

Waning potency of pertussis vaccine a significant contributor to recent whooping cough outbreaks

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In a large new Kaiser Permanente study, children who were up to date on their pertussis vaccine schedule were far less likely to develop the disease than unvaccinated children. However, most pertussis cases were in fully vaccinated children. The risk of vaccinated children becoming ill increased with the time since vaccination, suggesting that waning effectiveness between doses was a significant contributor to recent outbreaks.

The study, "Acellular Pertussis Vaccine Effectiveness Over Time," was published on June 10 in the journal *Pediatrics*.

Pertussis, widely known as whooping cough, is a highly contagious and potentially life-threatening respiratory infection caused by the bacterium *Bordetella pertussis*. To help prevent it, the Centers for Disease Control and Prevention (CDC) recommends five doses of DTaP [vaccine](#)—a combination vaccine that protects against pertussis, diphtheria, and tetanus—between the ages of two months and six years.

"Most DTaP research has explored either vaccination status or waning effectiveness, but we looked at both at once," said Ousseney Zerbo, Ph.D., lead author of the new study and a staff scientist with the Vaccine Study Center at Kaiser Permanente Northern California's Division of Research.

Dr. Zerbo and his colleagues retrospectively analyzed the [electronic health records](#) of 469,982 children under the age of 11 who were members of Kaiser Permanente Northern California. Focusing on data from January 2006 through June 2017, they performed a series of statistical analyses to determine risk of pertussis according to vaccination status and time since a child's last dose.

The researchers found that risk of pertussis was 13 times higher for children who had never received DTaP than for children who were fully vaccinated with all recommended doses for their age. Under-vaccinated children—those who had received at least one dose but were behind schedule—were almost twice as likely to develop pertussis than were fully vaccinated children.

"However, for fully vaccinated children, we found that risk of pertussis increased as more time passed since their last dose," Dr. Zerbo said. Among age-appropriately vaccinated children between the ages of 19 months and 7 years the risk of pertussis was 5 times higher when they were more than 3 years from their last vaccine dose. Notably, most children diagnosed with pertussis in the study were up to date on DTaP. Of 738 pertussis cases, 603 were fully vaccinated, 99 completely unvaccinated, and 36 were partially vaccinated but behind schedule.

These findings suggest that in a US population where vaccine coverage is high, waning DTaP effectiveness is a significant driver of outbreaks, including the 2010 and 2014 outbreaks in California that each resulted in more than 9,000 pertussis cases.

"The big question has been whether pertussis outbreaks are due to under-vaccination, as in other diseases like measles, or to waning immunity," said Nicola P. Klein, MD, Ph.D., senior study author and director of the Vaccine Study Center. "The answer is that both factors matter."

More research is needed to quantify the relative roles of vaccine waning and under-vaccination in pertussis outbreaks. Still, the new findings point to the need for a better vaccine that lasts longer between doses. Meanwhile, the authors emphasize that families and clinicians should continue vaccinating children according to the CDC's recommended schedule.

The researchers emphasize that those vaccinated had lower rates of pertussis than those not vaccinated at all.

"Despite increased media attention on parents choosing not to vaccinate, children in our study had high coverage, which was not completely surprising," Dr. Zerbo said. One percent of the children with pertussis were unvaccinated, and 3 percent were under vaccinated. "We need to continue to encourage vaccination, no doubt about it," he said.

This study builds on a growing body of research from the Vaccine Study Center beginning with a 2012 study in *New England Journal of Medicine* which found that protection against pertussis after 5 DTaP doses wanes rapidly among school age [children](#) who had only ever received DTaP vaccines. This was followed by 2016 and 2017 studies in *Pediatrics*, one which showed that the routine adolescent Tdap booster also wanes rapidly, and one which showed that Tdap given to pregnant women was highly effective in preventing pertussis in newborns.

Provided by Kaiser Permanente

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