



Examination of universal purchase programs as a driver of vaccine uptake among US States, 1995–2014

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ABSTRACT

Background: Immunization against numerous potentially life-threatening illnesses has been a great public health achievement. In the United States, the Vaccines for Children (VFC) program has provided vaccines to uninsured and underinsured children since the early 1990s, increasing vaccination rates. In recent years, some states have adopted Universal Purchase (UP) programs with the stated aim of further increasing vaccination rates. Under UP programs, states also purchase vaccines for privately-insured children at federally-contracted VFC prices and bill private health insurers for the vaccines through assessments.

Methods: In this study, we estimated the effect of UP adoption in a state on children's vaccination rates using state-level and individual-level data from the 1995–2014 National Immunization Survey. For the state-level analysis, we performed ordinary least squares regression to estimate the state's vaccination rate as a function of whether the state had UP in the given year, state demographic characteristics, other vaccination policies, state fixed effects, and a time trend. For the individual analysis, we performed logistic regression to estimate a child's likelihood of being vaccinated as a function of whether the state had UP in the given year, the child's demographic characteristics, state characteristics and vaccine policies, state fixed effects, and a time trend. We performed separate regressions for each of nine recommended vaccines, as well as composite measures on whether a child was up-to-date on all required vaccines.

Results: In the both the state-level and individual-level analyses, we found UP had no significant ($p < 0.10$) effect on any of the vaccines or composite measures in our base case specifications. Results were similar in alternative specifications.

Conclusions: We hypothesize that UP was ineffective in increasing vaccination rates. Policymakers seeking to increase vaccination rates would do well to consider other policies such as addressing provider practice issues and vaccine hesitancy.

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1. Background

Childhood immunization against potentially life-threatening illnesses is widely viewed as a great public health achievement [1,2].

Abbreviations: VFC, Vaccines for Children; UP, Universal Purchase; CDC, Centers for Disease Control; HepB, hepatitis B; PCV, pneumococcal conjugate vaccine; ACIP, Advisory Committee for Immunization Practice; DTaP/DT/DTP, tetanus toxoids and acellular pertussis; MMR, measles-mumps-rubella; HepA, hepatitis A; Hib, Haemophilus influenzae type b; NIS, National Immunization Survey.

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Indeed, a recent study finds that fully vaccinating a one-year birth cohort of US children results in 1.2 million additional quality-adjusted life-years, which translates into \$184.1 billion in social value, or \$45,000 per child [3]. Because of vaccines' population-level impact in eradicating diseases, federal, state and local governments have played an important role in their purchase [4,5]. Section 317 of the federal Immunization Grants Program, which was expanded in 1991, assists jurisdictions with the purchases of essential vaccines such as polio and tetanus [6]. Section 317 has been associated with a significant increase in immunization rates [6].

Since the implementation of Section 317, several other federal reforms have impacted state-level purchasing power and

childhood access to vaccines. Among these reforms is the Vaccines for Children (VFC) program, which was established by the federal government in 1993. VFC is intended to ensure vulnerable children have access to vaccines at no cost. Children under age 18 are VFC-eligible if they meet at least one of the following criteria: they are eligible for Medicaid, uninsured, American Indian or Alaska Native, or underinsured.¹ Through VFC, the Centers for Disease Control and Prevention (CDC) purchases vaccines directly from manufacturers at discounted prices, and distributes them to grantees such as state health departments and local public health agencies, who distribute the vaccines at no charge to private physicians' offices and public health clinics registered as VFC providers. The implementation of VFC has coincided with higher immunization rates, the introduction of five new childhood vaccines, and a large reduction in vaccine-preventable diseases nationwide [7].

In the late 1990s, some states extended the VFC model to a "Universal Purchase" (UP) structure, with the intention of increasing vaccination uptake [8], and to reduce the burden on providers who may have had to finance the up-front vaccine costs or receive insufficient reimbursement for vaccines [9]. It should be noted, however, that there are many other factors associated with high immunization coverage other than vaccine cost [10].

States with UP programs buy all routinely recommended vaccines through the CDC purchasing contracts and provide them to all children, including those who are privately insured, through eligible providers within the state. In some states, UP programs were replaced by "UP Select" programs which either provide select vaccines or provide all routine vaccines only to some children. Sixteen states have had either a UP or UP Select program in place at some point between 1995 and 2014; as of 2014, seven states had UP programs, whereas three had UP Select programs for public providers and five had UP Select programs with select vaccines [11].

Initially, UP programs were funded by state appropriations, in conjunction with federal VFC funds [12]. State budget estimates for UP programs from 2005 ranged from \$10 million in New Hampshire (\$714 per eligible child) to \$54 million in Massachusetts (\$671 per eligible child) [13]. In recent years, state governments have assessed per-child fees on insurers rather than fund the programs through state appropriations [14]. The *de facto* result of this funding system is a reduction in the price of vaccines paid by private insurers, as their assessments are based on the CDC public sector contract price. This allows private insurers to benefit from the bargaining position of the public sector when acquiring vaccines.

Although UP programs were introduced over two decades ago, literature considering their effect on vaccination rates is sparse, with mixed findings. Freed et al. (1998) report an association between the North Carolina UP program and increased vaccination rates; however, their study only includes children who were born after UP program implementation [8]. Consequently, their results likely reflect both differences across the two birth cohorts as well as underlying time trends in vaccination rather than the effect of the UP program itself. Olshen et al. (2007) find no association between UP programs and adolescent vaccination rates for hepatitis B (HepB) and varicella zoster (varicella); however, the authors point out this may be due in part to low power in their study [15]. Finally, Stokley et al. (2006) find that children living in UP states are more likely to have three doses of pneumococcal conjugate vaccine (PCV) compared to children living in a non-UP state, but this difference is not significant after adjusting for child and maternal characteristics [16]. Our study contributes to the literature by estimating the association between UP programs, including UP Select, and vaccination rates.

2. Methods

2.1. Overview

We used state-level variation in timing of UP legislation from 1995 to 2014 to implement a difference-in-difference framework to estimate the association between UP programs and state-level vaccination rates for children aged 19–35 months. Regression analyses were conducted at the state- and individual-level. Fig. 1 provides the list of states which implemented a UP program during our study period, the type of program (UP or UP Select), and the years it was in effect.

We focused on vaccination rates for vaccines recommended by the Advisory Committee for Immunization Practices (ACIP): polio, diphtheria and tetanus toxoids and acellular pertussis (DTaP/DT/DTP), measles or measles-mumps-rubella (MMR), hepatitis A (HepA), HepB, Haemophilus influenzae type b (Hib), varicella, PCV, and rotavirus. A subset of these vaccines is of specific interest because of their higher purchase price (e.g. PCV, varicella, and rotavirus) or their varying uptake rates (e.g. MMR, DTaP, and HepA); these may be more likely to be affected by UP programs. In addition, we also considered the proportion of children aged 19–35 months in a state who are up-to-date for a given set of recommended vaccines, specifically the 5, 6, and 7-series.²

2.2. State-level data

For the state-level analysis, the sample included state-year observations for all 50 states and the District of Columbia from 1995 to 2014. The dependent variable was the state-level vaccination rate for the selected vaccines (Polio, DTaP, MMR, HepA, HepB, Hib, varicella, PCV, and rotavirus) or the proportion of children who were up-to-date for the 5, 6, or 7-series. Vaccination rates and proportion up-to-date were collected from the CDC [17]. Trends in vaccination rates by UP status for PCV, rotavirus, and the 7-series are shown in Fig. 2; the others are in the Technical Appendix. PCV and rotavirus are two of the more costly vaccines to acquire, and therefore potentially more likely to benefit from UP programs. However, Fig. 2 shows that states without UP or UP Select programs had higher vaccination rates for PCV and rotavirus compared to states with UP programs.

Our independent variable of interest is an indicator for whether a state has either a UP or UP Select program. Information on UP program status was collected from the CDC, the Association of Immunization Managers, the Institute of Medicine, and published literature.[12,14,17–29] Information for UP programs was available for all 50 states in 1994, 2000, 2002, 2005–2009, 2011, and 2014; some states had other years of information available. For the years in which information was not available, we assumed that a state's UP status remained unchanged between the two observed years. For example, Alaska reported having a UP program in 2002 and 2005. Therefore, we assumed Alaska had a UP program in 2003 and 2004. For states that did not have matching policies across years, we assumed the missing years took on the same policy as the earlier of the two values. For example, Hawaii reported having a UP program in 2002 and a UP Select program in 2005. We assumed the 2002 UP program remained in place for 2003 and 2004.

The state-level dataset also included state-level demographics, health measures, and vaccination-related legislation. Demographic variables were constructed using the 1995–2014 March Current

¹ Children are defined as underinsured if they have health insurance that does not cover all or select vaccines.

² The 5-vaccine series includes: ≥ 4 doses DTaP, ≥ 3 doses polio, ≥ 1 dose measles-containing vaccine, Hib full series, and ≥ 3 doses HepB. The 6-vaccine series includes all vaccines in the 5-series plus ≥ 1 dose varicella. The 7-vaccine series includes all vaccines in the 6-series plus ≥ 4 doses PCV.

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