



## Association between provider recommendation and influenza vaccination status among children



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### ABSTRACT

**Background:** Provider recommendation is associated with influenza vaccination receipt. The objectives of this study were to estimate the percentage of children 6 months–17 years for whom a provider recommendation for influenza vaccination was received, identify factors associated with receipt of provider recommendation, and evaluate the association between provider recommendation and influenza vaccination status among children.

**Methods:** National Immunization Survey-Flu (NIS-Flu) parentally reported data for the 2013–14, 2014–15, and 2015–16 seasons were analyzed. Tests of association between provider recommendation and demographic characteristics were conducted using Wald chi-square tests and pairwise comparison *t*-tests. Multivariable logistic regression was used to determine variables independently associated with receiving provider recommendation and the association between provider recommendation and influenza vaccination status.

**Results:** Approximately 70% of children had a parent report receiving a provider recommendation for influenza vaccination for their child. The strongest association between receipt of provider recommendation and demographic characteristics was with child's age, with younger children (6–23 months, 2–4 years, and 5–12 years) being more likely to have a provider recommendation than older children (13–17 years). In addition, children living in a household above poverty with household income >\$75,000 were more likely to have a parent report receipt of a provider recommendation than children living below poverty. Children with a provider recommendation were twice as likely to be vaccinated than those without.

**Conclusions:** This study affirms the importance of provider recommendation for influenza vaccination among children. Ensuring that parents of all children receive a provider recommendation may improve vaccination coverage.

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## 1. Introduction

Influenza causes significant morbidity and mortality among children [1,2]. Vaccination is an effective strategy in preventing

influenza and has been recommended by the Advisory Committee on Immunization Practices (ACIP) for all children 6 months and older since 2008 [3,4]. Despite this well-established recommendation, only 59.3% of children 6 months–17 years were vaccinated during the 2015–16 influenza season, which is considerably lower than the Healthy People 2020 target of 70% influenza vaccination coverage [5,6].

The ACIP has noted the critical role of a provider recommendation for influenza vaccination and has highlighted several studies that document the positive association between a provider recommendation and receipt of influenza vaccination in a variety of populations, including adults 50–64 years, high-risk adults, Medicare beneficiaries, young children 6–23 months, and children with

**Abbreviations:** ACIP, Advisory Committee on Immunization Practices; NIS-Flu, National Immunization Survey-Flu; NIS-Child, National Immunization Survey-Child; NIS-Teen, National Immunization Survey-Teen; CASRO, Council of American Survey and Research Organizations; APR, Adjusted Prevalence Ratio; AP, Adjusted Prevalence; PAR, Population Attributable Risk; CI, Confidence Interval; MSA, Metropolitan Statistical Area.

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asthma [7–13]. Numerous studies have shown that pregnant women who received a provider recommendation for influenza vaccination were much more likely to be vaccinated than those who did not [14–23]. Studies among hospitalized children and underserved adults also identified provider recommendation as an important factor associated with influenza vaccination [24,25]. A recent study on the general population of adults reported that adults who received a provider recommendation were 1.72 times more likely to be vaccinated than those who did not, but less than half of adults had received a provider recommendation [26]. To our knowledge, there are no published studies on provider recommendation of influenza vaccination that focus on all children 6 months–17 years, regardless of health conditions, using a national sample.

The objectives of this study were to: (1) quantify the proportion of children 6 months–17 years for whom a provider recommendation for influenza vaccination was received at the state and national levels by sociodemographic characteristics, (2) identify factors associated with parental receipt of a provider recommendation for their child's influenza vaccination, and (3) determine whether parental receipt of a provider recommendation is independently associated with influenza vaccination status among children 6 months–17 years.

## 2. Methods

Data from the National Immunization Survey-Flu (NIS-Flu) from the 2013–14, 2014–15, and 2015–16 influenza seasons were analyzed to assess parental receipt of a provider recommendation for influenza vaccination for the child and influenza vaccination coverage by receipt of a provider recommendation during the three seasons [27,28]. The NIS-Flu is an ongoing, national list-assisted random-digit-dialed dual frame landline and cellular telephone survey of households with children. It includes three components: the NIS-Child for children 19–35 months, the NIS-Teen for adolescents 13–17 years, and the NIS Child Influenza Module for children 6–18 months and 3–12 years identified during the screening of households for the NIS-Child and NIS-Teen [27–33]. Telephone interviews were conducted with parents or guardians during October through June for the three seasons from all 50 states and the District of Columbia. The NIS-Flu survey questionnaire was available in English and Spanish, and Language Line Services was used for real-time translation into many other languages [34]. The Council of American Survey and Research Organizations (CASRO) response rates ranged from 53.5% to 64.8% for landline and 29.9%–38.8% for cellular telephones [5,35–37].

The study sample included children in the NIS-Flu who had at least one visit to a doctor or other health professional since July 1st during the influenza season of the interview and had information about whether a provider recommendation for influenza was received. Survey questions about provider recommendation were only asked during the April–June interview months. Survey respondents were asked, 'Since July 1st, has [sample child] had a visit to a doctor or other health professional about his or her health?'; children were excluded if the respondent answered 'No', 'Don't Know', or if they refused to answer (26.4%, 24.6%, and 24.3% for the 2013–14, 2014–15, and 2015–16 seasons, respectively). Respondents who answered 'Yes' were asked, 'Since July 1st, did a doctor or other health professional tell you they recommend or say it was a good idea for [sample child] to get a flu vaccination?'; children were excluded if the respondent answered 'Don't Know' or refused to answer (5.2%, 5.9%, and 5.9% for the 2013–14, 2014–15, and 2015–16 seasons, respectively). Respondents were also asked if their child had received an influenza vaccination since July 1st and, if so, during which month and year.

Information on child, maternal, and household sociodemographic characteristics were also collected during the interviews.

State level and national influenza vaccination coverage estimates and methods were published previously for children 6 months and older and were calculated for this study using the same methodology for children who met the inclusion criteria described previously [5,35,36]. Tests of association between receipt of a provider recommendation for influenza vaccination and demographic variables were conducted using Wald chi-square tests followed by pair-wise comparison *t*-tests. Multivariable logistic regression was used to determine (1) variables independently associated with receipt of a provider recommendation, and (2) whether receipt of a provider recommendation was independently associated with receipt of an influenza vaccination. Independent variables in the models included the following: child's age, sex, and race/ethnicity, language of the survey, mother's education, poverty/annual household income, number of children in the household, urban/rural residence, and region of residence. Adjusted prevalence ratios (APR) and adjusted prevalences (AP) based on predicted marginals from the logistic regression models are reported. In addition, population attributable risk (PAR) was calculated using the prevalence of provider recommendation receipt and the prevalence ratio of influenza vaccination by provider recommendation receipt to assess the potential contribution of provider recommendation to the observed influenza vaccination level.

A two-sided significance level of 0.05 was adopted for all statistical tests. Reported percentages and corresponding 95% confidence intervals (95% CI) were weighted, while reported sample sizes were unweighted. All analyses were weighted to population totals and to adjust for households having multiple telephone lines, unit non-response, and non-coverage of non-telephone households. Analyses were conducted using SAS (version 9.3) and SUDAAN (version 11.0.0) statistical software to account for the complex design. Institutional review board (IRB) approval for conducting the NIS was obtained through the National Center for Health Statistics Research Ethics Review Board and the IRB of NORC at the University of Chicago [38].

## 3. Results

There were 24,515, 26,825, and 25,261 children who had a provider visit and were included in the study for the 2013–14, 2014–15, and 2015–16 seasons, respectively. The characteristics of children included in the study sample are presented in Table 1. In addition, the characteristics of children who did not have a provider visit and were excluded from the study are also presented.

National and state level estimates for parental receipt of a provider recommendation for influenza vaccination among children are shown in Table 2 and Fig. 1. During the 2015–16 season, 70.3% of children had a parent or guardian who reported receiving a provider recommendation for influenza vaccination of their child. Influenza vaccination coverage among children for whom a provider recommendation was received was 72.2%, compared with 32.1% among children for whom a provider recommendation was not received, resulting in a PAR estimate of 46.8%. At the state level during the 2015–16 season, the proportion of children for whom a provider recommendation was received ranged from 49.6% (Wyoming) to 83.7% (District of Columbia). In each state, vaccination coverage was higher among children with a provider recommendation compared with those without a provider recommendation. The PAR ranged from 16.7% (Maryland) to 70.7% (Montana). Overall, the proportion of children for whom a provider recommendation was received was similar during each season included in the study period. Comparing 2013–14 and

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