Homicide, suicide, and drug overdose hotspots in Arizona

Arizona Violent Death Reporting System and Arizona State Unintentional Drug Overdose Reporting System

January 1, 2020 – December 31, 2023

AZ VDRS Violent Death Reporting System

AZ SUDORS State Unintentional Drug Overdose Reporting System

ARIZONA DEPARTMENT OF HEALTH SERVICES

ASU Center for Violence Prevention and Community Safety
Arizona State University

The **Arizona Violent Death Reporting System** (AZ-VDRS) and **Arizona State Unintentional Durg Overdose Reporting System** (AZ-SUDORS) are part of the larger National Violent Death Reporting System and National State Unintentional Drug Overdose Reporting System, respectively, both sponsored by the Centers for Disease Control and Prevention. The AZ-VDRS collects violent death data from multiple sources: death certificates issued by the Arizona Department of Health Services, police reports obtained from investigating agencies, and autopsy reports from medical examiner offices. The AZ-SUDORS collects unintentional fatal drug overdose data from multiple sources: death certificates issued by the Arizona Department of Health Services and autopsy and toxicology reports from medical examiner offices. The purpose of these projects is to assist stakeholders with strategic planning and prevention efforts aimed toward reducing the number of violent deaths and fatal unintentional drug overdoses that occur each year in Arizona.

AZ-VDRS and AZ-SUDORS data are managed by the **Center for Violence Prevention and Community Safety**. To become more committed to the Arizona community and to society as a whole, Arizona State University is setting a new standard for research universities through the model of the New American University. As a New American University, ASU is measured not by whom we exclude but by whom we include and by our pursuit of research that considers the public good; we assume major responsibility for the economic, social, and cultural vitality of our community.

The Center's mission is to generate, share, and apply quality research and knowledge to create "best practice" standards. The center specifically evaluates policies and programs; analyzes and evaluates patterns and causes of violence; develops strategies and programs; develops a clearinghouse of research reports and "best practice" models; educates, trains, and provides technical assistance; and facilitates the development and construction of databases.

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Background

The intertwined crises of homicide, suicide, and fatal unintentional overdose are urgent public health and safety challenges in the United States, claiming the lives of hundreds of thousands of individuals each year. Beyond the personal toll, these crises strain public health systems, law enforcement, and social services, creating a pressing need for focused attention and intervention. There is limited understanding of how neighborhood-level factors might predict outcomes across these different types of fatalities.

Data and Analysis

Data. This report utilizes data from the AZ-VDRS and the AZ-SUDORS. Only data on homicide, suicide, and unintentional drug overdose deaths between 2020 and 2023 were included. Census tract-level FIPS codes indicating the location of injury were created for each decedent. American Community Survey (ACS) five-year population estimates were gathered by census tract. Only census tracts present in all four years and whose pooled population was 500 or greater were retained. This resulted in a final dataset including 16,602 homicide, suicide, and overdose deaths that occurred in one of 1,699 Arizona census tracts between 2020 and 2023.

Analysis. First, a statistical technique for identifying hotspots was employed. Crude incidence rates by manner of death were calculated and smoothed using the Empirical Bayes method. Smoothed rates were used to calculate LISA statistics, which indicate the clustering of similar rates across tracts. 'HH' tracts are hotspots, meaning both a given tract and its surrounding tracts have significantly high rates; 'HL' tracts are those that have a significantly high rate but their surrounding tracts do not; 'LL' tracts are clusters of tracts with significantly low rates; 'LH' tracts are those that have a significantly low rate but their surrounding tracts have high rates; and 'NS' tracts are those with non-significant rates.

Second, 16 socio-structural variables utilized in previous research were gathered from the US Census Bureau's American Community Survey 5-year estimates (Exhibit 1). 14 of the 16 variables were submitted to Principal Components Analysis, resulting in four principal components that represent underlying latent variables in the data. These components were given labels, namely 'Immigrant enclaves with low educational attainment', 'Transient young urban enclaves,' 'Established young urban enclaves, and 'Concentrated disadvantage among AI/AN enclaves' (Exhibit 2). Two variables, namely households recently receiving public assistance and population in group quarters, were retained as separate independent variables.

Finally, regression analysis was used to examine the relationship between socio-structural variables and the counts of deaths within tracts. Model comparisons indicated that negative binomial regression with county included as a random effect achieved the best fit. Thus, three mixed effect negative binomial models were run. For each, a single manner of death served as the dependent variable, and the six independent variables served as predictors.

All analyses were performed in R.

Results

Hotspots. LISA statistics reported that 10.2% of tracts were homicide hotspots, 9.5% of tracts were suicide hotspots, and 10.7% of tracts were overdose hotspots. Exhibit 3 displays the count of hotspot tracts by type of fatality and county. Of the 399 tracts designated as hotspots, 286 were hotspots for a single fatality type, 110 were hotspots for two fatality types, and 3 were hotspots for all three fatality types. Crude rates within hotspots were much higher than their respective overall state rates. The crude homicide rate within hotspots was 24 per 100,000 people, while its overall crude rate was 6.8 per 100,000 people (rate ratio [RR] = 3.5). The crude suicide rate within hotspots was 48.1 per 100,000 people, while its overall crude rate was 19.7 per 100,000 people (RR = 2.4). The crude overdose rate in overdose hotspots was 101.7 per 100,000 people, while its overall crude rate was 32.3 per 100,000 people (RR = 3.1) (Exhibit 4). Compared to cold spots, hotspots have a higher risk of fatality. Homicide hotspots are at 24 times greater risk than homicide cold spots, suicide hotspots are at 5.2 times greater risk than suicide cold spots, and overdose hotspots are at 10.5 times greater risk than overdose cold spots. 35.9% of homicides occurred in hotspots, 17.6% of suicides occurred in hotspots, and 32.1% of overdoses occurred in hotspots. High-definition hotspot maps are shown in Exhibit 5-8.

Regression. Exhibit 9 displays results of the three regression models. All four components significantly predict the count of homicides in tracts. Two components, namely 'Transient Young Urban Enclaves' and 'Concentrated Disadvantage among AI/AN enclaves', are associated with increased risk in homicide, suicide, and overdose. In other words, as the presence of these factors increase in a given area, so too does the risk of all three fatalities. By contrast, the 'Established Young Urban Enclaves' component is associated with decreased risk of homicide, suicide, and overdose. In other words, as the presence of these factors increase in a given area, the risk of all three fatalities decreases. The final component, 'Immigrant Enclaves with Low Educational Attainment', has a mixed effect on homicide, suicide, and overdose. This variable is associated with increased risk of homicide and overdose but a decreased risk of suicide. Generally, effect sizes were greatest for homicide and overdose and less for suicide.

Implications

This report examined hotspots and neighborhood-level factors that may impact outcomes across homicide, suicide, and fatal unintentional drug overdose. Several key findings emerged, providing important insights in these areas. First, this report establishes the geospatial concentration of homicide, suicide, and overdoses, contributing to the growing evidence that these fatalities are not evenly distributed across space. Each fatality reported that about ten percent of census tracts were hotspots. Homicide and overdose hotspots were especially concentrated in a small number of tracts. Second, most hotspot tracts were associated with only one type of fatality. Where hotspot tracts did overlap, the fatalities were almost always homicide and overdose but not suicide. Third, hotspots for homicide and overdose are notably concentrated in the two most urban areas of Arizona, namely the Phoenix metropolitan area in Maricopa County and the city of Tucson in Pima County, while suicide hotspots showed greater presence in other, more rural areas. Lastly,

regression results highlight the significant role of neighborhood-level factors, with some factors predicting all three fatalities and others having a mixed effect.

This report reveals several implications. First, targeting hotspots with prevention efforts could be effective. For instance, while only about 10.2% of Arizona census tracts were identified as homicide hotspots, these areas accounted for over 35.9% of homicides from 2020 to 2023. Targeting hotspots may be particularly effective for homicide and overdose. Second, that most hotspot tracts were hotspots for a single fatality highlights the importance of tailoring public health services and strategies to toward the specific fatality. More specifically, personnel and resources experienced in these specialized crises can concentrate on areas where hotspots exist and persist for those specific fatalities. Third, findings about the spatial patterns and significant neighborhood-level factors of homicide, suicide, and overdose highlight the opportunity for local government, public health and social service agencies, and community advocacy groups to use geospatial and statistical analyses to identify hotspots and monitor population health across different areas. This would inform agencies about the patterns and trends of these crises over time and across locations, as well as how to best allocate their time, money, and resources to prevent and address these public health crises.

Limitations

This report has several limitations. While this report utilized several neighborhood-level factors, there are likely other factors that could also be insightful. Future research could incorporate additional individual and neighborhood-level factors, such as marital status, type of employment, religious affiliation, the built environment, the opportunity or availability of prescription drugs, community health issues, and sense of community. Additionally, due to the limited availability of AZ-SUDORS data, we were unable to examine temporal trends in hotspots. Important policy and practical implications can be drawn from understanding which hotspots are increasing, decreasing, or remaining stable over time. Future research may aim to examine the temporal aspect when sufficient data becomes available, especially in a rapidly evolving area like Arizona.

Exhibit 1

Descriptive statistics for 16 socio-structural variables

Variable	Mean	St. dev.	Min	Max
Renter-occupied housing	33.26	22.17	0	100
Hispanic population	30.60	23.55	0	100
Males aged 15-29	20.49	10.33	0	97.50
Population >64 years old	19.83	16.25	0	91.42
Residential mobility	15.87	8.66	0	82.35
Population living in poverty	14.07	10.70	0	100
Foreign-born population	12.61	8.82	0	54.52
Vacant homes	11.41	10.38	0	100
Young men without high school diploma	12.24	11.21	0	60.77
Female-head households	10.09	8.31	0	54.06
African American population	3.98	4.92	0	35.49
American Indian and Alaska Native population	3.88	14.43	0	99.49
People per sq mile (in thousands)	3.68	3.32	0.0003	27.17
Unemployed population	3.33	2.26	0	16.3
Households on public assistance	2.08	2.10	0	17.77
Population in group quarters	2.08	9.78	0	100

Exhibit 2

Component loadings from the principal components analysis of social structural variables

Variables	**Comp. 1** Immigrant enclaves with low educational attainment	**Comp. 2** Transient young urban enclaves	**Comp. 3** Established young urban enclaves	**Comp. 4** Concentrated disadvantage among AI/AN enclaves
Foreign-born population	0.87			
Hispanic population	0.88			
Young men without high school diploma	0.84			
Residential mobility		0.86		
Renter-occupied housing		0.80		
Males aged 15-29		0.67		
Population density		0.47		
Vacant homes			-0.88	
Population >64 years old			-0.75	
African American population		0.42	0.42	
AI/AN population				0.85
Population living in poverty				0.67
Unemployed population				0.58
Female-head households				0.44

Exhibit 3

The number, percent, and crude rate of violent deaths and unintentional overdoses among census tracts by type of hotspot

Hotspot type	Homicide		Suicide		Unintentional Overdose	
	n (%)	Crude rate	n (%)	Crude rate	n (%)	Crude rate
NS	1,201 (70.7)	5.8	1,279 (75.3)	18.5	1,108 (65.2)	29.4
LL	250 (14.7)	1.0	159 (9.4)	9.3	369 (21.7)	9.7
LH	58 (3.4)	2.6	63 (3.7)	13.0	25 (1.5)	23.1
HL	17 (1.0)	12.0	37 (2.2)	29.4	16 (0.9)	52.6
HH	173 (10.2)	24.0	161 (9.5)	48.1	181 (10.7)	101.7
Total	*1,699*	*6.8*	*1,699*	*19.7*	*1,699*	*32.3*

Note: High-High (HH) are tracts with high rates surrounded by other tracts with high rates; High-Low (HL) are tracts with high rates surrounded by tracts with low rates; Low-Low (LL) are tracts with low rates surrounded by other tracts with low rates; Low-High (LH) are tracts with low rates surrounded by tracts with high rates; Not Significant (NS) are tract that have neither significantly high nor low rates

Exhibit 9

Mixed effects negative binomial regression models by type of death

Independent variable	Homicide	Suicide	Unintentional Overdose
	RR (95% CI)	RR (95% CI)	RR (95% CI)
Immigrant Enclaves with Low Educational Attainment	1.67 (1.57, 1.77)***	0.89 (0.86, 0.93)***	1.45 (1.39, 1.52)***
Transient Young Urban Enclaves	1.33 (1.25, 1.42)***	1.05 (1.01, 1.09)**	1.49 (1.43, 1.56)***
Established Young Urban Enclaves	0.88 (0.81, 0.96)***	0.74 (0.71, 0.77)***	0.85 (0.8, 0.89)***
Concentrated Disadvantage among AI/AN enclaves	1.72 (1.61, 1.83)***	1.11 (1.07, 1.16)***	1.38 (1.3, 1.45)***
Population in group quarters	1.05 (0.98, 1.12)	1.11 (1.07, 1.14)***	1.10 (1.06, 1.15)***
Population receiving public assistance	1.03 (0.97, 1.1)	1.01 (0.98, 1.05)	1.06 (1.01, 1.11)**

Note: *p <0.05 level; **p <0.01 level; ***p <0.001 level

Acronyms: RR = rate ratio; CI = confidence interval; AI/AN = American Indian and Alaska Native