Social Distancing and Non-Pharmaceutical Intervention Strategies for Mitigating Pandemic Influenza Outbreaks

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Abstract

The recent influenza outbreak has resulted in 1435 hospitalized cases across New England and 6191 nationally to-date, widespread in 47 states, with associated deaths above CDC epidemic levels. Boston alone has had roughly 700 confirmed cases since October, a 10-fold increase over all of last year, with many media reports of hospital overcrowding and vaccine shortages. Interestingly, little has been done to contain the outbreak in terms of social distancing, despite a good body of recent research on this topic. We develop social distancing non-pharmaceutical interventions and demonstrate their efficacy on large-scale simulated outbreaks based on three different scenarios of virus transmissibility. We model pandemic influenza outbreaks using an agent-based simulation approach that incorporates detailed population demographics and dynamics, a variety of mixing groups and their contact processes, infection transmission processes, and non-pharmaceutical interventions. Using an experimental design approach we examine the influence of characteristic parameters of virus epidemiology, social behavior, and non-pharmaceutical interventions on various pandemic impact measures such as total number of infections, deaths, and contacts. The experimental design also yields knowledge of the extent of interactions among the above parameters. Results indicate that significant improvements in pandemic mitigation approaches can be attained by these strategies.

Bio

Dayna Lee Martinez is a post-doctoral research associate in the Healthcare Systems Engineering Institute at Northeastern University. She received her Ph.D. from the Industrial and Management Systems Engineering Department at the University of South Florida and before joining Northeastern was an engineering fellow in the Veterans Engineer Resource Center at the Tampa FL Veterans Medical Center. During her doctoral studies, Dayna was a Fellow of the NSF Bridge to Doctorate program (2006-2008) and NSF GK-12 program STARS (Student, Teachers and Resources in the Sciences) from 2008 to 2011, where she also served as a manager from 2011 to 2012. Dr. Martinez has taught Probability and Statistics for Engineers and received several awards including the 2007 SHPE/GEM graduate award and the 2010 national HEENAC, 2010 USF Research One, and 2012 ISERC Doctoral Colloquium poster competitions.