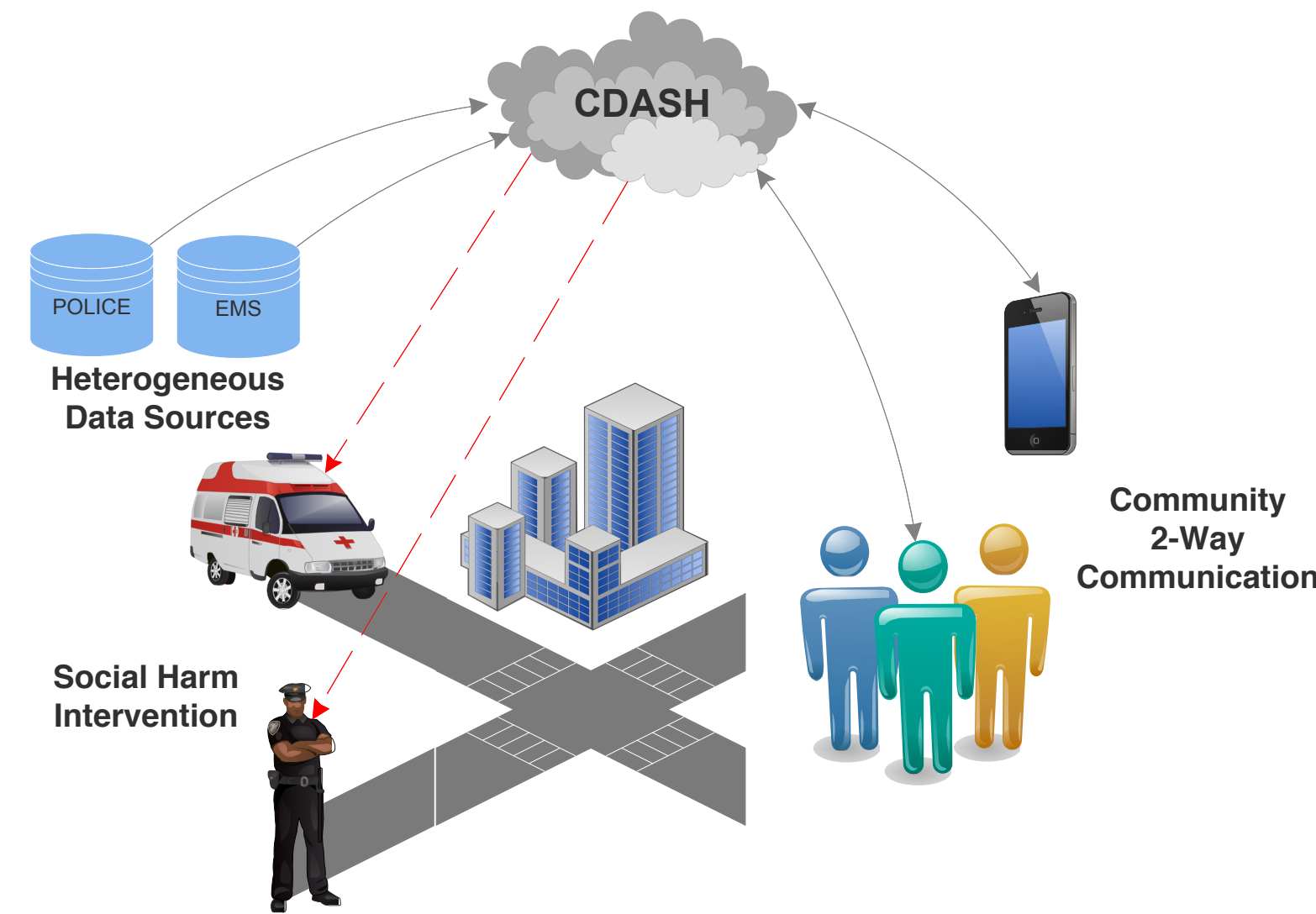


Real-time algorithms and software systems for heterogeneous data driven policing of social harm

PIs: George Mohler, Jeremy Carter, and Rajeev Raje
 Indiana University Purdue University Indianapolis
 IRG Track 2, 2017

Community identified problem

- Social harm (crime, medical emergencies, traffic crashes) costs Indianapolis ~\$1billion/yr
- Highly concentrated with disparate impacts: 50% of crime and overdoses occur in 5% of city
- Heterogeneous data sources need to be integrated
- Dynamic risk necessitates dynamic algorithms for resource allocation



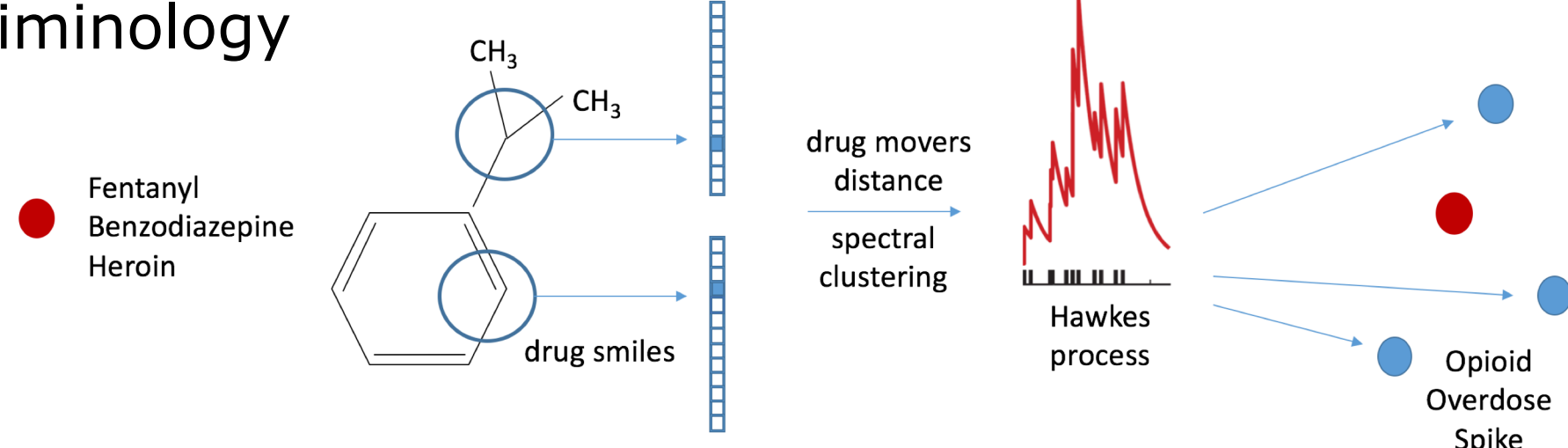
Intellectual Merit

- State of the art predictive modeling and optimal control of social harm risk (tied for 1st in 2017 NIJ Crime forecasting competition)
- Design of fairness aware algorithms and measuring bias in real-world deployments
- Software application deployed in Indianapolis in 3 month field trial
- Multi-disciplinary team: computer science, criminal justice and public policy, police and emergency medical services

Activities to date

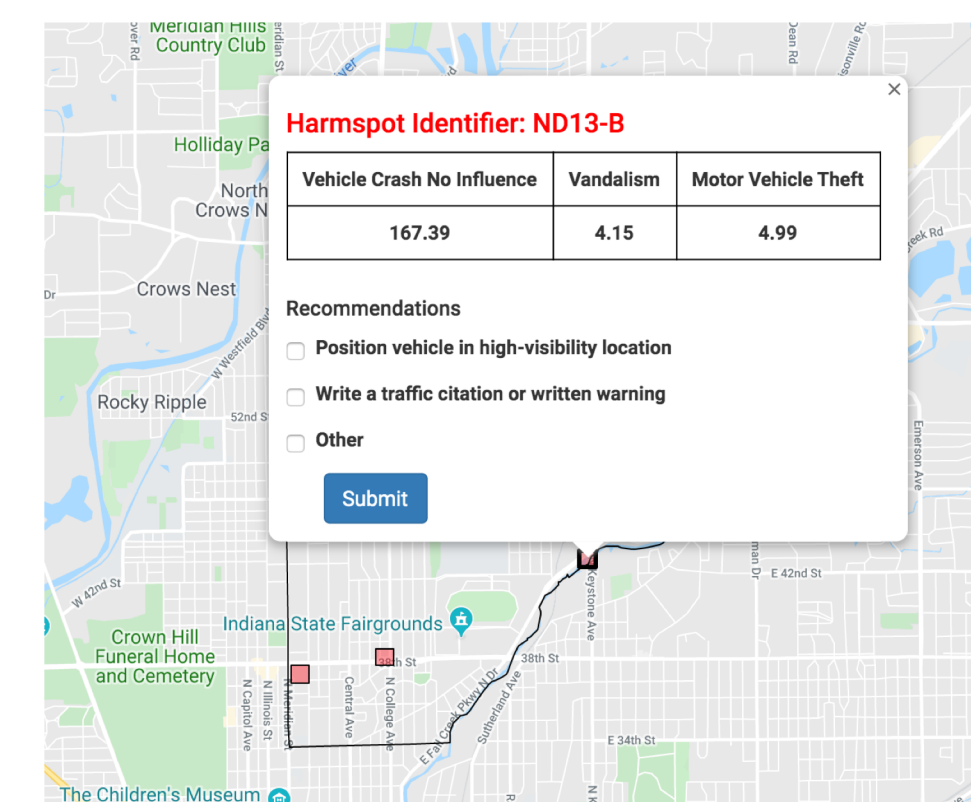
Algorithmic and software engineering advances

- Design of learning to rank algorithms for dynamic event hotspot identification
- High dimensional point processes for modeling event risk with structured event covariates (e.g., text, toxicology screen)
- Service-oriented software architecture for scalable and flexible software applications for social harm risk assessment and resource allocation
- Publications in KDD, IEEE BigData, IEEE Smart Cities, Int. J. Forecasting, Annals of Applied Statistics, J. Quant. Criminology



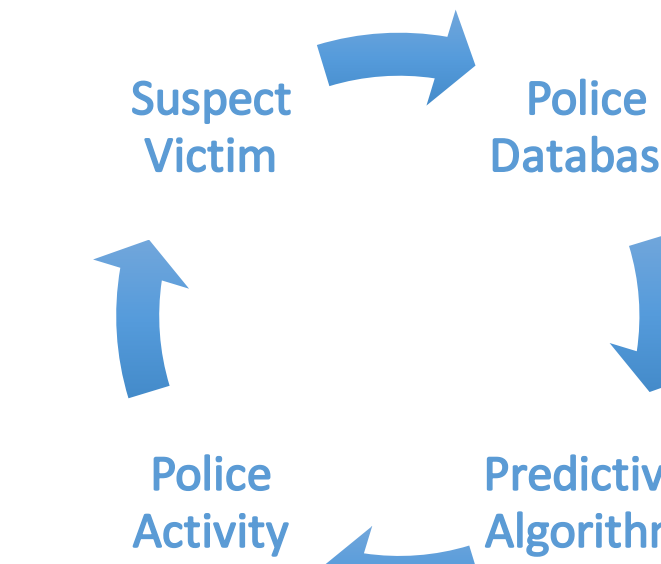
Indianapolis Harmspot Experiment

- Block randomize patrol beats
- A/B test "harmspot" vs. crime hotspot interventions
- Over 6000 proactive activities in crime, traffic crash, overdose hotspots
- Pre/post community survey



proactive activity	treatment	control	total	avg. dur.
vehicle patrol	337	2764	3101	10.2 min
foot patrol	-	215	215	10.7 min
foot patrol/explain data-driven policing handout to citizen/business	499	-	499	10.8 min
position vehicle in high-visibility location for traffic crash prevention	2227	-	2227	10.7 min
write a traffic citation or written warning	39	-	39	12.2 min
distribute information flyer on drug treatment centers	918	-	918	-

Measuring/mitigating bias and fairness aware algorithms



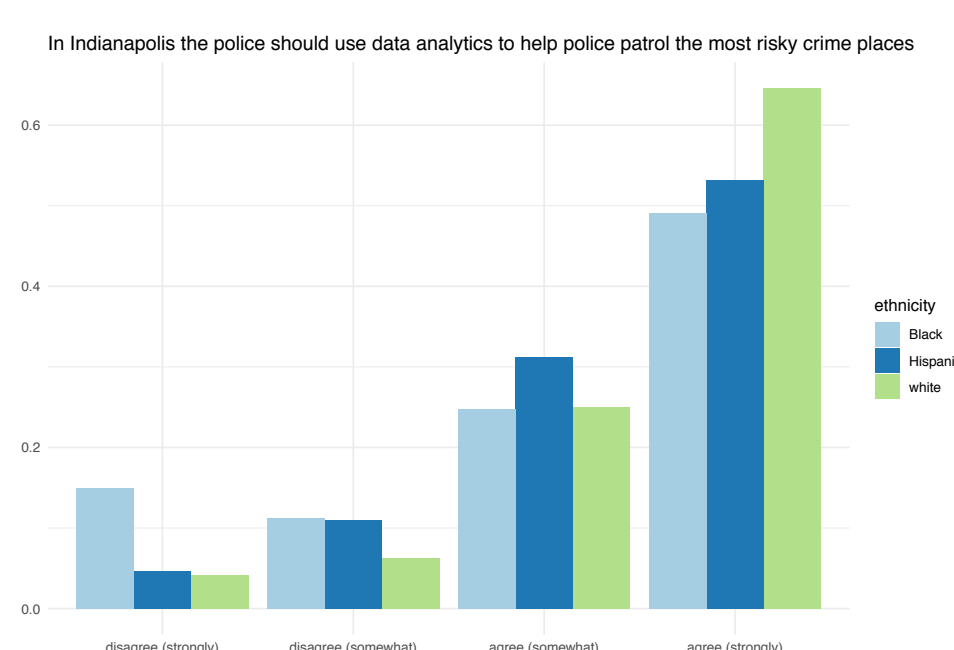
Bias feedback loops can arise in algorithmic policing

- Mohler et al. "A Penalized Likelihood Method for Balancing Accuracy and Fairness in Predictive Policing," *SMC 2018*.
- Brantingham et al. "Does Predictive Policing Lead to Biased Arrests? Results From a Randomized Controlled Trial," *Statistics and Public Policy, 2018*.
- Khorshidi et al. Repurposing recidivism models for forecasting police officer use of force. *IEEE Big Data, 2020*.
- Short & Mohler. "A Fully Bayesian, Logistic Regression Tracking Algorithm for Mitigating Disparate Misclassification." *arXiv 2020*.

$$L(\vec{a}, w, \theta) = \sum_{i=1}^N \log(\lambda_g(t_i)) - \sum_{g \in G} \int_0^T \lambda_g(t) dt - \chi F \quad \text{fairness encouraging penalty in MLE}$$

Broader Impact (immediate)

- Social harm cost reduction of ~\$40 per every 10 minutes of proactive activity
- No significant change in use of force incidents, small increase in arrests of white and Black individuals (small decrease of arrests of Latino individuals)
- In survey, Community largely supportive of data driven/algorithmic policing, though some concern about potential bias and some differences by age and race/ethnicity



Broader Impact (sustained)

- Calls for police reform following George Floyd's killing
- Non law enforcement interventions for some types of social harm (for example Gang Reduction and Youth Development --GRYD-- org. in Los Angeles)
- Using algorithms to flag high risk officers and officer pairings in misconduct networks
- 4 PhD students (3 women) and 2 undergrads trained through the project



Next Steps

- Publish results of Indianapolis harmspot policing experiment (in review at Journal of Criminal Justice)
- Project analyzing the impact of law enforcement drug seizures on drug overdose
- IU Racial Justice Research Fund Seed Grant, High-stakes pairing systems for mitigating police bias and misconduct. Joint w/ Jeremy Carter and James Hill
- Graduate student embedded with IMPD to collect data on officer academy records, field training officer pairings and post training outcomes