Stealth transmission fuels fast spread of COVID-19 outbreak

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Undetected cases, many of which were likely not severely symptomatic, were largely responsible for the rapid spread of the COVID-19 outbreak in China, according to new research by scientists at Columbia

University's Mailman School of Public Health. The findings, based on a computer model of the outbreak, are published online in *medRxiv*, a preprint server for health sciences. (Read a Q&A with study co-author Jeffrey Shaman below.)

The researchers report:

- 86 percent of all infections were undocumented prior to the January 23 Wuhan travel shutdown
- Per person, these undocumented infections were half (52 percent) as contagious as documented infections yet were the source of two-thirds of documented infections
- Government control efforts and population awareness have reduced the rate of spread of the virus in China; after travel restrictions and control measures were imposed, it spread less quickly

"The explosion of COVID-19 cases in China was largely driven by individuals with mild, limited, or no symptoms who went undetected," says co-author Jeffrey Shaman, professor of environmental health sciences at Columbia University Mailman School. "Depending on their contagiousness and numbers, undetected cases can expose a far greater portion of the population to virus than would otherwise occur. We find for COVID-19 in China these undetected infected individuals are numerous and contagious. These stealth transmissions will continue to present a major challenge to the containment of this outbreak going forward."

The researchers used a computer model that draws on observations of reported infection and spread within China in conjunction with mobility data from January 10-23 and January 24—February 8. They caution that major changes to care-seeking or patient documentation practices, as well as rapid developments with regard to travel restrictions and control

measures, may make predictions difficult.

"Heightened awareness of the outbreak, increased use of personal protective measures, and travel restriction have helped reduce the overall force of infection; however, it is unclear whether this reduction will be sufficient to fully stem the virus spread," says Shaman. "If the novel coronavirus follows the pattern of 2009 H1N1 pandemic influenza, it will also spread globally and become a fifth endemic coronavirus within the human population."

Additional co-authors include first author Ruiyun Li, Imperial College London, London; Bin Chen, University of California, Davis; Yimeng Song, University of Hong Kong; Tao Zhang, Tsinghua University, Beijing; and Sen Pei and Wan Yang at the Columbia Mailman School.

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Q&A With Jeffrey Shaman

The U.S. Centers for Disease Control and Prevention is warning that COVID-19 outbreaks will likely happen in the U.S. Are we heading toward a pandemic?

The evidence suggests that COVID-19 will not be contained and will become a pandemic. Roughly six out of seven infections are undocumented yet still contagious, making the outbreak very difficult to control. A rough rule of thumb is that about half of the world population is infected by an influenza pandemic in two years. If COVID-19 follows suit, that's about 3.5 billion infections, 500 million confirmed cases, and

11.5 million deaths. This is an upper bound and assumes no advances in the point-of-care treatment of confirmed cases, no new therapeutics, and no vaccine. An effective vaccine or new therapeutic would greatly reduce mortality. However, the second most severe flu pandemic was in 1957 and is estimated to have killed 1-2 million people. COVID-19 could be worse—not as bad as 1918—but the worst since then.

Some say travel restrictions don't help prevent the spread of outbreaks. You found that these restrictions worked in China for COVID-19?

A common dogma is that travel restrictions don't work against respiratory agents; however, no country has implemented travel restrictions as effectively as the Chinese. They have essentially put up to 800 million people under house arrest. These people are only contacting a handful of people each day rather than hundreds per day. The real question is how long the Chinese can impose these measures which come at an enormous economic cost. If they truly feel they can eliminate the virus within China (which I doubt) it will only be reintroduced from another country. They can buy some time to allow vaccine development, but that will take months at a minimum. They may hope that areas in northern China, where other coronaviruses tend to be seasonal and minimal in summer, could be helped by holding out for a few more months.

What's next on your COVID-19 research agenda?

We're continuing simulations of the spread of the outbreak and plan to forecast activity in the U.S. We've also started simulating the effects of interventions, such as vaccines and therapeutics.

More information: Ruiyun Li et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus

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