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From Compartmentalized to Agent-based Models of Epidemics[1]

CHARLES MACAL, Argonne National Laboratory — Supporting decisions in the throes of an impending epidemic poses distinct technical challenges arising from the uncertainties in modeling disease propagation processes and the need for producing timely answers to policy questions. Compartmental models, because of their relative simplicity, produce timely information, but often do not include the level of fidelity of the information needed to answer specific policy questions. Highly granular agent-based simulations produce an extensive amount of information on all aspects of a simulated epidemic, yet complex models often cannot produce this information in a timely manner. We propose a two-phased approach to addressing the tradeoff between model complexity and the speed at which models can be used to answer to questions about an impending outbreak. In the first phase, in advance of an epidemic, ensembles of highly granular agent-based simulations are run over the entire parameter space, characterizing the space of possible model outcomes and uncertainties. Meta-models are derived that characterize model outcomes as dependent on uncertainties in disease parameters, data, and structural relationships. In the second phase, envisioned as during an epidemic, the meta-model is run in combination with compartmental models, which can be run very quickly. Model outcomes are compared as a basis for establishing uncertainties in model forecasts.

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