Predicting Counties At-Risk of a Synthetic Opioid Overdose Outbreak: A Statistical Modeling Approach

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Abstract for CPDD 300 word limit (word count: 300)

Aim: Rather than a uniform increase in opioid-related mortality, the U.S. opioid crisis is the result of a series of geographically concentrated, drug-specific overdose outbreaks. This study aimed to evaluate the performance of a model built to predict counties at highest risk of synthetic opioid (i.e. fentanyl) overdose outbreaks in 2017 based on available data from 2012-2016, as a tool to predict future outbreaks.

Methods: Data on number of overdose deaths by county (n=3143) were extracted from the CDC Wonder database, and from the American Community Survey, Highway Safety Improvement Program, Esri, and the National Center for Health Statistics, for potential predictors. We fit a time-dependent Cox regression model to data from 2012-2016 data that was then used to calculate a predicted probabilities for of an outbreaks in 2017 in counties that had yet to experience one. Predictive performance was evaluated by comparing predictions to actual outcomes and calculating area under the (receiver operating characteristic) curve (AUC), accuracy, sensitivity, and specificity. Optimal cut-point was determined by maximizing sensitivity with a minimum specificity of 90%. In addition, we ran a 5-fold cross-validation on the training data to assess model overfitting.

Results: Our predictions had an AUC of 0.96, 90% accuracy, 92% sensitivity and 90% specificity, indicating strong overall performance. Of the 102 counties that newly experienced a synthetic opioid overdose outbreak in 2017, we correctly identified 94 (92%) at our optimal cut-point, including counties in Washington, Nevada, Minnesota, Iowa and Texas that were isolated from other counties experiencing such outbreaks. Cross-validation indicated the model was not overfit.

Conclusion: We show that, by leveraging observed data from 2012-2016, our model was able to accurately predict which counties would experience a synthetic opioid overdose outbreak in 2017. Having demonstrated model performance, next steps will entail predicting future overdose outbreaks, as such modeling forecasts can inform much needed preemptive responses.

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