Math can improve flu vaccine, experts say

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Mathematical modeling can improve the flu vaccine's effectiveness, according to experts at Rice University—where one such model has existed for more than 15 years—and its Baker Institute for Public Policy.

Michael Deem, the John W. Cox Professor of Biochemical and Genetic Engineering at Rice; Melia Bonomo, a Ph.D. candidate in physics and astronomy at the university; and Kirstin Matthews, a fellow in science and technology policy in the Center for Health and Biosciences at the Baker Institute, outlined their insights in a new policy brief, "Improving the Effectiveness of the Annual Flu Vaccine."

Seasonal influenza (flu) causes as many as 49 million illnesses and 79,000 deaths in the United States annually since 2010. To combat its impact, the Centers for Disease Control and Prevention (CDC) recommends all healthy children and adults obtain a flu vaccination every year. In 2017-18, 58 percent of healthy children (6 months to 17 years old) and only 37 percent of adults obtained the vaccine. Approximately 80 percent of pediatric deaths from influenza during that season were children who were unvaccinated.

"To develop a vaccine in time for the beginning of flu season in the fall, scientists must start in early January," the authors wrote. "The current method that the CDC uses involves scientists vaccinating ferrets with several vaccine candidates. They then extract the antibodies from the ferrets to estimate which vaccine was the most effective against the dominant viruses from the previous flu season. This method has been used for almost 50 years. However, it has been proven to be inconsistent in predicting how well the vaccines would perform in humans, especially with the recent, rapidly mutating A(H3N2) viruses. Additionally, experiments with ferrets are time-consuming and costly."

By contrast, mathematical models, including a model developed at Rice more than 15 years ago, allow scientists to calculate how well the flu vaccine matches the infecting viruses. The Rice model, called pEpitope, estimates vaccine effectiveness, and it has been shown to work well for flu A(H3N2), A(H1N1) and B vaccines. For the 2018-19 flu season, Rice scientists predict that the vaccine will be between 20 and 40 percent effective against the majority of A(H3N2) viruses.

"Public health researchers are often slow to change," the authors wrote. "Despite the fact that Rice's pEpitope model has been around for more than 15 years, it is unclear why the CDC has yet to take advantage of it in developing their seasonal flu vaccine. Adding such a model to the already existing ferret experiments will enhance the current vaccination

decision-making process.

"This mathematical modeling technique can rapidly narrow down the viruses that would be good candidates for the vaccine during a particular flu season," they continued. "It can serve as a check to make sure that the vaccine virus does not mutate during the manufacturing process. The pEpitope model is also low-cost, as it does not require any specialized equipment. Finally, it is extremely quick, taking just a couple of seconds to analyze the potential effectiveness of a vaccine against thousands of infecting viruses in a particular geographic region."

The authors said the CDC should strengthen its current protocols for choosing vaccine candidates by utilizing all available prediction modeling. "This will improve overall flu vaccine effectiveness rates and potentially coverage rates as well," they wrote. "Scientists hope that with improved effectiveness, they will also be able to improve vaccine coverage rates, which still trail behind the CDC's Healthy People 2020 goal of 70 percent. Given the difficulty in producing effective vaccines and the general climate of public mistrust of immunization, this work has the potential to improve vaccine strain selection and education by providing a tool that is accessible to researchers and citizen scientists alike."

More information: Improving the Flu Vaccine: www.bakerinstitute.org/researc … roving-flu-vaccines/

Provided by Rice University