

Identifying and explaining suicide, homicide, and overdose hotspots in Arizona

Plus, an AZ-VDRS dashboard presentation

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Introduction to AZ-VDRS, AZ-SUDORS

- The CVPCS manages¹ the following two surveillance systems:



- Participation in NVDRS in 2015
- Primarily homicides, suicides, legal intervention deaths
- Death certificates, medical examiner reports, law enforcement reports



- Participation in SUDORS in 2020
- Primarily unintentional overdose events
- Death certificates, medical examiner reports, toxicology reports

¹CVPCS is the bone fide agent for AZ-VDRS and sub-contracted through Arizona Department of Health Services for AZ-SUDORS

Presentation Outline

Part 1. Homicide, suicide, and overdose hotspot study

Part 2. AZ-VDRS data dashboard demonstration

Part 3. Q&A (if time permits)

Identifying and explaining homicide, suicide, and overdose hotspots in Arizona

Background

- **Interconnected Public Health Challenges**
 - Homicide/suicide/overdose leading causes of death in US (CDC, 2022)
 - Arizona has 18th highest highest fatal unintentional overdose rate, 14th highest homicide rate, and 12th highest suicide rate

Background

- **Interconnected Public Health Challenges**
 - Homicide/suicide/overdose leading causes of death in US (CDC, 2022)
 - Arizona has 18th highest highest fatal unintentional overdose rate, 14th highest homicide rate, and 12th highest suicide rate
- **Spatial clustering of manners of death**
 - These risk are not evenly distributed (Zhang & Monnat, 2024)
 - Clusters found in US South (homicide), West (suicide), and Appalachia (overdose) (Amin et al., 2021; Monnat, 2018)
 - Rural areas may increase social isolation resulting in more suicide, while urban areas offer greater substance availability (Rosenfeld et al., 2021)

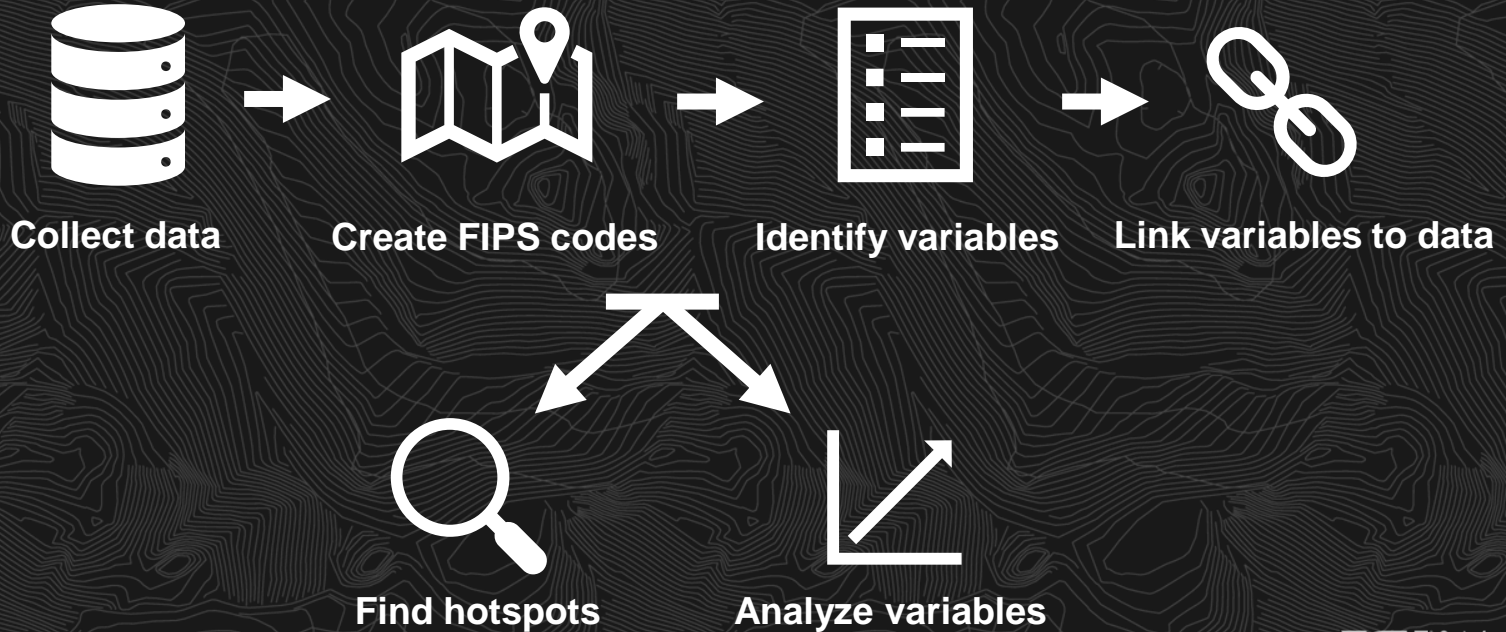
Background

- **Predictors and risk factors**
 - Social, economic, and environmental factors impact risk of suicide/homicide/overdose, with socioeconomic disadvantage and access to resources key (Chichester et al., 2020; Sampson, 2003)

Background

- **Predictors and risk factors**
 - Social, economic, and environmental factors impact risk of suicide/homicide/overdose, with socioeconomic disadvantage and access to resources key (Chichester et al., 2020; Sampson, 2003)
- **Study aims**
 - Identify suicide, homicide, and overdose hotspots in Arizona, 2020-2023
 - Examine relationship between counts of deaths within regions and several socio-structural predictors

Methods: Overview



Methods: Data collection

- **Collect data.** Nearly all suicides, homicides, and fatal unintentional overdoses in Arizona, 2020-2023
- **Create FIPS codes.** Created tract-level FIPS codes from data
- **Identify variables.** Reviewed, identified 15 independent variables
- **Link variables to data.** Retrieved variables from US Census Bureau's American Community Survey 5-year estimates



1,699 tracts,
2020-2023

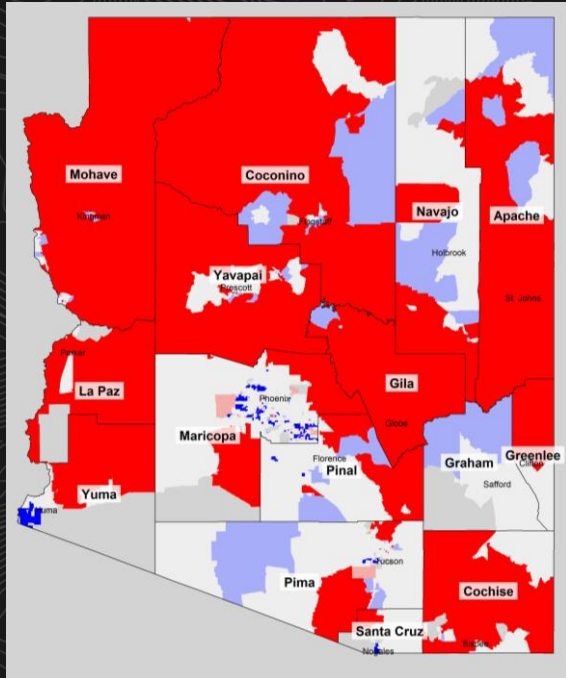
9,125 overdoses
5,552 suicides
1,925 homicides

Methods: Analyses

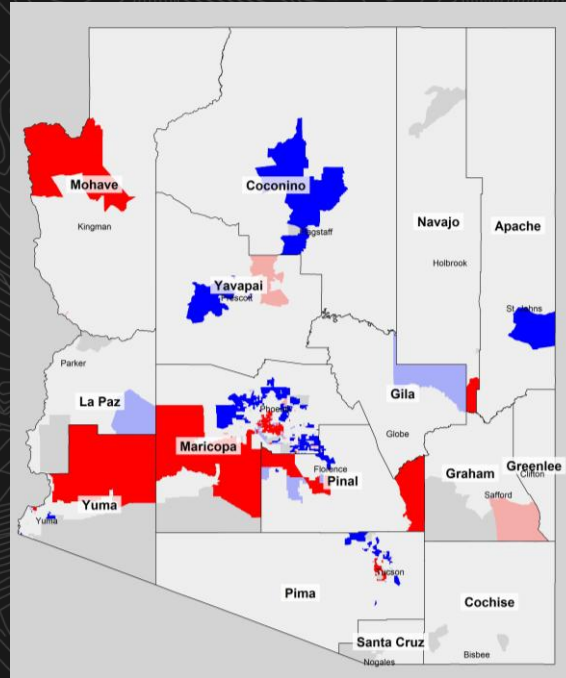
- **Find hotspots.**
 1. Compute incidence rates for manners of death separately
 2. Smooth rates with Empirical Bayes method
 3. Local Indicators of Spatial Autocorrelation (Anselin, 1995)
 4. Identify tracts labelled as High-High according to LISA
- **Analyze independent variables.**
 1. Perform Principal Component Analysis to reduce variables
 2. Perform separate negative binomial regressions

Findings: Hotspots

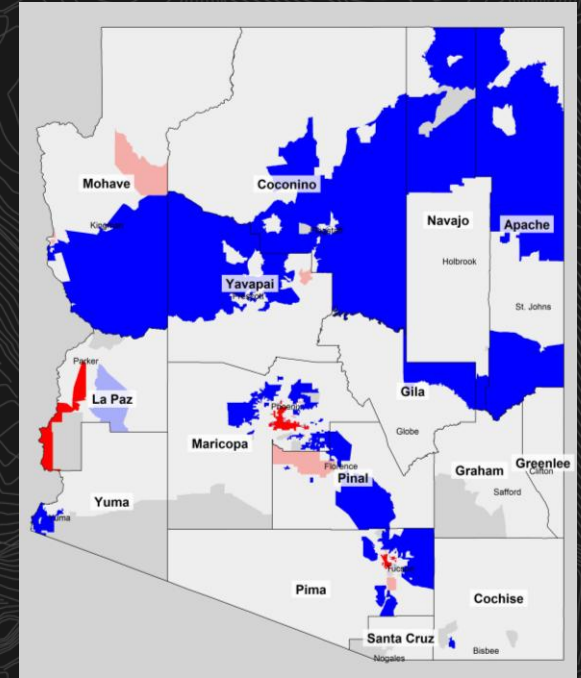
Suicides



Homicides



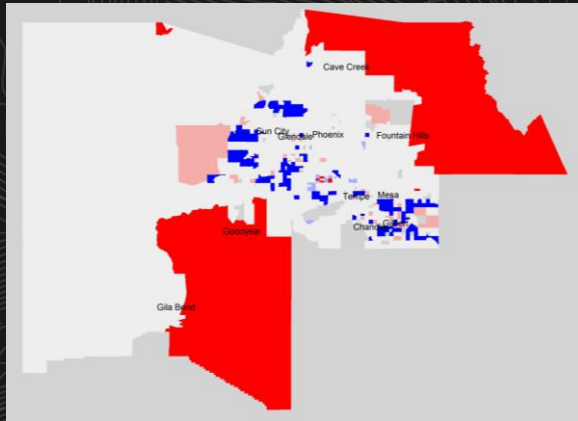
Unintentional overdoses



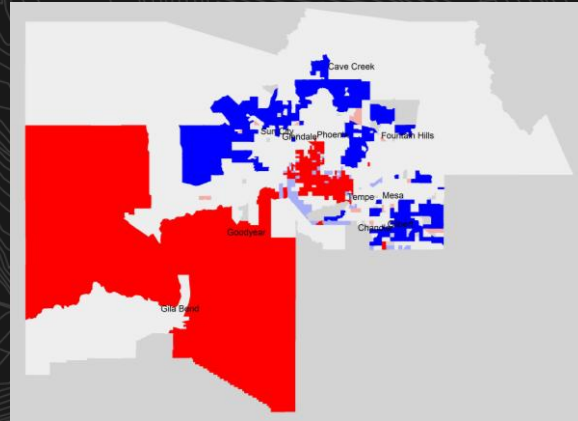
Deep red = HH; light red = HL; deep blue = LL; light blue = LH; light gray = non-significant

Findings: Hotspots: Maricopa County

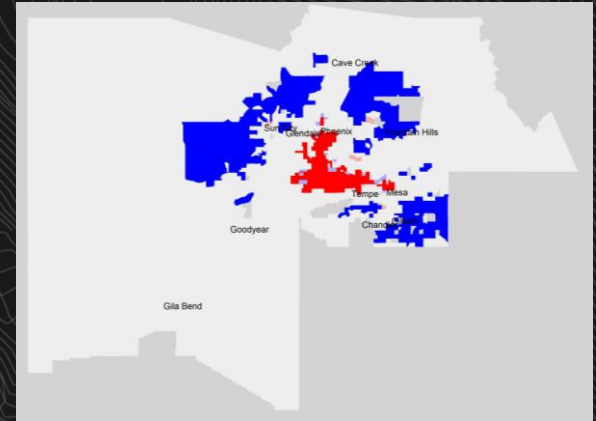
Suicides



Homicides



Unintentional overdoses

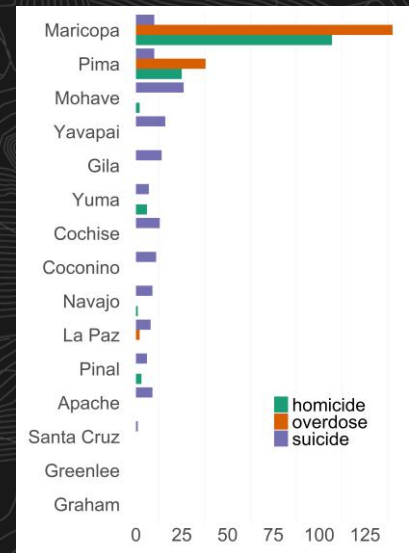


Deep red = HH; light red = HL; deep blue = LL; light blue = LH; light gray = non-significant

Findings: Hotspots

- About ten percent of tracts classified as hotspots
 - **Suicide** hotspots: n=162, 9.5%, 48.2 per 100,000
 - **Homicide** hotspots: n=172, 10.1%, 24.1 per 100,000
 - **Overdose** hotspots: n=180, 10.6%, 101 per 100,000
- A total of 396 tracts identified as a hotspot
 - 281 tracts hotspots for a **single** manner of death
 - 112 tracts hotspots for **two** manners of death
 - 3 tracts hotspots for **all three** manners of death

Number of hotspot tracts by county

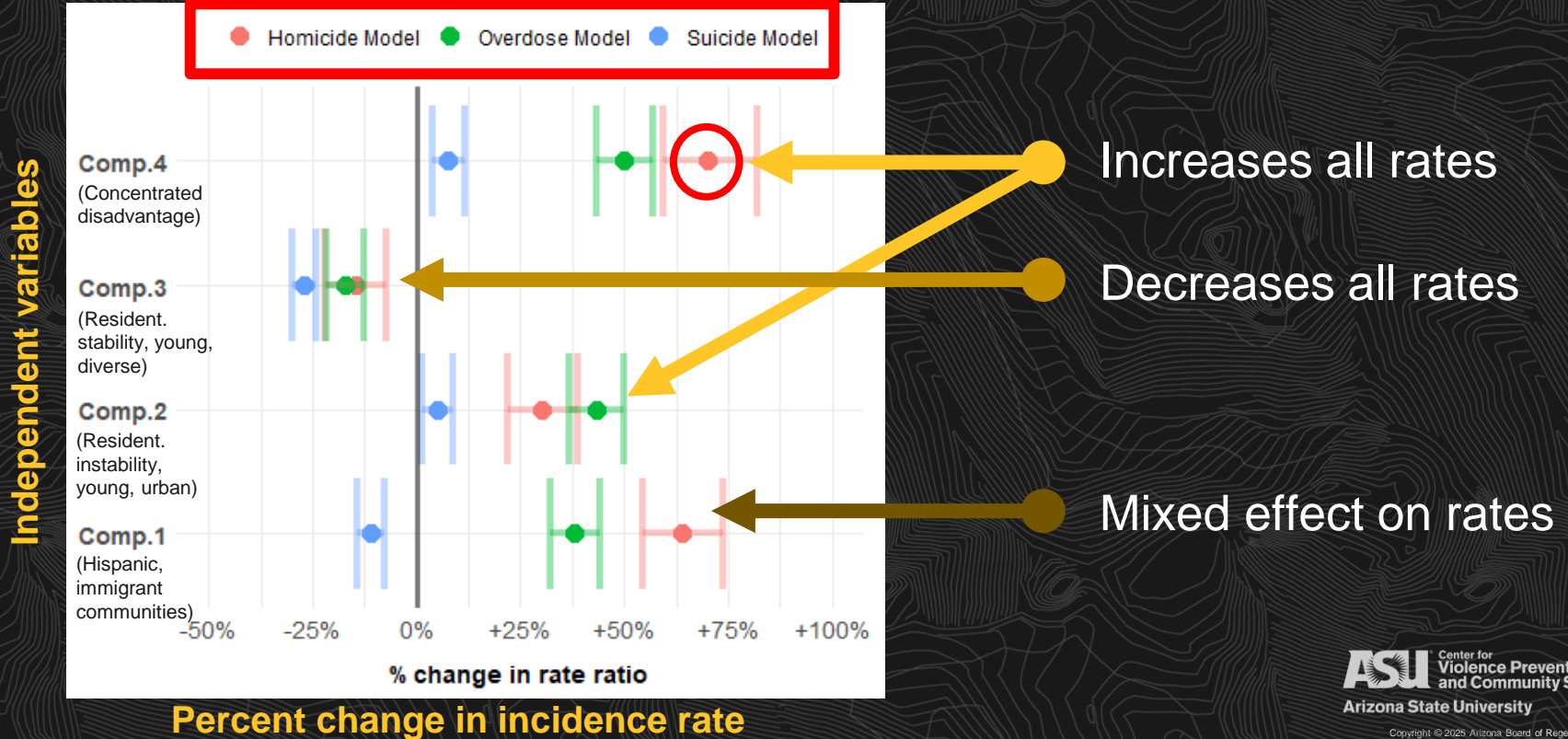


Findings: Regression analyses

- Three regression analyses
 - **Dependent** variable → count of deaths for a given manner
 - **Independent** variables → 4 components plus 2 other variables
 1. Hispanic and immigrant communities (Comp. #1)
 2. Residential instability in young, urban communities (Comp. #2)
 3. Residential stability in young, diverse communities (Comp. #3)
 4. Concentrated disadvantage (Comp. #4)

Findings: Regression analyses

Example: For a one unit increase in Comp.4, the homicide rate increases by 64%



Implications and future directions

1. Spatial clustering of violent deaths, fatal overdoses
 - **Finding:** Suicides, homicides, and fatal unintentional overdoses in Arizona not evenly distributed across space
 - **Implication:** Prevention efforts targeting hotspots may make greatest impact
 - **Future research:** Identify hotspots, cold-spots using smaller geographies (e.g., blocks, neighbors, streets)

Implications and future directions

2. Distinct and overlapping hotspots

- **Finding:** Most hotspots linked to one manner of death, but homicide + overdose hotspots often overlapped
- **Implication:** Prevention efforts targeting overlapping hotspots may make greatest impact
- **Future research:** Investigate temporal trends in AZ hotspots

Implications and future directions

3. Broadly significant risk factors

- **Finding:** Certain risk factors uniformly associated with increased/decreased risk for all manners of death
- **Implication:** Policies targeting economic stability, housing security may have overarching impacts
- **Future research:** Examine micro-level risk factors, including those addressing suicide risk

An AZ-VDRS dashboard demonstration

AZ-VDRS Dashboard

- Faculty and staff at the Center for Violence Prevention and Community Safety seek to collect timely, accurate, and complete data on Arizona's violent deaths
- The next question is, what can we do with the data? How can we use it to inform the public?

AZ-VDRS Dashboard

- Led us to building public-facing dashboard for displaying AZ-VDRS data in summer 2024, with update as of January 2025
- Goal to display accurate, comprehensive AZ-VDRS data that may be useful to media, researchers, and members of public
- View at azvdrs.org/dashboard

Thank you for coming

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References

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Extra materials

Extra materials

- Empirical Bayes smoothing
- $EB_{tract} = weight_{tract} \times R_{tract} + (1 - weight_{tract}) \times R_{AZ}$
 - Left-hand side weights a tract's raw rate
 - Right-hand side weights the global (Arizona) tract
 - Large $weight_{tract}$ means raw rate holds more influence on resulting EB rate
 - Small $weight_{tract}$ means global rate holds more influence on resulting EB rate

Extra materials

- LISA statistic
- $$I_{tract} = (R_{tract} - R_{AZ}) / var_{Rs} \times \sum_{neighbors} weight \times (R_{neighbor} - R_{AZ})$$
 - Left-hand side is standardized difference between local and global rates
 - Right-hand side is sum of weighted differences between neighbor and global rates
 - Outcome is standard deviations removed from global rate
 - Large $+I_i$ means hot/cold spots; large $-I_i$ means isolated hot/cold tracts

Extra materials

Variables	Comp. 1	Comp. 2	Comp. 3	Comp. 4
Foreign-born population (%)	0.88			
Hispanic population (%)	0.84			
Males >24 years old with less than a high school degree (%)	0.83			
Population that changed residence in past year (%)		0.86		
Renter-occupied housing (%)		0.78		
Males aged 15-29 (%)		0.65		
Population density		0.48		
Vacant homes (%)			-0.88	
Population >64 years old (%)			-0.72	
African American population (%)			0.43	
Unemployed population (%)				0.82
Population living in poverty (%)				0.67
Families with a female head and children <18 years old (%)				0.52

Extra materials

Independent variable	Suicide	Homicide	Overdose
	RR (95% CI)	RR (95% CI)	RR (95% CI)
Component #1	0.89 (0.86, 0.93)***	1.64 (1.54, 1.74)***	1.38 (1.32, 1.44)***
Component #2	1.05 (1.01, 1.09)**	1.3 (1.22, 1.39)***	1.43 (1.37, 1.5)***
Component #3	0.73 (0.7, 0.76)***	0.85 (0.78, 0.93)***	0.83 (0.78, 0.87)***
Component #4	1.08 (1.04, 1.12)***	1.7 (1.59, 1.82)***	1.5 (1.43, 1.57)***
Group quarters	1.01 (1.01, 1.01)***	1.01 (1, 1.01)	1.01 (1.01, 1.02)***
Public assistance	1.01 (0.99, 1.02)	1.02 (0.99, 1.05)	1.02 (1, 1.05)*

Note: * indicates significance at <0.05 level; ** indicates significance at <0.01 level; *** indicates significance at <0.001 level