

Four-compartment modeling can help determine best COVID-19 control strategy

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Researchers in China identified four key population categories useful in guiding COVID-19 public health policies aimed at minimizing the spread of the disease and reducing fatalities. The team, led by Dr.

Baoguo Jiang of the Department of Orthopedics & Traumatology at Peking University People's Hospital, published their findings in the journal *Precision Clinical Medicine* on May 28.

"Our research develops a decision-making support model to describe SARS-COV-2 infection, and can be adjusted to reflect local transmission characteristics and public health capabilities," Dr. Jiang said. "This model will be instrumental for local authorities to determine the optimal disease suppression strategy in a data-driven and science-driven manner.

The study divided subjects into four main categories: 'Isolated' (via quarantine or hospitalization), 'not infected,' 'infected and not isolated,' and 'removed' (recovered or deceased). Within those broad categories, they analyzed the effectiveness of the three main things public health policy can control—whether [face masks](#) and other heightened hygiene measures are required in public, mandatory lockdowns, and mandatory social distancing.

Data collected were from Wuhan, China, where the COVID-19 outbreak began last year. In designing the study, the researchers calibrated the model based on 32,583 confirmed COVID-19 cases in Wuhan between December 2019 and March 2020. The 'infected and not isolated' category presented an extra challenge, because not all infected persons displayed symptoms, yet had the potential to infect many others. To control for this, their model allows for a predetermined number of subjects presumed infected but not showing symptoms to progress to the 'removed' (and recovered) category.

Public health officials in Wuhan estimated the probability of having close contact with someone infected with COVID-19 was reduced by about 75 percent amid stringent quarantine conditions. Implementing mandatory face masks and hygiene practices in public was estimated to

reduce the likelihood of transmitting the infection by 50 percent.

"Our research demonstrates that implementation of case isolation and mass quarantine is the most effective measure to the complete suppression of COVID-19 outbreak," Dr. Jiang said.

The research team found that their study model could be applied in the U.S., U.K., and Italy, with only minor adjustments in likelihood of person-to-person transmission within each of the four main population categories. Population density accounted for most of those differences, explaining why cities like Wuhan and New York saw the disease spread more rapidly.

One of the study's key findings was that face masks and social distancing were not enough to reverse upward trend of the disease. Wuhan only saw reversal in COVID-19 infection rates after adding contact tracing and strict quarantines to their containment policy. Further, they found that if no quarantine was implemented and the disease was allowed to spread unchecked, over 10 million people in Wuhan alone—or about 91 percent of the population—would become infected before the population would achieve herd immunity. "Starting mass quarantine and case isolation earlier greatly improves the effectiveness of disease suppression and also demands fewer health care resources," Dr. Baoguo said.

Another important finding was that quarantine must be implemented at a rate of at least 50 percent, and a maximum of 10 weeks after the start of a COVID-19 outbreak to have a chance at reversing the infection rate. If less than 40 percent of the population remains quarantined or the quarantine begins more than 11 weeks after onset of the outbreak, it is too late, the study says.

Dr. Jiang said his team plans to further investigate how to optimally allocate prevention and control measures.

"On the one hand, through arduous efforts, our fight against COVID-19 has achieved major results with strategic significance," Dr. Jiang said.

"The prevention and [control measures](#) have been normalized. On the other hand, an increasing number of asymptomatic COVID-19 carriers have been reported recently. More study on transmission characteristics of the [disease](#) among asymptomatic persons is necessary to better control the epidemic."

More information: Tianbing Wang et al, A four-compartment model for the COVID-19 infection—implications on infection kinetics, control measures, and lockdown exit strategies, *Precision Clinical Medicine* (2020). [DOI: 10.1093/pcmedi/pbaa018](https://doi.org/10.1093/pcmedi/pbaa018)

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