RESEARCH SUMMARY

The Effectiveness of COVID-19 Control Measures Given Prevailing Rates of Vaccination

This summary discusses an analysis of the effectiveness of outbreak control measures for reducing COVID-19 transmission, given prevailing rates of vaccination within a population of interest. It builds upon previous research and methodology on measures used against contagious disease in a military operational environment, using COVID-19 as a case study.

The body of work summarized here builds on the idea that outbreak control measures are successful when the average number of infections caused by a contagious individual at any point in a given outbreak falls below one. For this analysis, IDA researchers Julia Burr, Robert Cubeta and Sean Oxford expanded their earlier methodology to account for unique aspects of COVID-19, particularly asymptomatic transmission.

Collectively, outbreak control measures are designed to limit both the opportunities for contagious individuals to spread disease and the vulnerability of those exposed. The analysis focuses on three types of control measures: medical countermeasures (i.e., vaccination), isolation of contagious individuals, and quarantine of individuals who may have been exposed to a disease and are at risk of becoming contagious.

At the time of the analysis, U.S. military populations were not fully vaccinated against COVID-19. IDA evaluated the prospects for controlling outbreaks through vaccination alone by considering the effectiveness of the vaccine in

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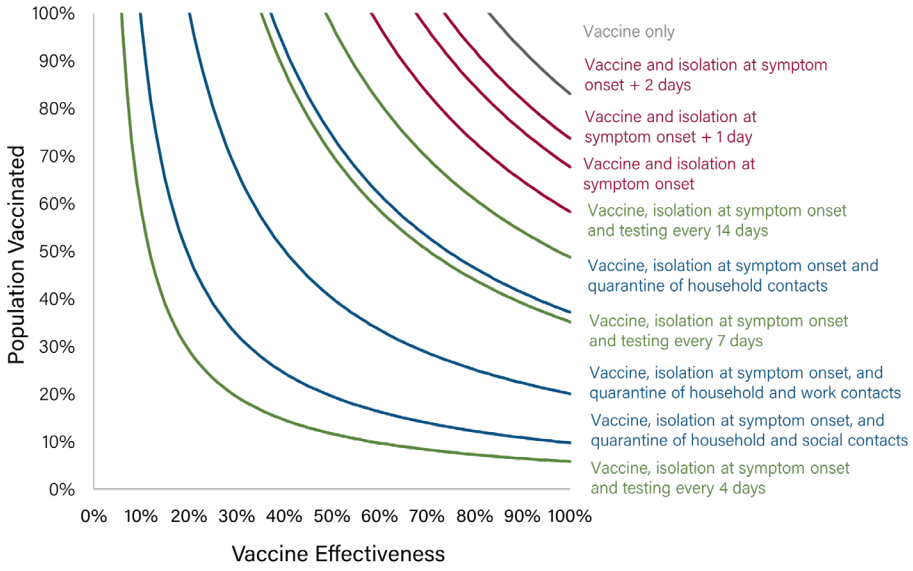
preventing transmission and the rates of vaccination within the population, deducing that given an effectiveness of 95%, 83% of the population would have to vaccinate to reduce the average number of infections caused by a given individual below one. Although a mandatory vaccination policy could aid compliance, effectiveness can diminish over time as vaccine-resistant variants emerge. In short, vaccination would be insufficient to control an outbreak on its own.



Julia, Robert and Sean also evaluated isolation as a countermeasure. Traits unique to COVID-19 create challenges to timely isolation and undermine the effectiveness of routine isolation practices that typically contain infectious diseases. They found that to infect less than one individual, those with COVID-19 would have to isolate within a few days of their exposure. Unfortunately, this isolation window ends prior to symptom onset, and asymptomatic cases can continue to transmit disease when undetected.

However, the team's calculations also demonstrated that together, vaccines and isolation triggered by symptoms can cause an outbreak of COVID-19 to wane. Diagnostic testing can locate asymptomatic cases and reduce transmission among the population even further. In the figure above, the curves represent combinations of vaccine effectiveness, compliance, isolation and testing. The area above and to the right of each curve demonstrates the combination of vaccine effectiveness and compliance that is adequate to control an outbreak given the associated control measures.

Uncertainty pervades the scientific community's understanding of COVID-19, and IDA's methodology relies on the availability of accurate information related to the contagiousness of the disease. However, the methodology's flexibility means that results can be readily updated as collective understanding improves.

For details about this work, see the reports this summary is based on, IDA Paper P-22725 and IDA Document D-33380.

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