Team uses Google analytical tool to gauge vaccine effectiveness

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Using a statistical method initially developed by Google, a Yale School of Public Health-led research team has devised a novel way to better analyze the impact of vaccines. The research was published in the *Proceedings of the National Academy of Sciences*.

Pneumococcus, a bacterial pathogen, is one of the most significant causes of pneumonia around the world. According to the Centers for Disease Control and Prevention (CDC), pneumonia is the leading cause of death globally in children under the age of 5. Vaccines that prevent pneumococcal infection can decrease pneumonia rates, but quantifying the impact of the vaccine remains challenging.

A team led by Daniel Weinberger, assistant professor in the Department of Epidemiology of Microbial Diseases, used a method called "synthetic controls," which was not previously applied in an epidemiology context, to analyze the impact of the pneumococcal vaccine. Created by Google to analyze web traffic, the method allowed the team to separate changes in pneumonia rates caused by the vaccine from other unrelated factors, providing a clearer picture of the vaccine's impact.

The idea to use a method from outside the field of public health to analyze vaccine impact arose from a meeting Weinberger attended at the World Health Organization (WHO). At the meeting, "there was a discussion of how to adjust for changes in data that are unrelated to the vaccine," he said. To accomplish that, "we felt we had to look outside the typical toolbox we were using."

The team began to explore approaches used to analyze data in other fields, including economics and web analytics, and discovered a paper on Google's method of synthetic controls. They determined the method could be applicable to vaccine evaluation.

The team examined pneumonia hospitalization data from five countries: the United States, Brazil, Chile, Ecuador, and Mexico. They found that the pneumococcal vaccine significantly reduced pneumonia hospitalizations in young children, and reduced hospitalizations for invasive pneumococcal disease and pneumococcal pneumonia in children and adults. The team also found that, in contrast to previous studies, the vaccine did not reduce pneumonia hospitalizations for all causes in older adults in any of the five countries following the introduction of the vaccine in children.

"This suggests that our understanding of which pathogens are causing pneumonia in adults might not be exactly right," said Weinberger. "Pneumococcal strains targeted by the vaccine might be causing a smaller fraction of pneumonia in that age group."

Weinberger said that the synthetic controls method could be useful in analyzing other public health problems. Groups from the CDC and the Pan American Health Organization have come to Yale to learn about the method and how to apply it to

other data sets. Weinberger is also working with the Connecticut Emerging Infections Program, based at Yale, to apply this method to their data on other diseases, such as influenza.

More information: Estimating the population-level impact of vaccines using synthetic controls, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1612833114

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