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RESEARCH ARTICLE

Tetanus, Diphtheria, and Acellular Pertussis Vaccination Coverage Among Publicly Insured Pregnant Women, U.S., 2016–2019

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Introduction: Vaccination with tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine during pregnancy is highly effective against *Bordetella pertussis* in young infants. We aimed to evaluate the uptake of maternal tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccination during the recommended gestation period of 27 through 36 weeks among women enrolled in a public medical insurance plan in the U.S.

Methods: In this analysis using Centers for Medicare and Medicaid Services insurance claims data, we identified women aged 15 through 49 years who delivered a live-born infant from 2016 through 2019. We identified claims for tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccination to calculate the proportion of women who were vaccinated during Weeks 27 through 36 of gestation in each calendar year. We also assessed the average annual maternal tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis coverage by age group, race and ethnicity, U.S. Census region of residence, and plan type. Data were analyzed in 2021.

Results: Among 4,318,823 deliveries, the 4-year national average for tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccination was 26%, improving from 22% in 2016 to 31% in 2019 ($p<0.001$). Within subgroups, the lowest 4-year average coverage was among women aged 15 through 18 years (22%); Black, non-Hispanic (23%) and Hispanic women (24%); those residing in the South (18%); those enrolled in a Children's Health Insurance Program plan (22%); and those covered by a fee-for-service plan (19%). Coverage increased across all subgroups from 2016 through 2019.

Conclusions: Although maternal tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis coverage among publicly insured women in the U.S. increased from 2016 through 2019, it remained considerably lower than estimated national coverage, with notable differences by race and ethnicity.
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INTRODUCTION

Despite consistently high vaccination coverage among children, pertussis continues to cause substantial morbidity in the U.S.; infants aged <1 year are at the highest risk of severe illness and death.[1] Since 2011, the Advisory Committee on Immunization Practices (ACIP) has

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recommended vaccination with tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap) during pregnancy to protect infants against pertussis during the first 2 months of life before infant vaccinations begin.[1–4] Vaccination is recommended during the third trimester of every pregnancy, preferably during the earlier part of Weeks 27 through 36 of gestation to optimize the transplacental transfer of maternal pertussis antibodies.[5] Although overall maternal Tdap vaccination uptake has gradually increased since 2011, estimated as 57% nationally in 2020,[6] notable differences have been reported by age, race and ethnicity, as well as insurance type[6–14]; lower coverage has been observed among publicly insured pregnant women than that among those with commercial insurance plans.

In the U.S., pregnant women below a certain income level can receive health insurance through public assistance programs such as state Medicaid or Children's Health Insurance Programs (CHIPs).[15–17] Coverage for routine prenatal care should include recommended maternal vaccinations without cost sharing.[18] States may choose to administer Medicaid benefits by paying providers directly through a fee-for-service (FFS) model or by contracting with managed care plans, on a set payment per member, to provide covered services and coordinate provider payments.

In 2019, 42% of all U.S. deliveries were billed to Medicaid.[19] Using Centers for Medicare and Medicaid Services (CMS) data, we examined maternal Tdap vaccination during Weeks 27 through 36 of gestation among U.S. women enrolled in a public health insurance plan. We examined the temporal trends in maternal Tdap coverage from 2016 through 2019 and described differences in coverage by selected characteristics.

METHODS

Study Sample

We used CMS Transformed Medicaid Statistical Information System Analytic Files for this analysis. CMS Transformed Medicaid Statistical Information System Analytic Files data include eligibility; enrollment; claims; and demographic information—including age, sex, and combined race and ethnicity—of persons enrolled in traditional Medicaid and CHIP plans, available in all the 50 states and the District of Columbia, and enrolled in Medicaid expansion plans in states providing that option as part of the 2010 Patient Protection and Affordable Care Act.[15–17] The data are deidentified by CMS for research purposes.[20]

Using ICD-10-CM diagnosis codes (Appendix Table 1, available online), we identified women aged 15–49 years enrolled in traditional Medicaid, CHIP, or Medicaid expansion plans, with at least 1 live birth delivery code in the 4 years of interest.[21,22] Owing to the lack of gestational age information in Medicaid claims data, deliveries were assumed to have taken place at 40 weeks (280 days). To provide sufficient time to determine whether Tdap was administered during the optimal window of 27 through 36 weeks gestation, we restricted the analysis to women who delivered in an inpatient hospital setting between April 1 and December 31 of each calendar year and required at least 3 months of continuous enrollment in the insurance plan before delivery.

Measures

Receipt of Tdap was defined as having at least 1 claim including either a Current Procedural Terminology code or National Drug Code for Tdap vaccine (Appendix Table 2, available online). We elected not to calculate vaccination coverage at any time during pregnancy because doing so may have resulted in the exclusion of up to 40% of women who did not have enough continuous enrollment time to include the whole pregnancy and because research suggests that the optimal window of 27 through 36 weeks gestation is now the most common time period for women to receive maternal Tdap vaccination.[3,4,12,13,23,24]

Statistical Analysis

To describe maternal Tdap coverage trends from 2016 through 2019, we calculated the proportion of women who received Tdap during Weeks 27 through 36 of pregnancy in each year as well as the 4-year national average for publicly insured pregnant women. We further described maternal Tdap coverage by age, combined race and ethnicity, enrollment type (traditional Medicaid, CHIP, or Medicaid expansion), plan type (managed care or FFS), and U.S. Census region. The Cochran–Armitage trend test was used to evaluate changes in national coverage over time and within subgroups between 2016 and 2019; $p<0.05$ was considered significant. Analyses were conducted in 2021 with SAS 9.4 (Cary, NC). The deidentified data used for this analysis reside in a CMS Privacy Act System of Records; therefore, a human subjects research determination was not required for this study.

RESULTS

Among 4,913,355 deliveries identified from 2016 through 2019, a total of 4,319,823 (88%) met the study criteria. In the 4 calendar years, most pregnant women included in the study were aged 19–29 years (average of 65%), enrolled in traditional Medicaid (average of 87%), and enrolled in a managed care plan (average of 93%); the highest proportion of whom included pregnant women who resided in the South (average of 44%) (Table 1). Of note, race and ethnicity data were missing for 639,349 (15%) of deliveries (ranging from 13% to 17% across the study period) because not all states collect this information and because technical difficulties may have prevented states from transmitting complete data on race/ethnicity to CMS.[25] Among the deliveries with complete race and ethnicity information, 41% of pregnant women were non-Hispanic White, 24% were non-Hispanic Black, and 28% were Hispanic.

The 4-year national average for maternal Tdap vaccination among publicly insured pregnant women during Weeks 27 through 36 of gestation was 26% and varied

Table 1. Characteristics of Publicly Insured Pregnant Women With Livebirth Deliveries Between 2016 and 2019, U.S.

Characteristics	2016 total, *n* (%)	2017 total, *n* (%)	2018 total, *n* (%)	2019 total, *n* (%)
Total	1,116,355	1,095,176	1,062,128	1,046,164
Age category (years)				
15–18	47,811 (4.3)	43,643 (4.0)	40,173 (3.8)	37,870 (3.6)
19–29	742,038 (66.5)	721,309 (65.9)	687,639 (64.7)	667,598 (63.8)
30–39	303,833 (27.2)	306,382 (27.9)	309,928 (29.2)	315,441 (30.2)
40–49	22,673 (2.0)	23,842 (2.2)	24,388 (2.3)	25,255 (2.4)
Race/ethnicity[a]				
American Indian/Alaska Native, non-Hispanic	17,648 (1.9)	18,072 (1.9)	17,521 (1.9)	17,292 (2.0)
Asian, non-Hispanic	37,702 (4.1)	35,834 (3.8)	33,663 (3.7)	31,847 (3.6)
Black, non-Hispanic	216,155 (23.2)	226,144 (23.9)	222,092 (24.3)	218,004 (24.6)
Hawaiian/Pacific Islander, non-Hispanic	5,753 (0.6)	7,367 (0.8)	6,910 (0.8)	5,949 (0.7)
Hispanic, all races	264,275 (28.4)	261,304 (27.6)	252,549 (27.6)	247,838 (27.9)
Multiracial, non-Hispanic	3,304 (0.4)	4,119 (0.4)	3,645 (0.4)	3,565 (0.4)
White, non-Hispanic	386,702 (41.5)	394,600 (41.7)	377,786 (41.3)	362,834 (40.1)
Missing	184,816 (–)	147,736 (–)	147,962 (–)	158,835 (–)
Enrollment type				
Medicaid expansion	86,431 (7.7)	86,467 (7.9)	78,640 (7.4)	85,838 (8.2)
Traditional Medicaid	970,210 (86.9)	950,098 (86.8)	926,774 (87.3)	897,141 (85.8)
Children's Health Insurance Program	59,714 (5.4)	58,611 (5.4)	56,714 (5.3)	63,185 (6.0)
Plan type				
Fee-for-service	85,785 (7.7)	80,307 (7.3)	71,859 (6.8)	53,844 (5.2)
Managed care	1,030,570 (92.3)	1,014,869 (92.7)	990,269 (93.2)	992,320 (94.9)
U.S. Census region				
Northeast	155,858 (14.0)	155,876 (14.2)	149,276 (14.1)	145,124 (13.4)
Midwest	230,444 (20.7)	221,899 (20.3)	215,602 (20.3)	209,848 (20.1)
South	479,302 (42.9)	473,266 (42.2)	468,183 (44.1)	461,053 (44.1)
West	250,751 (22.5)	244,135 (22.3)	229,067 (21.6)	230,139 (22.0)
Tdap vaccination[b]	244,107 (21.2)	273,758 (23.2)	294,734 (27.7)	326,697 (31.2)

Note: Publicly insured were identified from the Centers for Medicare and Medicaid Services Transformed Medicaid Statistical Information System Analytic Files.
[a]Among women with complete race and ethnicity data; 931,539 (83.4%); 947,440 (86.5%); 914,166 (86.1%); and 887,329 (84.8%) in 2016, 2017, 2018, and 2019 respectively.
[b]Received tetanus, diphtheria, and acellular pertussis vaccine during gestational Weeks 27 through 36.

substantially within subgroups (Appendix Table 3, available online). By age, coverage ranged from a high of 27% in women aged 30–39 years to a low of 22% in women aged 15–18 years. Coverage was lower among non-Hispanic Black women (23%) and Hispanic women (24%) than among non-Hispanic White women (29%). Non-Hispanic Hawaiian and Pacific Islander women had the highest coverage (38%) across all racial and ethnic groups. By Census region, coverage was highest among women residing in the Midwest (36%) and lowest among women in the South (18%). We observed a range in coverage from 3% to 59% across the 51 U.S. jurisdictions (data not shown). Maternal Tdap coverage also varied by the type of public insurance women had at the time of delivery: women enrolled in Medicaid expansion had higher coverage (29%) than those enrolled in either traditional Medicaid (26%) or CHIP (22%), as did those covered by managed care (27%) than those with FFS plans (19%).

Across the study period, maternal Tdap vaccination improved nationally, from 22% in 2016 to 31% in 2019 ($p<0.001$). Coverage also improved significantly over time across all patient characteristics and insurance types ($p<0.001$ for all) (Figure 1).

DISCUSSION

In this analysis of national CMS Medicaid data, we found that <30% of women with public health insurance received Tdap during Weeks 27 through 36 of

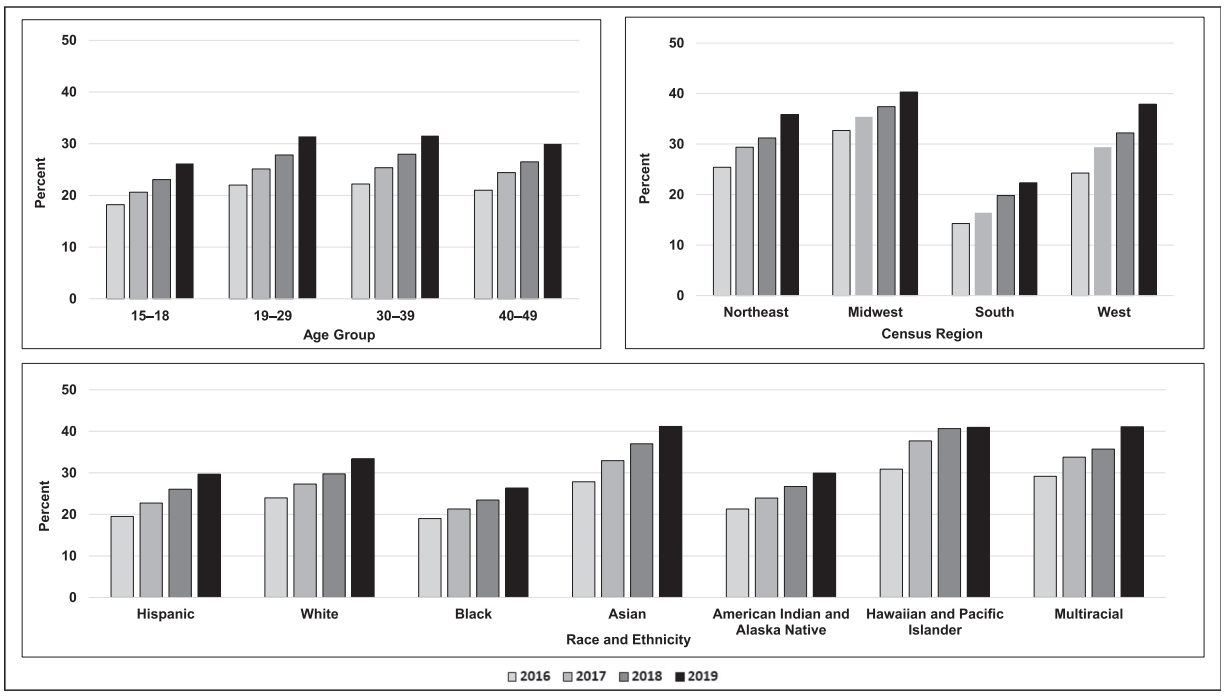

Figure 1. Maternal Tdap trends, 2016–2019.

Note: Shown is the proportion of publicly insured pregnant women, identified in Centers for Medicare and Medicaid Services Transformed Medicaid Statistical Information System Analytic Files, who received Tdap during gestational Weeks 26–37 by age group, race and ethnicity, and Census region, U.S., 2016 through 2019

Coverage for women with missing race and ethnicity data was 22.7%, 25.9%, 28.5%, and 32.9% in 2016, 2017, 2018, and 2019, respectively. The Hispanic group includes all races with Hispanic ethnicity. All other race groups include non-Hispanic women. Improvement in Tdap coverage from 2016 to 2019 was statistically significant for all subgroups ($p<0.001$).

Tdap, tetanus, diphtheria, and acellular pertussis.

pregnancy between 2016 and 2019. Although coverage increased over the 4-year study period in the present analysis, these results indicate that maternal Tdap vaccination in this population remained suboptimal in the 8 years since the ACIP first recommended it as a strategy to reduce infant pertussis. Our analysis also highlights important racial and ethnic disparities in maternal Tdap coverage as well as differences by age, enrollment type, plan type, and U. S. Census region.

Maternal Tdap coverage among pregnant women with public health insurance is substantially lower than reported national coverage among pregnant women, regardless of insurance type, which has been estimated at 57% using survey data.[6] Our findings are also consistent with those of previous analyses using different methodologies and data sources, which have shown lower coverage among women with public insurance (range=5%–63%) than among privately insured women (26%–76%).[6–9,11–13] We observed a gradual increase in annual maternal Tdap coverage throughout the study period. These results are consistent with findings from previous studies and likely reflect provider, healthcare system, and patient adaptation to these relatively new recommendations.[3,6,8,24]

Our analysis highlights racial and ethnic disparities in maternal Tdap uptake by showing substantially lower Tdap coverage in non-Hispanic Black and Hispanic pregnant women who accounted for over half of the women with known race/ethnicity. Importantly, the relative disparities in uptake remained the same even as overall coverage increased over time. This disparity in coverage has also been reported in other studies that used survey data, smaller cohorts, or data from earlier years when maternal Tdap uptake was low overall.[6–8,10,11,13,14] Whereas we observed the highest Tdap coverage among Hawaiian and Pacific Islanders, previous analyses comparing maternal Tdap coverage by race did not report findings for this group separately. However, higher Tdap coverage rates have been previously observed among Asian women.[7,13] Additional analyses will be necessary to fully understand the factors associated with the increased coverage among Hawaiian and Pacific Islanders. Racial and ethnic disparities in

maternal Tdap coverage are particularly concerning given that pertussis incidence is disproportionately high among Hispanic and Black infants.[26–29] Mistrust in vaccines or the medical sector, including concerns about safety, efficacy, and perceived low risk of contracting vaccine-preventable diseases,[30] and suboptimal provider communication have been suggested to play a role in lower vaccine confidence among Black or Hispanic women.[6,11] Methods previously described in the literature to reduce coverage disparities include more consistent provider referral for Tdap during pregnancy, coupled with culturally and linguistically appropriate communication.[6,11,31,32]

Our results were consistent with previously reported differences in other demographic characteristics.[6,8,24] We found coverage to be lowest among women residing in the Southern Census region compared with those residing in other Census regions and higher among women enrolled in managed care plans than among those enrolled in FFS. Variation by Census region likely reflects differences in state Medicaid policies around vaccination benefits for adult enrollees and reimbursement levels for providers. These factors may impact access to health services, including maternal Tdap vaccination as well as create additional barriers among pregnant women with access to care.[12,33] Although previous studies have not examined maternal Tdap coverage by plan type for publicly insured pregnant women, cost sharing for women enrolled in either plan type is prohibited, so it is currently unclear how enrollment in FFS plans may have negatively impacted vaccine uptake in this population.

Although we identified lower maternal Tdap coverage among publicly insured women and differences in coverage by race and ethnicity, additional research is needed to identify the specific factors that may further explain and address these findings. For example, a detailed review of state Medicaid program policies on immunization benefits during pregnancy, for all enrollment and plan types, may help to identify policies or practices that make it difficult for women to receive a Tdap vaccine during pregnancy. This can be challenging because specific details about benefits covered by managed care plans are not often publicly available. In addition, a more granular analysis of geographic variation in coverage, coupled with data describing social determinants of health, could highlight additional areas for policies or programs targeting improved maternal vaccine acceptance in this population.

Limitations

Our analysis is subject to certain limitations. Quality issues related to enrollment, eligibility, or inpatient claims reporting may have impacted our ability to identify all eligible pregnant women, whereas underreporting of outpatient claims could have resulted in misclassification by Tdap status; therefore, maternal Tdap coverage may be higher in jurisdictions with noted data quality issues. In addition, insurance claims data are collected for billing purposes, and any coding errors could result in misclassification by Tdap status or livebirth delivery event and timing. Maternal Tdap status may have also been impacted by variability in gestational age at delivery because we assumed that deliveries occurred at 40 weeks of gestation and only counted Tdap vaccinations during Weeks 27 through 36 of gestation. In some cases, the administration of maternal Tdap may not result in a claim being generated, which could also lead to an underestimation of Tdap coverage. Our analysis was also limited to women with deliveries from April through December of each calendar year; however, we do not believe that this would significantly impact our estimates because at least 1 previous study suggests little evidence of seasonal differences in maternal Tdap uptake.[13]

Despite these limitations, our analysis of CMS Medicaid data from all U.S. states and jurisdictions is the first to describe national trends in maternal Tdap coverage for the entire population of pregnant women with public health insurance. Assessing maternal Tdap coverage by race and ethnicity is also a notable strength of this analysis given that race and ethnicity are often missing in surveillance and administrative data.

CONCLUSIONS

Maternal Tdap immunization during pregnancy is a safe and effective strategy to prevent infant pertussis in the early months of life. Although adherence to the ACIP recommendations for maternal Tdap vaccination during pregnancy has improved over time, our analysis highlights that coverage continues to be lower among publicly insured women than published national estimates, most of which were among women with private insurance. Importantly, our findings show that disparities in coverage by race and ethnicity exist even among women with public health insurance. A better understanding of the driving factors behind these disparities will help public health officials and healthcare providers to target educational efforts and other interventions for improving both access to and uptake of maternal Tdap vaccination.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.focus.2022.100060.

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