Vaccine 33 (2015) 5196–5203

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Influenza vaccination type, live, attenuated influenza vaccine (LAIV) versus inactivated influenza vaccine (IIV), received by children, United States, 2011–12 through 2013–14 influenza seasons

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ARTICLE INFO

Article history:
Received 7 May 2015
Received in revised form 17 July 2015
Accepted 20 July 2015
Available online 1 August 2015

Keywords:
Influenza vaccines
Vaccination
Child
LAIV vaccine
Health surveys

ABSTRACT

Background: Influenza vaccines available for children in the United States include inactivated influenza vaccine (IIV) and live, attenuated influenza vaccine (LAIV). Objectives of this study were to quantify proportions of IIV and LAIV received by vaccinated children, and examine associations between vaccine type received and demographic characteristics.
Methods: National Immunization Survey-Flu (NIS-Flu) parental reported data for the 2011–12 through 2013–14 influenza seasons were used to estimate proportions of vaccinated children 2–17 years who received IIV and LAIV. Tests of association between vaccination type and demographic variables were conducted using Wald chi-square tests and pair-wise comparison *t*-tests. Multivariable logistic regression was used to determine variables independently associated with receipt of LAIV versus IIV.
Results: In the 2013–14 season, 33.3% of vaccinated children received LAIV, similar to the proportion in the 2011–12 (32.2%) and 2012–13 (32.1%) seasons. Across all seasons studied, the strongest observed association was between vaccination type and child's age, with children 2–8 years (Adjusted Prevalence Ratio (95% confidence interval) [APR(95% CI)] 1.41(1.27–1.56), 1.46(1.34–1.59), and 1.50(1.38–1.63) for 2011–12, 2012–13, and 2013–14) and 9–12 years (APR(95% CI) 1.37(1.23–1.54), 1.38(1.26–1.51), and 1.50(1.38–1.63) for 2011–12, 2012–13, and 2013–14) being more likely to have received LAIV than children 13–17 years. Among those vaccinated, whites were more likely to have received LAIV compared with blacks (APR(95% CI) 1.19(1.05–1.35), 1.24(1.10–1.39), and 1.22(1.11–1.34) for 2011–12, 2012–13, and 2013–14), and children living above poverty (annual income >$75,000) were more likely to have received LAIV than those living at or below poverty (APR(95% CI) 1.43(1.23–1.67), 1.13(1.02–1.26), and 1.16(1.06–1.28) for 2011–12, 2012–13, and 2013–14).
Conclusions: This study provides a baseline of the extent and patterns of LAIV uptake that can be used to measure the impact of relevant public health policy. Additional research is needed to investigate parental and provider preferences and barriers regarding LAIV.

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1. Introduction

Influenza is a serious disease that can lead to hospitalization and death. Rates of influenza infection are highest among children, with children <5 years and especially those <2 years at high risk for complications, hospitalizations, and deaths [1–9]. Vaccination is the most effective strategy for preventing influenza infection and its potentially serious complications [10]. The Advisory Committee on Immunization Practices (ACIP) recommended influenza vaccination for children 6–23 months in 2004, expanded the age range to include children 6–59 months in 2006, and further expanded the recommendation to include children 6 months–18 years in 2008 [11–13].

Abbreviations: ACIP, Advisory Committee on Immunization Practices; IIV, Inactivated Influenza Vaccine; LAIV, Live Attenuated Influenza Vaccine; NIS-Flu, National Immunization Survey-Flu; NIS, National Immunization Survey; NIS-Teen, National Immunization Survey-Teen; CASRO, Council of American Survey and Research Organizations; APR, Adjusted Prevalence Ratio; CI, Confidence Interval; IIS, Immunization Information Systems; VFC, Vaccines for Children; ACA, Affordable Care Act; MSA, Metropolitan Statistical Area.

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http://dx.doi.org/10.1016/j.vaccine.2015.07.064
0264-410X/Published by Elsevier Ltd.

Two types of influenza vaccine are available for children in the United States, inactivated influenza vaccine (IIV) and live, attenuated influenza vaccine (LAIV). IIV has been available for many years and is administered by intramuscular injection (i.e. a shot). A variety of IIV products are available from several different manufacturers. Age indications for IIV have no upper limit for children, but the lower limit varies by vaccine with some approved for children as young as 6 months [10,14]. LAIV first became available and recommended for use in healthy persons 5–49 years in 2003, and then expanded for use in healthy children 2–4 years in 2007 [15,16]. Only one LAIV product is available, and it is administered intranasally (i.e. the nasal spray) [10,14]. LAIV and IIV products were all trivalent, containing two influenza A and one influenza B viral antigens, until the 2013–14 influenza season when trivalent LAIV was replaced by a quadrivalent LAIV formulation, containing an additional influenza B viral antigen, and IIVs became available in both trivalent and quadrivalent formulations [10]. At the June 2014 meeting, the ACIP voted to include a preference for the use, when immediately available and there are no contraindications, of LAIV for healthy children 2–8 years in their recommendations for the 2014–15 influenza season based on studies that appeared to demonstrate superior efficacy of LAIV when compared with IIV among children, particularly younger children [17–20]. At the February 2015 meeting, the ACIP voted to remove this preferential recommendation when other study data showed that LAIV may not be superior to IIV [14,21].

The objectives of this study were to quantify the proportion of children vaccinated against influenza who received LAIV in recent seasons, and to examine associations between vaccine type received and demographic characteristics. The results of this study provide baseline data for vaccine policy considerations, and serve as essential input into vaccine impact, cost-effectiveness models, and vaccine safety analyses.

2. Methods

Data from the National Immunization Survey-Flu (NIS-Flu) from 2011–2014 were analyzed to assess type of influenza vaccination received by vaccinated children 2–17 years during the 2011–12, 2012–13, and 2013–14 influenza seasons [22]. The NIS-Flu is an ongoing, national list-assisted random-digit-dialed dual frame land line and cellular telephone survey of households with children. It includes three components: the NIS for children 19–35 months, the NIS-Teen for children 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 and NIS-Teen [22–27]. Data were collected by parental report, and interviews conducted September through June for the 2011–12 season and October through June for the 2012–13 and 2013–14 seasons from all 50 states and the District of Columbia were included in the analysis. The Council of American Survey and Research Organizations (CASRO) response rates ranged from 51.8–63.4% for landline and 18.1–33.5% for cellular telephones [28–31].

The NIS-Flu sample included 102,254, 107,550, and 130,409 children for the 2011–12, 2012–13, 2013–14 seasons, respectively. The study sample used to examine LAIV uptake was limited to a subset of data (n = 34,025, n = 42,331, and n = 55,256 for the 2011–12, 2012–13, and 2013–14 seasons, respectively) that included children who were at least 2 years old (at October 1st of each season), had received at least one dose of influenza vaccine, and had information about influenza vaccination type available. Survey respondents were asked if their child had received an influenza vaccination and, if so, during which month and year; for vaccinated children with missing month and year of vaccination (2.3, 6.3, and 7.7% for the 2011–12, 2012–13, and 2013–14 seasons, respectively), this information was imputed from donor pools matched for week of interview, age group, state of residence, and race/ethnicity. For children who received an influenza vaccination, respondents were asked "Was this a shot or the spray in the nose?"; children missing this information were excluded from the study (4.3, 4.3, and 5.7% for the 2011–12, 2012–13, and 2013–14 seasons, respectively). Information on child, maternal, and household socio-demographic characteristics were also collected during the NIS-Flu interviews.

Children were considered vaccinated if they were reported to have received an influenza vaccination August through May for the 2011–12 season and July through May for the 2012–13 and 2013-14 seasons. 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 but for children who were at least 2 years old (at October 1st) [22,29–31]. Tests of association between vaccination type received and demographic variables were conducted using Wald chi-square tests followed by pair-wise comparison t-tests. Multivariable logistic regression was used to determine variables independently associated with receipt of LAIV versus IIV. The dependent variable in the multivariable model was receipt of LAIV, and independent variables included the following: child's age, sex, race-ethnicity, mother's education, poverty/annual household income, number of children in the household, urban–rural residence, region of residence, and vaccination facility type. Adjusted prevalence ratios (APR) based on predicted marginals from the logistic regression model are reported.

Although some children in the study had received two doses of influenza vaccine in an influenza season, this study focused on the first (or only) dose received. A sub-analysis was done among children who received two doses in a season to quantify the consistency in vaccination type received, excluding those with missing information on vaccination type for one or both of their vaccinations (2.3, 5.3, and 2.8% for the 2011–12, 2012–13, and 2013–14 seasons, respectively).

To assess accuracy of parental reported type of influenza vaccination, NIS and NIS-Teen parental and provider reported vaccinations during the study vaccination period for the 2012–13 influenza season, the most recent available season, were summarized, and status over one or more vaccinations was classified as delivered by IIV only, LAIV only, or both IIV and LAIV for children with available type information. The sample for this analysis included children 2 years and older (at October 1st) with both a parent and provider reported influenza vaccination (n = 2685 for NIS and n = 2918 for NIS-Teen). Children were excluded if type information was missing (2.8% for NIS and 4.2% for NIS-Teen) or if type was reported as both IIV and LAIV (1.0% for NIS and 0.4% for NIS-Teen) from either source. The difference between the percent of children who received the nasal spray according to parental versus provider report was calculated.

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.

3. Results

The sample characteristics are presented in Table 1. The distribution across the various groups of children remained consistent for all three seasons studied.