

Deployment of targeted outreach interventions utilizing a novel overdose predictive model in West Virginia's state opioid response regional coordinators program

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Abstract

West Virginia, grappling with a severe opioid crisis, saw a 40% increase in overdose deaths in 2020, with significant impact in eight high-burden counties. The State Opioid Response (SOR) Regional Coordinators program, developed and implemented by the Potomac Highlands Guild, introduced a predictive overdose model to identify high-risk areas and deploy targeted interventions. Piloted in Berkeley County and expanded to all Action Counties, the model integrates real-time data, geospatial analysis, and geofenced digital messaging to reduce overdoses. This study evaluates the model's effectiveness, finding significant reductions in overdose rates and improved access to harm reduction resources. The establishment of the I-81 Corridor Multi-State Collaborative highlights the program's scalability, offering a replicable framework for addressing the opioid epidemic.

Keywords: Overdose spike, hotspot analysis, predictive modeling, pre-emptive outreach, naloxone

Introduction

In 2020, West Virginia faced a 40% surge in overdose deaths, with 60% of cases concentrated in eight high-burden counties designated as Action Counties. Berkeley County, located along the I-81 corridor—a major drug trafficking route from Baltimore, Frederick, and Washington counties in Maryland—emerged as a critical focus. The Potomac Highlands Guild, a community mental health organization, developed and implemented the State Opioid Response (SOR) Regional Coordinators program to address this crisis through data-driven interventions.

The SOR Regional Coordinators program introduced a novel predictive overdose model, initially piloted in Berkeley County, to enable preemptive responses in high-risk areas. The model leverages real-time data from multiple jurisdictions, geographic information systems (GIS), and advanced analytics to forecast overdose spikes. Its success in Berkeley County led to its expansion across all Action Counties and the formation of the I-81 Corridor Multi-State Collaborative, uniting stakeholders from West Virginia, Maryland, Pennsylvania, Virginia, Tennessee, and North Carolina. This study evaluates the model's impact on overdose prevention and its potential as a scalable solution.

Hypothesis

We hypothesized that the predictive overdose model, developed and implemented by the Potomac Highlands Guild for the SOR Regional Coordinators program, would accurately identify high-risk overdose areas and timeframes, enabling targeted interventions that reduce overdose rates and increase access to harm reduction resources in West Virginia's Action Counties.

Methods

Study Design

A mixed-methods study was conducted from January 2021 to December 2022 to evaluate the SOR Regional Coordinators program's predictive model and interventions. The study included a pilot phase in Berkeley County

(January–May 2022) and a statewide expansion to all Action Counties (June–December 2022).

Data Collection

Data Sources

- **Overdose Incident Reports:** Compiled from emergency medical services (EMS), law enforcement, and public health agencies in Berkeley County and Action Counties.
- **Naloxone Administration Data:** Sourced from EMS logs and community-based naloxone distribution programs.
- **Source County Overdose Data:** Real-time and retrospective data from Baltimore, Frederick, and Washington counties in Maryland to capture upstream overdose trends along the I-81 corridor.

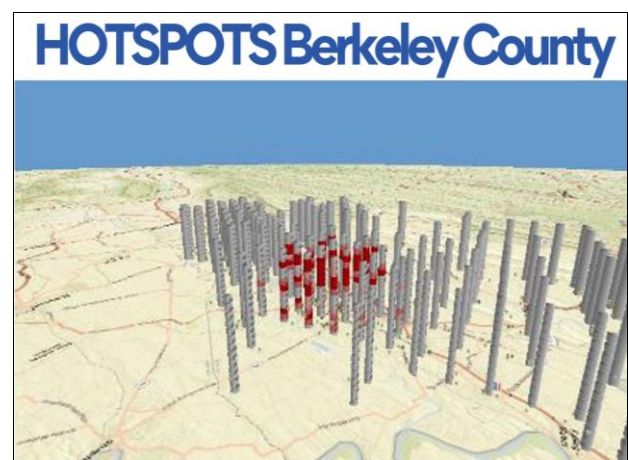


Fig 1

Geospatial and Temporal Analysis

- Overdose incidents were geocoded and plotted on heat maps to identify high-risk areas.

- Temporal analysis focused on lag times between overdose spikes in source counties and corresponding increases in Berkeley County.

Coefficient of Determination computation: R^2

COEFFICIENT OF DETERMINATION	
Coefficient of determination	R^2
Berkeley and Baltimore	0.772
Berkeley and Frederick	0.719
Berkeley and Washington	0.839

Fig 2

Predictive Model Development Regression Analysis

- Data Preprocessing:** Independent variables included overdose events in Baltimore, Frederick, and Washington counties; dependent variables were overdose events in Berkeley County. Covariates

included population density, proximity to highways, and drug trafficking routes.

- Model Types:** Multiple linear regression and time-series regression models were developed to quantify relationships and predict lag times. A lagged regression approach captured delays between source and destination counties.
- Model Validation:** Historical data validated the accuracy of predicted lag times. Key Model Parameters:
 - Baltimore County:** $R^2 = 0.772$, mean lag time of 38.16 hours.
 - Frederick County:** $R^2 = 0.719$, mean lag time of 37.64 hours.
 - Washington County:** $R^2 = 0.839$, mean lag time of 28.32 hours, reflecting closer proximity.

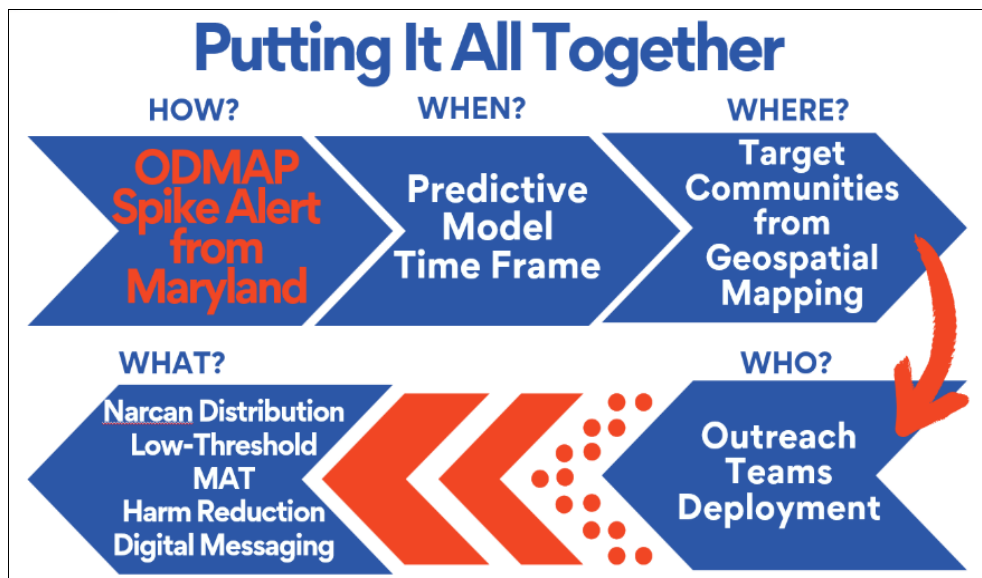


Fig 3

Intervention Strategies

- Naloxone Deployment:** Proactive distribution of naloxone to predicted hot spots, with 984 doses deployed during the Berkeley County pilot.
- Geofenced Digital Messaging:** Real-time alerts triggered by model predictions, directing individuals to harm reduction resources, naloxone access points, and medication for opioid use disorder (MOUD) providers.
- Harm Reduction and Peer Support:** Outreach teams provided education, naloxone training, and MOUD linkages.
- Cross-Jurisdictional Collaboration:** Real-time data sharing with Maryland counties enabled coordinated responses.

- Statewide Expansion:** The model was customized for each Action County, tailoring interventions to local overdose patterns.

I-81 Corridor Multi-State Collaborative

The Berkeley County pilot informed the creation of a multi-state collaborative involving West Virginia, Maryland, Pennsylvania, Virginia, Tennessee, and North Carolina. The collaborative focused on data sharing, predictive modeling, and joint interventions.

Data Analysis

Quantitative outcomes (e.g., overdose rates, naloxone distribution, MOUD linkages) were analyzed using paired t-tests to compare pre- and post-intervention periods. Qualitative feedback from stakeholders was analyzed using thematic analysis in NVivo 12. All quantitative analyses were conducted in SPSS v.27.

Discussion

The SOR Regional Coordinators program, developed and implemented by the Potomac Highlands Guild, demonstrated that predictive modeling combined with targeted interventions can significantly reduce overdose rates in high-burden areas. The model's high R^2 values (0.719–0.839) indicate strong predictive accuracy, particularly for Washington County due to its proximity to Berkeley County. The 20% reduction in overdose rates during the statewide expansion aligns with studies showing the efficacy of data-driven interventions (Zimmerman, 2021).

Geofenced alerts were critical in linking individuals to MOUD and naloxone, addressing barriers like transportation and awareness. The I-81 Corridor Multi-State Collaborative exemplifies the potential for regional partnerships to amplify impact. Limitations include the model's reliance on timely data from source counties and the need for sustained funding to maintain coordinator roles. Future research should assess long-term outcomes and scalability to other regions.

Conclusion

The SOR Regional Coordinators program's predictive overdose model, developed by the Potomac Highlands Guild, effectively identified high-risk areas and reduced overdose rates through targeted interventions. The model's integration of real-time analytics, geofenced messaging, and cross-jurisdictional collaboration offers a replicable framework for addressing the opioid crisis. The I-81 Corridor Multi-State Collaborative further positions this approach as a scalable solution, with potential to save lives nationwide.

References

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