Effect of Work-related Mobility in the Simulation of Aerosol Anthrax Releases with BARD

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OBJECTIVE

To refine the simulation algorithm used in the Bayesian Aerosol Release Detector (BARD) so that it takes into account the work-related mobility and to compare the refined simulator with the existing one.

BACKGROUND

An important problem in biosurveillance is the early detection and characterization of outdoor aerosol releases of *B. anthracis*. The Bayesian Aerosol Release Detector (BARD) [1] is a system for simulating, detecting and characterizing such releases. BARD integrates the analysis of medical surveillance data and meteorological data. The existing version of BARD does not account for the fact that many people might be exposed at a location other than their residence due to mobility. Incorporation of a mobility model in biosurveillance has been investigated by several other researchers [2, 3]. In this paper, we describe a refined version of the BARD *simulation* algorithm which incorporates a model of work-related mobility and report the results of an experiment to measure the effect of this refinement.

METHODS

To create the commuting model, we used data from the U.S. Census Bureau. A focused analysis restricted our investigation to 62156 tract-to-tract commuting flows corresponding to a seven-county region around the city of Pittsburgh (Figure 1). Currently, BARD supports the zip-code and block-group modes of simulation. The latter mode was used in this study. In a pre-processing step, we converted the tract-level flows provided by the U.S. Census Bureau to block group-level flows. To refine BARD simulation algorithm first we divided the population of each block group into several sub-populations based on the workplace of its residents. Then we computed the number of cases and the time of ED visit for each case based on the exposure level of a sub-population at its place of work. We applied the existing and the refined versions of BARD simulator to several hand-picked locations around the region described earlier. For each release, we measured the change in the number of ED visits per block group produced by the two versions of the simulator.

RESULTS

Figure 1 illustrates a release from the Northwestern corner of the seven-county region with the wind direction pointing toward downtown Pittsburgh. The darker colors in this map correspond to larger counts generated in the case of simulation with commuting. As shown in Figure 1, the main effect of incorporating the commuting model in our simulations appears to be an increase in the number of simulated ED visits for the block groups located crosswind and further from the release location.

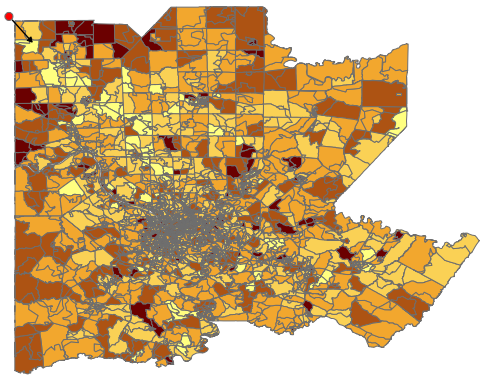

Figure 1 – Classed cloropleth map of the difference between the counts generated by the two versions of BARD simulator. The release location (dot) and wind direction (arrow) are also shown.

This effect can be explained by considering that a large number of workers from those block groups work in downtown and thus will have a higher level of exposure as compared to the exposure they would get at their home location.

CONCLUSIONS

This study shows that work-related mobility can have a significant impact in the simulation of aerosol releases of anthrax with BARD. [This work was supported by grant CDC-R01PH000026-01. The contents do not necessarily represent the official view of the Centers for Disease Control and Prevention.]

REFERENCES

[1] Hogan WR, Cooper GF, Wallstrom GL, Wagner M, Depinay J-M, The Bayesian Aerosol Release Detector: An algorithm for detecting and characterizing outbreaks caused by an atmospheric release of Bacillus anthracis, *Statistics in Medicine*, (to appear).
[2] Buckeridge DL, A method for evaluating outbreak detection in public health surveillance systems that use administrative data, PhD Thesis, Stanford, 2005.
[3] Duczmal L, Buckeridge DL, A workflow spatial scan statistic. *Statistics in Medicine*, 2006, 25(5):743-754.

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