



THE JOURNEY TO OVERDOSE: USING SPATIAL SOCIAL NETWORK ANALYSIS AS A NOVEL FRAMEWORK TO STUDY GEOGRAPHIC DISCORDANCE IN OVERDOSE DEATHS

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INTRODUCTION

There were an estimated 100,306 drug overdose deaths in the United States in 2021, an increase of 28.5% from the 78,056 deaths during 2020.

Of those deaths, almost 76% involved a prescription or illicit opioid.

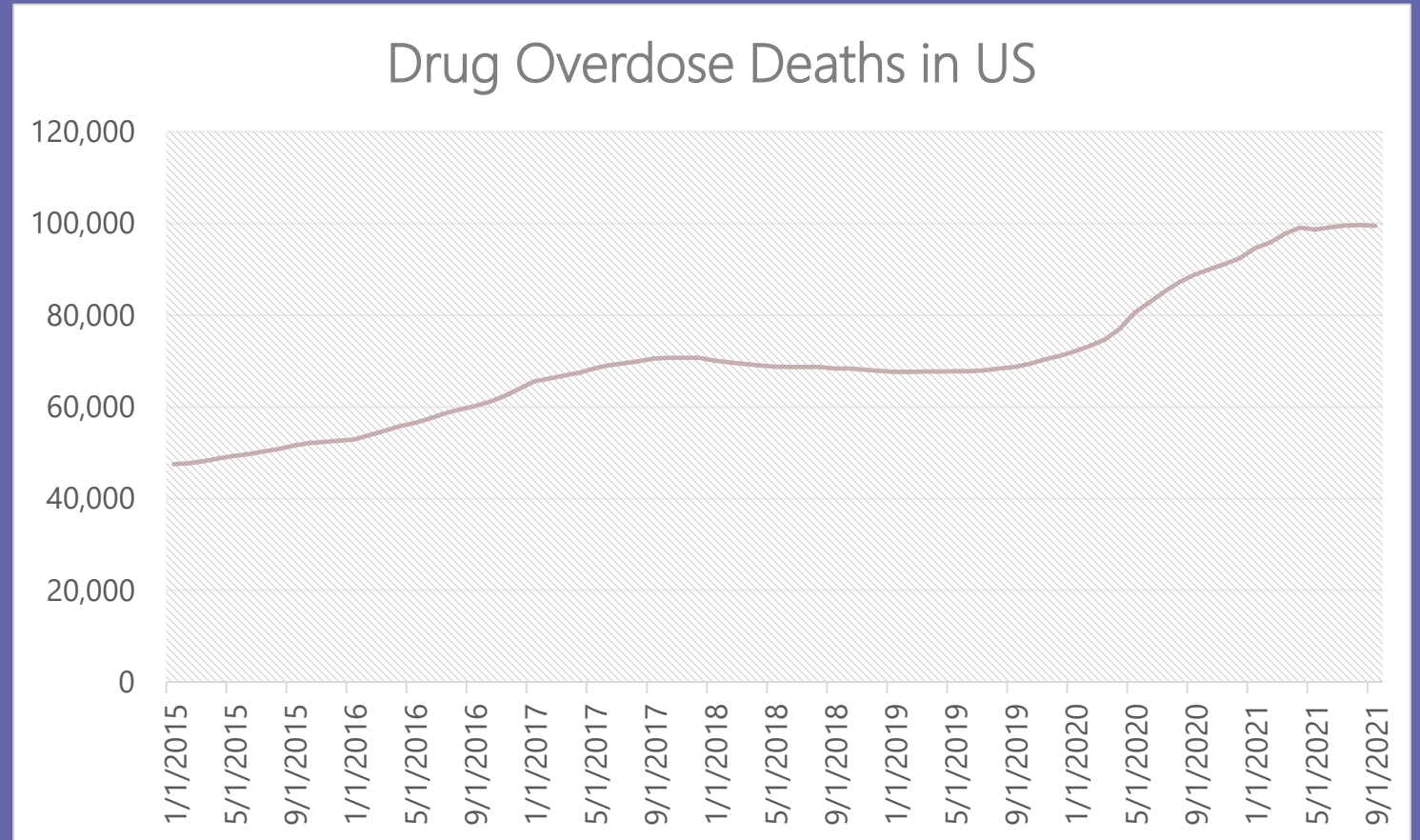
Drug overdose remains a leading cause of injury-related death in the United States

**209
people**

Die every day because of overdoses involving prescription and illicit opioids

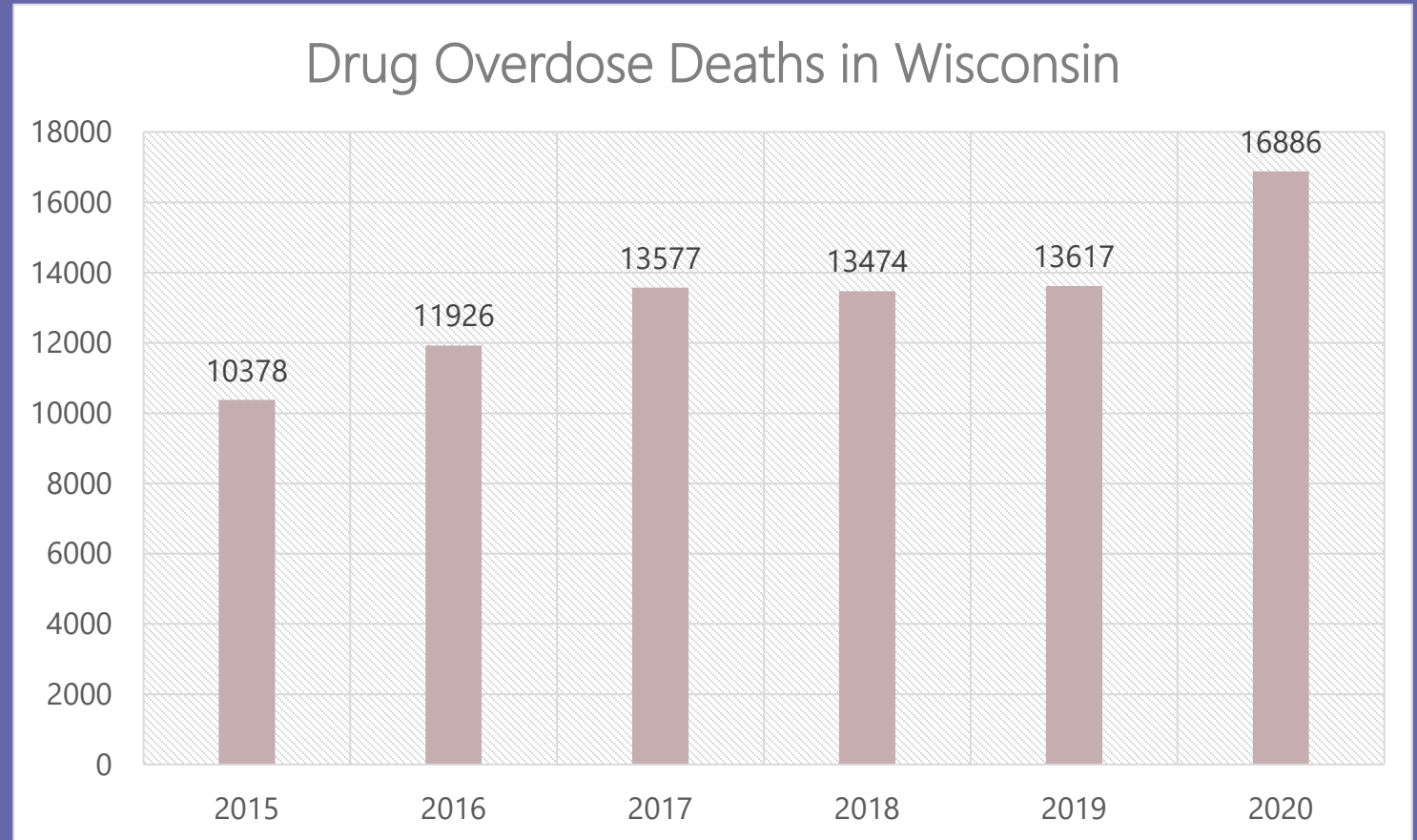
INTRODUCTION

Drug overdose deaths continue to increase in the United States.



STUDY SITE

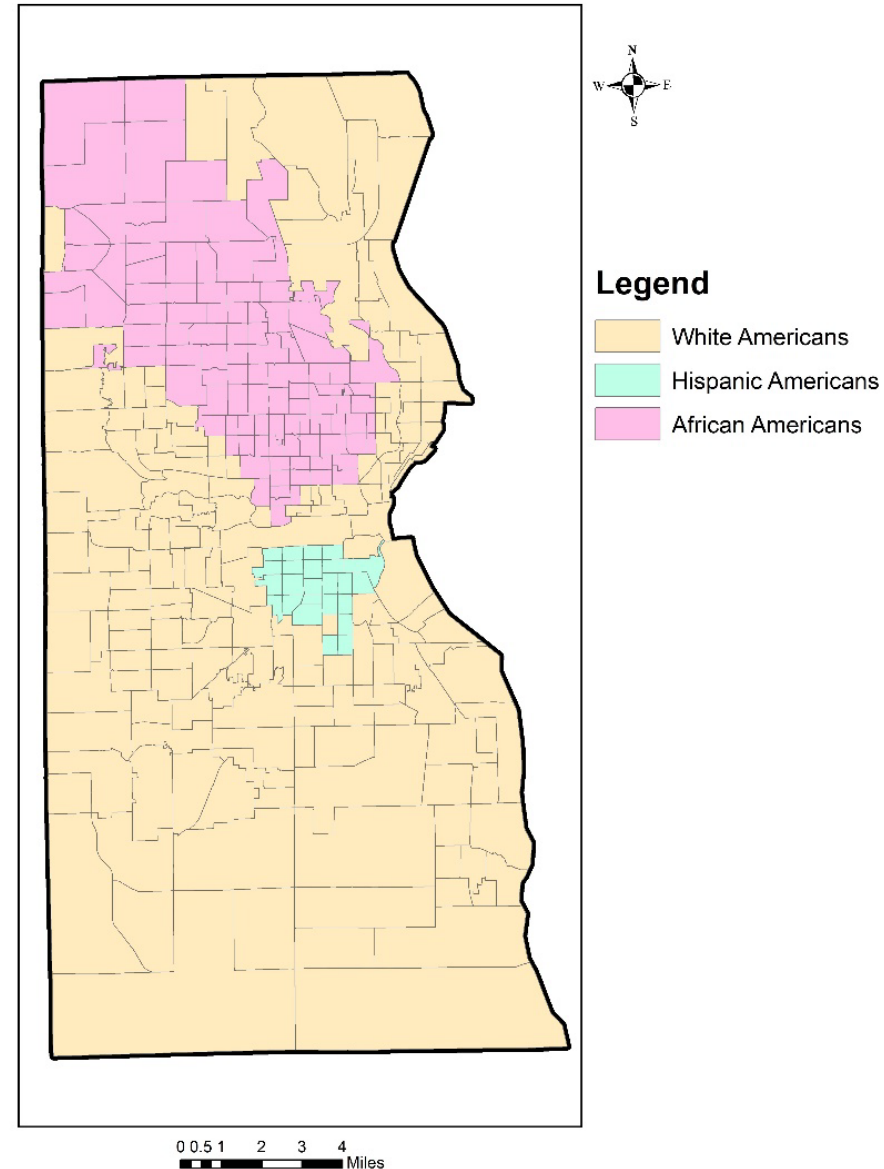
Drug overdose deaths continue to increase in the Wisconsin.



STUDY SITE

The hyper-segregated City of Milwaukee (population 590,157) exhibits concentrated urban poverty in neighborhoods occupied primarily by Black and Hispanic communities.

Residential Segregation in Milwaukee County

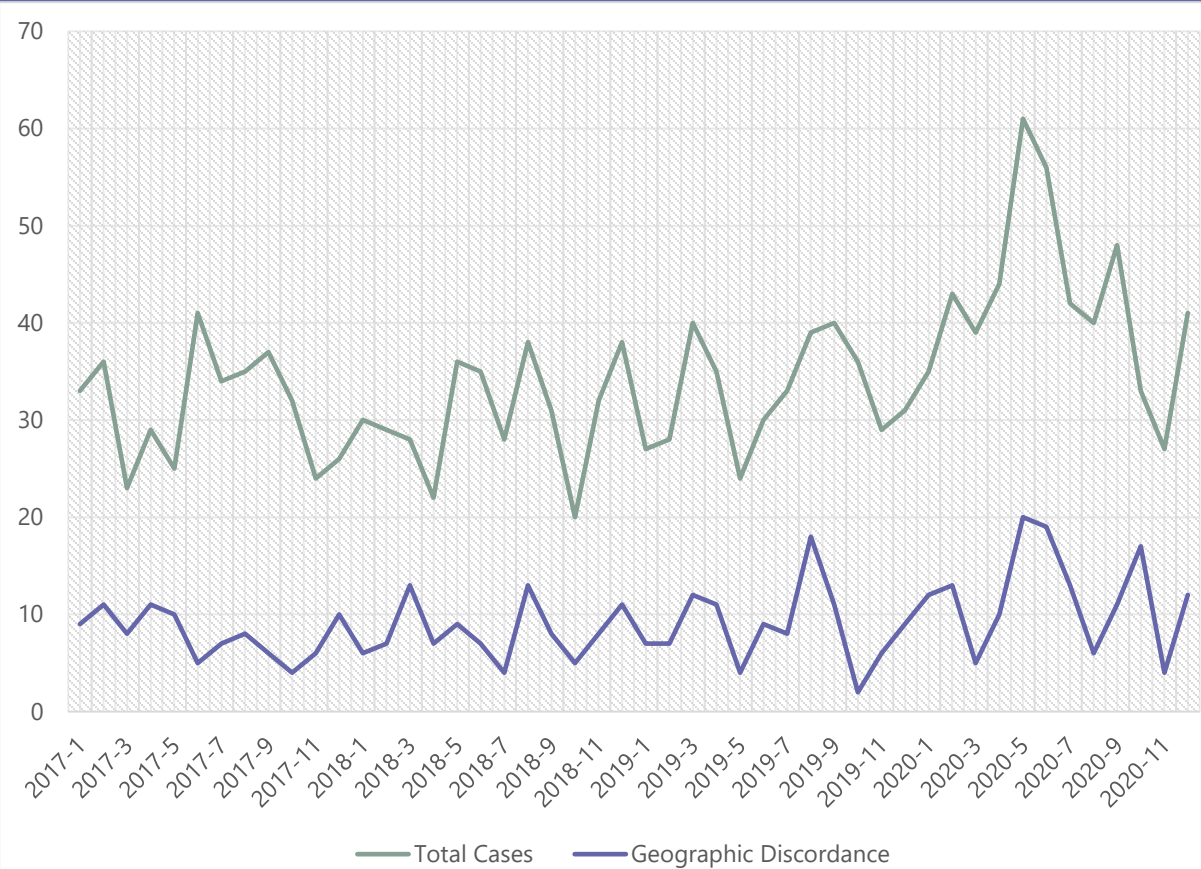


GEOGRAPHIC DISCORDANCES

Historical Trend

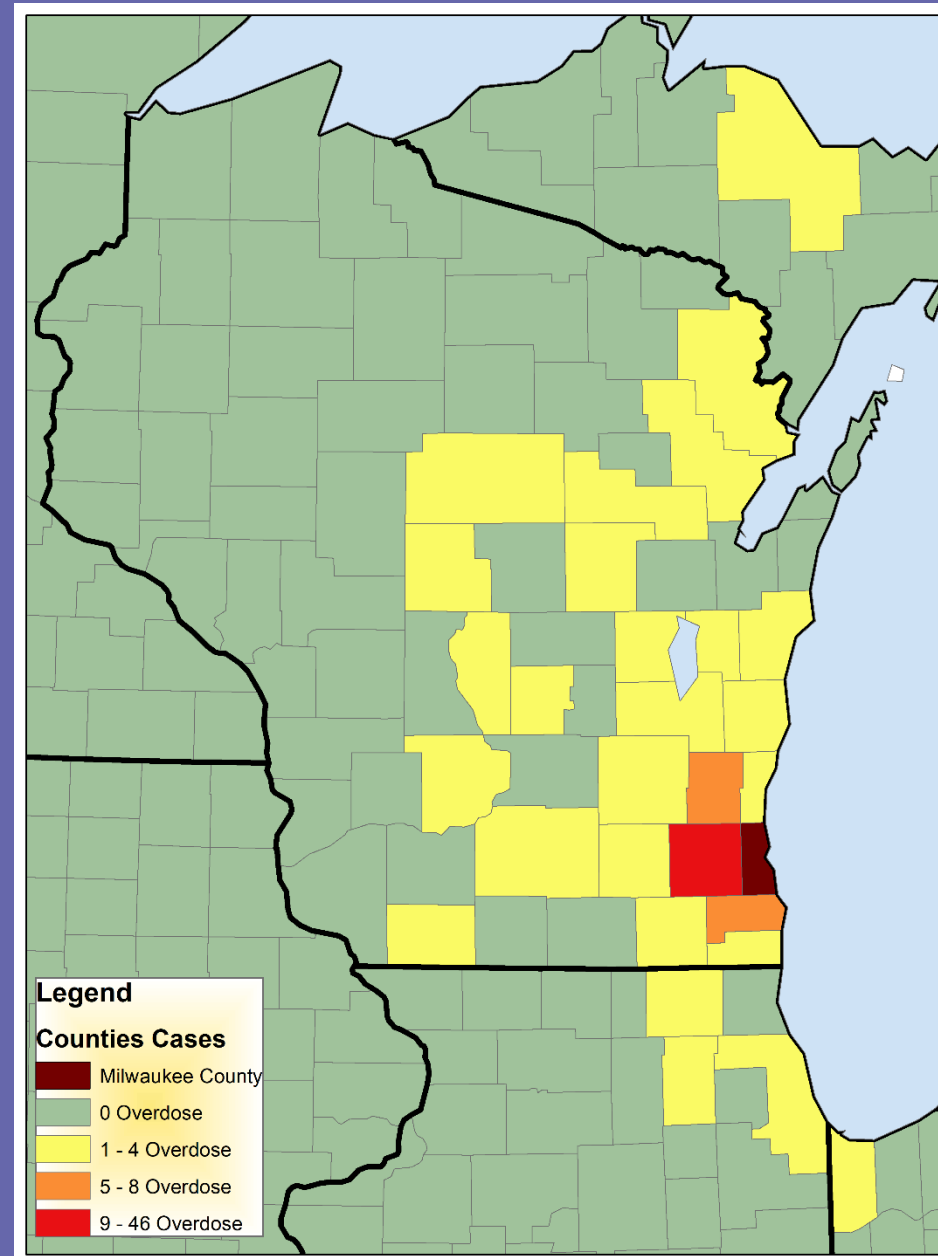
When overdose incident location differs from the residential address

Geographic Discordance		
(2017-2020)	Number of Cases	Percentage
Different Residence and Incident Location	439	26.72%
Total	1643	100.00%



STUDY SITE

Geographic distribution



STUDY SITE

Descriptive statistics

Geographic Discordance		
(2017-2020)	Distance (Km)	Duration (mins)
Mean	24.92	22.66
Standard Error	2.35	1.74
Median	8.91	11.08
Standard Deviation	48.45	35.93
Range	310.15	224.43
Minimum	0.57	0.62
Maximum	310.73	225.05

INTRODUCING: *"JOURNEY TO OVERDOSE"*

The distance/duration traveled from an offender's residence to the crime incident location is known as the ***journey to crime*** (Rengert, 2002).

So, inspired by criminology studies, we define the ***"journey to overdose"*** as the difference between drug overdose decedent residence and overdose incident location.

Furthermore, the journey to overdose is a novel concept, and it is not merely a measure of having to travel to consume drugs (eventually overdose); rather, it encompasses receiving drugs in socioeconomically different localities, with varying norms, values, cultures, and spatial accessibility to healthcare resources which may influence the overdose rate.

A NOVEL FRAMEWORK TO ANALYZE THE JOURNEY TO OVERDOSE

This study is the first known study to examine the journey to overdose; this study proposes a novel framework to analyze the journey to overdose through spatial social network analysis

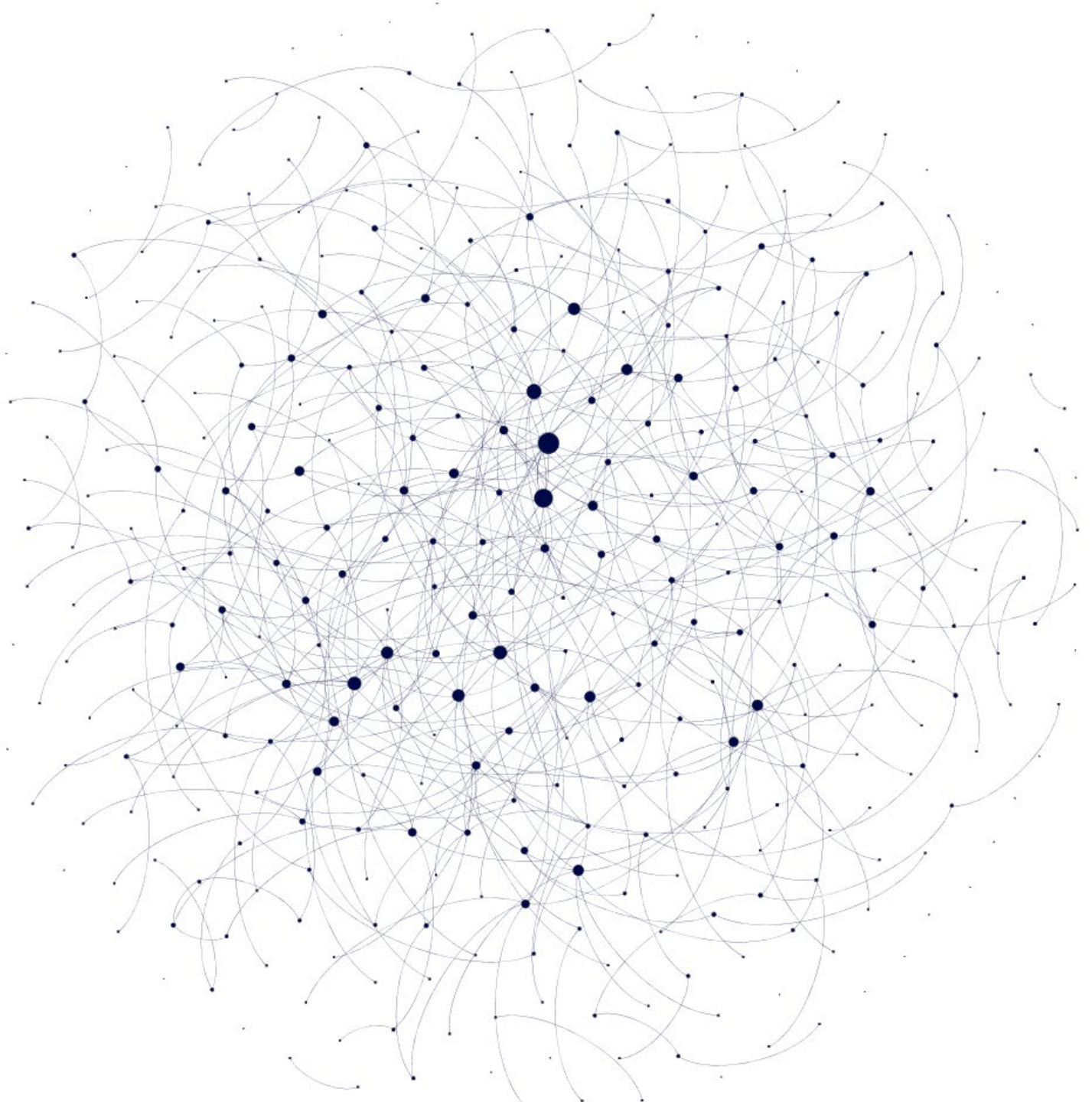
1. pinpoint focal points of geographically discordant overdoses incidents and original residence
2. unveil imported, and domestic hotspots of drug overdoses
3. investigate differentiating demographic and involved drug characteristics of geographically discordant and non-discordant overdoses.

SOCIAL NETWORKS

Node: A node, actor, or object that represents a social entity.

Edges: Ties that link nodes.

Graph: A graph depicts the relations among nodes.



SOCIAL NETWORKS

Spatial Social Network



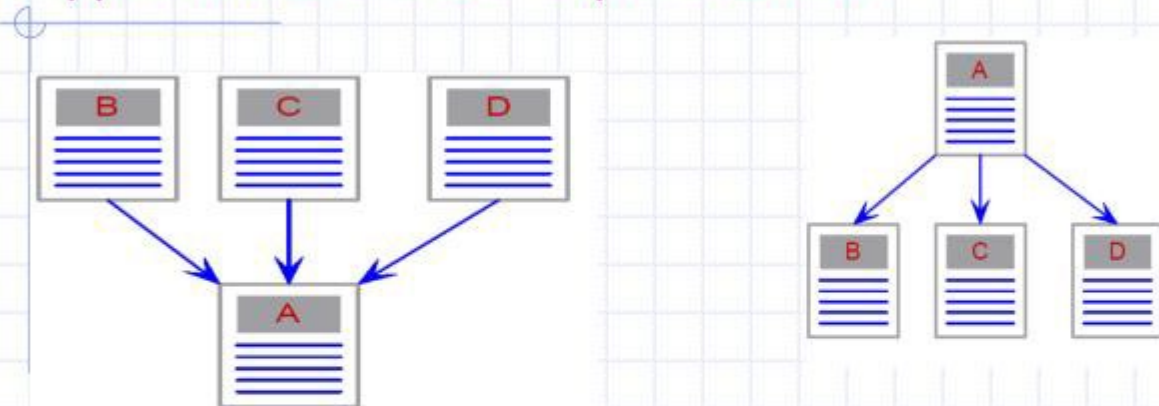


1. Pinpoint focal points of geographically discordant overdoses incidents and original residence

HYPERLINK-INDUCED TOPIC SEARCH (HITS)

A node is an authority if it is linked to by hubs; it is a hub if it links to authorities.

HITS - Hubs and Authorities - Hyperlink-Induced Topic Search



- ◆ A on the left is an **authority**
- ◆ A on the right is a **hub**

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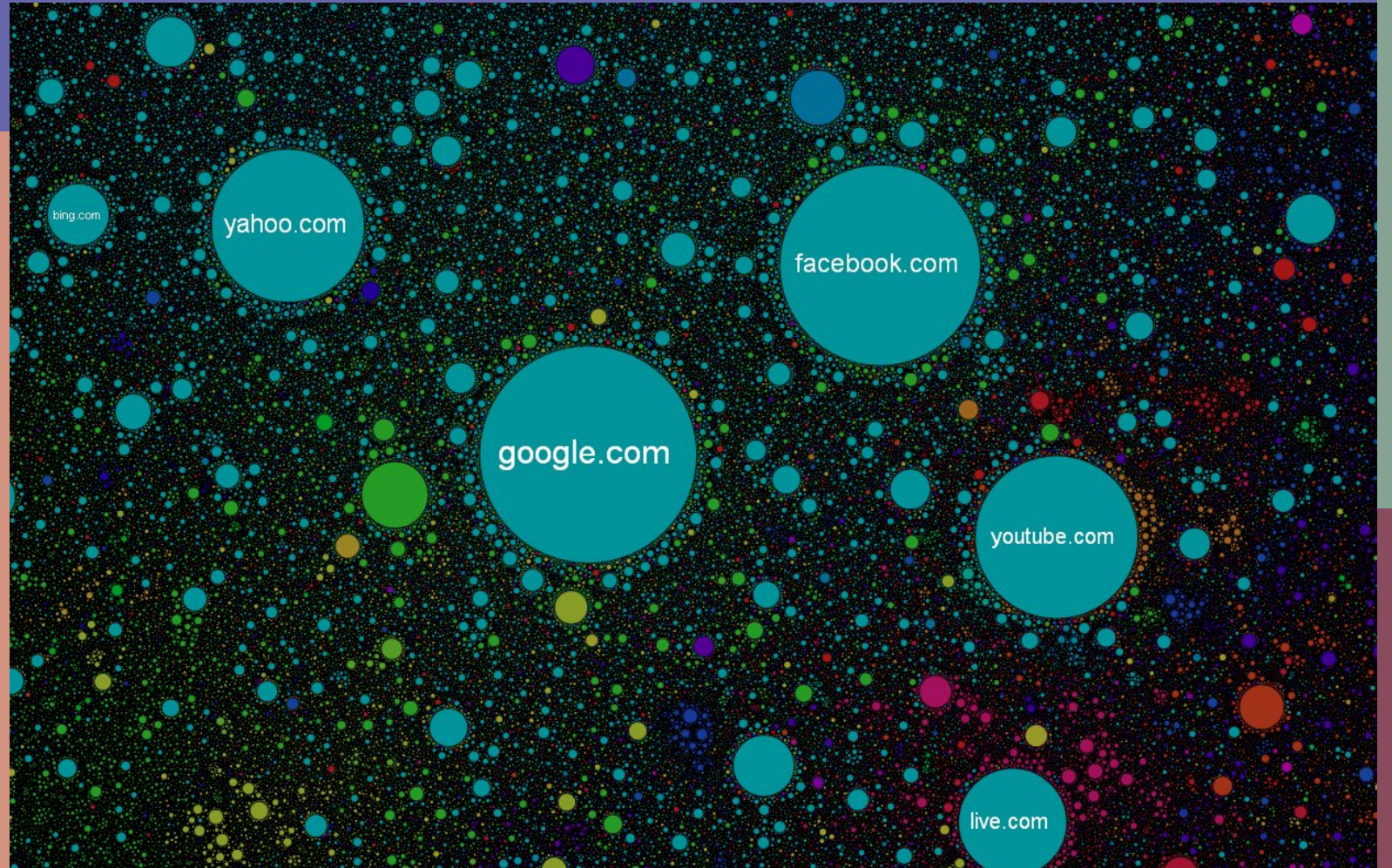
In the context of academic publications network:

a review article cites other important original articles that can be considered authoritative sources of information; in this network, review articles have edges directed toward many important original articles. On the other hand, important papers are referenced by well-structured review articles; therefore, in the network, they are pointed to by many review papers.

Consequently, it can be perceived that there are two important node types in the academic publications network, authorities of important information and hubs that can lead us to authorities.

HYPERLINK-INDUCED TOPIC SEARCH (HITS)

Internet Map



HYPERLINK-INDUCED TOPIC SEARCH (HITS)

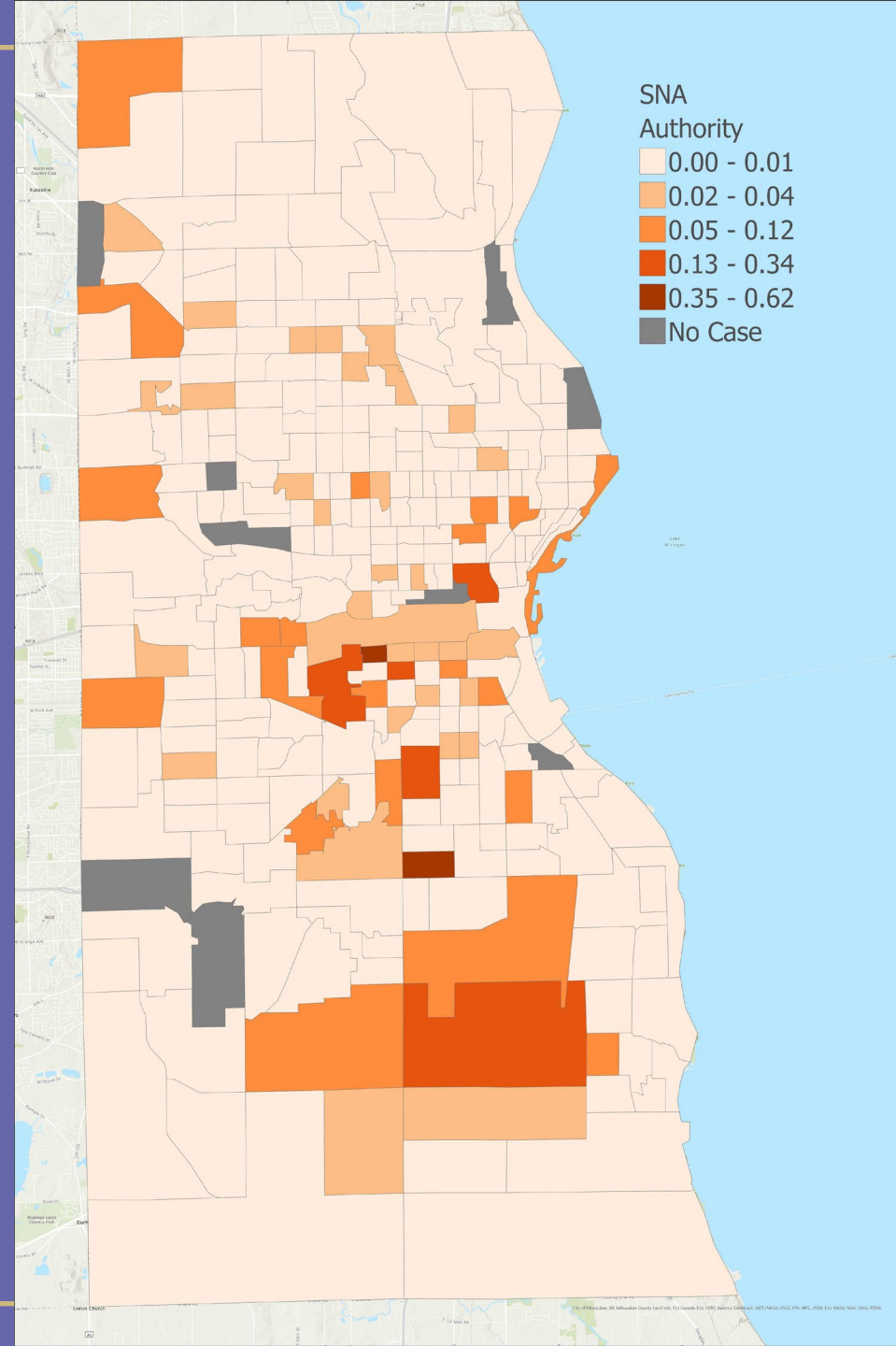
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The algorithm has been constantly improved and widely used across a wide range of applications, including:

- bioinformatics (Nickerson et al., 2018; Liu et al., 2020)
- education (Yang & Sun 2013)
- economics (Zhang et al., 2017; Deguchi et al. 2014)

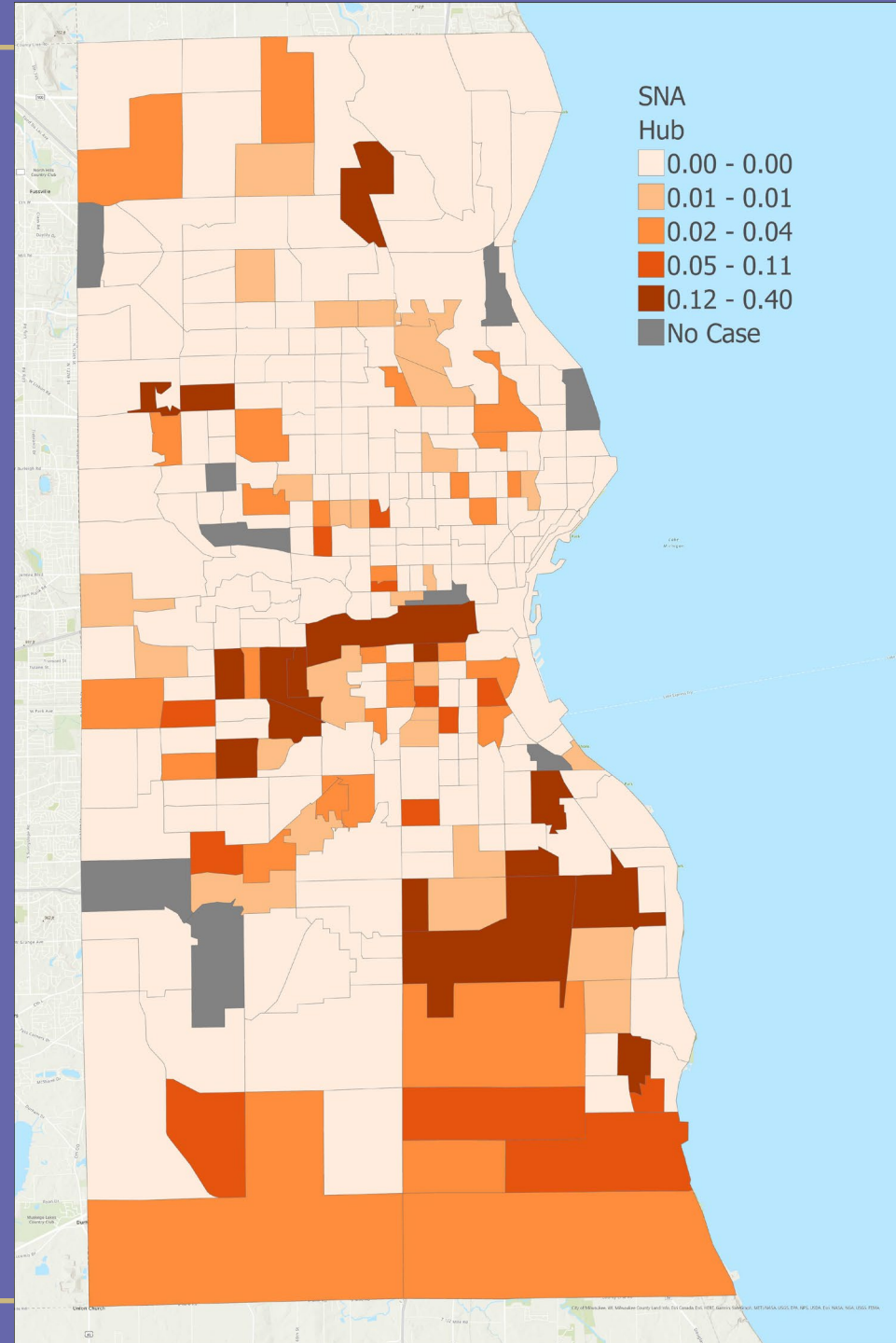
HYPERLINK-INDUCED TOPIC SEARCH (HITS)

HITS algorithm was used to pinpoint the focal point of geographically discordant overdoses and original residences in the directed and weighted journey to overdose network.



HYPERLINK-INDUCED TOPIC SEARCH (HITS)

HITS algorithm was used to pinpoint the focal point of geographically discordant overdoses and original residences in the directed and weighted journey to overdose network.



	Renter-occupied	White	Black	Hispanic	Median age	Single households	Educational attainment	Below Poverty Level	Median Household Income
Authorities	61.46%	50.68%	11.55%	33.02%	32.45	48.41%	11.60%	25.99%	39636.8
Hubs	46.66%	71.18%	12.13%	13.11%	40.09	39.01%	16.01%	17.72%	48802.3

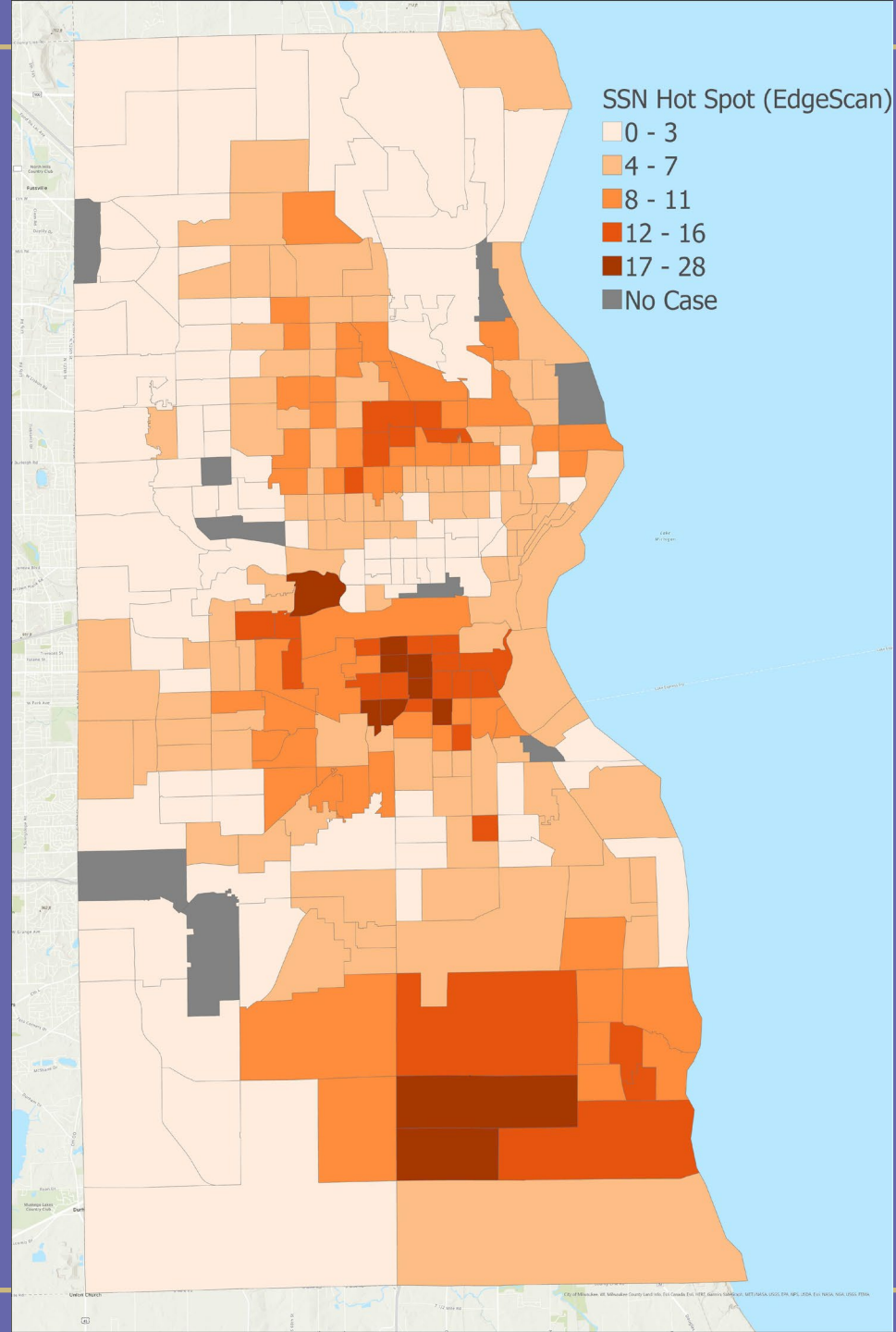


2. Unveil imported, and domestic hotspots of drug overdoses

HOTSPOT DETECTION FOR SPATIAL SOCIAL NETWORKS

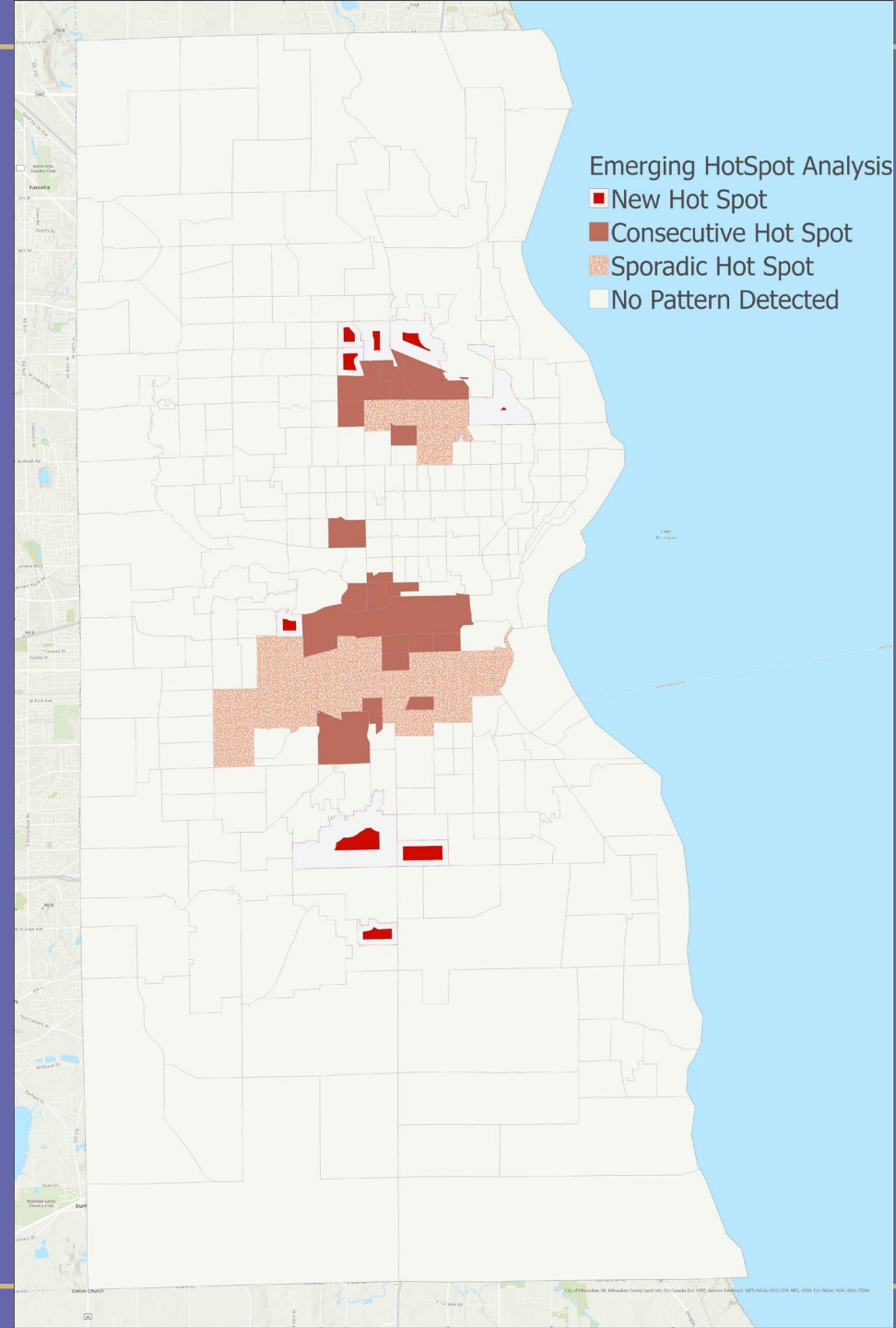
The goal for the current function of SSNtools is to detect the number of non-planar edges and the network density of a subset of a social network contained within a focal window.

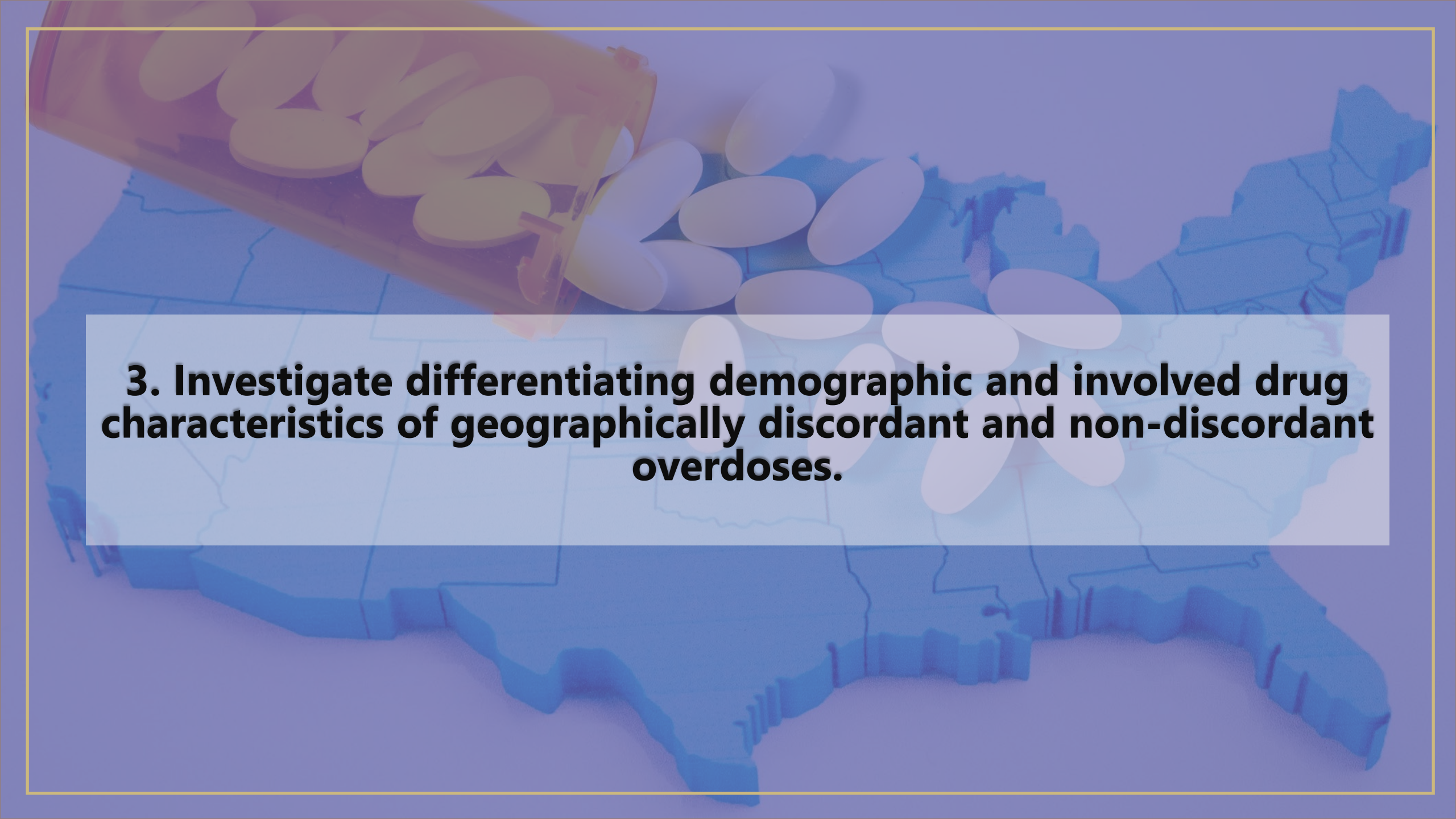
In another words, the algorithms return hotspots where nodes are **not only densely located but also connected.**



EMERGING HOT SPOT ANALYSIS

Identifies trends in the clustering of point densities (counts) or values in a space-time cube created using either the Create Space Time Cube By Aggregating Points, Create Space Time Cube From Defined Locations or Create Space Time Cube from Multidimensional Raster Layer tool.



A 3D map of the United States is shown in a light blue color. A clear plastic pillbox, tilted as if it has been spilled, is positioned in the upper left corner. Numerous white, oval-shaped pills are scattered across the map, primarily concentrated in the central and eastern regions. The entire scene is set against a solid purple background.

3. Investigate differentiating demographic and involved drug characteristics of geographically discordant and non-discordant overdoses.

PIVOT TABLES

Sex
Year
Race
Mode
Age
Cause of Death

	Geographic Discordance			
	True	False	P-Value	Significance
Mode				
Undetermined	2.05%	1.83%	0.775	
Accident	95.90%	93.19%	0.023	**
Suicide	1.82%	4.82%	0.001	***
Homicide	2.05%	0.17%	0.810	
Drug Evident in Toxicology Report				
Fentanyl	64.46%	55.81%	0.001	***
Heroin	32.57	29.73%	0.275	
Cocaine	44.42%	36.13%	0.003	***
Ethanol	17.08%	17.28%	0.927	
Amphetamines	8.43%	4.73%	0.012	**
Sedatives	19.82%	22.59%	0.219	
Gabapentin	7.31%	5.92%	0.306	
Synthetic Cannabinoid	1.37%	1.00%	0.554	
Gender				
Male	69.48%	67.28%	0.395	
Female	30.52%	32.72%	0.395	
Race				
Hispanic	8.20%	8.97%	0.619	
Black	26.88%	26.00%	0.721	
White	63.10%	62.04%	0.696	
Multiracial	0.68%	1.00%	0.520	
Native American	1.14%	1.16%	0.968	
Asian Pacific Islander	0.00%	0.75%	0.003	***
Eastern Indian	0.00%	0.08%	0.318	
Age (years)				
Average Age	40.92	44.57	0.000	***

PIVOT TABLES

Significant differentiator

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REFERENCES

Forati, A. M., Ghose, R., & Mantsch, J. R. (2021). Examining Opioid Overdose Deaths across Communities Defined by Racial Composition: a Multiscale Geographically Weighted Regression Approach. Journal of Urban Health, 98(4), 551-562.

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