The author(s) shown below used Federal funding provided by the U.S. Department of Justice to prepare the following resource:

Document Title:	Delaware Opioid Metric Intelligence Project, Final Report
Author(s):	Tammy L. Anderson, Ph.D., Daniel O'Connell, Ph.D.
Document Number:	305452
Date Received:	October 2022
Award Number:	2017-IJ-CX-0016

Delaware Opioid Metric Intelligence Project, Final Report

June 2022

SUMMARY OF THE PROJECT

The Delaware Opioid Metric Intelligence Project (DOMIP) sought to improve timely drug intelligence and community surveillance capabilities in Delaware to help reduce its prescription (Rx) opioids, heroin, opioid, and other related problems. DOMIP achieved this by producing an integrated dataset with public health (e.g., overdose (OD) deaths) and criminal justice (e.g., offenses and arrests for drug-related crime) metrics. Six years were proposed, but the University of Delaware team was able to produce an 8-year dataset ranging from 2013 to 2020. The resultant eight-year integrated data set has enabled unprecedented community surveillance, statistical analysis, and mapping of a wide range of opioid and crime-related metrics, leading to recommendations for best practices in reducing drug market and drug diversion activities and public health risk factors.

DOMIP provides accessible community data on an open web portal (see the project page at https://www.cdhs.udel.edu/projects/domip) and an interactive mapping app for use by policy-makers, practitioners, and civilians. DOMIP allows queries on opioid and crime metrics and offers downloadable maps that identify hot spots. The mapping app also adds community "assets" or resources (e.g., # treatment beds, EMS services, 12 Step meetings, etc.) to balance the dataset's opioid risk factors with "protective" ones. Therefore, DOMIP will not only improve and expand drug intelligence and community surveillance for the adaptation of best practices for state agencies, and community providers, it will increase opioid-related awareness and services for the public.

MAJOR GOALS & OBJECTIVES

DOMIP has three main objectives and five specific goals. Objective #1 is a public service goal to establish a public-facing dashboard (see https://www.cdhs.udel.edu/projects/domip) or mapping app containing the 8-year trend in opioid-related metrics. This objective was met with an 8-year dashboard and dataset on OD death, crime, and US Census metrics measured at the US census tract, zip code, and house district levels.

Objective #2 is also a public service goal, seeking to conduct predictive analyses on the geography and correlates of the opioid problem as it changes over time. We have been able to identify hot spot areas, and how they have changed geographically and seasonally, for intervention and recommend courses of action for law enforcement and public health practitioners.

Objective #3 seeks contributions to research and science. It pursues the identification of predictors and correlates of the opioid problem over time. This goal has also been met with 12 published papers to date (with 3 others currently under review at scholarly journals) and more than 20 conferences and invited presentations across the country (see Appendices).

Below is a list and description of the five specific goals of the project and the Appendices show a list of publications related to each.

Project Goals:

Goal #1. Build a six-year (2013 - 2018) de-identified dataset with critical Rx opioid, heroin, and opioid-based new psychoactive substance (NPS), public health, and crime metrics measured at the census tract level for improved community surveillance. We produced an 8-year de-identified dataset (2013 - 2020) instead of a 6-year one.

Goal #2. Perform overall and demographic-based trend analyses to investigate changes over time in metrics.

Goal #3: Perform pre & post-test analysis of new Rx opioids, heroin, and opioid-based NPS policies to assess the impact on public health and crime metrics.

Goal #4: Conduct hot spot mapping (identification of high-risk and lower-risk communities) for place-based interventions and the development of best practices.

Goal #5: Statistically model concentrated disadvantage and other theories of negative opioid and crime outcomes.

RESEARCH QUESTIONS & RELATED FINDINGS

Below is a list of research questions for Goals #2[1] - #5 and highlighted findings for each.

Goal #2:

1. Is the gender gap in OD deaths still decreasing as the opioid epidemic wages on?
   The gender gap is evident in opioid OD death rates during the period 2013 - 2017. The male rate has expanded relative to the female rate because of third-wave illegal opioid deaths compared with Rx opioids. Age and drug type impact the role of gender in drug OD deaths.

2. How does Rx drug history relate to decedents' post-mortem toxicological profiles?
   Fentanyl decedents had, on average, more Rxs for opioids than other decedents before death. Fentanyl decedents more often had Rxs for fentanyl 60 days before death.

3. Has there been an increase in opioid-involved OD deaths across all opioid types and all race/ethnicity*sex dyads? How are cocaine and Rx opioids distributed in such deaths?
   White males had the highest rates of OD deaths for all drugs, followed by Black and Hispanic males. Fentanyl is the most prevalent drug in OD decedent toxicology. Heroin places second, from 2013 - 2016, but was replaced by cocaine as the second most common drug. The 2019 fentanyl deaths have high cocaine positivity, suggesting Wave 4 is underway and/or tainted cocaine in the drug supply. Rx opioids remain present in OD deaths.

Goal #3:

1. What are some of the advantages and challenges of implementing 'data science' methodologies for combatting the opioid epidemic?
   The opioid crisis requires a multidisciplinary approach to effectively address the problem. Data use agreements and memoranda of understanding are required for data acquisition.

---

[1] There is no research question attached to Goal #1 as its purpose was to build the opioid dashboard/mapping app.

Data security protections must be a top priority when working with protected health information (PHI) or crime data. Maintaining active relationships with stakeholders from agencies providing data is essential.

2. How do OD deaths and related metrics—OD calls for service to police and non-fatal OD emergency department visits—in Delaware vary seasonally during the most recent years of the opioid epidemic (2016-2020)?

Yearly variations across OD metrics exist, with OD deaths reporting the only consistent increases per year. Seasonal variations show the spring months have the most consistent increases in OD deaths and OD calls for service. There are significant differences for all OD metrics across years and seasons.

Goals #4 & #5:

1. How has prescribing oxycodone, hydrocodone, pharmaceutical fentanyl, and all other opioids changed over time?

Oxycodone and fentanyl Rxs remain stable, hydrocodone Rxs dropped, and all other opioid Rxs increased.

2. How do community-level indicators explain changes in Rx patterns for these types of opioids?

Veteran populations and Medicaid/Medicare populations had higher opioid Rxs.

3. How do OD death rates vary across urban/rural neighborhood types?

OD death rates vary up to 13-fold by neighborhood and the demographic groups within them. Urban areas have the highest OD death rates in Delaware.

4. What are the drivers of global and local patterns of Black-White opioid-related possession arrests?

OD calls for service predict White more than Black opioid-related arrests, especially in disadvantaged, rural areas as opposed to urban areas. Economic disadvantage and racial composition of communities matter more in shaping Black arrest rates across the state.

5. Have OD deaths over the third wave of the epidemic increased across neighborhoods and are shifts towards increased heroin and fentanyl involvement consistent across neighborhoods?

OD deaths between 2013 and 2018 exhibited two concerning neighborhood patterns – those consistently high and those spiking due to fentanyl. Fentanyl dominates recent OD deaths with heroin also present in many. Up to 50% of OD deaths still involved Rx Opioids.

6. How are neighborhood disadvantages and differential access to drug markets associated with neighborhood opioid OD trends and changing drug type compositions?

Neighborhoods with few OD deaths enjoy economic prosperity. The availability of drugs increases the risk for OD deaths. Concentrated disadvantage increases drug selling, which indirectly spikes OD deaths.

7. What are the individual and contextual factors that predict how far Black and White arrestees travel from their residences to the locations of their alleged opioid possession offenses?

Disparities exist in how far arrestees travel, with differences relating to demographic characteristics. Social disorganization and availability-proneness theory predict travel distances. Racial differences in travel to crime vary by type of area.

RESEARCH DESIGN AND METHODS, ANALYTICAL AND DATA ANALYSIS TECHNIQUES

DOMIP sought to integrate at the US Census tract-level identifiable data from three Delaware state databases: Prescription Monitoring Program (PMP), Delaware Justice Information System (DELJIS crime data), and OD death data from the Division of Forensic Science (DFS). DOMIP would de-identify six years of these by geocoding them at the US census tract (N=214) and then add US Census data as a fourth component. The PMP, DELJIS, and DFS datasets each feature a complete universe of cases in Delaware, since all Rx prescriptions (approximately 1 million per year) for Schedule 2 - 5 drugs are required to be reported to the PMP, all arrests and offenses (approximately 40,000 per year) to DELJIS, and all drug-related deaths (approximately 300 per year recently) to the DFS.

Scientific analyses and other work related to DOMIP's objectives and aims utilized numerous statistical techniques hailing from traditional approaches (i.e., ordinary least squares and hypothesis testing) to more contemporary strategies, including maximum likelihood, multi-trajectory modeling, finite mixture modeling, geodemographic analysis, and geographically weighted regression to name a few. We also utilized various machine learning techniques to train random forest and other models on existing data so the prediction of future trends and patterns could be achieved.

Our efforts and statistical approaches featured various ways to organize data. In some cases, we matched cases between data sets at the individual level, and in others, we performed more group-based analyses using data at the census block or census tract levels. Each data source we worked with had to be cleaned, coded, or recorded and geocoded before we could begin our work. For example, the DFS provided us with death reports and toxicology data on OD deaths. Death report data came to us as an Excel spreadsheet with both numerically coded and open-text fields. Toxicology reports, however, came as individual .pdf files that had to be entered and coded by hand into a matching Excel file.

Also, data management and analysis of crime data obtained from DELGIS were necessary. For example, data on drug markets in DELJIS includes all offenses and arrests reported to or are known to police in Delaware. DELJIS provided address information on incident locations as well as arrestees' home addresses from 2013 - 2018. We geocoded incidence and home address information using ArcMap and a custom composite locator and assigned the points to census tracts. National Crime Information Center codes were provided and used to code drug offenses and drug types. Subsequently, we calculated neighborhood rates for heroin, cocaine, and another opioid (e.g., oxycodone, fentanyl, etc.) related selling and possession offenses (i.e., selling offenses based on incidence—the neighborhood where the offense occurred—and possession offenses based on arrestee home addresses—the neighborhood the person lived).

The rates for each indicator were z-score transformed and averaged into a drug availability index (selling offenses) and substance use index (possession offenses).

IMPACT & APPLICABILITY OF THE RESEARCH

The great value of DOMIP is being able to bring multiple opioid metrics together in one project and aggregate them to the census tract level so precise intervention can take shape. Knowing where, when, and why metrics are concentrated in Delaware and neighboring states allows for the prioritization of effective community interventions. This promises to significantly impact policies and practices to reduce the opioid problem in Delaware and beyond.

DOMIP's impact in Delaware has been quick, timely, and considerable. For example, early in the project, Bethany Hall-Long, the Lt. Governor of Delaware, and her Behavioral Health Council (BHC) invited PI Anderson to meet with the Pew Charitable Trusts during its policy consultation selection process to consult with the state. Anderson discussed DOMIP as a resource for Pew to conduct its substance abuse policy consultation with Delaware. Pew chose Delaware as a site to develop opioid policies. https://www.wdel.com/news/video-all-hands-on-deck-delaware-looks-to-transform-mental/article_a203ff9c-8f80-11e8-9ecd-9fb302c94a53.html DOMIP was used as a resource for Pew's work with the state and PI Anderson has been named to the BHC data and Policy subcommittee for DOMIP-related work/recommendations.

Various state planners/agency heads and media outlets have requested information about DOMIP and have featured it in press releases. When requested, future collaboration followed.

A year into the DOMIP project, the state of Delaware launched "My Healthy Community: a Delaware Environmental Public Health Tracking Network" (see https://myhealthycommunity.dhss.delaware.gov/). Like other states, Delaware wanted to offer its citizens a public-facing web portal to track the opioid problem. This dashboard would become the state's premier mapping app for the public to track public health and environmental indicators. It contains many health measures, including OD deaths, OD saves, and PMP Rx drug data. It currently doesn't contain any crime data and zip codes are the lowest unit it reports data. The state has announced plans, recently, to expand the scope of this website and working groups are being formed to advise the effort.

There is little doubt that the development of My Healthy Community DOMIP diminished the DOMIP mapping app's impact and state agency's willingness to share data for it. However, we consider there are some positive aspects to this since DOMIP PIs were consulted by the state during My Community Health's development, the state now has an opioid web portal it can sustain for a long time as it is now hard-lined in the state budget, and DOMIP is still consulted for scientific analyses. It is also important to point out that the My Healthy Community website contains different indicators measured at fewer levels and years than DOMIP. DOMIP is also more recent and hones in on the relationships between drugs and crime, a focus on the NIJ grant portfolio.

Three years ago, and at the recommendation of Linda Truitt at NIJ, we reached out to Dr. Christopher Delcher—another NIJ grant recipient—who helped establish the opioid mapping portal called FROST in Florida. We have engaged in a collaboration with Dr. Delcher and his associates since then in recommending best practices for opioid surveillance efforts and research. In our work, we found more than 100 opioid dashboards across the country and that nearly all states now have dashboards in place, and most are administered and housed by state agencies. Like the FROST dashboard in Florida—which Dr. Delcher helped originate—DOMIP will likely exist alongside state efforts and have to cooperate with state officials for continued sustainability.

PARTICIPANTS AND OTHER COLLABORATING ORGANIZATIONS

Participation in DOMIP has been considered throughout the project. This participation will likely continue in the future given the value and archival nature of the data, duration of the existing data use agreements, and relationships between UD faculty and staff and Delaware state agencies.

University Partners. Participation at UD has been considerable. Faculty, staff, and students from numerous departments, including the Department of Sociology & Criminal Justice, the Data Science Institute, Computer Information & Technology, College of Health Sciences, Office of Communications, Center for Community Research and Service, The ACCEL program, and UDEL Public Media. Approximately 10 faculty, 8 research staff, and 10 graduate students have worked on the project at one time or another. Their work features scientific papers, Master's theses, and doctoral dissertations.

We have also collaborated with university faculty and research centers at Northeastern University, Florida State University, University of Maryland- Baltimore, George Mason University, University of Kentucky, and University of North Carolina-Chapel Hill.

State Partners. Throughout the DOMIP project, we have partnered with numerous state agencies and personnel to enhance DOMIP and/or meet joint opioid abuse-reduction goals. Partners include the Delaware State Police, the Delaware Justice Information System (DELJIS), the Division of Forensic Science (DFS), Division of Public Health (DPH), Behavioral Health Consortium (BHC), the Criminal Justice Council (CJC), Hero Help, New Castle County Police, Department of Health and Social Services (DHSS), Division of Child and Family Services, Health Science Alliance (HAS), Office of the New Castle County Executive, and the Office of the Lt. Governor.

Private and Community Partners. Private or community partners with DOMIP include Attack Addiction, Christiana Health Care, Connections Corporation (now Connexio CSP), Brandywine Counseling, Pew Research Institutes, and the RAND Corporation.

Other Partners. Others involved in DOMIP work include technology agencies such as Compass Red, Mapticks, and ESRI in consultation with the US Centers for Disease Control and Prevention and the Philadelphia/Camden High Intensity Drug Trafficking Area (HIDTA) office.

CHANGES FROM THE ORIGINAL APPROACH & DESIGN

An unanticipated change emerged early in the DOMIP project due to problems in securing PMP data. While the predecessor project funded by the Bureau of Justice Assistance featured identifiable PMP data, we were not able to secure a data use agreement for the NIJ grant for numerous reasons (which we conferred with NIJ staff about throughout the project). Mainly, Delaware law prohibits the use of PMP identifiable data for use outside of a contract (i.e., a Business Associate Agreement) with the state to perform its work. While DOMIP staff and some state officials believed (and advocated for) the DE law would allow for PMP data to be used for "research purposes," PMP staff administrators and Deputy Attorney Generals disagreed. They informed us we could have PMP data with no personal, demographic, or geographic identifiers, but the DOMIP project required at least some of these metrics to meet its project goals. Thus, we continued trying to secure PMP data throughout our project. For example, we sought Rx drug data from another source: Rx drug claims data from Medicaid recipients. The Center for Community Research and Service (CCRS) at UD has a data use agreement with the Delaware Medicaid and Medicare Association (DMMA) for identifiable Medicaid claims data. We worked with CCRS and DMMA officials but were not able to reach an agreement for data suitable for DOMIP's purposes. Our next effort to obtain PMP data was with the Delaware Health Information Network (DHIN). DHIN is a large health care data exchange featuring Medicaid, Medicare, and some commercial insurance providers. It cannot provide as comprehensive Rx drug data as Delaware's PMP, but it is much broader in scope than the Medicaid option we were pursuing before. DHIN could provide the same Rx drug indices shown in the figure below and permit us to address our research goals. Changes in leadership and high costs associated with the data eliminated this as an option. We also considered data from private sources but could not afford the fees associated with obtaining the data.

Throughout DOMIP, we continued negotiations with the Delaware PMP and in November 2021 signed a data use agreement for a "report" of PMP data that contains monthly counts of Rx drug data by demographic group. While the data we will eventually secure from this report will not be sufficient in content and format to integrate into our existing data sets, it will enable us to execute trend analyses in Rx drugs for opioids over time, informing Goals #2 and #3 of our project. However, our work on DOMIP will continue with other funding after the NIJ grant end date (2021).

OUTCOMES AND ARTIFACTS

a. Activities and accomplishments

DOMIP analyses have been disseminated via peer-review journals, professional conferences (American Society of Criminology, Eastern Sociological Society, and American Public Health Association (see https://www.cdhs.udel.edu/projects/domip/papers-presentations), at state planning meetings (Behavioral Health Council, Criminal Justice Council, HIDTA, State Police), directly to stakeholders at Delaware agencies, and during various media events. In April 2019,

DOMIP was featured at the University's Day in the US Senate (see attached .pdf of the poster presented), Washington, DC. This day for UD alum now working in the US Senate and Washington, DC, celebrates current federally-funded research. In June 2019, we presented the DOMIP app and its research projects at the Center for Evidence-Based Crime Policy Symposium sponsored by George Mason University (see https://cebcp.org/cebcp-symposium-2019/). The symposium gathers practitioners and scholars together in hopes of improving criminal justice practices based on scientific evidence.

The DOMIP website is available to the public and policymakers. The DOMIP website was highlighted in the Wilmington Newspaper and CDHS staff informs practitioners and policymakers of DOMIP uses and updates at community meetings such as the State Epidemiological Workgroup, Division of Substance Abuse and Mental Health, Statistical Analysis Center, AtTAcK Addiction, and the National Criminal Justice Reform Project meetings.

To date, DOMIP has provided master (n=2) and doctoral-level (n=5) students with data management, advanced statistical training, machine learning procedures, and hot spots mapping training. One graduate student (J. Wagner) successfully defended his dissertation in May 2021, which partially drew on DOMIP data. Two undergraduate students were enrolled in the Fall of 2019 to help revise the DOMIP website and build the dashboard Excel sheet to track national efforts. All students have seen their research, writing, and web-building skills improve. They have also gained expertise in producing papers for publication in journals. On a more applied side, DOMIP staff have gained training and expertise in producing web-based technologies and deliverables for practitioners, policy-makers, and civilians through the preparation of deliverables at state meetings (e.g., the Lt. Governor's Behavioral Health Council) or to media outlets. Graduate students and staff are learning advanced functioning in Excel, Stata, Tableau, and ArcGIS software programs. Most recently, DOMIP staff and students have worked with R programming to apply spatial statistical approaches, such as creating spatial lags and estimating geographically weighted regression models. All continue to learn how to prepare the text for websites, grant proposals, policy briefs or datagram-like papers, and short and long peer-review articles.

b. Limitations

There are a few limitations in the DOMIP project that warrant attention. Most of them pertain to the data acquired and the analyses we performed. Before discussing them, it's most important to note that our study is based solely on the state of Delaware. While Delaware has ranked consistently in the top ten states for OD deaths in the country and is an important part of the Mid-Atlantic HIDTA, it remains a small state with three counties and a population under 1 million. In our analytical work, we have shown Delaware is a useful case by which to gauge opioid and drug problems. Nevertheless, the state's population is likely to be considered by some as a limitation.

With each of our data sources, there are some limitations worth mentioning. Again, these shortcomings matter mostly in a scientific sense for analysis outcomes and

findings. For example, data from the Division of Forensic Science does not distinguish between ODs due to medical versus nonmedical use of pharmaceutical drugs. Also, because heroin and morphine are metabolized similarly, some heroin deaths might have been misclassified as deaths involving Rx opioids other than fentanyl, leading to misclassification bias.

Our measure of OD calls for service may underestimate drug use, especially the use of opioids, because not all users OD or ask for assistance from first responders (e.g., a friend or family member could take someone overdosing directly to the hospital).

Next, some classifications of our substances may be subject to bias. In Delaware, police officers identify the type of illicit substance a person is booked for, and these determinations stand until laboratory processing occurs before a criminal trial. Substance type categories may then reflect an individual police officer's experience, biases, and interests in drug law enforcement.

c. List of products (see Publication table in the Appendices)

d. Datasets generated (ICPSR archive, de-identified dataset)

DOMIP data has been archived as required by NIJ and we have produced several de-identified datasets, measured at the US Census tract level, for continued scientific work after the grant period ends. De-Identified data sets are available to UD project staff and students who have been cleared on security protocols to work with the data. Fully identified data files remain on a biometrically-secured computer in a locked office at CDHS and will remain there until data use agreements expire.

e. Dissemination activities

Presentations

2021. Anderson, Tammy L. and O'Connell, Daniel J. "Delaware Opioid Metric Intelligence Project: NIJ Briefing," Remote WebEx meeting (December 3).

2021. Jascha Wagner "Exploring Predictors of Crime in Micro-Places Across Geographic Areas." *Annual Meeting of the American Society of Criminology*. Chicago.

2021. Jascha Wagner "Developing Holistic Hot Spots Profiles across Geographic Areas." *Annual Meeting of the Society for the Study of Social Problems,* Virtual.

2021. Gray, Andrew C., & Hughes, Cresean. "Opioid-Stimulant Trends in Overdose Toxicology by Race, Ethnicity, & Gender: An Analysis in Delaware, 2013-2019." *Graduate Student Conference: Spotlighting Diverse Perspectives at UD.* Department of Sociology & Criminal Justice, Newark, DE.

2020. Jascha Wagner, Ellen A. Donnelly, Tammy L. Anderson "Race, and Rationality Revisited: An Empirical Examination of Differential Travel Pattern to Acquire Drugs across Geographic Contexts." *Annual Meeting (virtual) of the Criminological Consortium*. Available at: https://www.youtube.com/watch?v=W4n7-cXyfA4

2020. Donnelly, Wagner, Anderson. "Disparities in the Distances Drug Offenders Travel: The Roles of Race, Community, and Substance Type," *Annual Meeting of the American Society of Criminology*, Washington DC. (Cancelled due to COVID-19).

2020. Ellen A. Donnelly, Jascha Wagner, Madeline Stenger, Hannah G. Cortina, Daniel J. O'Connell, and Tammy L. Anderson "Opioids, Race, and Drug Enforcement: Exploring Relationships Between Neighborhood Context and Black-White Opioid-Related Possession Arrests." Invited virtual talk at *Northeastern's Health in Justice Action Lab*.

2020. Jascha Wagner. "Beyond Urban Areas: Drug Crime Concentrations across Geographic Areas." *Annual Meeting of the American Society of Criminology.* (Cancelled due to COVID-19).

2020. Tammy L. Anderson, Cresean Hughes, Jascha Wagner, Logan Neitzke-Spruill, Ellen Donnelly, Sachin Gavali, Cathy Wu, and Dan O'Connell "Revisiting the Drugs-Crime Relationship amid the Opioid Epidemic." *Annual Meeting of the American Society of Criminology.* (Cancelled due to COVID-19).

2020. Sachin Gavali, Tammy L. Anderson, CH Wu, "Understanding the where, when and why of substance use disorder using machine learning techniques", *Annual Conference of American Society of Criminology, 2020, Washington DC, (Cancelled due to COVID-19).*

2020. Sachin Gavali, J Cowart, C Chen, CH Wu, Tammy L. Anderson "Predicting modeling of the Opioid Epidemic in the United States", *Computational Social Science Virtual Symposium, 2020, Data Science Institute, Newark DE, USA.*

2019   Ellen A. Donnelly, Jascha Wagner, Tammy L. Anderson, and Daniel O'Connell "Revisiting Neighborhood Context and Racial Disparities in Drug Arrests Under the Opioid Epidemic." *Annual Meeting of the American Society of Criminology,* San Francisco*.*

2019. Tammy L. Anderson, Daniel O'Connell, and Ellen Donnelly. Thematic Panel on Opioid & Crime Mapping Projects. *American Society of Criminology*, San Francisco.

2019   Ellen A. Donnelly, Jascha Wagner, Tammy L. Anderson, and Daniel O'Connell "Revisiting Neighborhood Context and Racial Disparities in Drug Arrests Under the Opioid Epidemic." *ACCEL Community Exchange Conference,* Newark, DE

2019. Jascha Wagner, Logan-Neitzke-Spruill, Daniel O'Connell, Ellen Donnelly, and Tammy L. Anderson "Overdose Deaths in Context: How Relations between Drug Types and Socio-

Economic Neighborhood Characteristics Contributed to Overdose Deaths in Delaware 2013-2017." *Meeting of the Eastern Sociological Society*, Boston.

2019. Wagner, Jascha, Logan-Neitzke-Spruill, Daniel O'Connell, and Tammy L. Anderson. *Overdose Deaths in Context: How relations between drug types and socio-economic neighborhood characteristics contributed to overdose deaths in Delaware 2013-2017, Department of Sociology and Criminal Justice Graduate Student Conference*, University of Delaware, Newark, DE.

2019. Highberger, James and Smith, Olena. 2019 (April 9). Delaware Opioid Metric Intelligence Project and ArcGIS Online: Using Story Map to tell the story of Delaware's opioid crisis. Presented at *ARGIS Coffee Hour*. Virtual.

2019. Donnelly, Wagner, O'Connell, and Anderson· "Developing and Using Metrics to Reduce Opioid-related Problems in Delaware." *Center for Evidence-Based Crime Policy Symposium*, George Mason University.

2019. DOMIP poster presentation. *Hayes Symposium*, University of Delaware Star Campus

2019. DOMIP poster presentation. The *University of Delaware Day in US Congress*. Washington, DC

2019. DOMIP poster presentation. *Accel Research Conference*, University of Delaware

2018. Jascha Wagner "Uneven Recovery: Exploring Relationships between the Recovery from the Financial Crisis and Changes to Neighborhood Level Crime Rates." *Annual Meeting of the American Society of Criminology.* Atlanta, GA.

2018. Tammy L. Anderson, Jascha Wagner, and Daniel O'Connell "Prescription Fentanyl's role in fentanyl-related drug overdoses: Matching overdose death data with prescription data." *Annual Meeting of the American Public Health Association,* San Diego, CA.
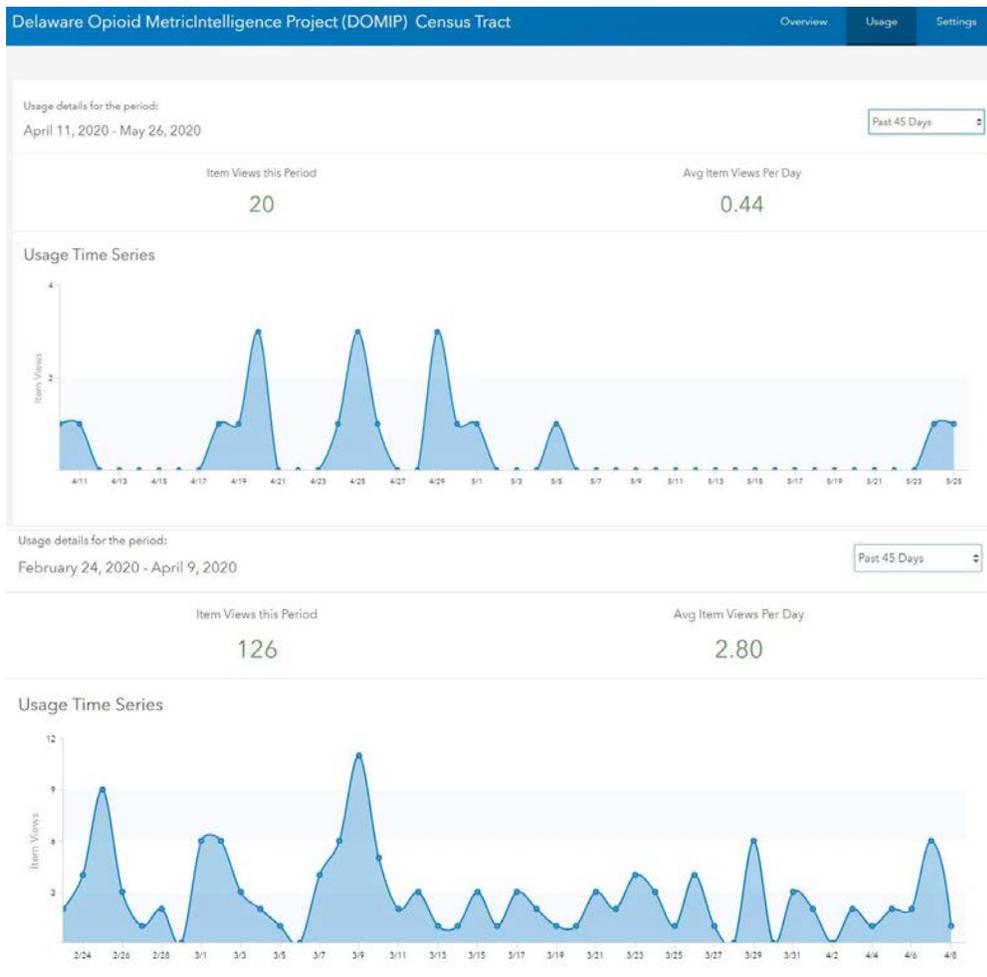
2018. James Highberger and Logan Neitzke-Spruill. Seminar: The Opioid Epidemic -- Guest lecture on geo-spatial mapping, *Department of Sociology and Criminal Justice Graduate Student Conference*, University of Delaware, Newark, DE.

Marketing/Promotional

We have produced various posters, datagrams, short reports, handouts, and other marketing materials to promote the DOMIP project. These materials were produced by University offices or by Vistaprint an Animoto video. They were disseminated mostly in the state of Delaware and at conferences and invited talks.

Mapping App Analytics

To promote our dashboard more broadly, and track usage of it, we subscribed to Maptiks, a web traffic platform. Below is sample usage data from Mapticks during our project. We present some highlights from Maptick's analytics program below. The screenshots show daily usage of the DOMIP mapping app from February-May 2020. The graphics show an average of 2.8 views per day over 45 days in early 2020 (middle panel), with decreasing activity over time, which was anticipated when the state's dashboard (see https://myhealthycommunity.dhss.delaware.gov/locations/state) was published. It is important to note that our subscription to Maptiks has now expired and we are out of funds to renew it for more recent usage data.
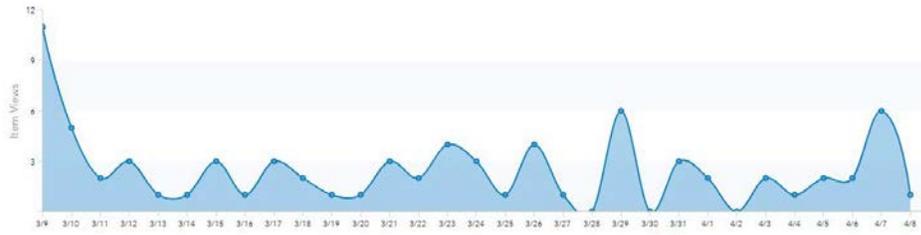
March 10, 2020 - April 9, 2020

Past 30 Days

Item Views this Period	Avg Item Views Per Day
77	2.57

Usage Time Series

APPENDICES

Paper Title	Research Question	Main Findings/Recommendations
1. "Understanding geographic and neighborhood variations in overdose death rates." 2018. Journal of Community Health. 44: 272-283. https://doi.org/10.1007/s10900-018-0583-0.	How do overdose death rates vary across urban/rural neighborhood types?	*Findings (DOMIP Goals 4 & 5)*: --OD deaths are not homogenous across neighborhood. OD death rates vary up 13-fold by neighborhood the demographic groups within them. --Urban areas have the highest overdose death rates in DE. *Recommendations*: --Consider neighborhood characteristics, i.e., socioeconomic and demographic markers, in developing OD prevention strategies and prioritize those communities most distressed.
2. "Understanding differences in types of opioid prescriptions across time and space: a community-level analysis." 2018. Journal of Drug Issues. 49(2): 405-418. https://doi.org/10.1177/0022042618815687	How has prescribing of oxycodone, hydrocodone, pharmaceutical fentanyl, and all other opioids changed over time? How do community-level indicators explain changes in prescription patterns for these types of opioids?	*Findings (DOMIP Goal 4 & 5)*: --Rx prescribing for main opioid types have changed. --Oxycodone and fentanyl prescriptions remain stable, hydrocodone prescriptions dropped, and all other opioid prescriptions increased. --Veteran populations and Medicaid/Medicare populations had higher Rx opioid prescriptions. *Recommendations*: --Track and report on all opioids by type/brand to detect new and troubling trends. --Track Rx prescribing by neighborhood and population chars to reduce risk for vulnerable groups.
3. "Revisiting neighborhood context and racial disparities in drug arrests under the opioid epidemic." 2019. Race and Justice. Online First: https://doi.org/10.1177/2153368719877222	What do Black-White disparities in drug arrests look like under the opioid epidemic? What is the size and sources of arrest disparities across substance types?	*Findings (DOMIP Goals 3 & 4)*: --Racial disparities in drug arrests remain with Blacks at higher arrest rates for possession and selling of any drug --Racial disparities in drug arrests vary by type of drug and by neighborhood type: (1) Black arrests are higher for marijuana and cocaine in more disadvantaged, high-crime, and diverse areas; (2) White arrests are driven by heroin and are highest in economically deprived

		communities with more residential stability and high overdose calls for service. *Recommendations*: --Increase public health role of police in solving drug problems --Investigate if racial disparity in drug arrest worsens downstream inequality among arrestees
4. "Is the gender gap in overdose deaths (still) decreasing? An examination of opioid deaths in Delaware, 2013-17." 2020. <u>Journal of Studies on Alcohol and Drugs</u>. 81(1):68-73. https://doi.org/10.15288/jsad.2020.81.68	Is the gender gap in overdose deaths still decreasing as the opioid epidemic wages on? To what extent are younger (i.e., childbearing age) and older women at similar risk as their male counterparts for overdose deaths, and does their risk vary by type of drug?	*Findings (DOMIP Goal 2)*: --Gender gap is evident in opioid overdose death rates during the period 2013–2017 --Male rate expanding relative to female rate because of third wave illegal opioid deaths compared with prescription opioids. --Age and drug type impact the role of gender in drug overdose deaths. *Recommendations*: --Interventions should match the unique gender and age-specific patterns in types of drugs consumed.
5. "Opioids, race, and drug enforcement: Exploring local relationships between neighborhood context and Black- White opioid-related possession arrests." 2020. <u>Criminal Justice Policy Review</u>. Online First: https://doi.org/10.1177/0887403420911415	What are the drivers of global and local patterns of Black-White opioid related possession arrests?	*Findings (DOMIP Goals 4 & 5)*: --Overdose calls for service predict White more than Black opioid-related arrests, especially in disadvantaged, rural areas as opposed to urban areas. --Economic disadvantage and racial composition of communities matter more in shaping Black arrest rates across the state. *Recommendations*: --Increase public health role of police in solving drug problems --Investigate if racial disparity in drug arrest worsens downstream inequality among arrestees
6. "Prescription Drug Histories among Drug Overdose Decedents in Delaware." 2020. <u>Substance Use and Misuse</u>. Online First: https://doi.org/10.1080/10826084.2020.1775650	What is the nature of overdose decedents prescription drug histories? How does prescription drug history relate to decedents' post-mortem toxicological profiles?	*Findings (DOMIP Goal 2)*: --Fentanyl decedents had, on average, more prescriptions for opioids than other decedents prior to death. --Fentanyl decedents more often had prescriptions for fentanyl 60 days prior to death. *Recommendation*s:

		--Careful monitoring of prescribing practices, especially for Rx opioids and fentanyl, and drug distribution is necessary. --Off-label fentanyl prescribing to opioid naïve patients should be monitored carefully.
7. "Data Science Approaches in Criminal Justice and Public Health Research: Lessons Learned From Opioid Projects." *Journal of Contemporary Criminal Justice*. 2021;37(2):175-191. doi:<u>10.1177/1043986221999858</u>	What are some of the advantages and challenges for implementing 'data science' methodologies for combatting the opioid epidemic?	*Recommendations (DOMIP Goal 3)*: --opioid crisis requires a multidisciplinary approach to effectively address the problem. Data use agreements and memoranda of understandings required for data acquisition. --Data security protections must be top priority when working with PHI or crime data. --Maintain active relationships with stakeholders from agencies providing data
8. "The Current Community Context of Overdose Deaths: Relations among Drug Types, Drug Markets, and Socioeconomic Neighborhood Characteristics." <u>Sociological Forum</u>. 2021. DOI: 10.1111/socf.12746	Have overdose deaths over the third wave of the epidemic increased across neighborhoods and are shifts towards increased heroin and fentanyl involvement consistent across neighborhoods? How are neighborhood disadvantage and differential access to drug markets associated with neighborhood opioid overdose trends and changing drug type compositions?	*Findings (DOMIP Goals 3, 4 & 5)*: --Overdose deaths between 2013 and 2018 two neighborhood types of concern- those consistently high and those spiking due to fentanyl. -- fentanyl dominates recent OD deaths with heroin also present in many -- up to 50% overdose deaths still involved Rx Opioids -- neighborhoods with few OD deaths enjoy economic prosperity --the availability of drugs increases risk for OD deaths --concentrated disadvantage increases drug selling, which indirectly spikes OD deaths *Recommendations*: --Consider neighborhood characteristics, i.e., socioeconomic and demographic markers, in developing OD prevention strategies and prioritize those communities most distressed. --Connect opioid supply surveillance to public health efforts
9. "Opioids, Race, Context, and Journeys to Crime: Analyzing Black–White Differences in Travel Associated With Opioid Possession	What are the individual and contextual factors that predict how far Black and White arrestees travel from their	*Findings (DOMIP Goals 4 & 5):* -- Disparities exist in how far arrestees travel, with differences relating to demographic characteristics.

Offenses." *Criminal Justice and Behavior*. April 2021. doi:[10.1177/00938548211006757](10.1177/00938548211006757)	residences to the locations of their alleged opioid possession offenses?	-- social disorganization and availability-proneness theory predict travel distances --racial differences in travel to crime vary by type of area. *Recommendations*: --more alternative opioid programs, ranging from safe injection sites to civilian-based Angel initiatives offering treatment services through police departments, should be introduced in poorer urban and rural communities. --Protect against drug law enforcement entrenching and expanding inequalities among drug users.
10. "Race and Rationality Revisited: An Empirical Examination of Differential Travel Pattern to Acquire Drugs across Geographic Contexts," in progress and presented at the <u>Criminology Consortium (CrimCon)</u> conference, November 2020.	Do individual level predictors of travel distances to acquire drugs differ across geographic areas? Do the same place characteristics predict where drug possession arrests occur across geographic areas?	*Prelim Findings (DOMIP Goals 4 & 5):* -- Individual level predictors vary significantly across non-urban areas. --Socioeconomic place characteristics predict where drug possession arrests occur across geographic areas for Whites and Blacks. --Crime generators show independent impacts on where drug possession arrests occur across geographic areas as well.
11. "An examination of opioid- and stimulant-involved overdose death trends in Delaware, 2013-2019," Currently under review at *Journal of Ethnicity and Substance Abuse*.	Has there been an increase in opioid-involved overdose deaths across all opioid types and all race/ethnicity*sex dyads? Has the presence of cocaine in overdose deaths increased and are these increases present across all race/ethnicity*sex groups What Is the relationship between fentanyl and cocaine in OD deaths?	*Findings (DOMIP Goal 2)*: --Fentanyl most prevalent drug in OD decedent toxicology. --Heroin places second, from 2013 – 2016, but was replaced by cocaine as the second most common drug. --2019 fentanyl deaths have high cocaine positivity, suggesting Wave 4 underway and/or tainted cocaine in drug supply. --White males report highest rates of OD deaths for all drugs, followed by Black and Hispanic males --Rx opioids remain present in OD deaths *Recommendations*: --Tailor interventions to demographic group patterns and needs --Adopt interventions for multi-drug use patterns, not solely opioids --Expand supply-side interventions to stimulants

		Findings (DOMIP Goals 4 & 5):
12. Understanding the factors driving the opioid epidemic using machine learning." Forthcoming in proceedings from *IEEE International Conference on Bioinformatics and Biomedicine* 2021.	How can machine learning models, using Shapley Additive explanations (SHAP), overcome the limitations of more traditional statistical tests (OLE and MLE), to identify opioid risks of Delaware neighborhoods and correlations of factors therein?	---Environment-related (education and community health) factors were the most significant drivers of the opioid epidemic, followed by a significant increase in importance of crime related variables, suggesting an accelerating shift in the opioid epidemic from the legal to illegal space. *Recommendations*: --Tailor interventions to specific drug-crime dynamics --Expand supply-side interventions to address legal/illegal drug market dynamics.
13. "Emerging Disparities in the Placement of Law Enforcement-Based Treatment and Recovery Programs*," Currently in progress.*	Police departments implement treatment and addiction recovery programs in association with the Police Assisted Addiction Recovery Initiative (PAARI). To what extent are PAARI efforts equally distributed across communities and how is access to diversionary programming disparate in the criminal processing of drug-related offenses?	Findings (DOMIP Goals 3 & 4): --Law enforcement agencies with more sworn officers and situated in less impoverished communities are more likely to establish a PAARI program. --The racial/ethnic composition (percent White population) of an agency's community has a non-linear effect on program adoption. --Agencies based in counties with more overdose deaths and greater unmet treatment needs have increased odds of diversionary programming. *Recommendations*: --Improve police-community relations and resource allocation to alleviate growing disparities in the deployment of law enforcement-based treatment programs.
14. "An Examination of Seasonal Trends in Delaware's Drug Overdoses, 2016 – 2020," currently under review in the *Delaware Journal of Public Health*.	How do overdose deaths and related metrics—overdose calls for service to police and non-fatal overdose emergency department visits—in Delaware vary seasonally during the most recent years of the opioid epidemic (2016-2020)?	Findings (DOMIP Goals 2, 3): --We find yearly variations across the three overdose-related metrics, with overdose deaths reporting the only consistent increases per year. --Within year, or seasonal, variations show the spring months have the most consistent increases in overdose deaths and overdose calls for service across years we studied. --Finally, we report significant differences for all overdose metrics across years and seasons.