Modeling an Anthrax Plume: Prioritizing the Delivery of Antibiotics After an Anthrax Bioterrorism Event

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Anthrax is a potentially fatal biological pathogen and could be used as a biological weapon with devastating consequences. In particular, in the case of an hypothetical anthrax attack on Maricopa County, AZ, the current governmental response plan is inadequate. The currently used plume model predicts an unrealistically high number of infections because it assumes that anthrax spores are symmetrically distributed over a large area and that 100% of those who breathe the spores get infected. Since the predictions are unrealistically high, it is logistically impossible to deliver that many antibiotics before the infections progress to an untreatable stage. We develop a fine-grained plume model by using GIS (Geographic Information System) data. The model is based on the scalar transport equation and in-host modeling in order to better prioritize the distribution of antibiotics. We assume that the attack is carried out via drone. We obtain the diffusion and advection coefficients of the plume of anthrax spores based on meteorological data and use the resultant concentrations along with census data to build a susceptibility model. This model predicts which areas will be the hardest hit and, therefore, what quantity of antibiotics should be delivered based on population density. Wind conditions play a significant role in shaping the plume. We conclude that the state and local governments should modify their simplistic Gaussian plume models in order to take into account environmental conditions and hence better serve the people in harm's way.