BOSTON – The acellular pertussis vaccine's failure to deliver durable infection protection to children aged 7-10 years led to the 2010 California pertussis epidemic, and has prompted infectious diseases experts to question the current schedule of childhood pertussis vaccination.

"An increase in the risk of pertussis is occurring in the time since completion of the five-dose DTaP [diphtheria, tetanus, acellular pertussis] series, with similar trends seen in California, Minnesota, and Oregon," Sara Tartof, Ph.D., said at the annual meeting of the Infectious Diseases Society of America.

"Continued evaluation of DTaP duration of protection is needed to determine the appropriateness of timing of pertussis vaccinations," said Dr. Tartof, an epidemic intelligence officer in the Centers for Disease Control and Prevention’s National Center for Immunization and Respiratory Diseases in Atlanta.

Dr. Tartof and a second CDC researcher presented results from two independent studies that both showed children faced a substantially increased rate of pertussis infection 4 or more years out from their fifth and final childhood vaccination, which these days usually occurs when U.S. children are 4 years old. Recent surges in U.S. pertussis cases, which began in 2005, and then spiked even higher in 2010, implicated the acellular vaccine as the cause.

"It certainly caused the 2010 California epidemic, and it happened in Minnesota and Oregon, too. Waning immunity with acellular pertussis led to greater vulnerability in 7- to 10-year-olds," commented Dr. Kathryn M. Edwards, director of the Vaccine Research Program at Vanderbilt University, Nashville, Tenn.

"The durability of protection with the acellular vaccine is not as good as with the whole-cell vaccine, but the problem with the whole-cell vaccine was that it was quite reactive," causing fevers and local reactions, she said in an interview.

"At this point, people would not accept the whole-cell vaccine," she said. Possible options include additional boosted vaccinations, or moving administration of the fifth childhood dose of DTaP from age 4 to age 6. The CDC’s recommended vaccination schedule already calls for delivery of the fifth dose at ages 4-6 years, but in reality most U.S. children receive it at age 4 when they enter preschool.

One of the CDC studies focused on pertussis cases that appeared in any of 15 California counties during the state’s 2010 epidemic. Chart reviews by CDC researchers identified 682 pertussis cases among children aged 4-10 years, and 2,016 unmatched controls from the same age group and counties. Roughly 70% of the children who had received all five scheduled doses had received their fifth dose at 4 years, and about 30% received their fifth dose at 5 years.

An analysis of the time elapsed following the fifth dose relative to when pertussis infection occurred showed that after 5 years the vaccine efficacy was 71% below where it stood immediately after the fifth dose, reported Lara K. Misegades, Ph.D., an epidemic intelligence officer also with the CDC’s National Center for Immunization and Respiratory Diseases.

This translated into a 15-fold higher relative risk for infection in children during the sixth year following their final dose, compared with the first 12 months after their fifth dose, Dr. Tartof said.

The second CDC study, presented by Dr. Tartof, used data collected by immunization registries and reports to the CDC through the National Notifiable Disease Surveillance System. This analysis included 224,378 fully immunized children and 521 pertussis cases in Minnesota, and 179,011 fully immunized children and 99 reported cases in Oregon.

Dr. Tartof and her associates used these data to calculate a pertussis incidence rate during each year following delivery of the fifth childhood dose, and the relative risk for infection during each follow-up year relative to the first 12 months after the fifth dose. The risk for infection rose steadily during each year following the fifth dose. (See table.)

Dr. Tartof, Dr. Edwards, and Dr. Misegades had no relevant disclosures.
Dr. Burt Lesnick, FCCP, comments: The failure of acellular pertussis vaccine, and the corresponding lack of herd immunity, presents a problem for patients of all ages. As the prevalence of pertussis increases in a population with waning immunity, we must be prepared for more disease in formerly atypical age groups.