How to control an influenza outbreak without a specific vaccine

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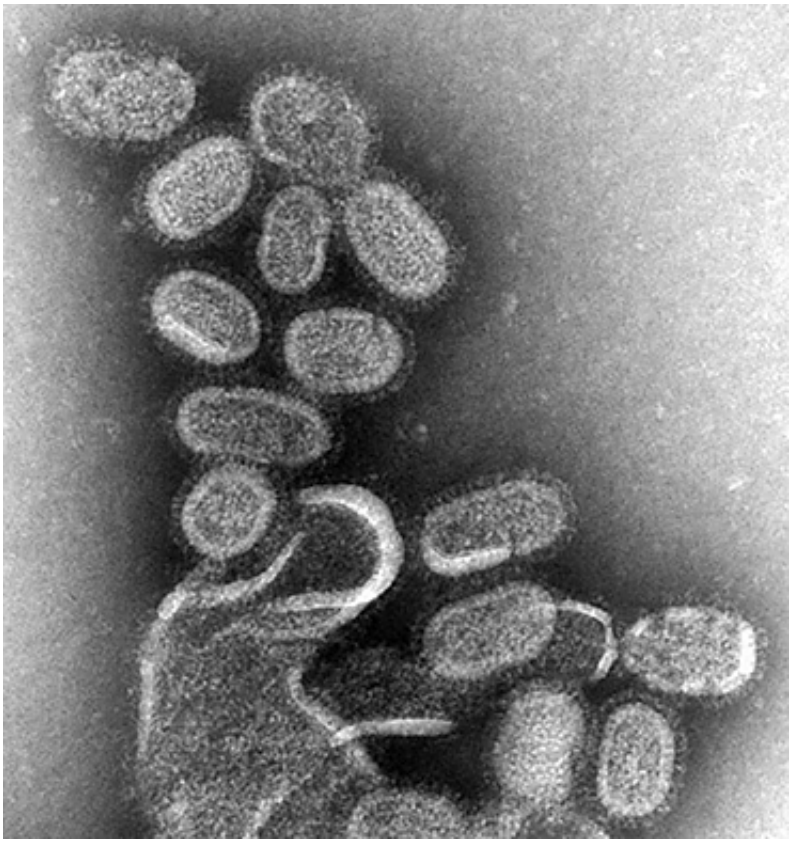

Electron microscopy of influenza virus. Credit: CDC

A group of pandemic modeling experts from the University of Sydney's Faculty of Engineering have published new research that simulated viral influenza outbreaks to examine the efficacy of pandemic interventions in the absence of a tailored vaccine.

The general use of low-efficacy vaccines, coupled with a targeted application of antiviral medications, may be effective at countering the spread of influenza pandemics, new research from the University of Sydney has found.

Published by the *Journal of The Royal Society Interface*, the modeling sought to examine the effectiveness of pandemic interventions in the absence of a strain-specific vaccine.

"Pandemics typically occur with the emergence of new viral strains for which no tailored vaccine exists," said Dr. Cameron Zachreson from the University's Centre for Complex Systems, who in 2018 published research that found urbanization and air travel were leading to a growing risk of pandemic in Australian cities.

"Without a readily available vaccine, governments must mitigate outbreaks in other ways, making do with mechanisms at hand, such as antiviral medications, social distancing and low-efficacy vaccines developed for different viral strains. These are known as pre-pandemic vaccines."

Dr. Zachreson's team found pre-pandemic vaccines are most effective at containing a pandemic when combined with fast, contact-targeted, antiviral medication, which helps reduce transmission.

"These targeted interventions need to be implemented quickly compared to the transmission rate of the disease," said Dr. Zachreson.

"The more effective a targeted strategy is at mitigating the epidemic, the longer it will have to be in place," he added. "Mitigation will slow down disease spread but is unlikely to eradicate the pathogen completely."

Even if a pre-pandemic vaccine is unable to bring about herd immunity,

it can slow the spread of the virus and open a longer time window in which other measures can be effectively implemented, the researchers found.

Lessons for the COVID-19 pandemic

"Our study focuses on influenza, for which many vaccines have previously been developed. There are no coronavirus vaccines available so pre-pandemic vaccination is not currently possible for COVID-19," said Dr. Zachreson.

"If, hypothetically, a low-efficacy coronavirus vaccine was developed, our study would support its distribution in combination with other measures, as this would likely make them more effective.

"Another takeaway is that timing is everything in preventing a pandemic with targeted interventions. Cases must be identified, contacts traced, and measures implemented before the disease has time to spread within the community."

Targeting neighborhoods less effective than contact targeting

The study showed that giving antiviral medication to people living in the same neighborhoods as index cases (the first documented patients within a population) was inefficient and did not significantly impact the disease's rate of spread.

"On the other hand, giving antiviral medication to the social contacts of index cases did slow down disease spread if the response was fast compared to disease transmission speed," Dr. Zachreson said.

"While there are no known antivirals that are effective for COVID-19, our study does reinforce the importance of contact tracing for the targeting of mitigation measures, as opposed to targeting by residential location."

How the modeling worked

The AceMod simulator, a peer-reviewed method created by the Centre for Complex Systems, comprises over twenty-four million software agents, each with attributes of an anonymous individual, such as age, occupation, susceptibility and immunity to diseases. Contact rates within different social contexts, such as households, household clusters, local neighborhoods, schools, classrooms and workplaces are also built into the program.

The set of generated agents captures average characteristics of the real population and is calibrated to 2016 Australian Census data with respect to key demographic statistics.

More information: Cameron Zachreson et al. Interfering with influenza: nonlinear coupling of reactive and static mitigation strategies, *Journal of The Royal Society Interface* (2020). DOI: 10.1098/rsif.2019.0728

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