

Vaccine Coverage for United States Infants at Milestone Ages: Missed Opportunities for Vaccination

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Presented in part: IDWeek 2014, Philadelphia, PA.

Received October 1, 2015; accepted May 31, 2016; electronically published August 8, 2016.

We used a claims database to assess coverage for rotavirus (RV), diphtheria-tetanus-acellular pertussis, and pneumococcal conjugate vaccines among infants in the United States. Similar coverage was seen until 7 months of age, after which RV coverage lagged. Missed opportunities for vaccination at well-child visits were found to vary by age.

Key words. coverage rate; DTaP; missed opportunity; PCV; rotavirus vaccine.

Estimated coverage for rotavirus vaccine (RV) at 19 to 35 months of age, as assessed by the US National Immunization Survey (NIS), lags behind the other vaccines recommended at 2, 4, and 6 months of age [1]. In 2012 and 2013, coverage for ≥ 3 doses of diphtheria-tetanus-acellular pertussis vaccine (DTaP) and pneumococcal conjugate vaccine (PCV) each exceeded 90%, whereas coverage for RV was only 69% and 72.3% [2, 3]. Lower coverage for RV has also been observed in commercial insurance database assessments [4]. Coverage for RV falls short of the Healthy People 2020 objectives of 80% [5].

It is important to understand why coverage for RV is lower than for the 2 contemporaneously recommended vaccines. Identification of time periods during which RV coverage rates diverge could point to specific interventions [6, 7]. In the United States, the last dose of RV is not recommended beyond 8 months of age, whereas DTaP is routinely given up to 6 years of age and PCV up to 5 years of age. Our objective was to determine whether the discrepancy in coverage rates between RV and DTaP and PCV arises during the first 7 months of life, or whether it arises after 8 months of age, when there is opportunity for catch up with DTaP and PCV but not RV. We also examined missed vaccination opportunities in practitioners' offices [8–10].

METHODS

We conducted a retrospective longitudinal descriptive study using data from the Truven Health MarketScan

Commercial Claims and Encounters Database, which covers approximately 45 million individuals per year in the United States and includes private health sector data from approximately 100 payers. Our primary objective was to assess the coverage for the designated infant vaccines at the relevant milestone ages. The database contains deidentified, person-level data, including sociodemographic information, health plan eligibility, and healthcare utilization.

The study population included infants born between January 1, 2009 and May 31, 2012. Birthdates are not available in the deidentified database, so we used the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes for live-born infants (V30–V39) to infer birthdates. We included infants who had at least 13 months of continuous enrollment in a health plan from birth. Current Procedural Terminology (CPT) codes were used to identify the 3 vaccines, irrespective of brand name (RV, DTaP, and PCV), administered by the milestone ages of 3, 5, and 7 months and at 8 and 13 months of age during the catch-up period.

Descriptive statistics were generated. Vaccine coverage at each milestone age was computed as the proportion of all infants eligible for vaccination according to the Advisory Committee on Immunization Practices (ACIP)-recommended schedule who had received the vaccines. Coverage rates for the vaccines were stratified by variables such as year of birth, gender, geography, and provider type (defined as pediatrician,

family physician, or other and based on the physician who provided $\geq 70\%$ of healthcare to the patient), among others. Missed opportunities for vaccination in the outpatient setting were calculated for the first dose of RV as the proportion of infants who did not receive a vaccine during the time in which they were eligible to receive the vaccine (38 days through 104 days). Missed opportunities for the 2nd and 3rd doses were calculated as a proportion of all infants who missed either a 2nd or 3rd dose and had a well-child visit from 24 days after the 1st or 2nd dose until 8 months (the oldest age at which infants can receive a RV according to the ACIP). Of those infants who had a well-child visit but did not receive a RV, we also calculated the proportion who received either DTaP or PCV during 1 of the well visits.

RESULTS

Of approximately 1.4 million infants with birth codes, 410 410 had 13 months of continuous enrollment and formed the basis for our study population. The study population was 52% male; 36%, 29%, 23%, and 12% were born in 2011, 2010, 2009, and 2012 (up to May 31, 2012), respectively. The mothers' mean age at delivery was 32 years, and the majority of mothers (64%) were 25 to 34 years of age. Thirty-eight percent, 30%, 20%, and 12% of the infants resided in the South, North Central, Northeast, and West regions of the United States, respectively. The majority of infants (69%) received their care from pediatricians; 6.7% received care from family practitioners, and 11% received care from other providers. Most of the study subjects had insurance coverage that was described as exclusive provider organization or preferred provider organization (69%) with health maintenance organization and point of service (POS) or POS with capitation constituting 11% and 7%, respectively.

We observed an increasing trend in vaccine coverage for RV, DTaP, and PCV between 2009 and 2011, with similar rates between 2011 and 2012. For infants born in 2011 and 2012, first dose coverage at 3 months of age for RV, DTaP, and PCV was 79%, 86%, and 82%, respectively. At 7 months of age, coverage for the last dose of RV (defined as the third dose of RV5 [RotaTeq, Rotavirus Vaccine, Live, Oral, Pentavalent, Merck & Co., Inc.] or the 2nd dose of RV1 [ROTARIX, Rotavirus Vaccine, Live, Oral, GlaxoSmithKline Biologicals]) and for 3 doses of DTaP and PCV, respectively, was 69%, 73%, and 69%. At 13 months of age, the respective coverage rates were 73%, 83%, and 84% (Figure 1).

Among 75 089 infants who never received a dose of RV, 75% had at least one well-child visit during the period in which they were age-eligible for the first dose (between 38 and 104 days of life). Of the 56 167 infants who

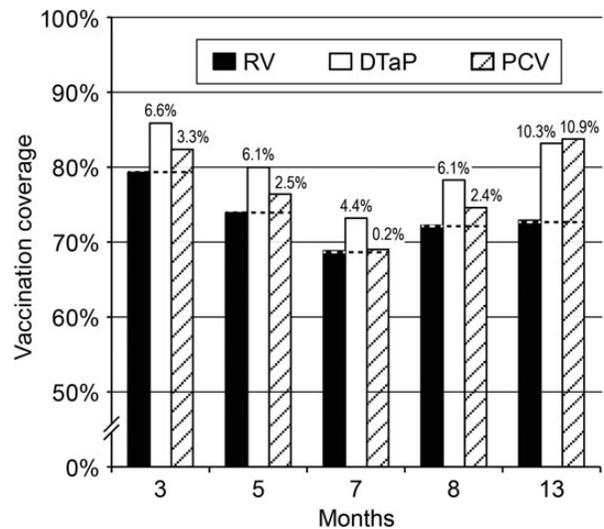


Figure 1. Vaccine coverage at milestone ages for infants born in 2011 and 2012. Abbreviations: DTaP, diphtheria-tetanus-acellular pertussis vaccine; PCV, pneumococcal conjugate vaccine; RV, rotavirus vaccine.

never received RV but had a well-child visit, 53% received a dose of DTaP, and 45% received a dose of PCV during the well-child visit during the time in which they were eligible to receive the 1st dose of RV.

A total of 58 339 infants (14% of original study population) started but did not complete the RV series. These infants missed either the 2nd dose of RV1 or RV5 or the 3rd dose of RV5. Forty-five percent of these infants had a well visit during the time period in which they could have received the 2nd or 3rd RV. Of those infants who had a missed opportunity for a 2nd or 3rd dose of RV, 72% received DTaP and 70% received PCV during 1 of those well visits.

DISCUSSION

Coverage rates in this study were similar to those reported in the NIS. For example, coverage for ≥ 2 doses of RV was 72.8% at 13 months of age in this commercial database, compared with 72.6% at 19 to 35 months of age in NIS 2013 [2].

US National Immunization Survey coverage rates at 19 to 35 months of age potentially mask discrepancies in coverage at earlier milestone age time points. By evaluating coverage rates at younger milestone ages, we were able to uncover the point in time when RV coverage rates begin to diverge from other infant vaccines. Coverage rates for RV, compared with DTaP and PCV, were slightly lower for the 1st dose, but the differences were smaller by the 7-month milestone. Vaccine coverage then diverged thereafter—DTaP and PCV coverage rates increased steadily after 7 months of age, whereas RV coverage remained flat. US National Immunization Survey milestone coverage

estimates for DTaP and PCV are available on the NIS website, and RV vaccine milestone coverage is available for 7 months starting in 2013, but not for earlier ages [11].

We also identified missed opportunities for vaccination. Of all infants who never received any RV, 75% had at least 1 well-child visit during the time in which they were eligible for the first dose. Among infants who never received a 2nd or 3rd dose of RV, only 45% had a well-child visit during the time in which they were eligible for those doses. These results indicate (1) that the reasons for failing to receive a dose of RV may be age dependent and (2) that there is less opportunity to provide RV due to narrow age windows.

The findings of this study should be robust given the large size of the database. Potential limitations include lack of generalizability to noncommercially insured children and the possibility that vaccine doses derived from CPT codes were inaccurate. In addition, birth dates may have been inaccurate because they were inferred from ICD-9-CM codes for live births. However, a pilot validation study matching the infant's birth with the mother's date of delivery showed a high positive predictive value (data not shown).

Another limitation is that geographic representation within the study cohort is also variable and does not represent the general population distribution in the United States. It is also possible that states with universal purchase for vaccines have different billing patterns than other states, which would impact capture of vaccine claims. We did complete a sensitivity analysis in which we excluded the 13 universal purchase states from the analysis and found the results to be similar to the national estimates.

CONCLUSIONS

Rotavirus vaccines have substantially reduced disease burden in the United States since they were first introduced in 2006 [12], but coverage for RV is somewhat lower during the first 6 months of life and diverges further from other infant vaccines after 7 months of age due to missed opportunities for vaccination as well as the absence of catch-up opportunities. Interventions, including taking advantage of all well-child visits as opportunities for vaccination, should target the first 6 months of life, specifically the first 3 months of age or the time of the first vaccination visit.

Acknowledgments

Potential conflicts of interest. M. A. O., M. G. G., and D. Z. are employees of Merck & Co. Inc, a manufacturer of rotavirus vaccine. B. G. G. completed this work as part of a research fellowship with Merck & Co Inc. G. S. M. has served on advisory boards for Merck & Co Inc. All other authors report no potential conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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