

# A Population-Based Cohort Study of Undervaccination in 8 Managed Care Organizations Across the United States

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**Objectives:** To examine patterns and trends of undervaccination in children aged 2 to 24 months and to compare health care utilization rates between undervaccinated and age-appropriately vaccinated children.

**Design:** Retrospective matched cohort study.

**Setting:** Eight managed care organizations of the Vaccine Safety Datalink.

**Participants:** Children born between 2004 and 2008.

**Main Exposure:** Immunization records were used to calculate the average number of days undervaccinated. Two matched cohorts were created: 1 with children who were undervaccinated for any reason and 1 with children who were undervaccinated because of parental choice. For both cohorts, undervaccinated children were matched to age-appropriately vaccinated children by birth date, managed care organization, and sex.

**Main Outcome Measures:** Rates of undervaccination, specific patterns of undervaccination, and health care utilization rates.

**Results:** Of 323 247 children born between 2004 and 2008, 48.7% were undervaccinated for at least 1 day before age 24 months. The prevalence of undervaccination and specific patterns of undervaccination increased over time ( $P < .001$ ). In a matched cohort analysis, undervaccinated children had lower outpatient visit rates compared with children who were age-appropriately vaccinated (incidence rate ratio [IRR], 0.89; 95% CI, 0.89-0.90). In contrast, undervaccinated children had increased inpatient admission rates compared with age-appropriately vaccinated children (IRR, 1.21; 95% CI, 1.18-1.23). In a second matched cohort analysis, children who were undervaccinated because of parental choice had lower rates of outpatient visits (IRR, 0.94; 95% CI, 0.93-0.95) and emergency department encounters (IRR, 0.91; 95% CI, 0.88-0.94) than age-appropriately vaccinated children.

**Conclusions:** Undervaccination appears to be an increasing trend. Undervaccinated children appear to have different health care utilization patterns compared with age-appropriately vaccinated children.

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IMMUNIZATION IS ONE OF THE MOST significant public health achievements of the past 100 years. However, an increasing number of parents have expressed concerns about immunizations, and survey data<sup>1-5</sup> have shown that more than 10% of parents report delaying or refusing certain vaccinations for their children. These concerned parents often request alternative vaccination schedules that either increase the time between vaccinations or reduce the number of vaccinations in a single well-child visit. Despite their concerns, however, the safety of alternative vaccination schedules is not known.

In an observational setting, examining the safety of alternative vaccination schedules poses significant methodo-

logic challenges. First, identifying children on intentional alternative vaccination schedules may be difficult because there are many potential causes of undervaccination, including missed opportunities, barriers to health care, missing immunization records, and medical contraindication to vaccination. Because

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vaccine-hesitant parents have a wide range of opinions on the benefits and risks of vaccination, it is also likely that there are numerous alternative schedules to study. Finally, parents who delay or refuse vaccinations may exhibit different health care-

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