Hot spots in mortality from drug poisoning in the United States, 2007-2009
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This study conducted by Rossen, Khan, and Warner in 2013 uses spatial statistical tools to examine variations at a county level in age adjusted death (AADR) rates for drug poisoning. The study's objective was also to highlight hot spots and cold spots area where drug related pointing mortality were higher/lower than expected. Furthermore, the analysis aimed to test the hypothesis of some studies which suggest that drug poisoning mortality disproportionally affects rural areas compared to urban areas. The final output of the study is intended to promote efforts in addressing the growing epidemic issue.

The study used data from the 2007-2009 National Vital Statistics Multiple Cause of Death Files, and classified the causes of death using the International Classification of Diseases. Due to the drug poisoning deaths being considered rare events, the study used small area estimation techniques to produce stable estimates of AADR in the 3141 counties (dude to the "rarity" of events using crude rates would produce highly unstable estimates).

The analysis used two-stage mixed effects model to estimate county level AADRs for poisoning. Mixed effects models are typically used in small area estimation, "as they can be used to predict empirical Bayes estimates which borrow information across clusters to shrink extreme values and provide stable small area estimates". The research also included county-level random intercepts and fixed effects in both steps of the model using the Generalised Linear and latent Mixed Modelling (GLAMM) procedures in Stata. The fixed effects included a variety of covariates drawn from several sources, including socio-demographic and economic characteristics, crime, urban-rural classification, and health related data — however no further details regarding these factors were mentioned.

Global indexes of spatial autocorrelation were used to calculate the spatial dependence across counties of poisoning related deaths. Global Moran's I statistics was used to look for spatial autocorrelation. In addition, Delaunay triangulation was used to conceptualise spatial relationships by creating Voronoi triangles from county centroids — this method is usually used where features are isolated and/or heterogenous. In addition, local indicators of spatial associations were used to identify specific clusters of high or low drug pointing AARS by using the Getis-Ord G_i* statistic to find clusters and to generate z-scores

and p-scores for each data point. Furthermore, sensitivity analyses using eight-nearest-neighbors were used to check the analysis, and were stated to have produced similar results, thus supporting the results of the analysis.

Two maps representing the Predicted drug pointing AADR by county for 2007-2009, and hot and cold spots in drug poisoning mortality were constructed. The results showed substantial geographic variation, and the Moran's I confirmed that drug pointing exhibited spatial dependence. In the United States, counties with high drug poisoning mortality rates tend to cluster geographically, and low level mortality also tend to cluster geographically. The main hot spots were detected along the North Pacific coast, the Southwest, Oklahoma, Appalachia , and the Gulf Coast. Cold spots were identified across the Central Plains, Texas and regions of Alaska. Previous research done on the subject suggested that rural areas were disproportionately high in rural areas compared to urban areas, however this research showed that rural areas in the US represented some of the lowest as well as highest drug poisoning death rates. The results showed that the variation in drug pointing mortality was heavily influenced geographically as opposed to just rural/urban classification.

This paper was well organised and carried out, as well as supported by a solid appendix. The study also acknowledged for some limitations, such as the underestimating of deaths or inaccurate classification of deaths. It also proposed ideas for further analysis, for example regarding the possibility to analyses mortality according to different types of drugs. In addition, the analysis used a sensitivity analysis to double check the hot/cold spots output which strengthened the conclusions. Nevertheless, some terms could require some further definitions, or explanations of terms such as Bayes Estimates, Opiod analgesics, Modifiable Areal Unit Problem, or ecological fallacies, if the reader is not familiar with such terms or is new at GIS.

The study depicts the results for the predicted drug poisoning AADRs across 3141 counties for 2007 - 2009 as well as the hot spots and colds spots statically calculated, however it could have proven to be useful to map the sensitivity analysis which uses the eight-nearest neighbours to see how similar the results were, as stated in the results section of the article. Therefore, this paper can be rated a 9/10 thanks to its relatively complete analysis, clear explanations and evaluation. The paper could have however addressed the issue of how the outputs can be issued to health future efforts in targeting the increasing epidemic, as the spread of hot and cold spots seem relatively scattered across the US counties in both rural and urban areas.