

COMMENTARY

 OPEN ACCESS 

Improving childhood vaccination coverage rates: the case of fourth dose of DTaP

Sarah J. Clark ^a, Anne E. Cowan ^a, and Katelyn Wells^b

^aSusan B. Meister Child Health Evaluation and Research (CHEAR) Center, University of Michigan, Ann Arbor, MI, USA; ^bAssociation of Immunization Managers, Rockville, MD, USA

ABSTRACT

Based on the most recently available national data, vaccination coverage for the combined seven-vaccine series recommended by age 24 months remains substantially below the Healthy People 2020 target of 80%. One focus for improvement is the lack of timely administration of the fourth dose of DTaP vaccine. Based on the perspective of state and local immunization program managers, key strategies include tracking immunization patterns through immunization information systems and other data sources, working with health-care providers to address challenges to timely vaccination, and developing partnerships with daycares, payers, and health systems.

ARTICLE HISTORY

Received 12 November 2019
Accepted 26 November 2019

KEYWORDS

Immunization; public health programs; DTaP vaccine; immunization information systems; childhood vaccination coverage

Childhood vaccination rates for the combined primary immunization series (informally known as “2-year-old rates”) were recently estimated at 68.5%,¹ substantially below the Healthy People 2020 target of 80% and below the level necessary for herd immunity to prevent outbreaks of vaccine-preventable diseases. Prior research has identified the fourth dose of DTaP (diphtheria-tetanus-acellular pertussis) vaccine as one of the main contributors to non-completion of the primary immunization series by 2 years of age.²

In June 2018, a group of immunization program managers, representing nine city/state public health programs, was convened to discuss how public health immunization programs could improve vaccination coverage rates for the primary immunization series, using the fourth dose of DTaP vaccine as an organizing theme. The in-person roundtable took place after the annual leadership conference of the Association of Immunization Managers (AIM). The convenience sample of participants had been invited by AIM staff and represented a range of experience as program manager, as well as geographic diversity. One of the authors (SJC) facilitated the two-hour discussion, using a general guide of questions developed prior to the roundtable. All participants agreed to audiotaping of the discussion to enable accurate reporting. The audiotape was transcribed and the authors reviewed the transcript to summarize key observations.

Using data to understand the problem

Population-based estimates are an essential tool to understand vaccination coverage rates. For the primary immunization series, the National Immunization Survey (NIS) is the main data source for monitoring trends over time. The NIS provides annual national coverage estimates for the 2-year-old age group, as well as estimates for states and select cities; NIS estimates include completion of the recommended number of

doses for individual vaccines, such as completion of four doses of DTaP, as well as completion of the recommended doses of a group of several vaccines (“vaccine series”).

While immunization program managers acknowledged that NIS data present a high-level metric to track performance over time, the relatively small number of children (which results in large confidence intervals) and lack of local-area results limits the usefulness of NIS data for illuminating factors associated with under-immunization. From an operational perspective, immunization program managers described a need for more granular information that portrays the nuances of immunization delivery (e.g., the timing of specific doses, the simultaneous administration of different vaccines on the same day) and delineates subpopulations by geographic area and by provider or payer. The greater level of detail allows public health officials to better understand vaccination patterns by informing key questions, such as the specific age at which children begin falling behind on vaccines and which vaccines have a higher likelihood of non-completion; moreover, detailed data can help to pinpoint small geographic areas – or even specific practices – with lower coverage rates.

Many immunization program managers noted that they can access such detailed data through their jurisdiction’s immunization information system (IIS). IIS are population-based public health registries of the immunization doses received by persons residing in a given jurisdiction, including forecasting of future doses based on a person’s vaccine history. However, data completeness and functionality vary across IIS in different jurisdictions. Among program managers with well-populated and high-functioning IIS, childhood vaccine coverage rates generated from IIS data are viewed as more accurate than NIS data, since IIS data represent the full population of young children residing in the jurisdiction. Moreover, many IIS can generate coverage rates

by county or even census tract, based on address information, to highlight variability across geographic areas in the timing of the fourth dose of DTaP. Finally, because IIS allow immunization program managers to query immunization data at any time, results may be viewed as being very timely, and thus more reflective of current practice patterns than NIS data.

In jurisdictions where the IIS has problems related to data incompleteness, immunization program managers described their desire to identify alternate data sources that would provide reliable information about subpopulations of children. Third-party payers (i.e., public or private insurance plans) are a valuable source of data because they represent a well-defined population of enrolled children. For example, one program manager had recently learnt that the state's Medicaid managed care plans were required to generate immunization coverage estimates in each county where they were operating; the program manager felt that having access to these data, particularly if it included individual vaccines such as completion of the fourth dose of DTaP, would help in identifying areas with the lowest immunization rates. Unfortunately, payer data is often proprietary, even for aggregate reports, which impedes the sharing of data with public health officials.

Another data source in some jurisdictions is kindergarten vaccination rates which are linked to school entry vaccination requirements. Although kindergarten rates can reflect geographic variation, the timeframe for data collection is several years past the recommended age for the fourth dose of DTaP, thus limiting their usefulness for identifying vaccination patterns associated with this specific dose.

Working with providers to improve vaccine administration

Immunization program managers emphasized that their main strategy to improve childhood vaccination coverage rates involves working directly with public and private immunization providers. Young children are seen primarily in primary care pediatric and family medicine practices, most of which are known to the public health immunization program through their participation in the Vaccines for Children (VFC) program.³ Immunization program staff are required to visit a portion of VFC clinics each year to review vaccination coverage rates and discuss strategies for improvement; these VFC site visits typically focus on the 2-year-old vaccination coverage rates.

Immunization program managers described common provider challenges with the fourth dose of DTaP vaccine that their staff have identified during site visits. The first involves provider confusion about when to administer the fourth dose of DTaP. The CDC's childhood immunization schedule recommends administration of the fourth dose of DTaP vaccine at 15–18 months,⁴ but allows for administration as early as 12 months. However, there must be a minimum interval of 6 months between the third and fourth doses; administering the fourth dose before that required interval results in an invalid dose that must be repeated. Many children have a well-child visit near their first birthday; whether a child is eligible to receive the fourth dose of DTaP at that visit

depends on whether the 6-month interval has passed. There are existing resources to guide providers, such as IIS forecasting algorithms that give the date a child is eligible for a particular vaccine dose based on that child's history of prior doses. However, immunization program managers noted that many practices do not routinely query the IIS, but instead have staff perform a manual review of the child's immunization needs, which can result in inaccurate decisions about what vaccines to administer if the staff member does not fully understand the schedule. Immunization program managers said they address this common challenge by taking time during VFC site visits to emphasize the importance of querying the IIS to get an accurate forecast of what doses the child should receive. To address the volume of questions from practices that did not use IIS-based forecasting, one immunization program manager described the development and dissemination of a simplified schedule to guide the timing of the fourth dose of DTaP and noted that it has decreased the number of calls for clarification.

Another challenge occurs when children are delayed in receiving their first three doses of DTaP, and therefore are not eligible for the fourth dose at their one-year visit. Although the CDC's childhood immunization schedule recommends administration of the fourth dose of DTaP vaccine at 15–18 months, immunization program managers noted that 15 months is not an established visit at many child health practices, even though it is included in the American Academy of Pediatrics' recommended schedule for well-child care.⁵ Even more worrisome is that some practices do not consistently schedule an 18-month well-child visit, in which case, children who do not receive the fourth dose of DTaP at 1 year of age may go a full year before the next dose. Immunization program managers noted that during VFC site visits, program staff talk with providers about their regular schedule of well-child visits in the second year of life, and how visits at 15 and 18 months offer more timely opportunity for DTaP vaccine administration.² Immunization program managers also agreed that recent attention to developmental screening,⁶ particularly recommendations for autism screening at 18 months,⁷ may provide an impetus for more consistent scheduling of well-child visits in the second year of life.

A third challenge involves the failure of immunization providers to administer all recommended doses at a visit, which is termed a missed opportunity for simultaneous administration. Missed opportunities have been shown to be a substantial contributor to low coverage rates for the fourth dose of DTaP vaccine.^{2,8} During site visits, immunization program staff often review data from the IIS or the practice's medical records to identify missed opportunities, and then explore whether the problem resulted from incorrect forecasting, parent refusal of one of the vaccines, or provider decision to delay vaccine administration.

A final challenge involves the failure of immunization providers to utilize a technique called reminder/recall. Shown to be effective in improving immunization rates,⁹ reminder/recall involves identifying children who are due or overdue for a vaccine dose, and then notifying parents (such as by mail or telephone) to bring the child in for vaccination.

Reminder/recall is a particularly useful technique for the fourth dose of DTaP vaccine, due to the 6-month interval and the limited number of well-child visits for catch-up. Immunization program managers noted that their staff typically discuss reminder/recall during site visits, but a common response from immunization providers is that there is insufficient time and technical capacity for this activity. For this reason, several immunization program managers described efforts to conduct centralized reminder/recall campaigns for all children in the jurisdiction, based on IIS data, for doses recommended in the second year of life.

Partnerships to promote completion of the primary series

Immunization program managers described partnerships that have been, or could be, helpful in facilitating completion of the primary immunization series, including the fourth dose of DTaP vaccine. Immunization program managers identified payers, both public and private, as key partners in several respects. First, payer reimbursement policies can affect immunization delivery patterns. For example, immunization program managers noted that payer policies limiting the number of vaccine administration fees in a single visit may prompt providers to spread vaccine administration across several visits, rather than administering all eligible vaccines on the same date; delaying some vaccines to a later visit has been linked to lower immunization rates.¹⁰ Similarly, when reimbursement amounts for vaccine administration are the same for combination vaccines as for single-antigen vaccines, it may serve as an incentive for providers to administer multiple single-antigen vaccines,¹¹ even though combination vaccines are associated with improved immunization rates. In addition, if reimbursement for primary care is based solely on capitation rates, providers have little incentive to schedule additional visits to ensure that children are up-to-date on immunizations. Several immunization program managers expressed the importance of working with payers to change reimbursement policies that detract from timely and efficient immunization delivery.

Immunization program managers described quality measurement as a more positive aspect of partnerships with payers. There are several established childhood immunization measures, as well as measures for receipt of well-child visits. Many payers offer financial incentives for providers who achieve a certain immunization rate. Some payers offer assistance in identifying children at risk of not meeting a quality measure, and may conduct outreach to parents to encourage them to schedule an immunization visit. Immunization program managers appreciated these efforts to promote timely immunization, but several noted that quality measures typically focus on children with 11 months of enrollment in a particular health plan, so that children who change insurance plans and/or who are not in managed care plans may not benefit from measurement and follow-up. Immunization program managers expressed particular concern about drop-off in Medicaid enrollment around 1 year of age, and its negative impact on children's ability to receive the fourth dose of DTaP at the recommended ages.

Overall, immunization program managers expressed a desire for broader collaborations with payers. Key areas

for expanded partnerships include data sharing with the IIS, sharing of quality measurement results, identifying pockets of low immunization rates, and shared quality improvement projects targeting underperforming practices. More generally, immunization program managers felt that any opportunity for ongoing dialogue with payers is likely to be beneficial.

Partnerships with health systems were mentioned as a relatively recent strategy for several immunization programs. While VFC site visits have often been focussed on independent pediatric and family medicine practices, an increasing proportion of primary care sites are integrated within larger health systems. These systems typically institute a consistent approach across all practice sites with regard to medical records, vaccine ordering and management, IIS data reporting, and other relevant processes. Immunization program managers noted that partnerships with health systems may eschew individual practice site visits in favor of a system-level focus, such as working with a system champion for immunization to improve immunization administration across all sites.

A final partnership mentioned by immunization program managers involves daycare providers and state regulatory agencies. Many states have immunization requirements for children who attend daycare, but with limited enforcement. For example, immunization requirements may be enforced at a child's initial enrollment, with no system for annual review of immunization records to ensure that the child is up-to-date. In some states, immunization requirements are enforced for daycare centers, but not home daycares. In expanding partnerships around daycare requirements, one immunization program manager described a multi-component strategy to work with the state's licensing agency to emphasize the importance of annual review of immunization status, followed by efforts to train daycare providers to use the IIS to facilitate the review. Other immunization program managers described taking a positive approach to daycare partnerships, such as offering recognition to daycares that achieve a high level of compliance, and using quality improvement techniques to help daycare providers become more efficient in reviewing immunization records.

Summary

Public health immunization programs play an integral role in improving childhood immunization rates, including more timely administration of the fourth dose of DTaP. Key strategies include tracking immunization patterns through IIS and other data sources, working with providers to improve timely vaccination, and partnering with daycares, payers, and health systems.

Abbreviations

AIM	Association of Immunization Managers
CDC	Centers for Disease Control and Prevention
DTaP	Diphtheria-tetanus-acellular pertussis
IIS	Immunization information systems
NIS	National Immunization Survey
VFC	Vaccines for Children

Disclosure of potential conflicts of interest

The authors have indicated that they have no potential conflicts of interest to disclose.

Funding

The Association of Immunization Managers received an educational grant from Sanofi Pasteur in support of this project.

Financial Disclosure

The authors have indicated that they have no financial relationships relevant to this article to disclose.

ORCID

Sarah J. Clark  <http://orcid.org/0000-0002-8859-731X>
Anne E. Cowan  <http://orcid.org/0000-0003-2754-6882>

References

- Hill HA, Singleton JA, Yankey D, Elam-Evans LD, Pingali SC, Kang Y. Vaccination coverage by age 24 months among children born in 2015 and 2016 — National Immunization Survey-Child, United States, 2016–2018. *MMWR Morb Mortal Wkly Rep.* 2019;68:913–18. doi:10.15585/mmwr.mm6841e2.
- Robinson SG. Incomplete early childhood immunization series and missing fourth DTaP immunizations; missed opportunities or missed visits? *ISRN Prev Med.* 2013. doi:10.5402/2013/351540.
- Centers for Disease Control and Prevention. Vaccines for children program (VFC): About VFC. [accessed 2019 May 10]. <https://www.cdc.gov/vaccines/programs/vfc/about/index.html>.
- Centers for Disease Control and Prevention. Recommended child and adolescent immunization schedule for ages 18 years or younger, United States. 2019 [accessed 2019 May 10]. <https://www.cdc.gov/vaccines/schedules/downloads/child/0-18yrs-child-combined-schedule.pdf>.
- American Academy of Pediatrics. Bright futures/AAP recommendations for preventive pediatric health care (Periodicity schedule). [accessed 2019 Nov 11]. https://www.aap.org/en-us/Documents/periodicity_schedule.pdf.
- Hirai AH, Kogan MD, Kandasamy V, Reuland C, Bethell C. Prevalence and variation of developmental screening and surveillance in early childhood. *JAMA Pediatr.* 2018;172(9):857–66. doi:10.1001/jamapediatrics.2018.1524.
- Johnson CP, Myers SM. Identification and evaluation of children with autism spectrum disorders. *Pediatrics.* 2007;120(5):1183–215. doi:10.1542/peds.2007-2361.
- Zhao Z, Smith PJ, Hill HA. Missed opportunities for simultaneous administration of the fourth dose of DTaP among children in the United States. *Vaccine.* 2017;35(24):3191–95. doi:10.1016/j.vaccine.2017.04.070.
- Jacobson Vann JC, Jacobson RM, Coyne-Beasley T, Asafu-Adjei JK, Szilagyi PG. Patient reminder and recall interventions to improve immunization rates. *Cochrane Database Syst Rev.* 2018;1:CD003941. doi:10.1002/14651858.CD003941.pub3.
- Zhao Z, Smith PJ, Hill HA. Evaluation of potentially achievable vaccination coverage with simultaneous administration of vaccines among children in the United States. *Vaccine.* 2016;34(27):3030–36. doi:10.1016/j.vaccine.2016.04.097.
- Clark SJ, Cowan AE, Freed GL. Private-sector vaccine purchase costs and insurer payments: a disincentive for using combination vaccines? *Hum Vaccin.* 2011;7(4):426–28. doi:10.4161/hv.7.4.14122.