HHS Public Access
Author manuscript
Med Care. Author manuscript; available in PMC 2019 January 01.

Published in final edited form as:
Med Care. 2018 January ; 56(1): 54–61. doi:10.1097/MLR.0000000000000844.

Payments and Utilization of Immunization Services Among Children Enrolled in Fee-for-Service Medicaid

Yuping Tsai, PhD
National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, GA

Abstract

Objective—To examine the association between state Medicaid vaccine administration fees and children's receipt of immunization services.

Methods—The study used the 2008–2012 Medicaid Analytic eXtract data and included children aged 0–17 years and continuously enrolled in a Medicaid fee-for-service plan in each study year. Analyses were restricted to 8 states with a Medicaid managed-care penetration rate <75%. Linear regressions were used to estimate the probability of children making ≥1 vaccination visit and the numbers of vaccination visits in the year as a function of state Medicaid vaccine administration fees, age group, sex, race/ethnicity, state unemployment rate, state managed-care penetration rate, and state and year-fixed effects.

Results—A total of 1,678,288 children were included. In 2008–2012, the average proportion of children making ≥1 vaccination visit per year was 31% and the mean number of vaccination visits was 0.9. State Medicaid reimbursements for vaccine administration was positively associated with immunization service utilization; for every $1 increase in the payment amount, the probability of children making ≥ 1 vaccination visit increased by 0.72 percentage point (95% confidence interval, 0.23–1.21; $P = 0.01$), representing a 2% increase from the mean and the number of vaccination visits increased by 0.03 (95% confidence interval, −0.00 to 0.06; $P < 0.1$). The estimated effect was greater among younger children.

Conclusion—Higher Medicaid reimbursements for vaccine administration were associated with increased proportion of children receiving immunization services.

Keywords

Medicaid reimbursements; immunization; children

Previous literature has demonstrated a strong positive association between health insurance coverage and medical care utilization.[1–6] The results, however, are inconclusive when comparing access with medical care among publicly and privately insured children. For

---

Reprints: Yuping Tsai, PhD, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road NE, MS A19, Atlanta, GA 30329. ytsai@cdc.gov.

The findings and conclusions of this paper are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

The author declares no conflict of interest.

services such as dental care and well-child care, publicly insured children had better or equivalent access than low-income children with private insurance.[1–3] Nevertheless, publicly insured children tend to have worse access to specialty care and lower vaccination coverage than privately insured children.[7–10]

There has been concerns regarding limited provider participation in Medicaid and the resulting barriers to medical care among Medicaid beneficiaries.[11,12] Low Medicaid reimbursements have been cited as one of the major reasons for low physician participation.[13,14] Although Medicaid reimbursements are generally lower than the payment in Medicare and private insurance, the gap in fees is particularly large for immunization services.

The Advisory Committee on Immunization Practices (ACIP) currently recommends routine vaccination of 14 vaccines for children 0–18 years. Children are recommended to initiate 9 vaccine series before 2 years old, 3 vaccines are targeted at adolescents aged 11–12 years, and annual influenza vaccination is recommended for all children.[15] Medicaid-eligible children 18 years and below are eligible for the Vaccines for Children (VFC) program, a state-operated federal entitlement program supplying VFC-enrolled providers with ACIP-recommended vaccines at no cost.[16] Providers are reimbursed for administering vaccines for children enrolled in Medicaid and the amount differs across states. In 2012, the state regional maximum fee, the maximum amount that a VFC-enrolled provider could charge for administering a dose of vaccine in each state, ranged from $13 to $18 according to the Centers for Medicare and Medicaid Services (CMS). However, the actual payment to providers is determined by the state, which in many states was substantially lower than the regional maximum fee set by the CMS. For example, in 2012 the maximum fee and the actual payment to providers were $15 and $5 in Iowa, $17 and $8 in Michigan, and $15 and $3 in New Hampshire.

Glazner et al[17] surveyed 10 private pediatric practices in Denver, Colorado where practices were paid on a fee-for-service (FFS) basis and concluded that the total cost per vaccine injection (excluding vaccine costs) averaged $11.5 in 2007. According to the 2012 Medicaid Analytic eXtract (MAX),[18] the Medicaid vaccine administration fee in at least 21 states was <$11. Insufficient reimbursements to vaccinate VFC-eligible children are a disincentive for providers to take part in the program.[19] Missed opportunities during well-child or sick visits are a well-documented barrier to childhood vaccination[20] and efforts made by providers have been proven to be effective in improving vaccination coverage.[21,22]

Many studies have shown a positive relationship between reimbursement rates and access to care among Medicaid beneficiaries.[14,23,24] Yet, research evaluating the link between payment for vaccine administration and immunization service utilization in Medicaid is limited. To our knowledge, only 1 study has formally looked at the link. Yoo et al[25] used the 2006–2008 National Immunization Surveys (NISs) and showed that a $10 increase in Medicaid reimbursements was associated with a 6.0, 9.2, and 6.4 percentage points (PPs) increase in influenza vaccination rate in the 2006, 2007, and 2008 NISs, respectively. Nevertheless, their study considered only 1 vaccine type as the service utilization measure and included Medicaid-eligible children aged 6–23 months.

Author Manuscript
Author Manuscript
Author Manuscript

This study examined the relationship between Medicaid vaccine administration fees and the receipt of immunization services among children enrolled in a Medicaid FFS plan. It adds to the literature in the following perspectives: first, this study used the CMS Medicaid insurance claims data. In addition to the merit of including a large number of Medicaid enrollees, it included children of all ages who actually enrolled in Medicaid and was able to include all ACIP-recommended vaccines as the measure of children's use of immunization services. Moreover, Yoo and colleagues used the 2005 and 2007 Medicaid fees obtained from the CMS unpublished data and they were unable to address a potentially important confounder, state-specific factors, as state dummy variables were perfectly collinear with state reimbursement rates. Our study calculated Medicaid reimbursement rates in each state for the most recent 5 years and was able to address the potential biases from state-specific factors. Finally, we used 2 outcome variables to capture changes in immunization service utilization: whether the child made ≥ 1 vaccination visit and the number of vaccination visits in the year. These variables allow us to gain insights into the mechanisms behind the findings (ie, whether changes in service utilization were driven by the number of children who made ≥1 vaccination visit, by the frequency of their visits among those who already made a visit, or both).

The goal of the study is to answer the following questions: what are the differences in vaccine administration reimbursements among Medicaid, Medicare, and private insurance? Whether and to what extent state Medicaid vaccine administration fees affect immunization service utilization among Medicaid-enrolled children? Would children's access to immunization services improved if the Medicaid fees were changed to the Medicare level? And lastly, we examined whether and to what extent the Medicaid relative to private insurance reimbursement rates affect children's use of immunization services as the rates are likely to affect providers' decision on whether to accept Medicaid children (a lower rate indicated that private insurance reimbursements were more generous than Medicaid reimbursements).

Vaccine administration was one of the services eligible for the Medicaid fee bump (ie, a 2-year increase in Medicaid reimbursements for some primary care services beginning in 2013). The fee bump raised the regional maximum fees and required the state to pay the lesser of the updated maximum fees or the Medicare fee schedule rate.[26] Our findings could have important policy implications and expand our knowledge on the association between Medicaid reimbursements and children's access to preventive care.

METHODS

This study used data from the 2008–2012 MAX system, generated by the CMS.[18] The MAX contains individual-level enrollment information and medical claims records for Medicaid beneficiaries in the 50 states and the District of Columbia (5 states—Colorado, Idaho, Kansas, Maine, and Rhode Island—were excluded because of missing data in 2011 and 2012). More recent data are available, but limited to only 20 states in 2013 and 11 states in 2014.

Children 0–17 years and continuously enrolled in a Medicaid FFS insurance plan for the entire study year were included (excluding ~80,000 children). The analyses were restricted to FFS enrollees to examine the association between Medicaid payments to providers and immunization service utilization. In managed-care arrangements, states contract with managed-care organizations (MCOs) to provide a defined set of services for beneficiaries and payment usually occurs on a capitated per-beneficiary per-month basis. Accordingly, FFS-based reimbursements do not apply to children in managed-care plans and providers serving Medicaid enrollees in a managed-care plan would be less likely to respond to changes in FFS-based reimbursements for vaccine administration compared with providers serving Medicaid enrollees in a FFS plan.

To ensure the number of children included in each state was sufficiently large and consistent across years, the analysis was restricted to states with a Medicaid managed-care penetration (MCP) rate <75% in each of the 5 study years (ie, Alaska, Florida, Minnesota, Missouri, New Hampshire, Virginia, West Virginia, and Wyoming).[27] In 2008–2012, about 19% of the Medicaid-enrolled children 0–17 years enrolled in a FFS plan and the study population represented about 24% of the Medicaid FFS children in the United States. The state Medicaid MCP rate referred to the percentage of continuously enrolled children aged 0–17 years enrolled in a managed-care plan, which was calculated using the MAX by the author.

Linear regressions were used to examine the association between state vaccine administration fees and utilization of immunization services among children. Two variables were used to capture immunization service utilization: whether the child had made ≥ 1 vaccination visit and the number of vaccination visits in the year. A vaccination visit was defined as an outpatient visit with the International Classification of Diseases-9th Revision (ICD-9) or Current Procedural Terminology (CPT) codes related to vaccines. The main independent variable is state Medicaid vaccine administration fees, which were calculated as the mode value of the Medicaid reimbursements for vaccination visits in each state and year (Appendix Table A1). To verify the payment amount generated from the MAX, the mode values were compared with the numbers reported in Medicaid Reimbursement Report by American Academy of Pediatrics.[28]

The Medicare and private insurance fees were estimated using the 2008–2012 CMS Medicare data[29] and the 2008–2012 MarketScan Commercial Claims and Encounters (CCAE) Database.[30] The study population were continuously enrolled beneficiaries who resided in the 8 states and were at least 65 years in the Medicare data and 0–17 years in the CCAE. We focused on the FFS claims for vaccination visits and used the mode value of the insurance payment for the vaccination visits as our payment variables. Subsequent analyses used the ratio of Medicaid to private insurance payment for vaccine administration as the key independent variable to measure the generosity of Medicaid relative to private insurance fess.

All regressions used robust SEs clustered at the state level to account for the nonindependence of observations within the same state over time and were adjusted for age group (0–3, 4–6, 7–10, and 11–17 y), sex (males vs. females), and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other race). The regressions controlled for state unemployment rate,[31] state Medicaid MCP rate, year-fixed effects (accounting for national trends in the use of immunization services), and state-fixed effects (accounting for state-specific factors that affected state vaccine administration fees and children's access to immunization services). As described above, providers serving managed-care patients were less likely to be responsive to changes in Medicaid reimbursements than providers serving FFS patients. If a large proportion of the Medicaid enrollees in the state were covered by managed-care plans, the estimated effects of the FFS-based reimbursement rates on immunization service utilization should be smaller. One possible reason may be that providers with a large proportion of their Medicaid patients in managed care may follow the same standard of care for all patients and be less concerned about reimbursement rates for a relatively smaller portion of their patients. To allow for differential effects of Medicaid fees by state Medicaid MCP rates and avoid potential biases, we followed previous studies to include an interaction term of vaccine administration fees and state Medicaid MCP rate in the regression equation.[25,32] Subsequent analyses stratified the study population by age group to examine whether the estimated effect differed according to age.

Three sensitivity analyses were performed. First, we calculated state vaccine administration fees excluding vaccination visits with the CPT codes indicating an additional vaccine dose (ie, 90461, 90466, 90468, 90472, and 90474). Second, we used \$10 (as opposed to \$14) as the vaccine administration fee for Wyoming as the state pays \$10 for children ≥ 8 years and \$14 for children under 8 years. Finally, identification of the effect of Medicaid fees came from changes in fees within states over time as state-fixed effects were included in the regression. Our data showed that Alaska and Minnesota experienced fee increases during 2008–2012. We included 34 states in the sensitivity analysis by relieving the sample restriction of including states with a MCP rate <75% (states with a large variation in the number of FFS enrollees across years were excluded). Among the 34 states, 14 states experienced fee changes during 2008–2012. Statistical analyses were performed using Stata software, version 13 (Stata Corporation, College Station, TX).

As an analysis of secondary data without identifiers, the study did not require institutional review board review.

RESULTS

State Vaccine Administration Fees

Table 1 displays the reimbursement rates for vaccine administration in Medicaid, Medicare, and private insurance by state and year. The table demonstrates large variations in fees across states and shows that Medicaid payments for vaccine administration were lower compared with the payment amount in Medicare and private insurance except for the state of Alaska. In 2008, Medicaid reimbursements for vaccine administration in the remaining 7 states averaged about 50% of the Medicare fees and the number was 45% in 2012; the corresponding numbers for private insurance were 62% in 2008 and 49% in 2012.

Study Population

A total of 1,678,288 Medicaid-enrolled children were included, ranging from 286,641 to 372,139 per year. In 2008–2012, the average percentage of children who had ≥1 vaccination visit in the year was 31%; the mean number of vaccination visits was 0.9. In each year, about 60% were between 0 and 10 years old, about 53% were males, and over 67% were non-Hispanic white (Table 2).

Vaccine Administration Fees and Utilization of Immunization Services

Table 3 shows the regression results of children's use of immunization services on state Medicaid vaccine administration fees. Children aged 4–6, 7–10, and 11–17 years were about 15, 32, and 27 PPs less likely to have made a vaccination visit than children aged 0–3 years ($P < 0.01$). Males were about 1 PP less likely to have made a vaccination visit than females ($P < 0.01$). For every 1 PP point increase in the state MCP rate, the probability that a child had made a vaccination visit increased by 0.56 PP [95% confidence interval (CI), 0.15–0.97; $P < 0.05$].

The coefficient on Medicaid vaccine administration fees is 0.72 (95% CI, 0.23–1.21; $P = 0.01$), meaning that the probability of children having made a vaccination visit in the year would increase by 0.72 PP (an increase of 2% from the mean) if the state increased Medicaid payment by $1. As expected, coefficients on the interaction term between Medicaid fees and state MCP rates show that changes in vaccine administration fees were differentially negatively associated with state MCP rates (−0.02; 95% CI, −0.03 to −0.01; $P = 0.001$). The result indicated that the estimated effect of Medicaid fees on the use of immunization services was smaller if the state had a higher MCP rate. The estimated effect of Medicaid fees on the number of vaccination visits was 0.03 (95% CI, −0.00 to 0.06; $P = 0.06$), indicating that higher payment was associated with increasing number of vaccination visits. For the probability of children having had a vaccination visit in the year, the coefficient on the Medicaid fees was the highest when we restricted the study population to children aged 0–3 years (1.34 PPs; $P < 0.05$) and the estimated effect was small and statistically insignificant (−0.18 PP; $P = 0.21$) when we restricted the study population to children aged 7–10 years.

In Table 4, we used the parameters estimated from the regression model in Table 3 to estimate changes in the probability of children having made a vaccination visit in the year if the state changed its Medicaid reimbursements to the Medicare level. Columns (2) and (3) of Table 4 shows the mean reimbursement rates in the state for the Medicaid and Medicare program in 2008–2012, respectively. In the state of New Hampshire, where the difference between the Medicare and Medicaid fee was the largest ($19), increasing payment from the Medicaid to the Medicare level would increase the probability that a child had made a vaccination visit by 14.26 PPs (95% CI, 4.58–23.93; $P < 0.05$), an increase of 30.1% from the mean percentage in the state. In the state of Wyoming, where the difference between the Medicare and Medicaid fee was the smallest ($7), reimbursing Medicaid-participated providers at the Medicare rate would increase the probability by 5.10 PPs (95% CI, 1.64–8.57; $P < 0.05$), an increase of 12.4% from the mean percentage in the state.

Using the ratio of Medicaid to private insurance fees as the main independent variable, the estimated effect on the probability of children having made a vaccination visit was positive (0.06 PP, 95% CI, −0.00 to 0.12; $P < 0.1$) (Table 5). The estimated effect increased considerably if the analysis was restricted to 4 states with a MCP rate <0.4 (0.17 PP, 95% CI, 0.02–0.31; $P < 0.05$). The result indicated that for every 1% increase in the ratio of Medicaid to private insurance fees, the probability of children making ≥ 1 vaccination visit would increase by 0.17 PP in states with a MCP rate <0.4.

Sensitivity Analysis

Results did not change when using $10 as the administration fees in Wyoming. Excluding vaccination visits during which an additional vaccine dose was administered did not change the mode value of state Medicaid vaccine administration fees. The results were similar to the baseline results (0.72 PP, $P < 0.05$; 0.03, $P = 0.06$) when including FFS enrollees in 34 states —the estimated effect of Medicaid fees on the probability of children having made a vaccination visit in the year was 0.45 (95% CI, 0.00–0.89; $P < 0.05$) and was 0.01 (95% CI, −0.00 to 0.03; $P = 0.15$) for the number of vaccination visits.

DISCUSSION

A total of 1,678,288 children enrolled in a Medicaid FFS plan and resided in the 8 states were included. In 2008–2012, 31% of these children made ≥ 1 vaccination visit in the year and the mean number of visits in the year was 0.9. State Medicaid payment for vaccine administration was positively associated with immunization service utilization; for every $1 increase, the probability of children making ≥ 1 vaccination visit increase by 0.72 PPs (95% CI, 0.23–1.21; $P = 0.01$). The estimated effect of Medicaid fees was larger among children aged 0–3 years compared with children in other age groups. Using the ratio of Medicaid to private insurance fees to measure the generosity of Medicaid reimbursements, the estimated effect was positive and statistically significant (0.17, 95% CI, 0.02–0.31; $P < 0.05$) in 4 states with a MCP rate <0.4.

Our findings suggest that increasing Medicaid reimbursements for vaccine administration could improve immunization services utilization among Medicaid-enrolled children. Increases in the probability of children making ≥ 1 vaccination visit indicated that Medicaid fees were positively associated with the number of children making a vaccination visit, which could be that higher payments attract more providers to accept Medicaid children and/or encourage Medicaid-participating providers to vaccinate current Medicaid children. Increases in the number of vaccination visits indicated that children having made a visit increased the frequency of their visits, which could be that providers make efforts to vaccinate current patients due to higher payments. Overall, our results suggest that increasing Medicaid reimbursement rates could be effective in reducing missed opportunities in the office settings.

Medicaid MCP has increased over the years, from 71% in 2008 to 77% in 2014.[33] Given that managed care usually emphasizes primary care services and providers with a large proportion of their Medicaid patients in managed care may follow same standard of care for all their patients, it is not surprising to find a positive association between state MCP rates and the probability of children having made a vaccination visit in the year. In Medicaid managed-care plans, MCOs receive per-member per-month capitated payments for providing medical services to beneficiaries and thus changes in FFS-based reimbursement rates would be unlikely to affect the payment amount to providers serving managed-care patients. Consistent with the expectation, our findings showed that the estimated effect of state Medicaid reimbursement rates decreased with state MCP rates and the payment gap between Medicaid and private insurance was an important factor influencing Medicaid patients' access to immunization services only in states with a low MCP rate.

The study has potential limitations. First, unobserved factors may simultaneously affect children's immunization service use and Medicaid vaccine administration fees, which in turn would bias the estimate. However, our regressions controlled for state and year-fixed effects, which accounted for state-specific characteristics and year trends in immunization service use. The omitted-variable bias should not play a key role in the findings. Second, the study focused on Medicaid FFS insurance claims and thus the results do not apply to the payment structure in Medicaid managed-care programs. As discussed above, MCOs negotiate payment and service contracts with state Medicaid agencies and thus methods used to analyze providers' responses to payment changes in managed-care arrangements would be entirely different from that in FFS arrangements. Moreover, to our knowledge, none of the existing datasets could be used to analyze the financial incentives among providers serving Medicaid managed-care patients.

CONCLUSIONS

Routine childhood immunization program is one of the most cost-effective disease prevention programs; every dollar spent in routine childhood immunization ultimately saves at least $10.[34] Insufficient reimbursements for immunization services remain one of the major concerns among physicians. This study shows a predicted improvement in access to immunization services among children in Medicaid FFS plans if Medicaid reimbursement rates were raised to the Medicare level. Nevertheless, while it is important to address the payment gap, to effectively improve physicians' willingness to accept Medicaid patients, state Medicaid agencies should address other barriers cited by physicians, such as long waiting time for reimbursements, complicated administrative processes, and low acceptance referrals by specialists.[35]

APPENDIX

TABLE A1

Codes to Identify Vaccination Visits and Details Regarding State Vaccine Administration Fees

Variables	Codes/Descriptions
Vaccination visits	90460–90461 and 90471–90474: Vaccine administration
	90632–90636, 90730: Hepatitis A
	90636, 90697, 90723, 90731, 90739–90740, 90743–90748: Hepatitis B
	90644–90648: Haemophilus influenza b (Hib)

Variables	Codes/Descriptions
	90649–90651: Human Papilloma virus (HPV)
	90653–90668, 90672–90673, 90685–90688: Influenza virus vaccine
	90669–90670: Pneumococcal conjugate vaccine
	90680–90681: Rotavirus vaccine
	90696: Diphtheria, tetanus toxoids, acellular pertussis vaccine and poliovirus vaccine, inactivated (DTaP-IPV)
	90697: Diphtheria, tetanus toxoids, acellular pertussis vaccine, inactivated poliovirus vaccine, haemophilus influenza type b PRP-OMP conjugate vaccine, and hepatitis B vaccine (DTaP-IPV-Hib-HepB)
	90698: Diphtheria, tetanus toxoids, and acellular pertussis vaccine, haemophilus influenza type B, and poliovirus vaccine, inactivated (DTaP-Hib-IPV)
	90700–90703, 90714–90715, 90718: Diphtheria, tetanus toxoids, and pertussis vaccine
	90705: Measles virus vaccine
	90706: Rubella
	90707–90708: Measles and rubella virus vaccine
	90710: Measles, mumps, rubella, and varicella vaccine (MMRV)
	90716: Varicella virus vaccine
	90720: Diphtheria, tetanus toxoids, and whole cell pertussis vaccine and haemophilus influenza B vaccine (DTP-Hib)
	90721: Diphtheria, tetanus toxoids, and acellular pertussis vaccine and haemophilus influenza B vaccine (DTaP-Hib)
	90723: Diphtheria, tetanus toxoids, acellular pertussis vaccine, Hepatitis B, and poliovirus vaccine, inactivated (DTaP-HepB-IPV)
	90732: Pneumococcal polysaccharide vaccine (PPSV)
	90733: Meningococcal polysaccharide vaccine (MPSV)
	90734: Meningococcal conjugate vaccine (MCV4)
State vaccine administration fees	The data included 13,854,130 insurance claims for vaccination visits made by 1,678,288 Medicaid-enrolled children aged 0–17 years, continuously enrolled in a Medicaid fee-for-service plan, and resided in the 8 states with a MCP rate <75%. We used the mode value of the Medicaid payment for the vaccination visit in each state and year as the state vaccine administration fees

MCP indicates managed-care penetration.

References

1. Dubay L, Kenney GM. Health care access and use among low-income children: who fares best? Health Aff (Millwood). 2001; 20:112–121.
2. Duderstadt KG, Hughes DC, Soobader MJ, et al. The impact of public insurance expansions on children’s access and use of care. Pediatrics. 2006; 118:1676–1682. [PubMed: 17015561]
3. Selden TM, Hudson JL. Access to care and utilization among children: estimating the effects of public and private coverage. Med Care. 2006; 44(suppl):I19–I26. [PubMed: 16625060]
4. Olson LM, Tang SF, Newacheck PW. Children in the United States with discontinuous health insurance coverage. N Engl J Med. 2005; 353:382–391. [PubMed: 16049210]
5. Long SK, Coughlin T, King J. How well does Medicaid work in improving access to care? Health Serv Res. 2005; 40:39–58. [PubMed: 15663701]
6. Currie J, Decker S, Lin W. Has public health insurance for older children reduced disparities in access to care and health outcomes? J Health Econ. 2008; 27:1567–1581. [PubMed: 18707781]
7. Allred NJ, Wooten KG, Kong Y. The association of health insurance and continuous primary care in the medical home on vaccination coverage for 19- to 35-month-old children. Pediatrics. 2007; 119(suppl 1):S4–S11. [PubMed: 17272584]

8. Santoli JM, Huet NJ, Smith PJ, et al. Insurance status and vaccination coverage among US preschool children. Pediatrics. 2004; 113(suppl):1959–1964. [PubMed: 15173467]
9. Smith PJ, Stevenson J, Chu SY. Associations between childhood vaccination coverage, insurance type, and breaks in health insurance coverage. Pediatrics. 2006; 117:1972–1978. [PubMed: 16740838]
10. Bisgaier J, Rhodes KV. Auditing access to specialty care for children with public insurance. N Engl J Med. 2011; 364:2324–2333. [PubMed: 21675891]
11. Ku L, Jones K, Shin P, et al. The states' next challenge—securing primary care for expanded Medicaid populations. N Engl J Med. 2011; 364:493–495. [PubMed: 21268720]
12. US Government Accountability Office. GAO. [Accessed April 28, 2017] Medicaid and CHIP: most physicians serve covered children but have difficulty referring them for specialty care. 2011. Available at: www.gao.gov/products/GAO-11-624
13. Berman S, Dolins J, Tang SF, et al. Factors that influence the willingness of private primary care pediatricians to accept more Medicaid patients. Pediatrics. 2002; 110(pt 1):239–248. [PubMed: 12165573]
14. Wang EC, Choe MC, Meara JG, et al. Inequality of access to surgical specialty health care: why children with government-funded insurance have less access than those with private insurance in Southern California. Pediatrics. 2004; 114:e584–e590. [PubMed: 15520090]
15. Centers for Disease Control and Prevention. [Accessed September 27, 2017] Recommended immunization schedule for children and adolescents aged 18 years or younger. 2017. Available at: www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html
16. Santoli JM, Rodewald LE, Maes EF, et al. Vaccines for Children program, United States, 1997. Pediatrics. 1999; 104:e15. [PubMed: 10429133]
17. Glazner JE, Beaty B, Berman S. Cost of vaccine administration among pediatric practices. Pediatrics. 2009; 124(suppl 5):S492–S498. [PubMed: 19948580]
18. Centers for Medicare and Medicaid Services. [Accessed November 14, 2017] Medicaid Analytic eXtract (MAX) general information. Available at: www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/index.html
19. Lindley MC, Shen AK, Orenstein WA, et al. Financing the delivery of vaccines to children and adolescents: challenges to the current system. Pediatrics. 2009; 124(suppl 5):S548–S557. [PubMed: 19948587]
20. Szilagyi PG, Rodewald LE. Missed opportunities for immunizations: a review of the evidence. J Public Health Manag Pract. 1996; 2:18–25. [PubMed: 10186652]
21. Alto WA, Fury D, Condo A, et al. Improving the immunization coverage of children less than 7 years old in a family practice residency. J Am Board Fam Pract. 1994; 7:472–477. [PubMed: 7847110]
22. Suh CA, Saville A, Daley MF, et al. Effectiveness and net cost of reminder/recall for adolescent immunizations. Pediatrics. 2012; 129:e1437–e1445. [PubMed: 22566415]
23. Shen YC, Zuckerman S. The effect of Medicaid payment generosity on access and use among beneficiaries. Health Serv Res. 2005; 40:723–744. [PubMed: 15960688]
24. McInerny TK, Cull WL, Yudkowsky BK. Physician reimbursement levels and adherence to American Academy of Pediatrics well-visit and immunization recommendations. Pediatrics. 2005; 115:833–838. [PubMed: 15805352]
25. Yoo BK, Berry A, Kasajima M, et al. Association between Medicaid reimbursement and child influenza vaccination rates. Pediatrics. 2010; 126:e998–e1010. [PubMed: 20956412]
26. Centers for Medicare and Medicaid Services. [Accessed September 26, 2017] Qs and As on the increased Medicaid payment for primary care. 2012. Available at: www.medicaid.gov/affordable-care-act/provisions/downloads/qs-and-as-on-the-increased-medicaid-payment-for-primary-care-set-iv.pdf
27. Gilmer TP, Kronick RG. Differences in the volume of services and in prices drive big variations in Medicaid spending among US states and regions. Health Aff (Millwood). 2011; 30:1316–1324. [PubMed: 21734206]

28. American Academy of Pediatrics. [Accessed February 17, 2017] Medicaid reimbursement report. 1998–2015. Available at: www.aap.org/en-us/professional-resources/Research/research-resources/Pages/Medicaid-Reimbursement-Reports.aspx
29. Centers for Medicare and Medcaid Services. [Accessed February 28, 2017] CMS Medicare data. Available at: www.cms.gov/Medicare/Medicare.html
30. Truven Health Analytics. [Accessed April 28, 2017] MarketScan Research Databases. Available at: http://truvenhealth.com/your-healthcare-focus/analytic-research/marketscan-research-databases
31. US Department of Labor, Bureau of Labor Statistics. [Accessed September 26, 2017] Local area unemployment statistics. Available at: www.bls.gov/lau/tables.htm
32. Cunningham PJ, Nichols LM. The effects of Medicaid reimbursement on the access to care of Medicaid enrollees: a community perspective. Med Care Res Rev. 2005; 62:676–696. [PubMed: 16330820]
33. [Accessed February 11, 2017] Centers for Medicare and Medicaid Services Medicaid managed care enrollment report. Available at: www.medicaid.gov/medicaid/managed-care/enrollment/index.html
34. Zhou F, Shefer A, Wenger J, et al. Economic evaluation of the routine childhood immunization program in the United States, 2009. Pediatrics. 2014; 133:577–585. [PubMed: 24590750]
35. Long SK. Physicians may need more than higher reimbursements to expand Medicaid participation: findings from Washington State. Health Aff (Millwood). 2013; 32:1560–1567. [PubMed: 24019360]

TABLE 1

Reimbursements for Vaccine Administration by Insurance Type and Year

States	Insurance Type	2008	2009	2010	2011	2012
Alaska	Medicaid	30.00	32.00	33.00	35.00	37.00
	Medicare	22.02	16.78	26.12	26.08	26.07
	Private	19.00	26.00	27.00	27.00	27.00
Florida	Medicaid	10.00	10.00	10.00	10.00	10.00
	Medicare	19.84	20.30	21.57	22.91	19.40
	Private	19.45	19.45	20.00	25.00	24.18
Minnesota	Medicaid	9.00	9.00	9.00	15.00	15.00
	Medicare	16.18	20.40	21.36	22.75	24.14
	Private	14.69	14.69	14.69	33.89	25.13
Missouri	Medicaid	5.00	5.00	5.00	5.00	5.00
	Medicare	19.74	18.34	20.41	22.58	19.40
	Private	14.56	14.56	19.74	20.25	20.25
New Hampshire	Medicaid	3.00	3.00	3.00	3.00	3.00
	Medicare	20.94	21.29	22.15	23.77	24.91
	Private	14.51	14.51	14.51	14.51	14.51
Virginia	Medicaid	11.00	11.00	11.00	11.00	11.00
	Medicare	15.66	19.96	21.21	22.63	23.66
	Private	15.47	15.47	19.50	19.50	19.50
West Virginia	Medicaid	12.00	12.00	12.00	12.00	12.00
	Medicare	18.17	18.55	20.59	21.70	21.14
	Private	10.00	24.33	24.33	24.33	24.33
Wyoming	Medicaid	14.00	14.00	14.00	14.00	14.00
	Medicare	18.00	18.60	20.52	23.12	24.25
	Private	14.31	14.31	14.31	14.31	14.31

Reimbursement amount for Medicaid was calculated from the 2008 to 2012 Medicaid Analytic eXtract data, amount for Medicare was calculated from the 2008 to 2012 Medicare data provided by the Centers for Medicare and Medicaid Services, and amount for private insurance was calculated from the 2008 to 2012 MarketScan Commercial Claims and Encounters Database. Numbers in the table were calculated as the mode value of the insurance payment for vaccination visits among continuously insured beneficiaries who were 0–17 years old in Medicaid and private insurance and at least 65 years old in Medicare. Vaccination visits were outpatient visits with the ICD-9 or CPT codes related to vaccines or vaccine administration.

CPT indicates Current Procedural Terminology; ICD-9, International Classification of Diseases-9th Revision.

TABLE 2

Characteristics of the Study Population, 2008–2012 Medicaid Analytic eXtract

	2008 (N=286,641)	2009 (N=322,718)	2010 (N=350,851)	2011 (N=372,139)	2012 (N=345,939)
Outcome variables					
At least 1 vaccination visit in the year	28.66	33.76	33.29	30.35	29.63
No. vaccination visits in the year	0.82	0.96	0.97	0.82	0.77
Control variables					
Age group (y)					
0–3	18.53	19.26	19.53	18.54	18.02
4–6	17.43	17.87	18.44	18.74	19.02
7–10	23.62	23.5	23.45	23.64	24.09
11–17	40.42	39.38	38.58	39.08	38.87
Sex					
Females	47.18	47.2	47.12	47.36	47.28
Males	52.82	52.8	52.88	52.64	52.72
Race/ethnicity					
Non-Hispanic white	72.53	69.66	69.33	67.29	67.31
Non-Hispanic black	12.99	13.16	12.68	13.46	11.48
Hispanic	2.49	3.05	3.22	4.14	6.25
Non-Hispanic other race	11.99	14.14	14.77	15.11	14.96
State variables					
MCP rates	37.23	38.91	39.42	39.96	36.09
Unemployment rates *	5.25	8.05	8.24	7.55	6.54

The analysis included 1,678,288 Medicaid-enrolled children aged 0–17 years, continuously enrolled in a Medicaid fee-for-service plan, and resided in the 8 states with a MCP rate <75%. Numbers are expressed as percentages except for the number of vaccination visits in the year. State and year-fixed effects were included in the estimation equation as control variables.

* *Source*: US Department of Labor, Bureau of Labor Statistics (www.bls.gov/lau/tables.htm).

MCP indicates managed-care penetration.

TABLE 3

State Vaccine Administration Fees and Utilization of Immunization Services by Children, 2008–2012 Medicaid Analytic eXtract

	N=1,678,288	
	At Least 1 Vaccination Visit in the Year PPs (95% CI)	**No. Vaccination Visits in the Year Coefficients (95% CI)**
State vaccine administration fee	0.72 (0.23–1.21) **	0.03 (−0.00 to 0.05) *
State vaccine administration fees×MCP rate	−0.02 (−0.03 to −0.01) ***	−0.00 (−0.00 to 0.00) *
Age group (reference: 0–3 y)		
4–6	−14.67 (−18.57 to −10.77) ***	−1.40 (−1.71 to −1.08) ***
7–10	−32.17 (−38.05 to −26.28) ***	−2.00 (−2.49 to −1.52) ***
11–17	−27.40 (−33.14 to −21.67) ***	−1.82 (−2.29 to −1.36) ***
Males	−1.48 (−2.26 to −0.70) ***	−0.04 (−0.07 to −0.01) ***
Race/ethnicity (reference: non-Hispanic other race)		
Non-Hispanic white	−1.88 (−8.12 to 4.36)	0.04 (−0.15 to 0.22)
Non-Hispanic black	0.73 (−7.71 to 9.17)	0.07 (−0.27 to 0.40)
Hispanic	−0.38 (−9.29 to 8.54)	0.05 (−0.24 to 0.34)
State MCP rate	0.56 (0.15–0.97) **	0.02 (−0.01 to 0.04)
State unemployment rate	0.43 (−2.06 to 2.91)	0.02 (−0.13 to 0.18)
Constant	19.29 (−9.33 to 47.91)	0.96 (−0.98 to 2.90

The analysis included 1,678,288 Medicaid-enrolled children aged 0–17 years, continuously enrolled in a Medicaid fee-for-service plan, and resided in the 8 states with a MCP rate <75%. All regression models included age group, sex, race/ethnicity, state MCP rate, state unemployment rate, and state and yearfixed effects as control variables.

CI indicates confidence interval; MCP, managed-care penetration; PP, percentage point.

* $P < 0.1$.

** $P < 0.05$.

*** $P < 0.01$.

TABLE 4

Changes in the Probability of Having Made a Vaccination Visit in the Year

	(1) Mean Proportion of Children Making ≥1 Vaccination Visit	Reimbursement Rates for Vaccine Administration		Differences (Medicare fees—Medicaid Fees) (4)	Estimated Changes in the Probability That a Child had Made a Vaccination Visit in the Year (5)[‡]
		(2) Medicaid[*]	(3) Medicare[†]		
	(%)	($)		($)	PPs (95% CI)
Alaska	25.78	33.69	23.75	−9.94	−7.19 (−12.06 to −2.31)[**]
Florida	24.69	10.00	21.24	11.24	8.13 (2.61 to 13.64)[**]
Minnesota	22.82	11.59	21.19	9.60	6.94 (2.23–11.65)[**]
Missouri	29.16	5.00	20.11	15.11	10.93 (3.51–18.34)[**]
New Hampshire	47.36	3.00	22.72	19.72	14.26 (4.58–23.93)[**]
Virginia	26.28	11.00	20.72	9.72	7.02 (2.26–11.80)[**]
West Virginia	28.88	12.00	20.08	8.08	5.84 (1.88–9.81)[**]
Wyoming	41.29	14.00	21.06	7.06	5.10 (1.64–8.57)[**]

[*] Reimbursements for vaccine administration in Medicaid, calculated from the 2008 to 2012 Medicaid Analytic eXtract data.

[†] Reimbursements for vaccine administration in Medicare, calculated from the 2008 to 2012 Medicare data provided by the Centers for Medicare and Medicaid Services.

[‡] The column represents the estimated change in the probability that a child had made a vaccination visit if Medicaid vaccine administration fees were changed to the Medicare level.

[**] $P < 0.05$.

CI indicates confidence interval; PP, percentage point.

TABLE 5

Medicaid Relative to Private Insurance Fees and Utilization of Immunization Services by Children

	N =1,678,288[†]		State MCP Rate <0.4 (N =645,243)[‡]	
	At Least 1 Vaccination Visit in the Year PP (95% CI)	**No. Vaccination Visits in the Year Coefficients (95% CI)**	**At Least 1 Vaccination Visit in the Year PP (95% CI)**	**No. Vaccination Visits in the Year Coefficients (95% CI)**
(Medicaid fees/private fees)×100	0.06 (−0.00 to 0.12)[*]	0.00 (−0.00 to 0.01)	0.17 (0.02–0.31)[**]	0.01 (0.00–0.01)[**]
Age group (reference: 0–3 y)				
4–6	−14.67 (−18.59 to −10.76)[***]	−1.40 (−1.71 to −1.08)[***]	−16.57 (−23.48 to −9.65)[***]	−1.36 (−1.85 to −0.87)[***]
7–10	−32.17 (−38.07 to −26.28)[***]	−2.01 (−2.49 to −1.52)[***]	−34.36 (−43.83 to −24.89)[***]	−1.86 (−2.48 to −1.24)[***]
11–17	−27.41 (−33.16 to −21.66)[***]	−1.82 (−2.29 to −1.36)[***]	−29.23 (−40.45 to −18.02)[***]	−1.66 (−2.14 to −1.19)[***]
Males	−1.43 (−2.20 to −0.65)[***]	−0.04 (−0.07 to −0.01)[***]	−1.92 (−3.39 to −0.45)[**]	−0.05 (−0.11 to −0.00)[**]
Race/ethnicity (reference: non-Hispanic other race)				
Non-Hispanic white	−1.91 (−8.15 to 4.33)	0.04 (−0.15 to 0.22)	−0.98 (−11.73 to 9.78)	0.08 (−0.22 to 0.38)
Non-Hispanic black	0.71 (−7.74 to 9.15)	0.07 (−0.27 to 0.40)	6.47 (−6.94 to 19.88)	0.25 (−0.09 to 0.59)
Hispanic	−0.46 (−9.30 to 8.37)	0.04 (−0.24 to 0.33)	2.21 (−13.52 to 17.95)	0.13 (−0.31 to 0.57)
State MCP rate	0.36 (−0.02 to 0.74)[*]	0.01 (−0.01 to 0.03)	0.23 (0.07 to 0.39)[**]	0.01 (0.00 to 0.02)[**]
State unemployment rate	0.35 (−1.72 to 2.43)	0.02 (−0.11 to 0.14)	−1.33 (−6.42 to 3.76)	−0.06 (−0.30 to 0.18)

All regressions included age group, sex, race/ethnicity, state MCP rate, state unemployment rate, and state and year-fixed effects as control variables.

[†]The analysis included Medicaid-enrolled children aged 0–17 years, continuously enrolled in a Medicaid FFS plan, and resided in the 8 states with a MCP rate <75%.

[‡]The analysis included Medicaid-enrolled children aged 0–17 years, continuously enrolled in a Medicaid FFS plan, and resided in the 4 states with a MCP rate <40%.

CI indicates confidence interval; FFS, fee-for-service; MCP, managed-care penetration; PP, percentage point.

[*] $P < 0.1$.

[**] $P < 0.05$.

[***] $P < 0.01$.