medicare insurance

35% of Encounters

Group 2: Medium Readmission (15.7%)

High proportions of
- White patients
- Older patients
- Living alone
- Low ADI

45% of Encounters

Group 3: Low Readmission (9.5%)

High proportions of
- White patients
- Females
- Low comorbidity scores

Low proportions of
- All SDOH

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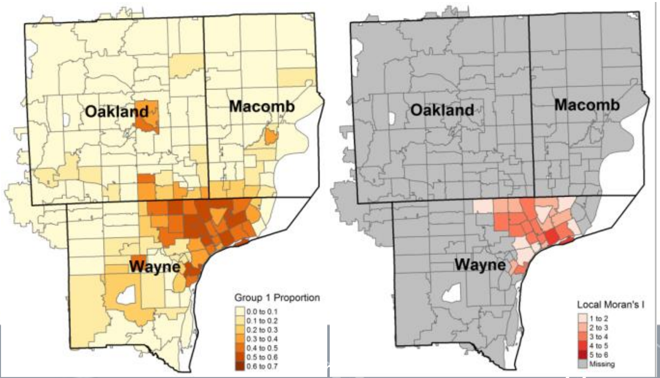
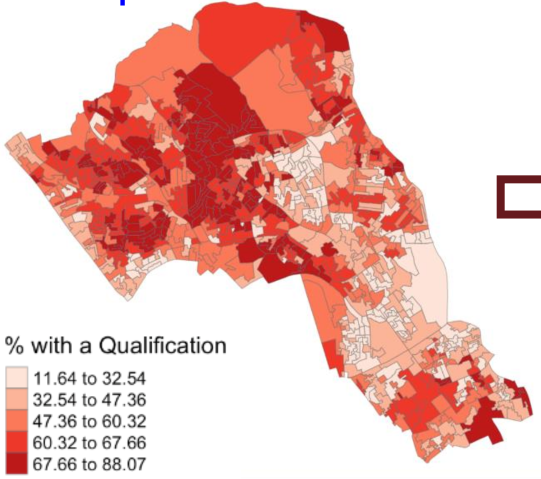


Spatial Analysis: Hot Spot Detection

- Analyze proportions of events that are located in geographical space
- Help understand the relationship between one object with other nearby objects
- Determine the location of clustering and dispersion

Spatial Distribution

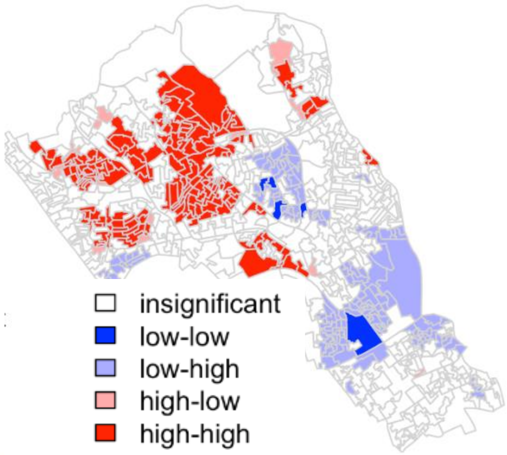


Spatial Autocorrelation

Spatial Statistics:
Local Moran Index

Spatial Autocorrelation Test

Cluster and Outlier Map



Source: Mendez C. (2020). Spatial autocorrelation analysis in R; ArcGIS Pro: https://pro.arcgis.com

Proportions of Patient Encounters from High-risk Readmission Group (Detroit Metropolitan Tri-County Area)

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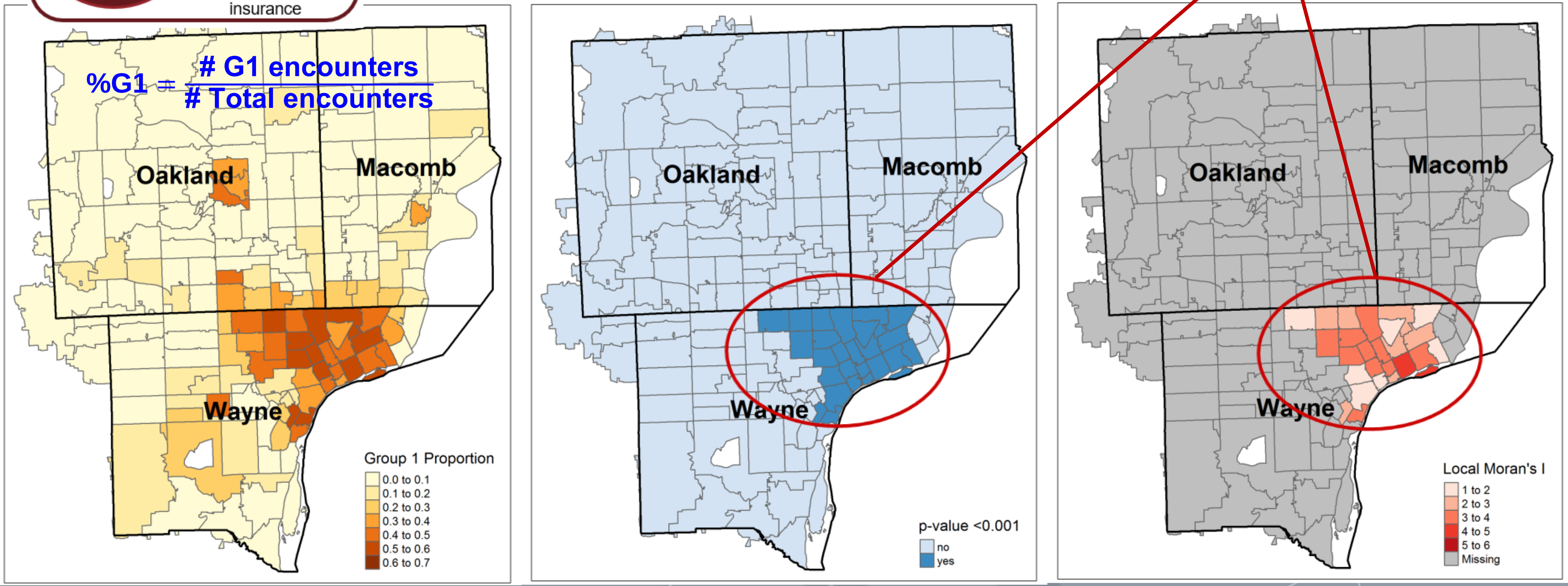
20% of Encounters

Group 1: High Readmission (19.5%)

High proportions of
- African American
- High ADI
- Drug use
- Living alone
- Depression
- Dual Eligibility
- Medicare insurance

Hot Spots: Detroit Cities (26 zip codes)
46% of high-risk encounters (G1) in **hot spots**
9% of total encounters (20%*46%) in **hot spots**



Limitations

- The data source is limited to one health system
  - However, HFHS consists of 5 hospitals and serves a diverse population throughout the metro-Detroit area
- Readmission may be underestimated if patients readmitted outside of our health system
  - Supplementary admission data was included from Michigan Health Information Network (MiHIN) and Post Acute Referral Information in an attempt to mitigate the effects of this limitation

Conclusion

- This study demonstrates the complex interplay between SDH and race-ethnicity influencing 30-day readmission
- Based on the identification of susceptible groups of patients, these results provide valuable information for prioritizing resource allocation within the health system
- Future work will leverage insight obtained from this study combined with additional SODH
  - Census data (healthcare access, transportation, etc.)
  - Social history (alcohol use, tobacco habits, etc.)

Practical Application of this Session

- This study addresses the following topics:
  - Exploration of important features associated with readmission and the racial-ethnicity specific effect of SDOH on readmission
  - Identification of sub-populations with varying levels of readmission risk
  - Spatial analysis and the detection of potential high-risk group hotspots
- Health care organizations should be aware of patient populations that are at high risk of readmission
  - The enhancement of education and support for appropriate resource deployment provides opportunity to reduce readmission and improve overall healthcare quality

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(Scientist)

Dr. Indra Adrianto
(Scientist)

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Henry Ford Hospital)

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(Sr. Performance
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AMIA
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Thank you!

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