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Impact of Pharmacist Immunization Authority on Seasonal Influenza Immunization Rates Across States

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ABSTRACT

Purpose: The goal of this study was to investigate the impact on immunization rates of policy changes that allowed pharmacists to administer influenza immunizations across the United States.

Methods: Influenza immunization rates across states were compared before and after policy changes permitting pharmacists to administer influenza immunizations. The study used Behavioral Risk Factor Surveillance System (BRFSS) survey data on influenza immunization rates between 2003 and 2013. Logistic regression models were constructed and incorporated adjustments for the complex sample design of the BRFSS to predict the likelihood of a person receiving an influenza immunization based on various patient health, demographic, and access to care factors.

Findings: Overall, as states moved to allow pharmacists to administer influenza immunizations, the odds that an adult resident received an influenza immunization rose, with the effect increasing over time. The average percentage of people receiving influenza immunizations in states was 35.1%, rising from 32.2% in 2003 to 40.3% in 2013. The policy changes were associated with a long-term increase of 2.2% to 7.6% in the number of adults aged 25 to 59 years receiving an influenza immunization (largest for those aged 35–39 years) and no significant change for those younger or older.

Implications: These findings suggest that pharmacies and other nontraditional settings may offer accessible venues for patients when implementing other public health initiatives. (*Clin Ther*. 2017;∎:∎∎∎–∎∎∎) © 2017 The Authors. Published by Elsevier HS Journals, Inc.

Key words: influenza, immunizations, pharmacy services, vaccines.

INTRODUCTION

Immunization is essential in the prevention of infectious diseases. The Centers for Disease Control and Prevention (CDC) identified immunizations as a public health achievement that has contributed to the 30-year increase in life expectancy in the United States since 1900.[1] The CDC also notes decreases in "cases, hospitalizations, deaths, and healthcare costs associated with vaccine-preventable diseases" from 2001 to 2010.[2] The seasonal influenza vaccination is one of the most common immunization programs in the United States.[3]

Despite the preventive effects of immunizations, however, many people who should get immunized do not. In the 2014 to 2015 flu season, only 38% of adults aged between 18 and 64 years were immunized against the flu. In that same season, 66.7% of adults aged ≥65 years were immunized.[4] The national immunization goals are 80% and 90% for these population segments, respectively.[5]

The economic burden of seasonal influenza in the United States is substantial. Recent research has estimated that the annual human and economic burden of influenza in the adult population aged ≥50 years exceeded $16 billion in 2013.[6] This figure includes direct medical costs for treatment, as well as lost wages related to decreased worker and household productivity for the year of infection. The Bureau of Labor Statistics noted a spike in absences due to illness, injury, or medical appointments from December to March of 2005 through 2010, overlapping with the peak flu season.[7]

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People fail to get seasonal influenza immunizations for many reasons. Lack of access to the administration of the immunization is a major barrier. For example, researchers have found that lack of a regular health care provider and insurance are significantly related to the nonreceipt of a seasonal influenza immunization.[8]

In a recent study, researchers found that 41% of people in the United States obtained seasonal influenza immunizations from nontraditional settings such as the workplace, retail establishment, or community center during the 2010 to 2011 influenza season. Supermarkets and drug stores provided 18.4% of immunizations for those aged ≥18 years during the 2010 to 2011 season, which increased to 20.1% during the 2011 to 2012 season.[9,10] Providing immunizations to consumers in such settings can help them overcome accessibility barriers through extended service hours and the multiple locations provided by these sites. A study of uptake rates for pneumococcal and herpes zoster vaccinations showed higher rates across states that had broader vaccination authority for pharmacists.[11]

Although immunizations provided in nontraditional settings have been shown to be cost-effective for healthy working adults aged <65 years, study results on overall cost-effectiveness of immunizations for this group of adults, when calculating net benefit due to avoided illness, tend to be sensitive to where the immunizations are provided, being more favorable in lower cost settings.[12–14] An analysis using a national database of commercial and Medicare administrative health care claims from 2010 found that the mean cost paid per enrollee per seasonal influenza immunization was notably lower at pharmacies ($21.57) compared with physician offices ($29.29) and other medical settings ($24.20).[15]

Currently, all 50 states and Washington, DC, allow pharmacists to administer immunizations to adults.[16] Regulations allowing pharmacists to administer immunizations to adults were adopted in certain states in the 1990s, while many others have passed legislation in the subsequent years.[17]

A study by Steyer et al[18] found that people aged ≥65 years had significantly higher seasonal influenza immunization rates in states in which pharmacists could provide immunizations than those who resided in states in which pharmacists could not provide immunizations. The study compared seasonal influenza immunization rates from 1995 (before any policy change allowing pharmacists to administer vaccinations) versus the rates in 1999, two years after a group of states allowed pharmacist-administered immunizations. Since the research was published, additional states have passed legislation allowing pharmacists to administer a variety of immunizations to adults.

McConeghy and Wing[19] estimated the effects of pharmacy-based immunization statute changes on the volume of vaccine prescriptions (on a per-capita basis) as well as the impact on adult vaccination rates. Results indicate a large increase in vaccinations dispensed in community pharmacies between 2007 and 2013 (3.2 million to 20.9 million) and a small nonstatistically significant increase in adult vaccination rates.

The present study builds on previous research by investigating the effect of changes in policies that allowed pharmacists to administer seasonal influenza immunizations. States varied in the timing of their policy changes. One half of states changed their policies in 2004 or later; the first state to do so was Michigan (1990), and the last were South Carolina and Louisiana (2010).

MATERIALS AND METHODS

Data Sources

We collected survey data from the 2003 to 2013 Behavioral Risk Factor Surveillance System (BRFSS) landline files to determine rates of seasonal influenza immunization for selected states of interest.[20] The BRFSS is an annual telephone survey of >350,000 adults nationwide and is maintained by the CDC. The BRFSS queries respondents for health risk behaviors, preventive measures, health care access, and utilization. Data are collected over the course of the year on a rolling monthly basis; records in the same BRFSS year may have been collected in any month of that year. BRFSS records from 2003 through 2013 were combined into a single dataset for our analysis. We used only the landline files for comparability across years. For these years, before subsetting to the analysis sample (as discussed later), the BRFSS respondents represented 2523 million person-years from 2003 through 2013, or 229.3 million people per year.

Information on state regulations pertaining to pharmacist-administered immunization authority was acquired and verified by using multiple sources. We primarily used proprietary regulatory databases to research the timing of each state's allowance of pharmacists to administer seasonal influenza immunizations (Compiled through original research using Westlaw and RegAlert, available upon request from the author). For the majority of states, the year of the promulgating regulations (either final or emergency rules that were later finalized) was considered as the implementation year. In some cases in which there was only a statute date available in the regulatory databases, and where there were no promulgating regulations, we called and e-mailed state boards of pharmacy to confirm when the law became effective.

Outcome

The study outcome of interest was whether a BRFSS survey respondent in the states of interest received a seasonal influenza immunization in the past 12 months. We defined receipt of an influenza immunization based on the respondent receiving a "flu shot." Before 2004, the BRFSS asked respondents whether they received a "flu shot" in the last 12 months. In 2004, the survey was expanded to include live attenuated influenza vaccine (LAIV), described in the BRFSS survey as "flu vaccine sprayed in the nose, also called FluMist." Only a small fraction (1.4%) of respondents received LAIV in 2008.[21] To allow consistent comparison across years, this study exclusively focused on injectable immunizations.

Explanatory Variables

In constructing the statistical models, the survey observation year was identified based on its reference to the timing of the regulation. To allow for identifying long-term effects, year relative to the year when the regulation was introduced was stratified into the following groups: (1) ≥4 years before; (2) 1 to 3 years before; (3) year of; (4) 1 year after; (5) 2 to 3 years after; (6) 4 to 5 years after; and (7) ≥6 years after. The 1 to 3 years before introduction of the regulation was used as the reference period. This year relative to regulation year stratification allowed for identifying short- and long-run effects that may be related to time needed to implement regulations, as well as transition periods for retail pharmacies to make arrangements (eg, staff training, purchase of immunization) to adequately prepare for administering seasonal influenza immunizations.

Because states' regulations allowing pharmacist-administered seasonal influenza immunizations varied over time, separate state- and calendar year–specific effects were also identified. The state-specific effects remove variation in average levels of the outcome across states driven by state-specific issues (eg, density of retail pharmacies), and the year-specific effects absorb national trends in seasonal influenza immunizations independent of individual states' actions (eg, the 2004–2005 influenza vaccine shortage).[22,23] We also controlled for confounding factors that may affect the likelihood of respondents obtaining a seasonal influenza immunization, including: demographic characteristics (eg, adding interactions between the age categories and the indicators for timing relative to the change in legislation) and household composition; insurance coverage status and perceived cost barriers to care; education level; income level; perceived health status (including whether physical or mental health has been poor); whether the subject has asthma, diabetes, or physical impairments; body mass index; whether the subject exercises or smokes; and whether the subject has a "personal doctor or health care provider" according to the BRFSS instrument.

The societal impact of the additional people receiving a seasonal influenza immunization in 2013 was estimated based on our modeling. To do this, we compared actual influenza vaccination rates in 2013 versus what the age category–stratified model would predict for an individual if all regressors are the same except for time relative to legislation change, which is set to be ≥4 years prior for all respondents. We then multiplied by the total population estimate for each age category.

Statistical Analyses

Using the outcome and explanatory variables described earlier, we estimated logistic regression models in which the probability of a particular respondent in a given year reporting receipt of a seasonal influenza immunization is a function of the following: (1) person-time level demographic and reported health characteristics; (2) state fixed effects; (3) calendar year fixed effects; and (4) years before or after the law/regulation change. Stata version 14.2 was used for all statistical analyses (StataCorp, College Station, Texas). These models incorporated adjustments for the complex sample design of the BRFSS using the sample design stratum, primary sampling unit, and final (poststratification) weight for each respondent in each year supplied in the BRFSS data.[24] Respondents with one or more missing values of the individual, state, and year confounding factors described earlier were excluded from estimation; specifically, the estimation sample was treated as a subpopulation from a complex sample design perspective for estimating SEs and CIs. The subpopulation with no missing covariates consisted of 1967 million person-years, with 4.1 million primary sampling units in 2451 strata.

Because of our choice of model (logistic regression), the natural expression of effects are odds ratios (ORs) (proportional increases in the odds of receiving a seasonal influenza vaccination), in which odds are themselves ratios of the proportion receiving such a vaccine to the ratio not receiving a vaccine. Based on the proportions of people receiving traditional seasonal influenza vaccinations compared with those receiving LAIV in 2010, we calculate that the measured effects of changes in legislation or regulation to permit pharmacist administration of seasonal influenza vaccines will be overstated by at most 0.4%.

RESULTS

Factors Associated With Receiving an Influenza Immunization

Across the years in the study, the average percentage of people receiving seasonal influenza immunizations nationally was 35.1%, rising from 32.2% in 2003 to 40.3% in 2013 (F-statistic for one-way ANOVA with numerator $df = 10$ and denominator $df = 4{,}339{,}718$ [$F(10, 4{,}339{,}718)$] = 649.3, $P < 0.001$). However, this rise was not monotonic; the rate dropped to 25.3% in 2005, presumably due to the 2004 to 2005 influenza vaccine shortage.

Table I describes the distribution of each group defined according to the study predictor variables, as well as the percentage of people in each group receiving seasonal influenza immunizations. The immunization rates rose monotonically with age, from 21.8% for those aged 18 to 24 years to 71.3% for those aged ≥75 years ($F[11, 4, 339, 717] = 10{,}305.5$, $P < 0.001$). Other demographic characteristics exhibited differences in seasonal influenza immunization rates across categories, including sex, race/ethnicity, number of adults in household, and whether there are children in the household, although these may be mediated through age. Immunization rates also rose with education (from 30.8% for those with no high school diploma to 39.7% for those with ≥4 years of college; $F[3, 4, 339, 725] = 1177.6$, $P < 0.001$) and with income (from 32.1% for income less than $15,000 to 37.7% for income above $75,000; $F[6, 4, 339, 722] = 158.1$, $P < 0.001$). Notably, people reporting access to care issues due to cost had much lower seasonal influenza immunization rates (22.3%) than those without such access issues (37.2%); $F(1, 4{,}339{,}727) = 8572.3$, $P < 0.001$. Likewise, respondents without health insurance were less likely to receive seasonal influenza immunizations (16.2% vs 38.5%; $F[1,4{,}339{,}727] = 20{,}432.8$, $P < 0.001$).

All measures of worse physical health were associated with greater seasonal influenza immunization rates, including self-reported overall health (48.7% for those reporting poor health vs 31.1% for excellent health; $F[4, 4, 339, 724] = 1154.0$, $P < 0.001$), days in the past month with poor health (44.9% for all days vs 36.4% for <1 full month; $F[2, 4, 339, 726] = 1245.9$, $P < 0.001$), having asthma (40.3% vs 34.4%; $F[1, 4, 339, 727] = 1114.8$, $P < 0.001$), having diabetes (56.4% vs 33.1%; $F[1, 4, 339, 727] = 13{,}852.4$, $P < 0.001$), having activity limitations (44.3% vs 32.9%; $F[1, 4, 339, 727] = 6751.0$, $P < 0.001$), needing equipment for health problems (54.0% vs 33.7%; $F[1, 4, 339, 727] = 9211.0$, $P < 0.001$), and body mass index (36.5% for obese vs 33.6% for normal or underweight; $F[3, 4, 339, 725] = 199.2$, $P < 0.001$). Notably, worse mental health was associated with lower seasonal influenza immunization rates (33.1% if mental health poor for the entire last month vs 36.8% if mental health never poor in the last month; $F[2, 4, 339, 726] = 755.5$, $P < 0.001$). Smokers were less likely to have a seasonal influenza immunization than nonsmokers (25.3% vs 37.5%; $F[1, 4, 339, 727] = 7945.9$, $P < 0.001$), and having exercised in the last month was marginally associated with greater seasonal influenza immunization rates (35.2% vs 34.8%; $F[1, 4, 339, 727] = 11.7$, $P < 0.001$).

People outside of the labor force (homemaker, student, retiree, or unable to work) had much higher seasonal influenza immunization rates (47.1%) than those employed (30.2%) or unemployed (23.0%); $F(2, 4{,}339{,}726) = 10{,}538.6$, $P < 0.001$. However,

Table I. Summary statistics of factors associated with receiving a seasonal influenza immunization among adults aged ≥18 years, 2003 to 2013.

Predictor	No. Total Analysis Sample Person-Years in Category (Thousands)	Percentage of Total Analysis Sample Person-Years in Category	Percentage of Category Person-Years Receiving an Influenza Vaccine
Total population	1,966,880	100.0	35.1
Flu vaccine			
No	1,275,802	64.9	0
Yes	691,078	35.1	100.0
Year			
2003	170,922	8.7	32.2
2004	173,479	8.8	32.5
2005	177,413	9.0	25.3
2006	179,183	9.1	31.1
2007	183,313	9.3	36.2
2008	187,247	9.5	35.8
2009	183,116	9.3	37.8
2010	183,903	9.4	40.1
2011	172,102	8.8	37.6
2012	182,330	9.3	37.3
2013	174,069	8.9	40.3
Years relative to legislation change			
≥4 years before	132,174	6.7	30.8
1–3 years before	314,897	16.0	30.3
Year of	119,390	6.1	33.9
1 year after	124,503	6.3	35.2
2–3 years after	267,496	13.6	36.0
4–5 years after	268,479	13.7	36.0
≥6 years after	740,137	37.6	37.5
Age category, y			
18–24	209,669	10.7	21.8
25–29	157,744	8.0	21.8
30–34	214,193	10.9	25.0
35–39	183,707	9.3	25.4
40–44	216,553	11.0	26.4

(continued)

Table I. (continued).

Predictor	No. Total Analysis Sample Person-Years in Category (Thousands)	Percentage of Total Analysis Sample Person-Years in Category	Percentage of Category Person-Years Receiving an Influenza Vaccine
45–49	186,854	9.5	28.4
50–54	201,605	10.3	34.6
55–59	154,990	7.9	40.9
60–64	134,338	6.8	48.3
65–69	96,770	4.9	58.9
70–74	75,135	3.8	65.7
≥75	135,321	6.9	71.3
Sex			
Male	993,274	50.5	33.1
Female	973,605	49.5	37.2
Race			
White	1,538,887	78.2	36.6
Black/African American	208,686	10.6	28.7
Other	219,110	11.1	31.0
Hispanic ethnicity			
No	1,715,512	87.2	36.4
Yes	251,367	12.8	26.4
No. of adults in household			
1	327,879	16.7	41.0
2	1,098,306	55.8	36.4
3	327,289	16.6	30.1
≥4	213,406	10.9	27.3
Children in household			
No	1,115,811	56.7	41.1
Yes	851,069	43.3	27.3
Education			
Less than high school	209,276	10.6	30.8
High school or less	550,726	28.0	32.6
1–3 Years of college	554,267	28.2	33.9
≥4 Years of college	652,611	33.2	39.7

(continued)

Table I. (continued).

Predictor	No. Total Analysis Sample Person-Years in Category (Thousands)	Percentage of Total Analysis Sample Person-Years in Category	Percentage of Category Person-Years Receiving an Influenza Vaccine
Health status			
Excellent	410,291	20.9	31.1
Very good	666,182	33.9	33.9
Good	582,196	29.6	35.4
Fair	224,421	11.4	40.6
Poor	83,986	4.3	48.7
Days physical health not good in past month			
0	1,255,263	63.8	33.6
<1 full month	593,408	30.2	36.4
Full month	118,209	6.0	44.9
Has asthma			
No	1,708,825	86.9	34.4
Yes	258,055	13.1	40.3
Has diabetes			
No	1,797,925	91.4	33.1
Yes	168,955	8.6	56.4
Has activity limitations			
No	1,581,174	80.4	32.9
Yes	385,705	19.6	44.3
Has equipment for health problems			
No	1,830,772	93.1	33.7
Yes	136,108	6.9	54.0
Body mass index/pregnant			
BMI <25 kg/m^2 (under/normal)	705,126	35.9	33.6
$25 \leq$ BMI <30 kg/m^2 (overweight)	711,027	36.2	35.9
BMI ≥ 30 kg/m^2 (obese)	528,304	26.9	36.5
Pregnant	22,422	1.1	28.9

(continued)

Table I. (continued).

Predictor	No. Total Analysis Sample Person-Years in Category (Thousands)	Percentage of Total Analysis Sample Person-Years in Category	Percentage of Category Person-Years Receiving an Influenza Vaccine
Days mental health not good in past month			
0	1,274,931	64.8	36.8
Less than full month	593,211	30.2	31.9
Full month	98,934	5.0	33.1
Smoker			
No	1,581,174	80.4	37.5
Yes	385,705	19.6	25.3
Exercised in past month			
No	457,890	23.3	34.8
Yes	1,508,990	76.7	35.2
Income			
Less than $15,000	205,342	10.4	32.1
Between $15,000 and $19,999	143,976	7.3	33.3
Between $20,000 and $24,999	175,249	8.9	34.3
Between $25,000 and $34,999	227,371	11.6	34.9
Between $35,000 and $49,999	296,999	15.1	34.3
Between $50,000 and $74,999	328,666	16.7	34.7
$75,000 or more	589,277	30.0	37.7
Access to care issues due to cost			
No	1,690,730	86.0	37.2
Yes	276,150	14.0	22.3
Insurance coverage			
No	296,409	15.1	16.2
Yes	1,670,471	84.9	38.5
Employment status			
Unemployed	127,454	6.5	23.0
Employed	1,210,418	61.5	30.2
Not in labor force	629,205	32.0	47.1
Has personal physician			
No	377,641	19.2	17.3

(continued)

Table I. (continued).

Predictor	No. Total Analysis Sample Person-Years in Category (Thousands)	Percentage of Total Analysis Sample Person-Years in Category	Percentage of Category Person-Years Receiving an Influenza Vaccine
Yes, only 1	1,441,329	73.3	39.2
Yes, >1	147,909	7.5	41.0
State and Washington, DC (year of regulation)			
Alabama (1998)	29,700	1.5	35.7
Alaska (2001)	4327	0.2	34.0
Arizona (2009)	39,141	2.0	33.2
Arkansas (2004)	18,292	0.9	38.1
California (2006)	251,171	12.8	31.1
Colorado (2004)	31,863	1.6	39.6
Connecticut (2006)	23,012	1.2	38.5
Delaware (1998)	5704	0.3	37.9
Florida (2007)	119,193	6.1	30.6
Georgia (2009)	60,777	3.1	32.0
Hawaii (2002)	8458	0.4	42.8
Idaho (1993)	9638	0.5	31.4
Illinois (2007)	87,526	4.5	31.9
Indiana (2008)	40,518	2.1	34.3
Iowa (2000)	20,259	1.0	42.0
Kansas (2000)	18,489	0.9	38.3
Kentucky (2004)	26,159	1.3	36.3
Louisiana (2010)	27,536	1.4	36.5
Maine (2009)	9244	0.5	39.1
Maryland (2006)	36,977	1.9	37.9
Massachusetts (2009)	41,895	2.1	39.8
Michigan (1990)	66,677	3.4	33.7
Minnesota (2003)	35,994	1.8	42.8
Mississippi (1991)	18,685	1.0	34.5
Missouri (2008)	39,928	2.0	36.7
Montana (2002)	6687	0.3	36.8
Nebraska (1994)	11,998	0.6	41.7

(continued)

Table I. (continued).

Predictor	No. Total Analysis Sample Person-Years in Category (Thousands)	Percentage of Total Analysis Sample Person-Years in Category	Percentage of Category Person-Years Receiving an Influenza Vaccine
Nevada (2001)	16,325	0.8	27.8
New Hampshire (2009)	8851	0.5	38.4
New Jersey (2009)	54,286	2.8	33.0
New Mexico (2002)	12,981	0.7	37.0
New York (2008)	120,963	6.2	35.2
North Carolina (2004)	57,236	2.9	38.3
North Dakota (2002)	4327	0.2	39.3
Ohio (2001)	76,315	3.9	35.1
Oklahoma (2009)	24,586	1.3	41.0
Oregon (2000)	25,176	1.3	34.5
Pennsylvania (2006)	82,216	4.2	35.9
Rhode Island (2008)	7081	0.4	40.7
South Carolina (2010)	28,716	1.5	35.7
South Dakota (2002)	5311	0.3	47.5
Tennessee (1996)	37,174	1.9	38.2
Texas (1998)	141,419	7.2	35.0
Utah (1999)	16,128	0.8	37.9
Vermont (2009)	4327	0.2	37.7
Virginia (1997)	51,139	2.6	39.0
Washington (1991)	43,665	2.2	36.9
West Virginia (2009)	12,785	0.7	39.3
Wisconsin (1999)	38,354	2.0	36.2
Wyoming (2006)	3540	0.2	37.2
Washington, DC (2009)	4130	0.2	37.1

Data from 2003 through 2013 were combined into a single analytic file, a total of 4,108,472 respondents representing 2522.7 million person-years. The analysis sample (the subpopulation with no missing covariates) consisted of 3,202,026 respondents representing 1966.9 million person-years, with 4.1 million primary sampling units in 2451 strata. Population proportions were calculated by using Behavioral Risk Factor Surveillance System survey weights to represent the adult population in the study states. The year of each state's policy change is indicated in parentheses next to the state name. Respondents labeled as "not in labor force" include those responding as being a homemaker, a student, a retiree, or unable to work.

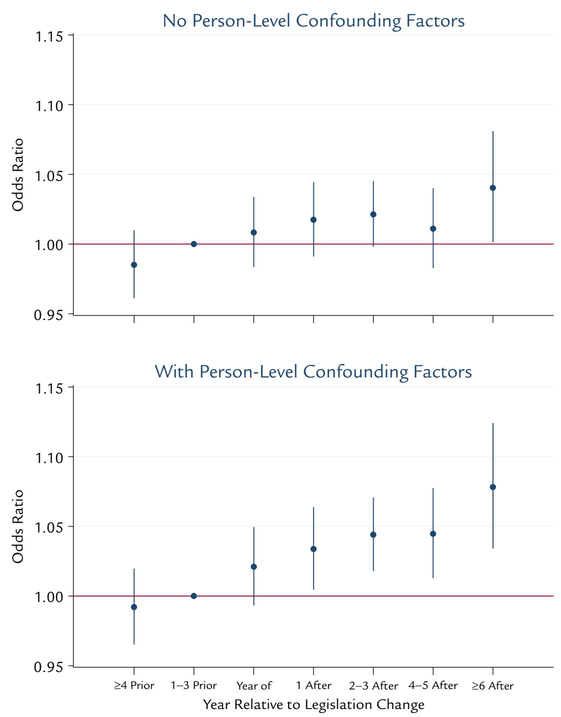

Figure 1. Estimated odds ratios for the effects on national seasonal influenza immunization rates from timing relative to the legislative change to allow pharmacist-administered influenza vaccines, assuming equal effects across age groups. Odds ratios and CIs are shown for estimates of the effect of a person's state allowing pharmacists to administer "flu shots" on the likelihood that a person will receive a flu shot, controlling for demographic characteristics, insurance coverage, education, sex, health status, income, year, and state of residence. Data from 2003 through 2013 are combined into a single analytic file, a total of 3.2 million respondents representing 1966.9 million person-years. Population proportions were calculated by using Behavioral Risk Factor Surveillance System survey weights to represent the adult population in the 50 states plus Washington, DC.

this outcome is strongly influenced by age (because retirees are no longer in the labor force). Not having a personal physician was also associated with lower seasonal influenza immunization rates (17.3% vs 39.2% or more; $F[2,4,339,726] = 11,661.2$, $P < 0.001$). The differences between categories of the characteristics described earlier were all statistically significant ($P < 0.001$).

Impact of Pharmacist-Administered Immunization Regulation Implementation

Overall, as states moved to allow pharmacists to administer seasonal influenza immunizations, the likelihood that an adult resident received a seasonal influenza immunization rose, with the effect increasing over time. Figure 1 displays estimated ORs for 2 models that have effects of the legislation allowing pharmacists to administer seasonal influenza immunizations common across all age categories (they do differ by time relative to the legislative change); the first 2 panels of Table II give the resulting adjusted national seasonal influenza immunization rates for 2013 under assumptions that all states were at the number of years indicated at the top of each column of Table II relative to legislative or regulation changes permitting pharmacist administration of such vaccines. The first model (with c statistic of 0.567) includes only indicators for state, year (2003–2013), and time relative to the change in legislation; no person-level confounding factors are included. The adjusted national seasonal influenza immunization rates rose over time after the change in legislation, but the effect (in Figure 1) was statistically significant only for ≥6 years after the legislation change. The **Appendix Tables** provide parameter estimates for all models.

However, as described earlier, there are a number of person-level confounding factors associated with receiving a seasonal influenza immunization, and systematic variation in these characteristics across states may confound estimates of the effect of states allowing pharmacists to administer influenza vaccines. The lower graph in Figure 1 presents the effects (ORs) on timing of the legislation change after controlling for the person-level characteristics described earlier ($c = 0.734$), and the second panel of Table II provides the associated adjusted seasonal influenza immunization rates. In the year after the change in legislation, the adjusted 2013 seasonal influenza immunization rate rose from 38.6% to 38.9% (underlying OR, 1.034 [95% CI, 1.004–1.064]). The 2013 adjusted rate rose to 39.1% for 2 to 3 years after the legislation change (OR, 1.044 [95% CI,

Table II. Adjusted national rates of seasonal influenza immunizations according to timing relative to the legislative change to allow pharmacist-administered influenza vaccines, 2013.

Model	≥4 Years Before	1–3 Years Before	Year of	1 Year After	2–3 Years After	4–5 Years After	≥6 Years After
Model with common effects of time since legislation, according to age group, no person-level characteristics ($c = 0.567$)							
All Ages	0.392 (0.380–0.403)	0.395 (0.386–0.405)	0.397 (0.388–0.406)	0.399 (0.391–0.408)	0.400 (0.393–0.407)	0.398 (0.392–0.404)	0.405 (0.400–0.410)
Model with common effects of time since legislation, according to age group, with person-level characteristics ($c = 0.734$)							
All Ages	0.380 (0.369–0.391)	0.382 (0.373–0.391)	0.386 (0.377–0.395)	0.389 (0.380–0.397)	0.391 (0.384–0.398)	0.391 (0.385–0.397)	0.398 (0.393–0.403)
Model with differing effects of time since legislation, according to age group ($c = 0.734$)							
18–24	0.276 (0.246–0.306)	0.277 (0.248–0.305)	0.270 (0.236–0.304)	0.257 (0.225–0.289)	0.259 (0.232–0.285)	0.267 (0.242–0.292)	0.274 (0.251–0.297)
25–29	0.276 (0.245–0.306)	0.267 (0.240–0.295)	0.270 (0.239–0.301)	0.265 (0.233–0.297)	0.274 (0.247–0.301)	0.279 (0.254–0.304)	0.291 (0.266–0.317)
30–34	0.299 (0.275–0.323)	0.294 (0.273–0.315)	0.314 (0.289–0.339)	0.321 (0.296–0.346)	0.304 (0.284–0.324)	0.313 (0.294–0.332)	0.326 (0.309–0.344)
35–39	0.313 (0.289–0.337)	0.316 (0.294–0.338)	0.325 (0.301–0.349)	0.335 (0.311–0.359)	0.324 (0.304–0.344)	0.332 (0.313–0.351)	0.345 (0.327–0.363)
40–44	0.315 (0.293–0.337)	0.323 (0.303–0.342)	0.328 (0.306–0.350)	0.335 (0.313–0.356)	0.333 (0.315–0.351)	0.340 (0.323–0.357)	0.342 (0.326–0.358)
45–49	0.337 (0.315–0.360)	0.346 (0.326–0.366)	0.345 (0.324–0.366)	0.351 (0.330–0.372)	0.352 (0.334–0.370)	0.354 (0.338–0.371)	0.366 (0.350–0.382)
50–54	0.374 (0.354–0.395)	0.383 (0.366–0.400)	0.376 (0.357–0.394)	0.390 (0.371–0.409)	0.396 (0.381–0.412)	0.386 (0.372–0.399)	0.401 (0.388–0.414)
55–59	0.441 (0.420–0.461)	0.429 (0.412–0.447)	0.440 (0.421–0.459)	0.430 (0.412–0.449)	0.449 (0.434–0.463)	0.441 (0.428–0.455)	0.445 (0.433–0.456)
60–64	0.479 (0.458–0.500)	0.477 (0.459–0.494)	0.488 (0.468–0.507)	0.493 (0.474–0.511)	0.500 (0.485–0.514)	0.488 (0.475–0.501)	0.490 (0.478–0.501)
65–69	0.560 (0.537–0.583)	0.559 (0.540–0.578)	0.574 (0.554–0.595)	0.564 (0.543–0.584)	0.575 (0.560–0.590)	0.573 (0.559–0.586)	0.565 (0.553–0.576)
70–74	0.599 (0.573–0.625)	0.606 (0.585–0.626)	0.597 (0.573–0.621)	0.625 (0.604–0.647)	0.620 (0.603–0.636)	0.615 (0.599–0.630)	0.613 (0.601–0.626)
≥75	0.634 (0.613–0.656)	0.649 (0.632–0.665)	0.654 (0.635–0.672)	0.649 (0.631–0.667)	0.662 (0.649–0.674)	0.649 (0.638–0.661)	0.646 (0.637–0.656)

Adjusted rates and associated CIs are estimates of national average seasonal influenza immunization rates assuming average demographic characteristics (overall or within age group), insurance coverage, education, sex, health status, income, year, and state of residence, in year 2013 and if all states were the given number of years from the legislative change allowing pharmacists to administer influenza vaccines. Data from 2003 to 2013 are combined into a single analytic file, a total of 3.2 million respondents representing 1,966.9 million person-years. Population proportions were calculated by using Behavioral Risk Factor Surveillance System survey weights to represent the adult population in the 50 states plus Washington, DC.

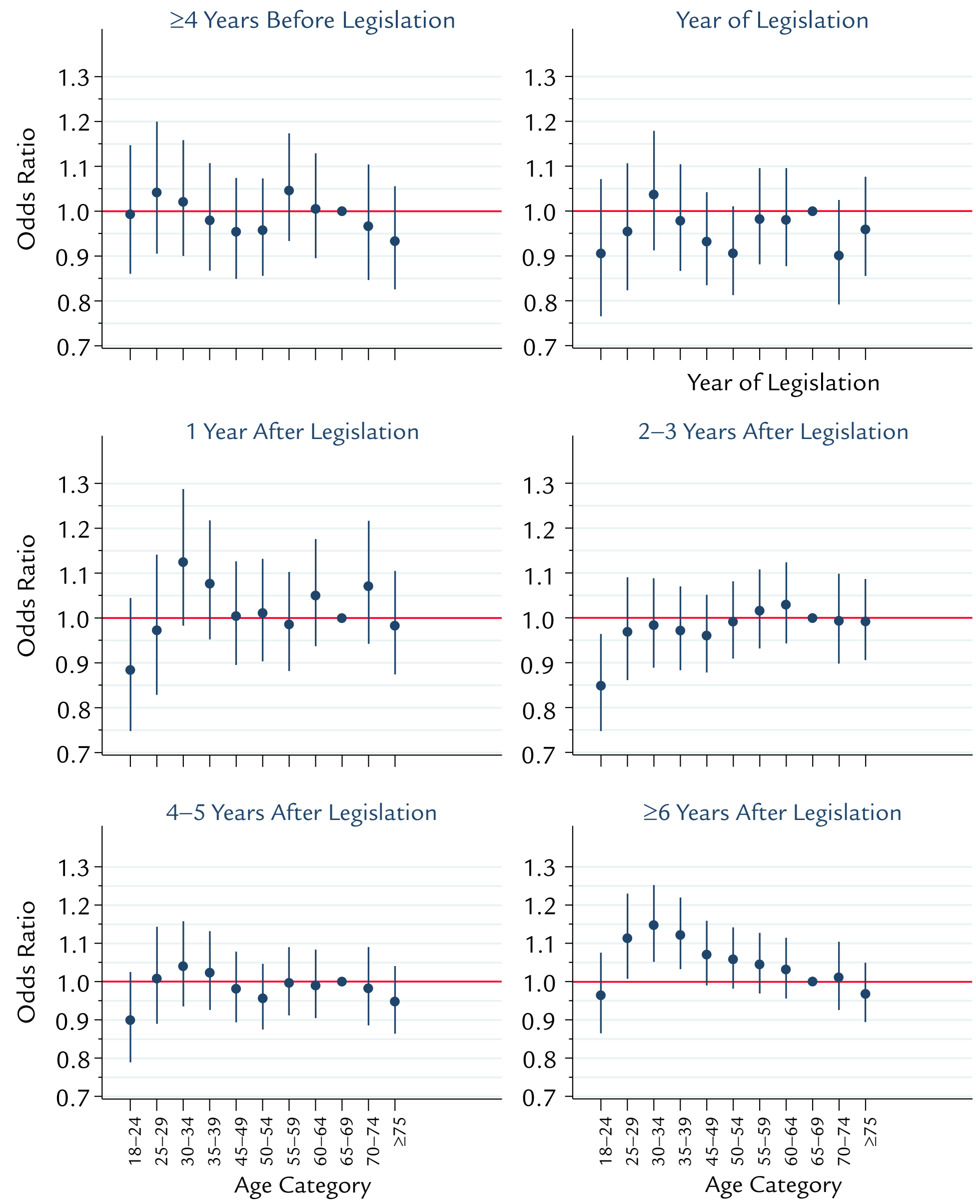

Figure 2. Estimated odds ratios for the effects on national seasonal influenza immunization rates from timing relative to the legislative change to allow pharmacist-administered influenza vaccines, assuming differing effects across age groups. Odds ratios and CIs are shown for estimates of the effect of a person's state allowing pharmacists to administer "flu shots" on the likelihood that a person will receive a flu shot, controlling for demographic characteristics, insurance coverage, education, sex, health status, income, year, and state of residence. Data from 2003 through 2013 are combined into a single analytic file, a total of 3.2 million respondents representing 1,966.9 million person-years. Population proportions were calculated by using Behavioral Risk Factor Surveillance System survey weights to represent the adult population in the 50 states plus Washington, D.C.

Table III. Estimated change in influenza vaccinations for adults in 2013 associated with state legislation to allow pharmacist-administered influenza vaccine, in total and according to age category.

Age Category	Actual Influenza Vaccination Rate 2013, %	Predicted Influenza Vaccination Rate if No 2003-2013 Legislative Changes Permitting Pharmacist-Administered Influenza Vaccines 2013, %	Total Population 2013 (thousands)	Total Extra Influenza Vaccinations in 2013 Associated With 2003–2013 Legislative Changes Permitting Pharmacist-Administered Influenza Vaccines (thousands)	Percent Increase in Seasonal Influenza Immunizations Associated With 2003–2013 Legislative Changes Permitting Pharmacist-Administered Influenza Vaccines
All adults	40.3%	38.2	246,064	5,190	5.5
Age category, y					
18–24	27.9%	27.7	28,343	79	1.0
25–29	27.8%	26.7	17,957	187	3.9
30–34	31.1%	29.4	28,219	492	5.9
35–39	34.0%	31.6	17,297	415	7.6
40–44	34.0%	32.3	23,307	411	5.5
45–49	36.2%	34.6	19,146	292	4.4
50–54	39.1%	38.3	25,294	212	2.2
55–59	43.9%	42.9	19,780	202	2.4
60–64	48.6%	47.7	19,429	182	2.0
65–69	57.2%	55.9	14,305	186	2.3
70–74	61.7%	60.6	11,568	129	1.8
≥75	65.0%	64.9	19,782	30	0.2

The predicted influenza vaccination rate if no 2003 to 2013 legislative changes permitting pharmacist-administered influenza vaccines is the 2013 adjusted influenza immunization rate for each age group for 1 to 3 years before a legislative change (see Table II). Total populations are for the entire 50 states plus Washington, DC, Behavioral Risk Factor Surveillance System landline files. The total extra vaccinations are equal to the difference in actual versus predicted vaccination rates multiplied by the total population in that age category.

1.018–1.071]) and also 3 to 5 years after the legislation change (OR, 1.045 [95% CI, 1.013–1.077]). Six years and more after the legislation change, the 2013 adjusted rate rose to 39.8% (OR, 1.078 [95% CI, 1.034–1.124]), an increase of 4.2% in the number of adults receiving a seasonal influenza immunization.

We next investigated whether the effect of allowing pharmacists to administer seasonal influenza immunizations varied according to age. As shown in Table I, there was a noticeable increase in the proportion of people who reported receiving a seasonal influenza immunization starting around 50 years of age. The CDC prioritizes people aged ≥50 years for receiving a seasonal influenza immunization during periods of shortage,[25] and the Centers for Medicare & Medicaid Services (CMS) includes the percentage of members receiving a seasonal influenza immunization as one of the quality measures in its Part C & D Star Ratings system upon which payments to Medicare managed care plans depend in part.[26] As shown in the third panel of Table II and in Figure 2, the long-term increases in seasonal influenza immunization rates are greatest for people aged 25 through 39 years. Relative to the baseline period (1–3 years before the legislative change), the adjusted 2013 seasonal influenza immunization rates increased by 9.1%, from 26.7% to 29.1% for people aged 25 to 29 years (OR, 1.138 [95% CI, 1.036–1.239]); by 10.9%, from 29.4% to 32.6% for people aged 30 to 34 years (OR, 1.173 [95% CI, 1.086–1.261]); and by 9.1%, from 31.6% to 34.5% for people aged 35 to 39 years (OR, 1.147 [95% CI, 1.066–1.228]). The youngest (18–24 years) and oldest (≥75 years) adults exhibited no long-run change in seasonal influenza immunization rates. Figure 2 shows, for each group of years relative to the legislative change, ORs (and 95% CIs) for each age category, illustrating the "inverse U-shape" of increases in seasonal influenza immunization rates associated with allowing pharmacists to administer the vaccine.

Finally, the results of these models were used to estimate how many extra people have received a seasonal influenza immunization in the most recent year of the study sample (2013) associated with allowing pharmacists to administer the immunization. As shown in Table III, because of states permitting pharmacists to administer influenza vaccines between 2003 and 2013, there were 5.1 million (5.5%) additional immunized adults in 2013 compared with a hypothetical scenario in which these states did not adopt this change. The increases were largest for adults aged 25 to 59 years (between 2.2% and 7.6%), with the largest increase among people aged 35 to 39 years.

DISCUSSION

The present study suggests that regulations implemented to expand pharmacists' role in health care delivery through the administration of seasonal influenza immunizations have had a positive impact on the national efforts to increase immunization rates. Our findings show that states had significantly higher long-run seasonal influenza immunization rates among most nonelderly adults after policy changes allowed pharmacists to administer immunizations. For example, in 2013, we estimated that 4.1 million additional adults were immunized for seasonal influenza. Jayasundara et al,[27] in a meta-analysis, estimated an "attack rate" (rate of infection among unvaccinated people) for influenza of 3.5% in adults and 15.2% in children. Assuming an average vaccine effectiveness of 45% (based on the authors' calculations of vaccine effectiveness estimated by Belongia et al[28] and the most common influenza strain circulating in each season from 2006–2014),[29] the extra 5.1 million immunized adults in 2013 would translate into 81,000 fewer influenza infections among adults in that year. If instead the vaccine effectiveness were the 75% found by Nichol[12] in years of a "good match" between circulating virus and vaccine strain, in 2013 there would have been 134,000 fewer influenza infections among adults. These fewer infections likely translated into less of a burden on the health care system. Therefore, policies to promote immunizations in nontraditional settings (in which administrations have been shown to be cost-effective as a result of lower costs of immunization delivery) may improve access to this preventive care; this improved access can increase immunization rates and ultimately reduce the burden of influenza on the health care system. Furthermore, retail pharmacies in particular are widely available and can offer seasonal influenza immunizations during their business hours over the course of the seasonal influenza season; they may lower people's opportunity costs of receiving such a vaccination relative to traditional providers and also employer-provided clinics (which may only occur 1 or 2 days during the season).

By comparison, the 7.8% increase in the odds of getting a seasonal influenza immunization after implementation of regulations is below the 22% to 27% estimated increase in such odds for people aged ≥65 years found by Steyer et al.[18] Differences in our results may be due to the survey periods analyzed (1995–1999 for Steyer et al vs 2003–2013 for the present analysis), including differences in the baseline immunization rate (lower before 2000, particularly for people aged ≤64 years).

In 2002 and 2003, the CMS adopted regulation changes that may have increased access to seasonal influenza immunizations, particularly for the elderly.[30] In 2002, the CMS permitted the existence of standing orders, based on Advisory Committee on Immunization Practices guidelines, for influenza and pneumococcal pneumonia vaccines at institutional providers participating in the Medicare and Medicaid programs. Because elderly individuals (those aged ≥65 years) may have a higher rate of encounters with physicians and other traditional providers of seasonal influenza immunizations, and these regulatory changes presumably increased access to immunizations at these providers, the effect of allowing pharmacists to administer seasonal influenza immunizations may have been muted for this group.

Furthermore, we found that the long-run (≥6 years after a change in legislation or regulations permitting pharmacists to administer seasonal influenza immunizations) effect on increased seasonal influenza immunizations peaks for people aged 40 to 44 years and 45 to 50 years. This finding may be due to the National Committee for Quality Assurance adding a measure of the number of adults aged 50 to 64 years receiving influenza immunizations to their Health Plan Employer Data and Information Set in 2001, which may have increased access to seasonal influenza immunizations for people in this age group who were covered by health plans. Finally, differences between our results and those from Steyer et al[18] may also be due to differences in methods (the study by Steyer et al uses a simple difference design without year or state fixed effects).

Our finding of a significant difference in long-run seasonal influenza immunization rates for adults aged 25 to 59 years differs from the findings of McConeghy and Wing,[19] who reported increases in rates across the 18- to 65-year-old category but were not statistically significant. We hypothesize that these results may differ due to our definition of a regulatory change (which we defined as the time at which open access to pharmacy-based immunizations was greatest vs "flexible"); our exclusion of intranasal administration and focus on injections; our statistical approach, which included consideration for an extended follow-up time after the regulations were implemented; and possibly that young adults (ages 18–25 years) may seek preventive care services at lower rates than do other adults.[31]

The states with more comprehensive policies allowing pharmacists to administer immunizations (eg, expanding other potential vaccines included) may likely experience the greatest benefit in improving overall immunization rates, particularly for people who may take advantage of wider access to care. The results of this study indicate that the policies implemented correlated with higher seasonal influenza immunization rates of adults aged 25 to 64 years. We hypothesize that this subpopulation may be more likely to utilize alternative settings to access health care services, such as a pharmacy.

As with all retrospective studies, the present study is specific to the time period and the states in which these data were collected; it is possible that events other than permitting pharmacists to administer seasonal influenza immunizations could affect our results. We could not determine whether people received their seasonal influenza immunizations in retail pharmacies because the BRFSS did not include the necessary detail to assess where the immunizations were provided across all survey years. Also, other than the state of residence, we did not identify the effects of local geographic factors (eg, urban vs rural) that may influence the likelihood of receiving a seasonal influenza immunization.

As with any study using self-reported survey data, these results are subject to patient recall bias. However, researchers have found that self-reporting of influenza immunizations is highly reliable.[32] Furthermore, because the survey data were collected via landline telephone, people without landline phones and those who primarily use mobile telephones were excluded, potentially affecting generalizability.[33,34]

We opted to use state-level fixed effects to control for the combined effect of all of the factors idiosyncratic to each state that may affect the overall level of seasonal influenza immunization in each state. The alternative would be to identify all of the factors that drive differences in seasonal influenza immunization rates across states. However, there are a multitude of these state-idiosyncratic factors that could influence immunization rates, including many that are difficult if not impossible to measure. State-specific fixed effects absorb these differences into a single factor to more easily and more consistently control for these state-idiosyncratic factors.

In reviewing the state statutes and regulations to identify the implementation year of pharmacy immunization authority, we noted that pharmacies in states with the same implementation year may not have implemented the policy at the same time depending on how early or late in the year the final rules were passed. Furthermore, even if states had comparable regulation dates, some pharmacies may have experienced variation in the time to implement immunization programs statewide.

CONCLUSIONS

Our findings of increased immunization rates, particularly among people between 25 and 59 years of age, after the implementation of state regulations allowing pharmacists to administer seasonal influenza immunizations is consistent with the economic literature showing that scope of practice regulations are barriers to entry.[35] The results point toward considering expansion of scope of practice in areas that leverage pharmacist-delivered patient care services and accessibility for patients, particularly where there is a well-established protocol in place, with the goal of increasing the provision of health services and potentially improving public health. Broader research opportunity into the expansion of pharmacists' role in preventive care exists, with the goal of seeking to further reduce health care system burden and increasing patient access to care.

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Dr. Drozd collected the data for this manuscript. All authors contributed to the design, analysis, and interpretation of data and writing of the manuscript. The authors acknowledge Shamonda Braithwaite for her support on earlier versions of this manuscript. Other than Dr. Miller's contributions, the study sponsor had no other role.

CONFLICTS OF INTEREST

This research was funded by the National Association of Chain Drug Stores. Dr. Miller is employed by the study sponsor.

SUPPLEMENTARY MATERIAL

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REFERENCES

1. Centers for Disease Control and Prevention. Achievements in public health, 1900–1999: control of infectious diseases. *MMWR*. 1999;48:241–243.
2. Centers for Disease Control and Prevention. Ten great public health achievements—United States, 2001-2010. *MMWR*. 2011;60:619–623.
3. U.S. Department of Health & Human Services. National vaccine plan implementation: protecting the nation's health through immunization2015. http://www.hhs.gov/nvpo/vacc_plan/.
4. Centers for Disease Control and Prevention. Flu vaccination coverage: United States, 2014-15 influenza season. 2015. Atlanta, GA. http://www.cdc.gov/flu/fluvaxview/coverage-1415estimates.html.
5. U.S. Department of Health and Human Services. Immunization and infectious diseases: objectives. Washington, DC. 2015. http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=23.
6. McLaughlin JM, McGinnis JJ, Tan L, et al. Estimated human and economic burden of four major adult vaccine-preventable diseases in the United States, 2013. *J Prim Prev*. 2015;36:259–273.
7. U.S. Bureau of Labor Statistics. Illness-related work absences during flu season. Issues in Labor Statistics: Summary 2010; 10-06. Washington, DC. http://www.bls.gov/opub/ils/pdf/opbils83.pdf.
8. Figaro KM, Belue R. Prevalence of influenza vaccinations in a high-risk population: impact of age and race. *J Ambul Care Manage*. 2005;28:24–29.
9. Centers for Disease Control and Prevention. Place of influenza vaccinations among adults—United States, 2010-2011. *MMWR*. 2011;60:781–785.
10. Lu P, Santibanez TA, Williams W, Zhang J, et al. Surveillance of influenza vaccination coverage—United States, 2007-08 through 2011-12 influenza seasons. *MMWR*. 2013;62:1–28.
11. Taitel MS, Fensterheim LE, Cannon AE, Cohen ES. Improving pneumococcal and herpes zoster vaccination uptake: Expanding pharmacist privileges. *Am J Manag Care*. 2013;19:e309–e313.
12. Nichol KL. Cost-benefit analysis of a strategy to vaccinate healthy working adults against influenza. *Arch Intern Med*. 2001;161:749–759.

13. Rothberg MB, Rose DN. Vaccination versus treatment of influenza in working adults: a cost effectiveness analysis. *Am J Med*. 2005;118:68–77.
14. Buxton Bridges C, Thompson WW, Meltzer MI, et al. Effectiveness and cost benefit of influenza vaccination of healthy working adults: a randomized controlled trial. *JAMA*. 2000;284:1655–1663.
15. Singhal PK, Zhang D. Costs of adult vaccination in medical settings and pharmacies: an observational study. *J Manag Care Spec Pharm*. 2014;20:930–936.
16. Immunization Action Coalition. State information: states allowing pharmacists to vaccinate. Saint Paul, MN. http://www.immunize.org/laws/pharm.asp.
17. Houge M, Grabenstein JD, Foster SL, Rothholz MC. Pharmacist involvement with immunizations: a decade of professional advancement. *J Am Pharm Assoc*. 2006;46:168–182.
18. Steyer TE, Ragucci KR, Pearson WS, Mainous AG. The role of pharmacists in the delivery of influenza vaccinations. *Vaccine*. 2004;22:1001–1006.
19. McConeghy KW, Wing C. A national examination of pharmacy-based immunization statutes and their association with influenza vaccinations and preventive health. *Vaccine*. 2016;34:3463–3468.
20. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. Washington, DC. http://www.cdc.gov/brfss/.
21. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2008 codebook report. 2008. Washington, DC. http://ftp.cdc.gov/pub/data/brfss/codebook08.rtf.
22. Centers for Disease Control and Prevention. Interim influenza vaccination recommendations, 2004–05 influenza season. 2004. Washington, DC. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5339a6.htm.
23. U.S. Government Accountability Office. Influenza vaccine shortages in 2004–05 season underscore need for better preparation. GAO-05-984. 2005. Washington, DC. http://www.gao.gov/new.items/d05984.pdf.
24. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System Operational and User's Guide. 2006. Washington, DC. http://ftp.cdc.gov/pub/Data/Brfss/userguide.pdf.
25. Centers for Disease Control and Prevention. Influenza (Flu) Vaccination: Who Should Do It, Who Should Not and Who Should Take Precautions. 2015. Washington, DC. http://www.cdc.gov/flu/protect/whoshouldvax.htm#annual-vaccination.
26. Centers for Medicare & Medicaid Services. Medicare 2016 Part C & D Star Rating Technical Notes. Baltimore, MD. https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovGenIn/Downloads/2016-Part-C-and-D-Medicare-Star-Ratings-Data-v10-06-2015.zip.
27. Jayasundara K, Soobiah C, Thommes E, et al. Natural attack rate of influenza in unvaccinated children and adults: a meta-regression analysis. *BMC Infect Dis*. 2014;14:670.
28. Belongia EA, Simpson MD, King JP, et al. Variable influenza vaccine effectiveness by subtype: a systematic review and meta-analysis of test-negative design studies. *Lancet Infect Dis*. 2016;16:942–951.
29. Centers for Disease Control and Prevention. Past Flu Seasons. 2016. Washington, DC. https://www.cdc.gov/flu/pastseasons/index.htm.
30. Centers for Disease Control and Prevention. Notice to readers: recommended adult immunization schedule—United States, 2003-2004. *MMWR Weekly*. 2013;52:965–969.
31. Callahan ST, Cooper WO. Changes in ambulatory health care use during the transition to young adulthood. *J Adolesc Health*. 2010;46:407–413.
32. Farmer GC, Papachristou T, Gotz C, et al. Does primary language influence the receipt of influenza and pneumococcal immunizations among community-dwelling older adults? *J Aging Health*. 2010;22:1158–1183.
33. Bureau of the Census. U.S. Department of Commerce. Phoneless in America. Statistical Brief 94–16. Washington DC. 1994.
34. Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, January–June 2010. National Center for Health Statistics; 2010.
35. U.S. Department of the Treasury Office of Economic Policy, Council of Economic Advisors, and U.S. Department of Labor. *Occupational Licensing: A Framework for Policymakers*. 2015. http://www.whitehouse.gov/sites/default/files/docs/licensing_report_final_nonembargo.pdf.

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SUPPLEMENTARY MATERIAL

Table SI-SIII.

Table SI. Logistic regression model odds ratios, differing effects of time since legislation, according to age group, with person-level characteristics.

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
State				
AL	0.986	0.024	0.562	(0.940,1.034)
AK	0.915	0.025	0.001	(0.867,0.965)
AZ	0.904	0.022	<0.001	(0.862,0.948)
AR	1.112	0.024	<0.001	(1.067,1.159)
CA	0.819	0.014	<0.001	(0.792,0.847)
CO	1.182	0.021	<0.001	(1.141,1.224)
CT	1.137	0.021	<0.001	(1.097,1.179)
DE	1.075	0.027	0.004	(1.023,1.129)
DC	1.080	0.023	<0.001	(1.035,1.127)
FL	0.800	0.014	<0.001	(0.773,0.829)
GA	0.858	0.016	<0.001	(0.827,0.890)
HI	1.316	0.029	<0.001	(1.260,1.375)
ID	0.806	0.020	<0.001	(0.769,0.846)
IL	0.841	0.016	<0.001	(0.811,0.873)
IN	0.957	0.017	0.011	(0.925,0.990)
IA	1.300	0.028	<0.001	(1.245,1.357)
KS	1.105	0.023	<0.001	(1.062,1.151)
KY	1.023	0.021	0.261	(0.983,1.065)
LA	1.050	0.019	0.007	(1.013,1.088)
ME	1.183	0.020	<0.001	(1.144,1.223)
MD	1.106	0.019	<0.001	(1.069,1.145)
MA	1.220	0.019	<0.001	(1.183,1.258)
MI	0.902	0.021	<0.001	(0.862,0.943)
MN	1.348	0.027	<0.001	(1.297,1.402)
MS	0.931	0.022	0.003	(0.888,0.976)
MO	1.063	0.021	0.002	(1.023,1.104)
MT	1.036	0.022	0.097	(0.994,1.081)
NE	1.264	0.029	<0.001	(1.209,1.321)
NV	0.681	0.018	<0.001	(0.646,0.718)
NH	1.146	0.020	<0.001	(1.107,1.186)
NJ	0.907	0.014	<0.001	(0.879,0.935)
NM	1.049	0.022	0.024	(1.006,1.093)
NC	1.114	0.020	<0.001	(1.076,1.154)
ND	1.157	0.025	<0.001	(1.108,1.208)
OH	0.970	0.022	0.168	(0.929,1.013)
OK	1.275	0.021	<0.001	(1.234,1.318)
OR	0.937	0.022	0.005	(0.896,0.981)
PA	1.019	0.017	0.275	(0.985,1.054)

(continued)

Table SI. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
RI	1.264	0.023	<0.001	(1.219,1.311)
SC	1.020	0.018	0.262	(0.985,1.056)
SD	1.630	0.036	<0.001	(1.562,1.702)
TN	1.101	0.029	<0.001	(1.046,1.159)
TX	0.953	0.024	0.056	(0.907,1.001)
UT	1.081	0.024	<0.001	(1.035,1.130)
VT	1.114	0.019	<0.001	(1.078,1.151)
VA	1.133	0.029	<0.001	(1.077,1.192)
WA	1.034	0.022	0.128	(0.991,1.079)
WV	1.192	0.021	<0.001	(1.151,1.235)
WI	1.014	0.025	0.591	(0.965,1.065)
WY	1.072	0.020	<0.001	(1.034,1.111)
Years relative to legislation change				
≥4 Years Before	0.985	0.012	0.236	(0.961,1.010)
Year of	1.008	0.013	0.515	(0.984,1.034)
1 Year After	1.017	0.014	0.198	(0.991,1.044)
2-3 Years After	1.021	0.012	0.075	(0.998,1.045)
4-5 Years After	1.011	0.015	0.451	(0.983,1.040)
≥7 Years After	1.040	0.020	0.043	(1.001,1.081)
Year				
2004	1.011	0.012	0.354	(0.987,1.036)
2005	0.709	0.009	<0.001	(0.692,0.726)
2006	0.940	0.013	<0.001	(0.916,0.965)
2007	1.181	0.015	<0.001	(1.151,1.212)
2008	1.160	0.016	<0.001	(1.130,1.191)
2009	1.256	0.018	<0.001	(1.222,1.291)
2010	1.383	0.021	<0.001	(1.343,1.424)
2011	1.245	0.020	<0.001	(1.206,1.285)
2012	1.223	0.022	<0.001	(1.180,1.267)
2013	1.387	0.026	<0.001	(1.337,1.439)
Constant				
Constant	0.483	0.008	<0.001	(0.467,0.499)

Odds ratios and CIs are shown for estimates of the effect of a person's state allowing pharmacists to administer "flu shots" on the likelihood that a person will receive a flu shot, controlling for demographic characteristics, insurance coverage, education, sex, health status, income, year, and state of residence. Data from 2003 through 2013 are combined into a single analytic file, a total of 3.2 million respondents representing 1,966.9 million person-years. Logistic regression model incorporates the weights, stratification, and primary sampling units from the Behavioral Risk Factor Surveillance System to represent the adult population in the 50 states plus Washington, D.C.

Table SII. Logistic regression model odds ratios, differing effects of time since legislation, according to age group, with person-level characteristics.

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
State				
AL	1.067	0.028	0.016	(1.012,1.124)
AK	1.111	0.033	<0.001	(1.049,1.178)
AZ	0.918	0.024	0.001	(0.872,0.968)
AR	1.218	0.028	<0.001	(1.164,1.275)
CA	0.875	0.016	<0.001	(0.844,0.907)
CO	1.310	0.026	<0.001	(1.261,1.361)
CT	1.068	0.021	0.001	(1.027,1.110)
DE	1.059	0.029	0.037	(1.004,1.117)
DC	1.194	0.029	<0.001	(1.138,1.252)
FL	0.761	0.015	<0.001	(0.732,0.791)
GA	1.031	0.021	0.138	(0.990,1.073)
HI	1.191	0.031	<0.001	(1.133,1.253)
ID	0.860	0.023	<0.001	(0.816,0.906)
IL	0.862	0.018	<0.001	(0.828,0.897)
IN	1.032	0.019	0.093	(0.995,1.071)
IA	1.323	0.031	<0.001	(1.263,1.386)
KS	1.113	0.025	<0.001	(1.065,1.162)
KY	1.138	0.026	<0.001	(1.089,1.189)
LA	1.300	0.026	<0.001	(1.249,1.353)
ME	1.144	0.021	<0.001	(1.104,1.186)
MD	1.171	0.022	<0.001	(1.128,1.215)
MA	1.154	0.020	<0.001	(1.117,1.193)
MI	0.887	0.022	<0.001	(0.845,0.931)
MN	1.440	0.031	<0.001	(1.381,1.503)
MS	1.110	0.029	<0.001	(1.054,1.168)
MO	1.122	0.024	<0.001	(1.076,1.170)
MT	1.104	0.026	<0.001	(1.055,1.156)
NE	1.307	0.032	<0.001	(1.246,1.372)
NV	0.735	0.022	<0.001	(0.694,0.780)
NH	1.126	0.021	<0.001	(1.085,1.169)
NJ	0.893	0.015	<0.001	(0.864,0.924)
NM	1.122	0.026	<0.001	(1.072,1.174)
NC	1.289	0.025	<0.001	(1.240,1.340)
ND	1.225	0.029	<0.001	(1.169,1.284)
OH	0.979	0.024	0.370	(0.934,1.026)
OK	1.449	0.027	<0.001	(1.398,1.502)
OR	0.918	0.023	0.001	(0.874,0.965)
PA	0.980	0.018	0.281	(0.945,1.017)
RI	1.262	0.025	<0.001	(1.214,1.313)
SC	1.169	0.023	<0.001	(1.125,1.215)
SD	1.779	0.043	<0.001	(1.697,1.865)

(continued)

Table SII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
TN	1.271	0.036	<0.001	(1.202,1.344)
TX	1.112	0.031	<0.001	(1.054,1.174)
UT	1.249	0.030	<0.001	(1.191,1.310)
VT	1.080	0.019	<0.001	(1.043,1.119)
VA	1.210	0.034	<0.001	(1.145,1.279)
WA	1.034	0.024	0.157	(0.987,1.083)
WV	1.291	0.025	<0.001	(1.242,1.342)
WI	1.031	0.028	0.263	(0.977,1.087)
WY	1.198	0.024	<0.001	(1.152,1.246)
Years relative to legislation change				
≥4 Years Before	0.992	0.014	0.567	(0.965,1.020)
Year of	1.021	0.014	0.140	(0.993,1.049)
1 Year After	1.034	0.015	0.023	(1.004,1.064)
2-3 Years After	1.044	0.013	0.001	(1.018,1.071)
4-5 Years After	1.045	0.016	0.006	(1.013,1.077)
≥7 Years After	1.078	0.023	<0.001	(1.034,1.124)
Year				
2004	0.986	0.051	0.784	(0.891,1.091)
2005	0.707	0.033	<0.001	(0.645,0.774)
2006	0.873	0.041	0.004	(0.797,0.957)
2007	1.008	0.046	0.865	(0.921,1.103)
2008	0.980	0.043	0.638	(0.900,1.067)
2009	0.941	0.041	0.160	(0.863,1.025)
2010	0.878	0.037	0.002	(0.808,0.955)
2011	0.734	0.032	<0.001	(0.674,0.799)
2012	0.700	0.031	<0.001	(0.641,0.765)
2013	0.757	0.035	<0.001	(0.691,0.829)
Age category				
18-24	0.276	0.016	<0.001	(0.246,0.309)
25-29	0.181	0.010	<0.001	(0.161,0.202)
30-34	0.166	0.009	<0.001	(0.150,0.185)
35-39	0.187	0.010	<0.001	(0.169,0.207)
40-44	0.206	0.010	<0.001	(0.187,0.227)
45-49	0.242	0.012	<0.001	(0.220,0.267)
50-54	0.321	0.015	<0.001	(0.292,0.352)
55-60	0.432	0.021	<0.001	(0.393,0.474)
60-64	0.617	0.030	<0.001	(0.560,0.680)
70-74	1.692	0.097	<0.001	(1.512,1.893)
≥75	2.282	0.123	<0.001	(2.054,2.536)
Sex				
Female	1.125	0.018	<0.001	(1.090,1.161)
Age category × year				
18-24, 2004	0.906	0.070	0.199	(0.779,1.053)

(continued)

Table SII. (continued).

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
18-24, 2005	1.084	0.083	0.288	(0.934,1.259)
18-24, 2006	0.943	0.078	0.480	(0.802,1.109)
18-24, 2007	0.990	0.074	0.893	(0.855,1.146)
18-24, 2008	1.002	0.074	0.982	(0.867,1.157)
18-24, 2009	1.137	0.085	0.085	(0.983,1.315)
18-24, 2010	1.271	0.093	0.001	(1.101,1.468)
18-24, 2011	1.615	0.121	<0.001	(1.393,1.871)
18-24, 2012	1.749	0.143	<0.001	(1.489,2.054)
18-24, 2013	1.795	0.153	<0.001	(1.519,2.120)
25-29, 2004	1.133	0.086	0.102	(0.975,1.316)
25-29, 2005	1.101	0.082	0.195	(0.952,1.274)
25-29, 2006	1.130	0.083	0.096	(0.979,1.305)
25-29, 2007	1.339	0.095	<0.001	(1.165,1.539)
25-29, 2008	1.258	0.089	0.001	(1.096,1.445)
25-29, 2009	1.543	0.108	<0.001	(1.345,1.769)
25-29, 2010	2.022	0.139	<0.001	(1.767,2.314)
25-29, 2011	2.585	0.197	<0.001	(2.227,3.001)
25-29, 2012	2.555	0.205	<0.001	(2.184,2.990)
25-29, 2013	2.547	0.222	<0.001	(2.146,3.022)
30-34, 2004	1.140	0.080	0.060	(0.994,1.308)
30-34, 2005	1.087	0.074	0.224	(0.950,1.242)
30-34, 2006	1.172	0.079	0.019	(1.027,1.338)
30-34, 2007	1.403	0.092	<0.001	(1.234,1.597)
30-34, 2008	1.370	0.086	<0.001	(1.212,1.549)
30-34, 2009	1.701	0.108	<0.001	(1.502,1.925)
30-34, 2010	2.341	0.142	<0.001	(2.078,2.636)
30-34, 2011	2.681	0.173	<0.001	(2.362,3.042)
30-34, 2012	2.974	0.207	<0.001	(2.594,3.410)
30-34, 2013	2.774	0.194	<0.001	(2.419,3.182)
35-39, 2004	1.138	0.077	0.056	(0.997,1.300)
35-39, 2005	0.920	0.060	0.203	(0.808,1.046)
35-39, 2006	1.120	0.073	0.082	(0.986,1.273)
35-39, 2007	1.295	0.080	<0.001	(1.147,1.461)
35-39, 2008	1.279	0.076	<0.001	(1.139,1.437)
35-39, 2009	1.505	0.090	<0.001	(1.339,1.693)
35-39, 2010	1.984	0.115	<0.001	(1.770,2.224)
35-39, 2011	2.433	0.151	<0.001	(2.154,2.749)
35-39, 2012	2.171	0.140	<0.001	(1.913,2.464)
35-39, 2013	2.583	0.178	<0.001	(2.257,2.956)
40-44, 2004	1.046	0.068	0.490	(0.921,1.189)
40-44, 2005	0.847	0.053	0.008	(0.748,0.958)
40-44, 2006	1.014	0.064	0.820	(0.896,1.148)
40-44, 2007	1.203	0.071	0.002	(1.071,1.352)

(continued)

Table SII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
40-44, 2008	1.170	0.067	0.006	(1.046,1.309)
40-44, 2009	1.395	0.080	<0.001	(1.246,1.562)
40-44, 2010	1.722	0.095	<0.001	(1.545,1.918)
40-44, 2011	2.046	0.118	<0.001	(1.827,2.291)
40-44, 2012	2.011	0.120	<0.001	(1.789,2.261)
40-44, 2013	2.256	0.144	<0.001	(1.991,2.557)
45-49, 2004	1.078	0.071	0.255	(0.947,1.225)
45-49, 2005	0.769	0.048	<0.001	(0.680,0.869)
45-49, 2006	0.983	0.060	0.778	(0.873,1.107)
45-49, 2007	1.071	0.063	0.241	(0.955,1.202)
45-49, 2008	1.112	0.063	0.060	(0.996,1.242)
45-49, 2009	1.273	0.071	<0.001	(1.140,1.421)
45-49, 2010	1.533	0.084	<0.001	(1.377,1.707)
45-49, 2011	1.782	0.102	<0.001	(1.594,1.993)
45-49, 2012	1.809	0.109	<0.001	(1.607,2.035)
45-49, 2013	2.062	0.132	<0.001	(1.819,2.338)
50-54, 2004	1.053	0.068	0.421	(0.929,1.194)
50-54, 2005	0.758	0.045	<0.001	(0.674,0.852)
50-54, 2006	0.925	0.055	0.191	(0.823,1.040)
50-54, 2007	1.085	0.062	0.155	(0.970,1.213)
50-54, 2008	1.096	0.060	0.094	(0.985,1.219)
50-54, 2009	1.232	0.066	<0.001	(1.108,1.369)
50-54, 2010	1.381	0.073	<0.001	(1.245,1.532)
50-54, 2011	1.574	0.086	<0.001	(1.414,1.751)
50-54, 2012	1.567	0.088	<0.001	(1.403,1.750)
50-54, 2013	1.690	0.099	<0.001	(1.508,1.895)
55-59, 2004	0.981	0.064	0.772	(0.864,1.115)
55-59, 2005	0.772	0.047	<0.001	(0.685,0.870)
55-59, 2006	0.979	0.058	0.721	(0.871,1.100)
55-59, 2007	1.035	0.060	0.556	(0.924,1.158)
55-59, 2008	1.072	0.059	0.206	(0.962,1.195)
55-59, 2009	1.198	0.066	0.001	(1.076,1.334)
55-59, 2010	1.296	0.069	<0.001	(1.168,1.439)
55-59, 2011	1.371	0.076	<0.001	(1.230,1.528)
55-59, 2012	1.415	0.080	<0.001	(1.267,1.581)
55-59, 2013	1.464	0.085	<0.001	(1.307,1.641)
60-64, 2004	0.960	0.064	0.535	(0.842,1.093)
60-64, 2005	0.787	0.049	<0.001	(0.697,0.889)
60-64, 2006	0.941	0.058	0.324	(0.834,1.062)
60-64, 2007	1.058	0.063	0.339	(0.942,1.188)
60-64, 2008	1.060	0.060	0.305	(0.949,1.184)
60-64, 2009	1.108	0.062	0.068	(0.993,1.236)
60-64, 2010	1.202	0.065	0.001	(1.081,1.337)

(continued)

Table SII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
60-64, 2011	1.215	0.068	0.001	(1.089,1.356)
60-64, 2012	1.184	0.068	0.003	(1.059,1.324)
60-64, 2013	1.220	0.071	0.001	(1.088,1.368)
70-74, 2004	0.833	0.064	0.018	(0.716,0.969)
70-74, 2005	0.991	0.071	0.904	(0.862,1.140)
70-74, 2006	0.894	0.064	0.119	(0.776,1.029)
70-74, 2007	0.913	0.063	0.184	(0.798,1.044)
70-74, 2008	0.864	0.057	0.027	(0.759,0.984)
70-74, 2009	0.838	0.055	0.006	(0.737,0.951)
70-74, 2010	0.817	0.051	0.001	(0.722,0.924)
70-74, 2011	0.756	0.049	<0.001	(0.666,0.858)
70-74, 2012	0.742	0.049	<0.001	(0.652,0.844)
70-74, 2013	0.764	0.051	<0.001	(0.671,0.871)
≥75, 2004	0.921	0.065	0.248	(0.802,1.059)
≥75, 2005	1.087	0.071	0.202	(0.956,1.237)
≥75, 2006	0.980	0.064	0.757	(0.862,1.114)
≥75, 2007	0.985	0.063	0.816	(0.869,1.117)
≥75, 2008	0.942	0.057	0.323	(0.837,1.060)
≥75, 2009	0.913	0.055	0.128	(0.811,1.027)
≥75, 2010	0.839	0.049	0.002	(0.749,0.940)
≥75, 2011	0.711	0.042	<0.001	(0.633,0.799)
≥75, 2012	0.709	0.043	<0.001	(0.630,0.798)
≥75, 2013	0.703	0.043	<0.001	(0.624,0.793)
Age category × sex				
18-24, Female	0.850	0.028	<0.001	(0.796,0.907)
25-29, Female	0.977	0.032	0.477	(0.918,1.041)
30-34, Female	1.044	0.028	0.111	(0.990,1.101)
35-39, Female	1.016	0.025	0.518	(0.968,1.066)
40-44, Female	1.043	0.024	0.075	(0.996,1.091)
45-49, Female	1.074	0.024	0.001	(1.028,1.123)
50-54, Female	1.132	0.024	<0.001	(1.085,1.180)
55-60, Female	1.094	0.023	<0.001	(1.050,1.140)
60-64, Female	1.054	0.022	0.013	(1.011,1.099)
70-74, Female	0.880	0.021	<0.001	(0.839,0.923)
≥75, Female	0.788	0.017	<0.001	(0.755,0.823)
Access to care issues due to cost				
Yes	0.759	0.008	<0.001	(0.743,0.775)
Insurance coverage				
No	0.637	0.008	<0.001	(0.622,0.653)
Education				
Less than high school	0.932	0.012	<0.001	(0.908,0.956)
1-3 Years of college	1.082	0.008	<0.001	(1.066,1.099)
≥4 Years of college	1.341	0.010	<0.001	(1.321,1.361)

(continued)

Table SII. (continued).

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
Health Status				
Excellent	0.901	0.008	<0.001	(0.886,0.917)
Very Good	0.947	0.007	<0.001	(0.933,0.960)
Fair	1.092	0.012	<0.001	(1.069,1.115)
Poor	1.206	0.020	<0.001	(1.167,1.246)
Income				
Less than $15,000	0.932	0.013	<0.001	(0.907,0.958)
Between $20,000 and $24,999	0.986	0.014	0.343	(0.959,1.015)
Between $25,000 and $34,999	0.996	0.013	0.764	(0.972,1.021)
Between $35,000 and $49,999	1.015	0.011	0.186	(0.993,1.037)
Between $50,000 and $74,999	1.023	0.010	0.015	(1.004,1.042)
$75,000 or more	1.151	0.011	<0.001	(1.131,1.172)
Race				
Black/African American	0.811	0.009	<0.001	(0.793,0.829)
Other	1.091	0.014	<0.001	(1.064,1.118)
Hispanic ethnicity				
Yes	1.054	0.015	<0.001	(1.026,1.084)
Body mass index/pregnant				
25≤BMI<30 kg/m^2 (overweight)	1.041	0.007	<0.001	(1.027,1.055)
BMI≥30 kg/m^2 (obese)	1.037	0.008	<0.001	(1.022,1.053)
Pregnant	1.157	0.034	<0.001	(1.092,1.226)
No. adults in household				
2	1.042	0.006	<0.001	(1.030,1.055)
3	0.956	0.010	<0.001	(0.938,0.975)
≥4	0.970	0.015	0.039	(0.941,0.998)
Days physical health not good in past month				
0	1.087	0.007	<0.001	(1.073,1.102)
<1 full month	1.005	0.014	0.724	(0.978,1.033)
Days mental health not good in past month				
0	0.990	0.007	0.142	(0.977,1.003)
<1 full month	0.968	0.014	0.019	(0.941,0.995)
Has personal physician				
No	0.585	0.006	<0.001	(0.573,0.597)
Yes, >1	1.014	0.010	0.167	(0.994,1.035)
Has asthma				
Yes	1.346	0.011	<0.001	(1.323,1.368)
Has diabetes				
Yes	1.644	0.016	<0.001	(1.613,1.674)
Children in household				
Yes	1.016	0.008	0.041	(1.001,1.032)
Employment status				
Employed	1.108	0.017	<0.001	(1.075,1.141)
Not in labor force	1.139	0.018	<0.001	(1.105,1.175)

(continued)

Table SII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
Has activity limitations				
Yes	1.150	0.009	<0.001	(1.133,1.168)
Has equipment for health problems				
Yes	1.217	0.013	<0.001	(1.191,1.243)
Smoker				
Yes	0.800	0.006	<0.001	(0.788,0.813)
Exercise in past month				
Yes	1.169	0.008	<0.001	(1.153,1.186)
Constant				
Constant	0.483	0.008	<0.001	(0.467,0.499)

Odds ratios and CIs are shown for estimates of the effect of a person's state allowing pharmacists to administer "flu shots" on the likelihood that a person will receive a flu shot, controlling for demographic characteristics, insurance coverage, education, sex, health status, income, year, and state of residence. Data from 2003 through 2013 are combined into a single analytic file, a total of 3.2 million respondents representing 1,966.9 million person-years. Logistic regression model incorporates the weights, stratification, and primary sampling units from the Behavioral Risk Factor Surveillance System to represent the adult population in the 50 states plus Washington, D.C.

Table SIII. Logistic regression model odds ratios, differing effects of time since legislation, according to age group, with person-level characteristics.

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
State				
AL	1.069	0.029	0.012	(1.015,1.126)
AK	1.111	0.033	<0.001	(1.048,1.177)
AZ	0.919	0.025	0.001	(0.872,0.968)
AR	1.220	0.029	<0.001	(1.165,1.277)
CA	0.875	0.016	<0.001	(0.844,0.907)
CO	1.312	0.026	<0.001	(1.262,1.363)
CT	1.069	0.021	0.001	(1.028,1.111)
DE	1.060	0.029	0.033	(1.005,1.118)
DC	1.198	0.029	<0.001	(1.142,1.256)
FL	0.759	0.015	<0.001	(0.731,0.790)
GA	1.032	0.021	0.123	(0.991,1.075)
HI	1.192	0.031	<0.001	(1.134,1.254)
ID	0.862	0.023	<0.001	(0.818,0.908)
IL	0.862	0.018	<0.001	(0.828,0.898)
IN	1.032	0.020	0.092	(0.995,1.071)
IA	1.324	0.031	<0.001	(1.264,1.387)
KS	1.114	0.025	<0.001	(1.067,1.164)
KY	1.139	0.026	<0.001	(1.090,1.190)
LA	1.301	0.026	<0.001	(1.250,1.354)
ME	1.143	0.021	<0.001	(1.103,1.185)
MD	1.172	0.022	<0.001	(1.129,1.217)
MA	1.155	0.020	<0.001	(1.117,1.194)
MI	0.889	0.022	<0.001	(0.847,0.933)
MN	1.442	0.031	<0.001	(1.382,1.504)
MS	1.111	0.029	<0.001	(1.056,1.170)
MO	1.122	0.024	<0.001	(1.077,1.170)
MT	1.106	0.026	<0.001	(1.057,1.158)
NE	1.307	0.032	<0.001	(1.246,1.372)
NV	0.736	0.022	<0.001	(0.694,0.780)
NH	1.127	0.021	<0.001	(1.086,1.170)
NJ	0.894	0.015	<0.001	(0.864,0.924)
NM	1.124	0.026	<0.001	(1.074,1.176)
NC	1.291	0.025	<0.001	(1.242,1.341)
ND	1.228	0.029	<0.001	(1.172,1.287)
OH	0.980	0.024	0.400	(0.935,1.027)
OK	1.450	0.027	<0.001	(1.399,1.503)
OR	0.920	0.023	0.001	(0.876,0.967)
PA	0.980	0.018	0.277	(0.945,1.016)
RI	1.263	0.026	<0.001	(1.214,1.314)
SC	1.170	0.023	<0.001	(1.126,1.216)
SD	1.782	0.043	<0.001	(1.700,1.868)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
TN	1.271	0.036	<0.001	(1.202,1.344)
TX	1.111	0.031	<0.001	(1.053,1.173)
UT	1.247	0.030	<0.001	(1.189,1.307)
VT	1.079	0.019	<0.001	(1.042,1.117)
VA	1.209	0.034	<0.001	(1.144,1.278)
WA	1.035	0.024	0.147	(0.988,1.084)
WV	1.289	0.025	<0.001	(1.240,1.340)
WI	1.033	0.028	0.237	(0.979,1.089)
WY	1.198	0.024	<0.001	(1.152,1.247)
Years relative to legislation change				
≥4 Years Before	1.005	0.046	0.920	(0.919,1.098)
Year of	1.067	0.045	0.129	(0.981,1.159)
1 Year After	1.018	0.045	0.682	(0.934,1.110)
2-3 Years After	1.070	0.037	0.051	(1.000,1.144)
4-5 Years After	1.058	0.038	0.119	(0.986,1.136)
≥7 Years After	1.022	0.036	0.532	(0.954,1.096)
Year				
2004	0.991	0.051	0.860	(0.896,1.096)
2005	0.715	0.034	<0.001	(0.651,0.785)
2006	0.877	0.043	0.007	(0.798,0.965)
2007	1.022	0.049	0.651	(0.930,1.122)
2008	0.991	0.045	0.835	(0.906,1.083)
2009	0.949	0.044	0.255	(0.867,1.039)
2010	0.894	0.040	0.013	(0.818,0.976)
2011	0.746	0.034	<0.001	(0.681,0.816)
2012	0.720	0.034	<0.001	(0.656,0.790)
2013	0.786	0.038	<0.001	(0.714,0.864)
Age category				
18-24	0.287	0.022	<0.001	(0.247,0.333)
25-29	0.176	0.013	<0.001	(0.153,0.203)
30-34	0.161	0.011	<0.001	(0.141,0.184)
35-39	0.186	0.012	<0.001	(0.163,0.212)
40-44	0.207	0.013	<0.001	(0.183,0.235)
45-49	0.246	0.016	<0.001	(0.217,0.279)
50-54	0.326	0.020	<0.001	(0.289,0.367)
55-60	0.422	0.026	<0.001	(0.374,0.477)
60-64	0.613	0.038	<0.001	(0.542,0.693)
70-74	1.717	0.124	<0.001	(1.490,1.979)
≥75	2.369	0.162	<0.001	(2.072,2.709)
Sex				
Female	1.124	0.018	<0.001	(1.090,1.160)
Age category × year				
18-24, 2004	0.904	0.070	0.190	(0.777,1.051)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
18-24, 2005	1.079	0.083	0.323	(0.928,1.256)
18-24, 2006	0.956	0.081	0.600	(0.809,1.130)
18-24, 2007	1.018	0.079	0.817	(0.875,1.185)
18-24, 2008	1.041	0.080	0.604	(0.895,1.210)
18-24, 2009	1.204	0.095	0.018	(1.032,1.405)
18-24, 2010	1.333	0.104	< 0.001	(1.144,1.553)
18-24, 2011	1.697	0.135	< 0.001	(1.451,1.984)
18-24, 2012	1.804	0.156	< 0.001	(1.522,2.138)
18-24, 2013	1.825	0.163	< 0.001	(1.531,2.174)
25-29, 2004	1.127	0.086	0.118	(0.970,1.308)
25-29, 2005	1.095	0.082	0.226	(0.945,1.269)
25-29, 2006	1.134	0.086	0.095	(0.978,1.315)
25-29, 2007	1.341	0.098	< 0.001	(1.161,1.548)
25-29, 2008	1.259	0.092	0.002	(1.092,1.452)
25-29, 2009	1.547	0.114	< 0.001	(1.340,1.786)
25-29, 2010	1.996	0.145	< 0.001	(1.731,2.302)
25-29, 2011	2.545	0.202	< 0.001	(2.177,2.973)
25-29, 2012	2.458	0.207	< 0.001	(2.084,2.898)
25-29, 2013	2.412	0.218	< 0.001	(2.020,2.880)
30-34, 2004	1.127	0.079	0.087	(0.983,1.293)
30-34, 2005	1.068	0.074	0.343	(0.932,1.224)
30-34, 2006	1.155	0.081	0.039	(1.007,1.325)
30-34, 2007	1.351	0.092	< 0.001	(1.183,1.543)
30-34, 2008	1.328	0.087	< 0.001	(1.168,1.510)
30-34, 2009	1.643	0.110	< 0.001	(1.441,1.873)
30-34, 2010	2.226	0.144	< 0.001	(1.962,2.526)
30-34, 2011	2.576	0.175	< 0.001	(2.254,2.943)
30-34, 2012	2.804	0.206	< 0.001	(2.429,3.237)
30-34, 2013	2.567	0.189	< 0.001	(2.223,2.965)
35-39, 2004	1.126	0.076	0.080	(0.986,1.286)
35-39, 2005	0.900	0.061	0.116	(0.788,1.026)
35-39, 2006	1.102	0.075	0.154	(0.964,1.259)
35-39, 2007	1.247	0.081	0.001	(1.098,1.417)
35-39, 2008	1.239	0.078	0.001	(1.095,1.402)
35-39, 2009	1.459	0.093	< 0.001	(1.288,1.654)
35-39, 2010	1.892	0.118	< 0.001	(1.674,2.138)
35-39, 2011	2.330	0.154	< 0.001	(2.047,2.652)
35-39, 2012	2.038	0.140	< 0.001	(1.781,2.332)
35-39, 2013	2.384	0.174	< 0.001	(2.067,2.750)
40-44, 2004	1.040	0.068	0.550	(0.915,1.182)
40-44, 2005	0.832	0.053	0.004	(0.733,0.944)
40-44, 2006	1.001	0.066	0.989	(0.880,1.138)
40-44, 2007	1.171	0.073	0.011	(1.037,1.322)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
40-44, 2008	1.140	0.069	0.029	(1.013,1.283)
40-44, 2009	1.362	0.083	<0.001	(1.209,1.536)
40-44, 2010	1.658	0.098	<0.001	(1.476,1.861)
40-44, 2011	1.969	0.121	<0.001	(1.746,2.221)
40-44, 2012	1.915	0.122	<0.001	(1.690,2.170)
40-44, 2013	2.125	0.144	<0.001	(1.861,2.426)
45-49, 2004	1.069	0.070	0.311	(0.940,1.216)
45-49, 2005	0.754	0.048	<0.001	(0.665,0.854)
45-49, 2006	0.970	0.061	0.634	(0.857,1.099)
45-49, 2007	1.045	0.064	0.474	(0.927,1.178)
45-49, 2008	1.089	0.065	0.152	(0.969,1.223)
45-49, 2009	1.251	0.075	<0.001	(1.113,1.406)
45-49, 2010	1.489	0.087	<0.001	(1.328,1.670)
45-49, 2011	1.731	0.105	<0.001	(1.537,1.949)
45-49, 2012	1.726	0.110	<0.001	(1.523,1.956)
45-49, 2013	1.944	0.131	<0.001	(1.704,2.218)
50-54, 2004	1.046	0.067	0.480	(0.923,1.186)
50-54, 2005	0.744	0.045	<0.001	(0.660,0.838)
50-54, 2006	0.919	0.057	0.172	(0.814,1.037)
50-54, 2007	1.060	0.063	0.324	(0.944,1.191)
50-54, 2008	1.074	0.062	0.212	(0.960,1.202)
50-54, 2009	1.210	0.069	0.001	(1.081,1.354)
50-54, 2010	1.343	0.076	<0.001	(1.202,1.500)
50-54, 2011	1.534	0.089	<0.001	(1.369,1.718)
50-54, 2012	1.505	0.090	<0.001	(1.338,1.692)
50-54, 2013	1.614	0.100	<0.001	(1.430,1.822)
55-59, 2004	0.981	0.064	0.769	(0.864,1.114)
55-59, 2005	0.776	0.048	<0.001	(0.687,0.877)
55-59, 2006	0.990	0.062	0.866	(0.876,1.118)
55-59, 2007	1.048	0.063	0.437	(0.931,1.180)
55-59, 2008	1.080	0.063	0.187	(0.963,1.210)
55-59, 2009	1.204	0.070	0.001	(1.074,1.350)
55-59, 2010	1.301	0.074	<0.001	(1.164,1.454)
55-59, 2011	1.371	0.081	<0.001	(1.222,1.539)
55-59, 2012	1.405	0.085	<0.001	(1.249,1.581)
55-59, 2013	1.450	0.089	<0.001	(1.285,1.636)
60-64, 2004	0.958	0.064	0.515	(0.840,1.091)
60-64, 2005	0.783	0.050	<0.001	(0.692,0.887)
60-64, 2006	0.942	0.060	0.350	(0.831,1.068)
60-64, 2007	1.047	0.065	0.456	(0.928,1.182)
60-64, 2008	1.048	0.062	0.431	(0.933,1.178)
60-64, 2009	1.092	0.065	0.141	(0.971,1.227)
60-64, 2010	1.183	0.069	0.004	(1.056,1.326)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
60-64, 2011	1.201	0.072	0.002	(1.068,1.350)
60-64, 2012	1.167	0.071	0.011	(1.036,1.315)
60-64, 2013	1.203	0.075	0.003	(1.065,1.358)
70-74, 2004	0.832	0.064	0.017	(0.715,0.968)
70-74, 2005	0.977	0.071	0.752	(0.848,1.127)
70-74, 2006	0.899	0.067	0.155	(0.776,1.041)
70-74, 2007	0.899	0.065	0.139	(0.780,1.035)
70-74, 2008	0.853	0.060	0.023	(0.743,0.978)
70-74, 2009	0.830	0.058	0.007	(0.724,0.951)
70-74, 2010	0.800	0.054	0.001	(0.700,0.914)
70-74, 2011	0.745	0.052	<0.001	(0.650,0.854)
70-74, 2012	0.730	0.052	<0.001	(0.635,0.838)
70-74, 2013	0.751	0.054	<0.001	(0.653,0.864)
≥75, 2004	0.914	0.065	0.208	(0.796,1.051)
≥75, 2005	1.071	0.072	0.311	(0.938,1.222)
≥75, 2006	0.963	0.066	0.587	(0.842,1.102)
≥75, 2007	0.969	0.065	0.639	(0.850,1.104)
≥75, 2008	0.927	0.059	0.233	(0.817,1.050)
≥75, 2009	0.898	0.057	0.092	(0.792,1.018)
≥75, 2010	0.829	0.051	0.003	(0.734,0.937)
≥75, 2011	0.707	0.045	<0.001	(0.625,0.800)
≥75, 2012	0.706	0.045	<0.001	(0.622,0.801)
≥75, 2013	0.703	0.046	<0.001	(0.619,0.799)
Age category × sex				
18-24, Female	0.850	0.028	<0.001	(0.796,0.908)
25-29, Female	0.978	0.032	0.497	(0.918,1.042)
30-34, Female	1.045	0.028	0.103	(0.991,1.102)
35-39, Female	1.017	0.025	0.492	(0.969,1.067)
40-44, Female	1.043	0.024	0.071	(0.996,1.092)
45-49, Female	1.075	0.024	0.001	(1.029,1.124)
50-54, Female	1.132	0.024	<0.001	(1.086,1.181)
55-60, Female	1.095	0.023	<0.001	(1.050,1.141)
60-64, Female	1.055	0.022	0.012	(1.012,1.099)
70-74, Female	0.880	0.021	<0.001	(0.840,0.923)
≥75, Female	0.789	0.017	<0.001	(0.755,0.823)
Years relative to legislation change age category				
≥4 Years Before, 18-24	0.993	0.073	0.927	(0.861,1.147)
≥4 Years Before, 25-29	1.042	0.075	0.571	(0.905,1.199)
≥4 Years Before, 30-34	1.021	0.066	0.748	(0.900,1.159)
≥4 Years Before, 35-39	0.979	0.061	0.738	(0.867,1.106)
≥4 Years Before, 40-44	0.961	0.058	0.503	(0.854,1.081)
≥4 Years Before, 45-49	0.954	0.057	0.437	(0.848,1.074)
≥4 Years Before, 50-54	0.958	0.055	0.455	(0.855,1.073)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
≥4 Years Before, 55-59	1.046	0.061	0.439	(0.933,1.173)
≥4 Years Before, 60-64	1.005	0.060	0.936	(0.895,1.128)
≥4 Years Before, 70-74	0.966	0.065	0.614	(0.846,1.104)
≥4 Years Before, ≥75	0.933	0.059	0.269	(0.825,1.055)
Year of, 18-24	0.906	0.078	0.248	(0.765,1.072)
Year of, 25-29	0.955	0.072	0.537	(0.823,1.107)
Year of, 30-34	1.037	0.068	0.577	(0.912,1.179)
Year of, 35-39	0.978	0.060	0.721	(0.867,1.104)
Year of, 40-44	0.961	0.057	0.502	(0.856,1.079)
Year of, 45-49	0.932	0.053	0.216	(0.834,1.042)
Year of, 50-54	0.906	0.050	0.077	(0.813,1.011)
Year of, 55-59	0.983	0.055	0.752	(0.881,1.096)
Year of, 60-64	0.980	0.056	0.728	(0.877,1.096)
Year of, 70-74	0.901	0.059	0.112	(0.792,1.025)
Year of, ≥75	0.959	0.056	0.480	(0.855,1.076)
Year after, 18-24	0.884	0.075	0.147	(0.748,1.044)
Year after, 25-29	0.972	0.079	0.731	(0.829,1.141)
Year after, 30-34	1.125	0.077	0.088	(0.983,1.287)
Year after, 35-39	1.076	0.068	0.242	(0.952,1.218)
Year after, 40-44	1.041	0.063	0.512	(0.924,1.173)
Year after, 45-49	1.004	0.059	0.944	(0.895,1.126)
Year after, 50-54	1.011	0.058	0.851	(0.903,1.132)
Year after, 55-59	0.986	0.056	0.802	(0.882,1.102)
Year after, 60-64	1.050	0.061	0.401	(0.937,1.176)
Year after, 70-74	1.071	0.070	0.295	(0.942,1.217)
Year after, ≥75	0.983	0.059	0.770	(0.874,1.105)
2-3 Years after, 18-24	0.849	0.055	0.012	(0.748,0.964)
2-3 Years after, 25-29	0.969	0.058	0.607	(0.861,1.091)
2-3 Years after, 30-34	0.984	0.051	0.752	(0.889,1.089)
2-3 Years after, 35-39	0.972	0.048	0.566	(0.884,1.070)
2-3 Years after, 40-44	0.981	0.047	0.689	(0.894,1.077)
2-3 Years after, 45-49	0.961	0.044	0.385	(0.878,1.052)
2-3 Years after, 50-54	0.992	0.044	0.851	(0.909,1.082)
2-3 Years after, 55-59	1.016	0.045	0.714	(0.932,1.108)
2-3 Years after, 60-64	1.030	0.046	0.513	(0.943,1.124)
2-3 Years after, 70-74	0.993	0.051	0.896	(0.898,1.099)
2-3 Years after, ≥75	0.992	0.046	0.867	(0.906,1.087)
4-5 Years after, 18-24	0.899	0.060	0.111	(0.789,1.025)
4-5 Years after, 25-29	1.008	0.064	0.901	(0.889,1.143)
4-5 Years after, 30-34	1.040	0.057	0.469	(0.935,1.157)
4-5 Years after, 35-39	1.023	0.052	0.652	(0.926,1.131)
4-5 Years after, 40-44	1.027	0.050	0.581	(0.933,1.131)
4-5 Years after, 45-49	0.982	0.047	0.697	(0.894,1.078)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	p Value	95% Confidence Interval
4-5 Years after, 50-54	0.957	0.044	0.332	(0.875,1.046)
4-5 Years after, 55-59	0.997	0.046	0.939	(0.911,1.090)
4-5 Years after, 60-64	0.990	0.046	0.825	(0.904,1.083)
4-5 Years after, 70-74	0.982	0.052	0.738	(0.886,1.090)
4-5 Years after, ≥75	0.948	0.045	0.261	(0.864,1.040)
≥7 Years After, 18-24	0.965	0.054	0.516	(0.865,1.075)
≥7 Years After, 25-29	1.113	0.057	0.036	(1.007,1.230)
≥7 Years After, 30-34	1.147	0.051	0.002	(1.052,1.252)
≥7 Years After, 35-39	1.122	0.048	0.007	(1.032,1.220)
≥7 Years After, 40-44	1.072	0.044	0.092	(0.989,1.162)
≥7 Years After, 45-49	1.071	0.043	0.087	(0.990,1.159)
≥7 Years After, 50-54	1.058	0.041	0.142	(0.981,1.142)
≥7 Years After, 55-59	1.045	0.040	0.256	(0.969,1.127)
≥7 Years After, 60-64	1.032	0.040	0.426	(0.955,1.114)
≥7 Years After, 70-74	1.011	0.045	0.809	(0.926,1.104)
≥7 Years After, ≥75	0.968	0.040	0.429	(0.894,1.049)
Access to care issues due to cost				
Yes	0.759	0.008	<0.001	(0.743,0.775)
Insurance coverage				
No	0.637	0.008	<0.001	(0.622,0.653)
Education				
Less than high school	0.931	0.012	<0.001	(0.908,0.955)
1-3 Years of college	1.082	0.008	<0.001	(1.066,1.099)
≥4 Years of college	1.341	0.010	<0.001	(1.321,1.361)
Health Status				
Excellent	0.902	0.008	<0.001	(0.886,0.917)
Very Good	0.947	0.007	<0.001	(0.933,0.960)
Fair	1.091	0.012	<0.001	(1.069,1.114)
Poor	1.206	0.020	<0.001	(1.167,1.246)
Income				
Less than $15,000	0.932	0.013	<0.001	(0.907,0.959)
Between $20,000 and $24,999	0.987	0.014	0.355	(0.959,1.015)
Between $25,000 and $34,999	0.997	0.013	0.807	(0.973,1.022)
Between $35,000 and $49,999	1.015	0.011	0.172	(0.993,1.037)
Between $50,000 and $74,999	1.023	0.010	0.016	(1.004,1.042)
$75,000 or more	1.151	0.011	<0.001	(1.131,1.172)
Race				
Black/African American	0.811	0.009	<0.001	(0.793,0.829)
Other	1.091	0.014	<0.001	(1.064,1.118)
Hispanic ethnicity				
Yes	1.055	0.015	<0.001	(1.027,1.085)
Body mass index/pregnant				
25≤BMI<30 kg/m^2 (overweight)	1.041	0.007	<0.001	(1.027,1.055)

(continued)

Table SIII. (continued).

Factor	Odds Ratio	Std. Err.	*p* Value	95% Confidence Interval
BMI≥30 kg/m^2 (obese)	1.037	0.008	<0.001	(1.021,1.053)
Pregnant	1.157	0.034	<0.001	(1.092,1.226)
No. adults in household				
2	1.042	0.006	<0.001	(1.030,1.055)
3	0.956	0.010	<0.001	(0.938,0.975)
≥4	0.970	0.015	0.039	(0.941,0.998)
Days physical health not good in past month				
0	1.087	0.007	<0.001	(1.073,1.101)
<1 full month	1.005	0.014	0.710	(0.978,1.033)
Days mental health not good in past month				
0	0.990	0.007	0.142	(0.977,1.003)
<1 full month	0.967	0.014	0.018	(0.941,0.994)
Has personal physician				
No	0.585	0.006	<0.001	(0.573,0.597)
Yes, >1	1.014	0.010	0.172	(0.994,1.034)
Has asthma				
Yes	1.346	0.011	<0.001	(1.324,1.368)
Has diabetes				
Yes	1.644	0.016	<0.001	(1.613,1.674)
Children in household				
Yes	1.015	0.008	0.051	(1.000,1.031)
Employment status				
Employed	1.107	0.017	<0.001	(1.075,1.141)
Not in labor force	1.139	0.018	<0.001	(1.104,1.175)
Has activity limitations				
Yes	1.150	0.009	<0.001	(1.133,1.168)
Has equipment for health problems				
Yes	1.216	0.013	<0.001	(1.191,1.242)
Smoker				
Yes	0.800	0.006	<0.001	(0.788,0.813)
Exercise in past month				
Yes	1.169	0.008	<0.001	(1.153,1.186)
Constant				
Constant	0.889	0.048	0.030	(0.800,0.989)

Odds ratios and CIs are shown for estimates of the effect of a person's state allowing pharmacists to administer "flu shots" on the likelihood that a person will receive a flu shot, controlling for demographic characteristics, insurance coverage, education, sex, health status, income, year, and state of residence. Data from 2003 through 2013 are combined into a single analytic file, a total of 3.2 million respondents representing 1,966.9 million person-years. Logistic regression model incorporates the weights, stratification, and primary sampling units from the Behavioral Risk Factor Surveillance System to represent the adult population in the 50 states plus Washington, D.C.