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Short communication

Variation in rotavirus vaccination coding in state US Medicaid data

J. Bradley Layton [a,b,*], Anne M. Butler [c], M. Alan Brookhart [b], Catherine A. Panozzo [d]

[a] RTI Health Solutions, Research Triangle Park, NC, USA
[b] Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA
[c] Departments of Medicine and Surgery, Washington University School of Medicine in St. Louis, St. Louis, MO, USA
[d] Department of Population Medicine, Harvard Pilgrim Health Care Institute and Harvard Medical School, Boston, MA, USA

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ABSTRACT

Differences in state Medicaid policies and practices may result in variation in the recording of individual-level vaccination claims, which may present challenges for vaccination research using state Medicaid data. We describe differences in procedure coding for rotavirus vaccination in four states' Medicaid programs by identifying rotavirus vaccine–specific codes and oral vaccine administration codes. The proportion of vaccinated children with vaccine-specific and oral vaccine administration codes differed substantially across states: two states used vaccine-specific codes almost exclusively (95.9% and 99.0%); one had exclusively oral vaccine administration codes (>99.9%); another had a mixture (32.1% vaccine-specific codes, 40.0% oral vaccine administration codes, and 27.9% both). Depending on the research question, studies using Medicaid data in states without (or with incomplete) vaccine-specific coding may be infeasible. Prior to initiating research, investigators should carefully evaluate state Medicaid policies and patterns of vaccination uptake, as vaccine reimbursement policies and availability of vaccine claims may vary.

1. Introduction

State-based Medicaid programs provide health care coverage for individuals with low income in the United States (US), and state Medicaid claims databases may be an attractive option for research into childhood vaccination use, safety, or effectiveness. Many states' programs prioritize coverage of pregnant women and children, and the US Centers for Medicare & Medicaid Services (CMS) reports that approximately 37 million children were enrolled annually in Medicaid programs during 2016 and 2017 [1]. In Federal Fiscal Year 2013, the Kaiser Family Foundation reported that 48% of US children 0–18 years old were enrolled in a Medicaid plan, with enrollment ranging from 34% in Vermont and New York to 65% in Texas [2]. Medicaid programs are administered independently by each state, but despite federal standards and guidelines, differences in the organization, implementation, eligibility criteria, and coverage of state Medicaid plans may result in variation in the reimbursement and recording of vaccination claims. For example, some states' Medicaid data may lack individual-level vaccination claims if plans do not reimburse for individual vaccines (e.g., by providing prepaid vaccines directly to providers) or if only general, vaccine administration codes are required for billing. These differences may provide challenges when harmonizing analytic approaches and interpreting results across multi-state analyses. A better understanding of the variation of vaccination records across states may inform researchers contemplating the use of Medicaid data for childhood vaccination research.

We sought to illustrate how state-specific factors may influence the recording of childhood vaccinations. As an example, we evaluated state-level differences in the use of vaccine-specific billing codes and vaccine administration codes for rotavirus vaccines in four states' Medicaid data—two large states, California and Texas; and two medium-sized states, Georgia and North Carolina.

2. Materials and methods

We utilized data from the CMS Medicaid Analytic Extract for Medicaid programs from four US states with varying levels of children enrolled in Medicaid: 2013 estimates of state-level enrollment are 38% (California), 65% (Texas), 59% (Georgia), and 53% (North Carolina) [2]. We identified infants born between January 1, 2010, and June 30, 2010 with 6 months of continuous enrollment in a Medicaid plan after birth without concurrent coverage by another insurer.

* Corresponding author at: 200 Park Offices Dr., PO Box 12194, Research Triangle Park, NC 27709-2194, USA.
E-mail addresses: jblayton@rti.org (J.B. Layton), anne.butler@wustl.edu (A.M. Butler), abrookhart@unc.edu (M.A. Brookhart), Catherine_Panozzo@harvardpilgrim.org (C.A. Panozzo).

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We identified all rotavirus vaccine–related claims in the cohort during the first 6 months of each child's life and categorized each claim as either vaccine specific or vaccine administration. Rotavirus vaccine is available in two oral forms: a 2-dose, monovalent vaccine (RV1) series recommended at 2 and 4 months; and a 3-dose, pentavalent vaccine (RV5) series recommended at 2, 4, and 6 months. There are Current Procedural Terminology (CPT) procedure codes specific to each rotavirus vaccine and separate CPT procedure codes for the administration of an oral or intranasal vaccine (Table 1); rotavirus vaccines are the only oral or intranasal vaccines licensed and recommended for routine use in US infants aged <1 year as the oral polio vaccine is no longer recommended in this age group [3], so we assumed all oral/intranasal administration codes were for rotavirus vaccines.

We allowed multiple claims per infant, including closely spaced codes and those received on the same day. We calculated the proportion of eligible newborns with claims for any rotavirus vaccination, overall and by state. Analyses were stratified by code types.

To evaluate whether one vaccination could result in multiple code types, we defined individual vaccination events within a child's claims as discrete 7-day periods during which at least one rotavirus-related vaccine code was present (Fig. 1). A period began at the first occurrence of any rotavirus-related code, and all codes occurring in the following 7 days were assumed to have resulted from the same vaccination event. During these periods, we described whether a vaccination event resulted in a vaccine-specific code only, vaccine administrative code only, or both, using the vaccination event as the unit of analysis, rather than the child.

This analysis of deidentified data was approved by the University of North Carolina at Chapel Hill Institutional Review Board. All analyses were performed with SAS 9.3 (SAS Institute, Cary, NC).

3. Results

During the first 6 months of 2010, we identified 378,101 newborns across the four states, of whom 273,312 (72.3%) were continuously enrolled for 6 months in Medicaid without additional insurance coverage. The proportion of newborns meeting eligibility criteria differed across states, ranging from 64.7% in Texas to 86.5% in North Carolina. Among all eligible infants, 162,277 (59.4%) had at least one claim for a rotavirus vaccine–related code, with state-specific proportions ranging from 44.0% in North Carolina to 69.6% in Georgia (Fig. 2).

We identified 259,857 unique vaccination events (approximately 1.6 events per vaccinated child). The distribution of vaccination code types differed widely across states (Table 2); vaccine-specific codes were used almost exclusively in Georgia (99.1%) and California (96.7%), whereas vaccination administration codes were used almost exclusively in North Carolina (>99.9%). In California, Georgia, and North Carolina, almost all vaccination events resulted in only a single billing code. In Texas, however, 27.9% of vaccination events resulted in both a vaccine-specific and an oral vaccine administration code within 7 days of each other, with the remainder of vaccination events having only a single code split between vaccine-specific codes alone (32.1%) or vaccine administration codes alone (40.0%).

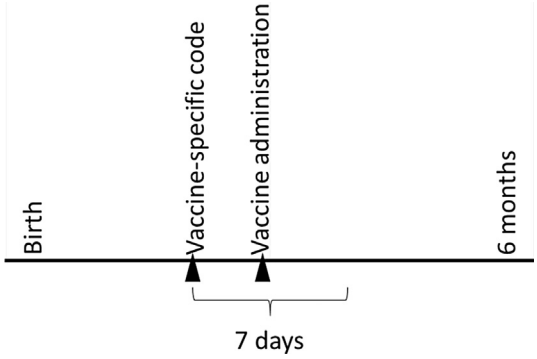

Fig. 1. A single vaccination event resulting in two rotavirus-related codes.

4. Discussion

In our evaluation, we observed substantial differences across states in the recording of rotavirus vaccination in Medicaid claims. Georgia and North Carolina had a much higher proportion of children meeting 6-month enrollment criteria, and Texas and Georgia had vaccination claims recorded in 10–20% more infants than did California or North Carolina. Rotavirus vaccination coding practices also differed between states, with vaccine-specific CPT codes used almost exclusively in California and Georgia, somewhat in Texas, and almost never in North Carolina. These coding practices may have substantial impact on the feasibility of identifying vaccination events in some states' data.

Previously, researchers have evaluated rotavirus vaccination in Medicaid data [4,5], with one study of four states reporting 60% of infants receiving at least one dose of rotavirus vaccine during the years 2008–2013 (exact years vary by state) [4] and another in a combined data set of 10–13 states (selected states change annually) with approximately 57%-60% receiving at least one dose during the years 2008–2012 [5]. Both studies used vaccine-specific codes to categorize vaccine doses as RV1 or RV5. Oral administration codes do not identify the specific vaccine administered; however, not considering administration codes may result in misclassification of vaccinated infants as unvaccinated, depending on the state policy for the years analyzed.

Our observed proportion of infants receiving rotavirus vaccination was similar to that in previously cited manuscripts that used Medicaid data, but was slightly lower than that in a commercially insured US population during a similar time period [6]; Panozzo et al. [6] reported a national rate of 69% of infants receiving at least one rotavirus vaccine dose by age 11 months during the years 2006–2010: we observed 59% by 6 months. Although the difference may be partially explained by the differences in the

Table 1
Rotavirus vaccination current procedural terminology (CPT) procedure codes.

Code Type	Code	Description	Vaccine product
Vaccine specific	90680	Rotavirus vaccine pentavalent 3-dose live oral	RV5
Vaccine specific	90681	Rotavirus vaccine human attenuated 2-dose live oral	RV1
Vaccine administration	90473	Immunization administration by intranasal or oral route; 1 vaccine (single or combination vaccine/toxoid)	Unknown
Vaccine administration	90474	Immunization administration by intranasal or oral route; each additional vaccine (single or combination vaccine/toxoid)	Unknown

RV5, pentavalent rotavirus vaccine; RV1, monovalent rotavirus vaccine.

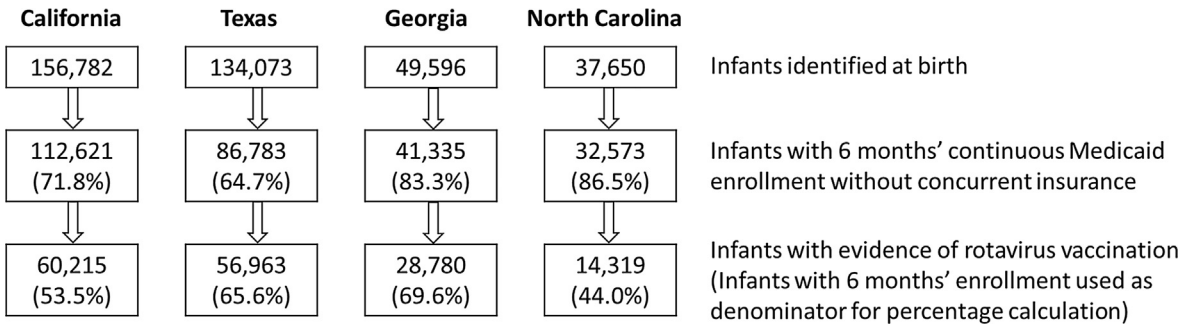

Fig. 2. Newborn enrollment and vaccination claims of newborns born January 1, 2010, through June 30, 2010, enrolled in four states' Medicaid programs.

Table 2
Rotavirus vaccination coding characteristics among unique vaccination events arising from infants born January 1, 2010, to June 30, 2010, in four states' Medicaid programs.

	California	Texas	Georgia	North Carolina
Vaccination events, n[a]	90,127	94,886	49,829	25,015
Number of rotavirus-related procedure codes per vaccination event, %				
1	95.9	72.1	99.0	99.8
≥2	4.1	27.9	1.0	0.2
Type of procedure codes per vaccination event, %				
Vaccine-specific codes alone	96.7	32.1	99.1	<0.1
Vaccine administration codes alone	0.2	40.0	<0.1	>99.9
Both	3.1	27.9	0.9	0.0

[a] Unique, 7-day periods in an infant's record during which at least one rotavirus-related vaccination code was present.

considered ages (infants may receive doses of rotavirus vaccine as late as 8 months), actual differences in vaccination series completion rates between commercially insured and Medicaid populations have been reported by the National Immunization Survey [7].

There are many potential explanations for missing vaccination claims in Medicaid data. Vaccines may be administered to children of lower socioeconomic status through local or county health departments or other programs for low-income children without submitting claims to Medicaid. Additionally, many states' Medicaid plans employ managed care structures in which providers or systems receive bundled payments for the entirety of or a portion of a patient's care rather than for individual services; the prevalence of these plans may vary by state, within a state, and over time [8,9]. Additionally, managed care plans vary in the types of services covered (e.g., comprehensive managed care or only specialty-specific managed care), and individual vaccine claims may not be submitted and recorded for patients enrolled in some types of managed care plans. California, Georgia, and Texas all offered comprehensive managed care plans for children during the study period [10]. Researchers should consider enrollment in certain types of managed care plans that may prevent observing individual vaccination bills as a potential study exclusion criterion.

Most vaccination events in each state resulted in only a single rotavirus vaccination code, although whether that code was vaccine specific or vaccine administration varied by state. We observed that even if a rotavirus vaccine-specific code was not recorded, there still may have been evidence of vaccination in an oral vaccine administration procedure code. All states in the study participated in the Vaccines for Children (VFC) program, a federally funded program that provides vaccines free of charge to participating health care providers to administer to eligible children. Depending on state policies, however, individual-level claims for these vaccines may not be submitted to and recorded in Medicaid, although the fee for the administration may be; in our study, North Carolina demonstrated this pattern. We observed wide variation in the use of both the vaccine-specific and vaccine administration codes across states, and vaccine administration codes may be used to identify rotavirus vaccination in the absence of a vaccine-specific code (although RV5 could not be distinguished from RV1 using administration codes alone). For example, we demonstrated that up to 40% of vaccinations in Texas may not be accompanied by a vaccine-specific code, and without considering the oral vaccine administration codes, these events could be missed or misclassified. Infant rotavirus vaccination may be unique in this regard, as during the study period and in the population aged < 6 months, we can be reasonably sure that a code for the administration of an oral or intranasal vaccine must be indicate rotavirus vaccination; however, this would not apply to other vaccines, as non-specific CPT codes for administration of intramuscular vaccines or general vaccination (any route) would not provide the necessary granularity to identify the vaccine in the absence of the vaccine-specific code.

Our study illustrates widely different coding practices in state-level Medicaid data; however, these specific results may not be generalizable to other states, other time periods, or infants without continuous Medicaid enrollment. These results illustrate the potential for differences in states and highlight the need to confirm data availability in advance of undertaking a study in Medicaid data. Our study evaluated only a single year of Medicaid data, so we were unable to evaluate changes over time; the enrollment eligibility limits as a function of the Federal Poverty Levels in the four included states did not change from 2005 to 2013 [11], although it is possible that specific, state-level, or plan-level reimbursement policies or coding practices changed over time.

5. Conclusions

Medicaid covers a large proportion of children in the US, and data from these individuals may be of great interest to researchers and public health authorities since they represent a relatively vulnerable population compared to commercially insured children. This study illustrated that the ability to identify infant vaccinations varied greatly between 4 states in 2010. While the specific patterns observed in this study may not be applicable to other states or time periods, they illustrate that high levels of managed care, universal

VFC programs, or lack of granular coding may reduce the availability of vaccination claims in Medicaid data, and these patterns may vary across states. Researchers considering the use of Medicaid data for vaccination research should consider the required data elements of the study, current and historical policies of the states during the study period, and patterns of coding to determine whether the necessary data would be available in the given state. Researchers should carefully investigate a state's Medicaid policies to ensure the availability of individual-level vaccine claims during the relevant study period, and vaccination-identification algorithms should reflect relevant coding practices and be clearly reported. As part of the eligibility criteria, researchers should require continuous coverage in a plan type that records individual vaccine claims, thereby avoiding underestimates of vaccination rates and misclassification of vaccination status.

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Declaration of interest

JBL is an employee of RTI International, an independent, not-for-profit research institute which performs research on behalf of governmental and commercial clients, including pharmaceutical companies; JBL performed this work while an employee of UNC where he received salary support from the Center for Pharmacoepidemiology in the UNC Department of Epidemiology; current member companies include GlaxoSmithKline, Merck, UCB Biosciences, and Shire. AMB has received investigator-initiated research support from Amgen and AstraZeneca. MAB has received research support from Amgen and AstraZeneca and has served as a scientific advisor for Merck, Amgen, and RxAnte; he also owns equity in NoviSci, LLC, a data sciences company. CAP: none to declare.

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