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Influenza vaccination coverage and timeliness among children requiring two doses, 2004–2009

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ABSTRACT

Objective. To assess influenza vaccination coverage and timeliness among children requiring two doses in a season.

Methods. This study examined seasonal influenza vaccination of 17,800 children from five academically-affiliated clinics in New York City using hospital and city immunization registries. Eligible children were 6 months–8 years and needed two influenza vaccine doses in a given season between 2004–05 and 2009–10. Any (≥1 dose) and full (2 doses) vaccination coverage by December 15 and March 31 as well as interval between doses were calculated. Vaccination trends over time, determinants, and missed opportunities were assessed.

Results. Children were primarily Latino and publicly insured. Full coverage by March 31 increased between the 2004–05 and 2009–10 seasons (9% vs. 29%, $p<0.001$). Few children received both doses by December 15 (2–13%). The interval between doses was almost twice as long as recommended and increased over time (2004–05: 52 days; 2009–10: 64 days; $p<0.001$). Older age and Latino ethnicity were negative predictors of full vaccination by March 31. Missed opportunities for the second dose were common.

Conclusion. Despite improvements, low-income, minority children requiring two influenza vaccine doses remain at risk of incomplete and delayed vaccination. Barriers to and strategies for timely full vaccination should be explored.

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Introduction

Young children are particularly vulnerable to influenza infection, resulting in increased provider visits and hospitalizations each season (Poehling et al., 2006). Pediatric influenza vaccination can prevent individual illness and reduce disease burden within communities (Cohen and Nettleman, 2000; Hurwitz et al., 2000; Loeb et al., 2010). Thus, the Advisory Committee on Immunization Practices (ACIP) incrementally expanded its influenza vaccination recommendations to include all 6–23 month-olds in 2004, 24–59 month-olds in 2006, and 5–18 year-olds in 2008 (Fiore et al., 2008; Harper et al., 2004; Smith et al., 2006). ACIP further specified that, for optimal efficacy (Allison et al., 2006; Englund et al., 2006; Neuzil et al., 2006; Shuler et al., 2007), children under 9 years should receive two doses separated by at least 28 days in their first influenza vaccination season and, in certain years, the second season if they received just one prior dose (Fiore et al., 2007, 2008, 2009; Harper et al., 2004, 2005; Smith et al., 2006).

While some studies suggest that many eligible children fail to receive one or both of the recommended doses (Bhatt et al., 2010, 2011; Centers for Disease Control, Prevention, 2009b; Jackson et al., 2006; Pabst et al., 2011), these data are limited to select ages and seasons. Thus, an in-depth description of influenza vaccination that includes all children requiring two doses and spans the multiple seasons with changing recommendations is needed. Moreover, the timing of vaccination may be particularly important for children needing two doses in a relatively short time period, ideally before the community onset of influenza activity (Centers for Disease Control, Prevention, 2011), yet studies have traditionally described coverage by the spring rather than the fall. Additionally, although low-income, minority children are at increased risk of influenza under-immunization as well as delayed vaccination in general (Centers for Disease Control, Prevention, 2009c; Luman et al., 2005; Wooten et al., 2009), few studies have assessed timely completion of the two-dose regimen in this population (Bhatt et al., 2011). Lastly, while missed opportunities for influenza

Abbreviations: ACIP, Advisory Committee on Immunization Practices; EzVac, NewYork-Presbyterian Hospital immunization registry; VFC, Vaccines for Children program.

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vaccination have been clearly demonstrated (Allred et al., 2011; Daley et al., 2005; Dombkowski et al., 2006; Verani et al., 2007), there is little data describing missed opportunities for second dose receipt among these high-risk children (Verani et al., 2007).

Therefore, this study examines seasonal influenza vaccination coverage and timeliness among low-income, minority children requiring two influenza vaccine doses in a given season between 2004 and 2009. It also assesses time trends in, sociodemographic determinants of, and missed opportunities for influenza vaccination. We hypothesized that overall coverage would improve over time in accordance with ACIP recommendations, yet many children would still lack timely and complete vaccination.

Methods

Study design and setting

This retrospective study examined seasonal influenza vaccination of children requiring two influenza vaccine doses in a given season between 2004–05 and 2009–10. It was conducted in four pediatric clinics and one family medicine practice in New York City, which are part of an ambulatory care network affiliated with a large academic medical center. All serve a predominately Latino, publicly insured population. Seasonal influenza vaccination typically began between early September (2008–09 and 2009–10 seasons) and early October (2004–05 season). Of note, 2009 H1N1 influenza vaccination of children from these clinics has been described previously (Stockwell et al., 2011).

Study population

For each season, children were eligible for inclusion if they 1) were 6 months–8.5 years as of October 1; 2) required two influenza vaccine doses (Fiore et al., 2007, 2008, 2009; Harper et al., 2004, 2005; Smith et al., 2006); and 3) had ≥1 clinic visit in the 12 months preceding March 31. Children were included in all seasons for which they met these criteria. Over 90% of study subjects were eligible to receive influenza vaccine through the Vaccines for Children (VFC) program. This study was approved by the Columbia University Medical Center Institutional Review Board.

Data sources

Eligible children were identified through the network registration system, which contains patient demographic and visit data. Race/ethnicity and parental language were recorded at point of care by clinic staff. Vaccine data was collected from the hospital immunization registry, EzVac, which contains active vaccine records for greater than 130,000 children receiving care at the hospital and affiliated clinics. It is estimated that EzVac captured over 95% of all vaccine doses administered at network sites during the study period (Stockwell et al., 2012; Verani et al., 2007). EzVac also reports to and receives data from the New York Citywide Immunization Registry, a population-based provider-mandated registry that includes greater than 93% of immunizations given in New York City through the VFC program (Metroka et al., 2009).

Outcome measures

Primary outcome measures were any (≥1 dose) and full (2 doses) seasonal influenza vaccination by March 31 each season. The minimum age for influenza vaccination was 177 days, and the minimum acceptable interval between doses was 24 days (Fiore et al., 2007, 2008, 2009; Harper et al., 2004, 2005; Kroger et al., 2011; Smith et al., 2006). Additional outcomes were vaccination by December 15 (i.e., median date when influenza virus was first isolated in Northern Manhattan during the 2004–2008 seasons) (New York State Department of Health, 2011), interval between doses, and missed opportunities for second dose receipt (i.e., (1) any visit 28 days or more after the first dose, but before March 31 for children who received only one dose; or (2) any visit 28 days or more after the first dose, but before receipt of the second dose for children who ultimately received both doses).

Statistical analysis

The proportion of children with any and full influenza vaccination by December 15 and March 31, along with 95% confidence intervals (C.I.), were calculated for each season. Among children who were fully vaccinated, the mean and 95% C.I. were determined for the interval between doses. A generalized linear mixed model assessed vaccination trends over the six seasons, accounting for repeated measurements among subjects included in multiple seasons. Multivariable logistic and linear regression examined the effect of age, race/ethnicity, parental language, and insurance on influenza vaccination

Table 1
Characteristics of study population (2004–2009 influenza seasons, New York City).[a,b]

Influenza season	2004–05 (n = 6406)	2005–06 (n = 5417)	2006–07 (n = 4317)	2007–08 (n = 4931)	2008–09 (n = 4233)	2009–10 (n = 3478)
Gender, % (n)						
Female	49.3 (3157)	49.7 (2692)	48.9 (2112)	48.1 (2372)	49.4 (2091)	48.8 (1696)
Male	50.7 (3249)	50.3 (2725)	51.1 (2205)	51.9 (2559)	50.6 (2142)	51.2 (1782)
Age, % (n)						
6–23 months	28.0 (1796)	27.9 (1509)	33.5 (1444)	39.2 (1934)	46.7 (1978)	51.2 (1780)
24–59 months	38.8 (2486)	32.9 (1781)	24.9 (1075)	26.6 (1310)	25.5 (1079)	26.6 (925)
5–8 years	33.2 (2124)	39.2 (2127)	41.6 (1798)	34.2 (1687)	27.8 (1176)	22.2 (773)
Race/ethnicity, % (n)						
Latino	57.4 (3016)	55.8 (2428)	53.1 (1732)	51.6 (1998)	50.4 (1941)	51.4 (1777)
Non-Latino black	12.4 (651)	13.2 (577)	13.2 (432)	14.4 (558)	15.8 (610)	15.6 (541)
Non-Latino white	2.6 (135)	1.9 (84)	1.8 (57)	1.5 (57)	1.8 (68)	1.7 (58)
Other	27.6 (1454)	29.1 (1265)	31.9 (1042)	32.5 (1259)	32.0 (1233)	31.3 (1081)
Parental language, % (n)						
Spanish	65.1 (4117)	64.0 (3434)	61.6 (2570)	59.0 (2584)	57.4 (2216)	56.9 (1959)
English	33.6 (2123)	35.0 (1875)	37.3 (1559)	39.8 (1744)	41.4 (1598)	41.8 (1438)
Other	1.3 (80)	1.0 (53)	1.1 (45)	1.2 (52)	1.2 (47)	1.4 (47)
Insurance, % (n)						
Public	86.5 (5010)	88.4 (4775)	86.1 (3715)	84.1 (4147)	85.1 (3603)	85.9 (2985)
Private	7.9 (455)	7.6 (410)	7.6 (327)	7.4 (367)	6.7 (285)	4.9 (171)
Uninsured	5.6 (323)	4.0 (219)	6.3 (274)	8.5 (417)	8.2 (345)	9.2 (320)
Clinic visits[c], mean (SD)	1.8 (1.7)	1.7 (1.7)	1.7 (1.8)	1.9 (1.9)	2.0 (1.9)	2.0 (1.9)

[a] There were 17,800 unique individuals in the study (35% were included in multiple seasons).
[b] In some seasons, there are missing data for race/ethnicity, parental language, and insurance type.
[c] Visits between October 1 and March 31 each season.

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