New study shows mathematical models helped reduce the spread of COVID-19

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Colorado researchers have published new findings in *Emerging Infectious Diseases* that take a first look at the use of SARS-CoV-2 mathematical modeling to inform early statewide policies enacted to reduce the spread of the Coronavirus pandemic in Colorado. Among other findings, the authors estimate that 97 percent of potential hospitalizations across the state in the early months of the pandemic were avoided as a result of social distancing and other transmission-reducing activities such as mask wearing and social isolation of symptomatic individuals.

The modeling team was led by faculty and researchers in the Colorado School of Public Health and involved experts from the University of Colorado Anschutz Medical Campus, University of Colorado Denver, University of Colorado Boulder, and Colorado State University.

"One of the defining characteristics of the COVID-19 pandemic was the need for rapid response in the face of imperfect and incomplete information," said the authors. "Mathematical models of infectious disease transmission can be used in real-time to estimate parameters, such as the effective reproductive number (Re) and the efficacy of current and future intervention measures, and to provide time-sensitive data to policymakers."

The new paper describes the development of such a model, in close collaboration with the Colorado Department of Health and Environment and the Colorado Governor's office to gage the impact of early policies to decrease social contacts and, later, the impact of gradual relaxation of Stay-at-Home orders. The authors note that preparing for hospital intensive care unit (ICU) loads or capacity limits was a critical decision-making issue.

The Colorado COVID-19 Modeling team developed a susceptible-exposed-infected-recovered (SEIR) model calibrated to Colorado COVID-19 case and hospitalization data to estimate changes in the contact rate and the Re after emergence of SARS-CoV-2 and the implementation of statewide COVID-19 control policies in Colorado. The modeling team supplemented model estimates with an analysis of mobility by using mobile device location data. Estimates were generated in near real time, at multiple time-points, with a rapidly evolving understanding of SARS-CoV-2. At each time point, the authors generated projections of the possible course of the outbreak under an array of intervention scenarios. Findings were regularly provided to key Colorado decision-makers.

"Real-time estimation of contact reduction enabled us to respond to urgent requests to actively inform rapidly changing public health policy amidst a pandemic. In early stages, the urgent need was to flatten the curve," note the authors. "Once infections began to decrease, there was interest in the degree of increased social contact that could be tolerated as the economy reopened without leading to overwhelmed hospitals."

"Although our analysis is specific to Colorado, our experience highlights the need for locally calibrated transmission models to inform public health preparedness and policymaking, along with ongoing analyses of the impact of policies to slow the spread of SARS-CoV-2," said Andrea Buchwald, Ph.D., lead author from the Colorado School of Public Health at CU Anschutz. "We present this material not as a final estimate of the impact of social distancing policies, but to illustrate how models can be constructed and adapted in real-time to inform critical policy questions."

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