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Factors impacting influenza vaccination of urban low-income Latino children under nine years requiring two doses in the 2010–2011 season

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Abstract

Background—The Advisory Committee on Immunization Practices (ACIP) recommends that certain children under nine years of age receive two influenza vaccine doses in a season for optimal protection. Recent data indicate that many of these children fail to receive one or both of these needed doses. Contributing factors to under-vaccination of this population remain unclear.

Methods—Caregivers of children aged 6 months–8 years requiring two influenza vaccine doses in the 2010–2011 season were identified from households enrolled in four urban Head Start programs. Recruitment and survey administration were conducted between March and June 2011. The impact of caregiver, provider, and practice-based factors on influenza vaccine receipt (0, 1, or 2 doses) was assessed using bivariate and multivariable logistic regression analyses.

Results—Caregivers (n=128) were predominantly mothers, Latina, Spanish-speaking, and non-U.S. born. Few children received one (31%) or both (7%) influenza vaccine doses. Caregivers who discussed influenza vaccination with providers were more likely to know their child needed two doses (55% vs. 36%, $p<0.05$) and have a fully vaccinated child (11% vs. 0%, $p<0.05$). Among caregivers whose child received the first dose, those who reported being told when to return for the second dose were also more likely to have a fully vaccinated child (35% vs. 0%, $p=0.05$). Belief in influenza vaccine effectiveness was positively associated with vaccination ($p<0.001$), while safety concerns were negatively associated ($p<0.05$).

Discussion—This study highlights the importance of provider-family communication about the two-dose regimen as well as influenza vaccine effectiveness and safety.

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Conflict of Interest:

AM Hofstetter receives research support for two investigator-initiated studies from the Merck Investigator Studies Program and the Pfizer Medical Education Group. MS Stockwell is an unfunded co-investigator on the latter study. A Barrett has no conflicts of interest to disclose.

Keywords

influenza; vaccination; underserved; children

BACKGROUND

Infants and young children are at high-risk of influenza-associated morbidity and mortality as well as transmission to other vulnerable populations (1). The Advisory Committee on Immunization Practices (ACIP) recommends influenza vaccination of children aged six months or older, ideally before the onset of influenza activity each fall (1). Certain children under age nine years require two doses separated by at least 28 days in a season based upon their receipt of influenza vaccine in previous seasons.

Despite these recommendations, data indicate that many children for whom two doses are recommended fail to receive one or both of these necessary doses (2–6). Moreover, even among those who are fully vaccinated, receipt of both doses commonly occurs after influenza begins to circulate within the community (7). Several studies have examined factors affecting pediatric influenza vaccination in general (8–14), yet the few studies of children requiring two doses have described only select demographic, visit, and vaccine delivery characteristics of large pediatric populations and practices (2, 3). Identifying other family, provider, and systems-based factors influencing vaccination is a crucial first step in designing an intervention to improve complete and timely influenza vaccination of this population.

This cross-sectional survey study assessed family, provider, and systems-based factors impacting seasonal influenza vaccination among low-income, minority children requiring two doses during the 2010–2011 season.

METHODS**Participants**

This study was conducted in a low-income community in New York City. Caregivers were eligible for participation if their child was 6 months–8.5 years of age as of October 1, 2010 and required two seasonal influenza vaccine doses in the 2010–2011 season based upon prior receipt of seasonal and 2009 H1N1 influenza vaccines, per ACIP recommendations (1). Eligible caregivers were identified from households enrolled in a randomized educational intervention aiming to improve care of upper respiratory infections for families of children attending four local Head Start Programs. Those in the intervention arm participated in two one-hour sessions focused on care of upper respiratory infections during which influenza and influenza vaccine were discussed briefly. Caregivers provided consent to review immunization records of all household children, i.e., not only those enrolled in Head Start. These records were reviewed to determine eligibility for the present study. This study was approved by the Columbia University Medical Center Institutional Review Board.

Data Collection

In total, 132 caregivers fulfilled eligible criteria. During home visits between March and June 2011, 128 (97%) were approached to complete a survey addressing influenza vaccination of the youngest child in the household for whom two doses was recommended during the 2010–2011 influenza season (1). After obtaining consent, the survey was verbally administered in English or Spanish by a trained research assistant. Survey responses were matched to each corresponding child's influenza vaccination status, determined using vaccine data from local hospital and citywide immunization registries. The former includes active vaccine records for >145,000 children seen at the hospital and affiliated clinics. It also synchronizes with the citywide immunization registry, which is a population-based provider-mandated registry including approximately 93% of vaccines given to children eligible for the Vaccines for Children (VFC) Program in New York City (15). All children in this study were VFC-eligible. When records were unavailable in one of these registries (n=4), immunization cards were reviewed. Caregiver report of vaccine receipt was not used. Baseline demographics and influenza knowledge were determined at the beginning of the 2011–12 influenza season as part of the intervention study.

Survey Instrument

The survey instrument was designed based upon expert opinion and prior studies (8, 9). It contained 11 open-ended and 26 closed-ended items with pre-coded responses addressing 1) general attitudes about preventive care and vaccination (e.g., “In general, how important do you think it is for [your child] to be vaccinated? Would you say very important, somewhat important, a little important, or not at all important?”); 2) knowledge about influenza vaccine, including two-dose recommendations (e.g., “Were you aware that [your child] needed two doses of the influenza vaccine this season?”); 3) beliefs about influenza vaccine, including safety concerns (e.g., “How concerned are you about the safety of the influenza vaccine? Would you say very concerned, somewhat concerned, a little concerned, or not at all concerned?”); 4) main reason underlying the vaccination decision (e.g., “What was the main reason you had [your child] get/not get the influenza vaccine this season?”); 5) perceived provider communication (e.g., “This season, did a doctor or nurse talk with you about the influenza vaccine?”; “What did the doctor or nurse tell you about the influenza vaccine?”; “Were you informed of when to come back for the second dose of the influenza vaccine?”); and 6) practice attributes.

Measures

The primary outcome measure was influenza vaccine receipt (0, 1, or 2 doses) by March 31, 2011. A secondary outcomes measure was full influenza vaccination (2 doses) by December 15, 2010 (2). Independent variables of interest include demographic characteristics of the child (e.g., age, insurance status) and caregiver (e.g., race/ethnicity, language, nativity, education level), caregiver survey responses, and practice type. Child age at the time of survey administration in the spring 2011 was categorized into 6–23 months, 24–59 months, and 5–8 years. Practice type was stratified into hospital-affiliated community-based practice vs. other community-based practice.

Analysis

Chi-square and Fisher's Exact tests were used to assess the impact of child, caregiver, provider, and practice-based factors on influenza vaccination by March 31, 2011. Factors found to be significant at $p < 0.10$ on bivariate analysis were entered into a multivariable logistic regression model to determine positive and negative predictors of any influenza vaccination (1 or 2 doses). Predictors of full influenza vaccination (2 doses) were not assessed using multivariable logistic regression due to the small sample that received both doses. Analyses were performed using SAS Version 9.3 (Cary, NC).

RESULTS

Caregivers were predominantly Latina, Spanish-speaking, and foreign-born (Table 1). The majority had a high school education or less. Most were mothers (87%), followed by fathers (7%), grandparents (5%), and other caregivers (1%). Children were, on average, 4.6 years (range: 14 months-8.75 years). Most were publicly insured and seen at community-based practices not affiliated with a hospital. In total, 38% received at least one influenza vaccine dose and 7% received both doses by March 31. The median interval between doses was 38 days (range: 30–147 days). Only 2% of all children received both doses by December 15.

No caregiver demographic characteristics were associated with influenza vaccination, with the exception of caregiver education level and any influenza vaccination (38% of children whose caregiver had a high school education or less *vs.* 21% of those whose caregiver had greater than a high school education received at least one vaccine dose, $p < 0.05$). Most caregivers had limited knowledge of influenza infection, but this did not impact influenza vaccine receipt (i.e., approximately three-quarters of caregivers, irrespective of the number of doses their child received, thought influenza infection was caused by a bacteria). Slightly less than half (48%) of caregivers knew their child needed two doses of influenza vaccine that season.

Approximately two-thirds of caregivers reported that a provider discussed influenza vaccination with them. Content included provider recommendations (e.g., “recommended it very highly”) as well as communication about the importance of influenza vaccination (e.g., “doctor told me the vaccine is important”), vaccine effectiveness (e.g., “it was much better to give her the vaccine to avoid a stronger flu”), vaccine safety (e.g., “there are not side effects”), and the two-dose regimen (e.g., “importance of two doses”; “he needs two doses”). Caregivers who reported discussing influenza vaccination with a provider were more likely to know their child needed two doses (55% *vs.* 35%, $p < 0.05$) and have a fully vaccinated child (11% *vs.* 0%, $p < 0.05$) compared to those who did not report discussing influenza vaccination with a provider. Among caregivers of children who received at least one vaccine dose, 61% reported being told when to return for the second dose, yet only 18% of these stated that they were told to return in one month.

Most caregivers (52%) identified influenza vaccine effectiveness as the main reason underlying their vaccination decision. This reason was given more often by those who discussed influenza vaccination with a provider compared to those who did not (75% *vs.* 25%, $p < 0.05$). Vaccination decisions were also based on the belief that influenza vaccine is

ineffective (13%) or unsafe (15%). Such perceptions about influenza vaccine effectiveness and safety impacted vaccination (Table 1). Only 5% of respondents identified provider recommendation or lack thereof as the main reason shaping their vaccination decision. Providers, however, were the main source of information about influenza vaccination in general (64%) and two-dose requirements specifically (81%). Other common sources included school/day care (14%) and media/Internet (14%).

Most influenza vaccine doses were administered at scheduled visits (80% of first doses; 57% of second doses) rather than walk-in visits (11% of first doses; 14% of second doses). Vaccination did not differ significantly between children attending hospital-affiliated vs. other community-based practices, although there was a tendency for fewer children to have received 1 or 2 doses among those attending the other community-based practices (Table 1). Child and caregiver demographic characteristics and caregiver beliefs about influenza vaccine effectiveness and safety were similar between hospital-affiliated and other community-based practices. There were also no differences between sites in the proportion of caregivers who reported discussing influenza vaccination with a provider or being informed of when to return for a second dose.

The multivariable model of any influenza vaccination during the 2010–2011 season included four independent variables with $p < 0.10$ on bivariate analysis (Table 1): effective influenza vaccine identified as the main reason underlying the caregiver vaccination decision, caregiver influenza vaccine safety concern, provider discussion of influenza vaccination, and practice type. Reason for two-dose eligibility and caregiver instruction of when to return for the second dose were excluded since they were less relevant to the analysis of any vaccination. The findings revealed that caregiver belief in influenza vaccine effectiveness was positively associated with any influenza vaccination (AOR 16.10, 95% CI 5.32–48.71), whereas attending a non-hospital-affiliated community-based practice was negatively associated (0.20, 95% CI 0.06–0.65). Caregiver safety concerns about influenza vaccine (AOR 0.75, 95% CI 0.29–1.95) and provider discussion about influenza vaccination (AOR 0.93, 95% CI 0.34–2.53) were no longer predictors of any influenza vaccination. Of note, intervention arm was not associated with influenza vaccination on bivariate analysis (intervention group: 63%, 30%, and 7% received 0, 1, and 2 doses; control group: 60%, 33%, and 7% received 0, 1, and 2 doses, respectively; $p = 0.96$).

DISCUSSION

This study highlights the problem of influenza under-immunization among children requiring two influenza vaccine doses during the 2010–2011 season. These urban low-income minority children had particularly low rates of receiving their two needed doses (7%) compared to rates reported previously among other children in this community (i.e., 29% of eligible children received both doses in 2009–2010 season) (2) as well as nationally (i.e., 35.9% of eligible 6–23 month-olds, 24.7% of eligible 24–59 month-olds, 17.5% of eligible 5–8 year-olds received both doses in 2010–2011 season) (6). Moreover, only three of the 128 children in this study received both doses by December 15, 2010, i.e., when influenza began circulating in this region (16), leaving them vulnerable to influenza infection. Other studies from this community have revealed markedly low, albeit slightly

higher, rates of timely vaccination coverage (i.e., 4–16% with full vaccination by influenza activity onset in the 2008–2009 season) (7), compared to somewhat higher rates of two-dose compliance by this time nationally (i.e., approximately 27–38% in the 2008–2009 season) (3). Consistent with these data, we previously found that Latino children exhibited a longer interval between the needed two doses compared to non-Latino white children. These findings could reflect particular barriers to influenza vaccination in this low-income minority population. These findings are especially worrisome given data that Latinos also may be at high risk of influenza exposure and influenza-associated complications (17, 18). The present study offers insight into the multiple factors contributing to under-immunization and illustrates the critical role that providers may play in shaping caregiver knowledge, attitudes, and decisions about influenza vaccination.

Provider discussion with families about influenza vaccination was particularly influential in completion of the two-dose regimen, which has not been demonstrated previously. Specifically, we found that caregivers who had a conversation were more likely to have a fully vaccinated (2 doses) child than caregivers who had not. In fact, all caregivers of fully vaccinated children reported that a provider talked with them about influenza vaccination. When asked about the content of these discussions, some caregivers mentioned that the provider clarified the importance of and need for two vaccine doses. In addition, some reported being informed when to return for a second dose by the provider; those who did were more likely to have a fully vaccinated child. It is noteworthy that the timing given by caregivers was frequently inconsistent with ACIP recommendations, which this likely contributed to delayed completion among some partially vaccinated children. It is unclear whether the caregiver incorrectly recalled this timing or whether the provider indicated that the dose should be given at an interval other than the recommended one-month. In support of the latter, one previous study found that 15% of providers were unaware of the appropriate interval between doses (19).

Interestingly, while earlier studies have found that provider recommendation impacts general influenza vaccine acceptability and uptake among children (10–13, 20), provider recommendation in this study was infrequently identified as the “main reason” underlying the caregiver decision about influenza vaccination of children requiring two doses. Instead, caregiver perceptions about vaccine effectiveness and vaccine safety, consistent with previous studies including Latino populations (9, 21–23), played a more prominent role in their influenza vaccination decision. These findings indicate that provider recommendation alone may be insufficient, as suggested recently for the HPV vaccine (24). Providers—as the main source of influenza vaccine information identified—should be familiar with existing evidence and use effective communication tools to address parental knowledge gaps and common misconceptions (20, 25). In support of this, we recently found that the children of urban Latino parents with vaccine safety fears and more limited communication with providers were more likely to miss an immunization appointment (26).

This study revealed that the majority of first and second doses were administered during preventive care visits. This, in addition to the key role that provider communication played in influenza vaccine receipt, highlights the critical importance of having regularly scheduled visits with a primary care provider in a medical home (26–28). A recent study of inner-city

minority children, for example, found that increased frequency of interaction with the usual source of medical care increased influenza vaccine receipt in the first season that the child was eligible (8). While other settings such as schools, pharmacies, or public health clinics may be considered to enhance influenza vaccine uptake (29), they are less ideal for addressing certain barriers to vaccination such as parental misconceptions and for delivering preventive care services in general.

Health information technology targeting providers and families also could improve timely completion rates among children requiring two doses by promoting exchange of crucial vaccine information (30). Immunization information systems, which are increasingly linked with electronic health records (EHR) (31), may enhance vaccine data quality and thus more accurately identify those children in need of two vaccine doses. Alerts in the EHR may be another useful strategy for identifying eligible recipients and prompting providers to discuss and offer influenza vaccine (32), thereby reducing missed vaccination opportunities (33). The use of clinician decision support in the EHR may be particularly valuable for children requiring two doses since one study found that approximately 40% of providers were unclear which children should receive the two-dose regimen (19). It may be especially useful for older children who need two doses, yet are less likely to receive them (2, 4, 6) or during seasons with changing recommendations, although it's important to note that influenza vaccination here did not differ based upon child age nor the reason for two-dose eligibility (i.e., prior seasonal vs. H1N1 vaccine receipt). These tools could be used during all types of provider visits (29), and their integration into settings with lower influenza vaccination coverage such as the non-hospital-affiliated community-based practices in this study may be beneficial.

Other strategies may complement these approaches. For example, reminder/recall may be useful for informing parents when their child is due for the second dose and how they should go about receiving this dose (i.e., scheduling appointment vs. walk-in visit). A novel approach using text messaging has recently been shown to increase influenza vaccination coverage among low-income minority children (34), a population for which traditional vaccine reminder/recall approaches have been less effective (35–37). An additional advantage of text messaging is the capability of embedding educational information, i.e., why two doses are needed or recommended timing of vaccination, into the general messages or through interactive features (38). This could serve as a prompt for caregivers to act upon (i.e., initiate a conversation about influenza vaccine) during subsequent visits with their provider.

There are some limitations of this study. First, since it was conducted in a relatively small homogenous sample of low-income minority families from one urban community, its ability to detect significant differences in select variables and its generalizability to other populations may be limited. In addition, since all families had children enrolled in Head Start programs, children requiring two doses in this study were primarily between 3–5 years of age. It is important to recognize that, while data suggests that these older children are less likely than children aged 6–23 months to receive both needed doses (2, 4, 6), the latter are at highest risk of influenza-related complications (1). Further examination of under-immunization in this population is warranted given the limited number included here.

Second, there may have been under- or over-reporting of influenza vaccination, although multiple sources were used to confirm vaccination status. Furthermore, while surveys were administered at the season's end to avoid impacting vaccination, this may have introduced recall bias. In addition, parents were also enrolled in an intervention study, which could have affected survey responses. However, no relevant differences were noted between study groups. Moreover, four of the 132 eligible participants were not approached about survey participation during the scheduled home visit for the intervention study, and return to these households was not possible due to limited staffing/resources. Lastly, certain provider- and practice-based information that would have been useful in assessing missed vaccination opportunities was unavailable.

CONCLUSION

This study identified factors affecting influenza vaccination of low-income, predominantly Latino children requiring two doses in a season and illustrates the importance of enhanced provider-family communication about two-dose requirements as well as influenza vaccine effectiveness and safety. These findings could be useful when designing interventions to improve timely full vaccination of similar high-risk populations.

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References

1. Fiore AE, Uyeki TM, Broder K, et al. Prevention and control of influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2010. *MMWR Recomm Rep*. 2010; 59(RR-8):1–62. [PubMed: 20689501]
2. Hofstetter AM, Natarajan K, Martinez RA, Rabinowitz D, Vawdrey DK, Stockwell MS. Influenza vaccination coverage and timeliness among children requiring two doses, 2004–2009. *Prev Med*. 2013; 56(3–4):165–70. [PubMed: 23219757]
3. Bhatt P, Block SL, Toback SL, Ambrose CS. Timing of the availability and administration of influenza vaccine through the vaccines for children program. *Pediatr Infect Dis J*. 2011; 30(2):100–6. [PubMed: 20686436]
4. Jackson LA, Neuzil KM, Baggs J, et al. Compliance with the recommendations for 2 doses of trivalent inactivated influenza vaccine in children less than 9 years of age receiving influenza vaccine for the first time: a Vaccine Safety Datalink study. *Pediatrics*. 2006; 118(5):2032–7. [PubMed: 17079576]
5. Pabst LJ, Fiore AE, Cullen KA. Completion of the 2-dose influenza vaccine series among children aged 6 to 59 months: immunization information system sentinel sites, 2007–2008 influenza season. *Clin Pediatr (Phila)*. 2011; 50(11):1068–70. [PubMed: 21098532]
6. Pabst LJ, Chaves SS, Weinbaum C. Trends in compliance with two-dose influenza vaccine recommendations among children aged 6 months through 8 years. *Vaccine*. 2013; 31(31):3116–20. [PubMed: 23684827]
7. Hofstetter AM, Natarajan K, Rabinowitz D, et al. Timeliness of pediatric influenza vaccination compared to seasonal influenza activity in an urban underserved community, 2004–2008. *Am J Public Health*. 2013; 103(7):e50–8. [PubMed: 23678935]

8. Uwemedimo OT, Findley SE, Andres R, Irigoyen M, Stockwell MS. Determinants of Influenza Vaccination Among Young Children in an Inner-City Community. *J Community Health*. 2012; 37(3):663–72. [PubMed: 22045471]
9. Cohen B, Ferng YH, Wong-McLoughlin J, Jia H, Morse SS, Larson EL. Predictors of flu vaccination among urban Hispanic children and adults. *J Epidemiol Community Health*. 2012; 66(3):204–9. [PubMed: 20881023]
10. Daley MF, Crane LA, Chandramouli V, et al. Influenza among healthy young children: changes in parental attitudes and predictors of immunization during the 2003 to 2004 influenza season. *Pediatrics*. 2006; 117(2):e268–77. [PubMed: 16452334]
11. Grant VJ, Le Saux N, Plint AC, et al. Factors influencing childhood influenza immunization. *CMAJ*. 2003; 168(1):39–41. [PubMed: 12515783]
12. Lin CJ, Zimmerman RK, Nowalk MP, et al. Parental perspectives on influenza vaccination of children with chronic medical conditions. *J Natl Med Assoc*. 2006; 98(2):148–53. [PubMed: 16708499]
13. Nowalk MP, Zimmerman RK, Lin CJ, et al. Parental perspectives on influenza immunization of children aged 6 to 23 months. *Am J Prev Med*. 2005; 29(3):210–4. [PubMed: 16168870]
14. Humiston SG, Lerner EB, Hepworth E, Blythe T, Goepf JG. Parent opinions about universal influenza vaccination for infants and toddlers. *Arch Pediatr Adolesc Med*. 2005; 159(2):108–12. [PubMed: 15699302]
15. Metroka AE, Hansen MA, Papadouka V, Zucker JR. Using an immunization information system to improve accountability for vaccines distributed through the Vaccines for Children program in New York City, 2005–2008. *J Public Health Manag Pract*. 2009; 15(5):E13–21. [PubMed: 19704302]
16. New York State Department of Health. [Accessed June 9, 2014] New York State Department of Health 2010–2011 flu monitoring - week ending May 21, 2011. <http://www.health.ny.gov/diseases/communicable/influenza/surveillance/2010-2011/archive/2011-05-21/>
17. Dee DL, Bensyl DM, Gindler J, et al. Racial and ethnic disparities in hospitalizations and deaths associated with 2009 pandemic Influenza A (H1N1) virus infections in the United States. *Ann Epidemiol*. 2011; 21(8):623–30. [PubMed: 21737049]
18. Quinn SC, Kumar S, Freimuth VS, Musa D, Casteneda-Angarita N, Kidwell K. Racial disparities in exposure, susceptibility, and access to health care in the US H1N1 influenza pandemic. *Am J Public Health*. 2011; 101(2):285–93. [PubMed: 21164098]
19. Dominguez SR, Daum RS. Physician knowledge and perspectives regarding influenza and influenza vaccination. *Hum Vaccin*. 2005; 1(2):74–9. [PubMed: 17038822]
20. Larson E, Ferng YH, Wong J, et al. Knowledge and misconceptions regarding upper respiratory infections and influenza among urban Hispanic households: need for targeted messaging. *J Immigr Minor Health*. 2009; 11(2):71–82. [PubMed: 18506622]
21. Wooten KG, Wortley PM, Singleton JA, Euler GL. Perceptions matter: beliefs about influenza vaccine and vaccination behavior among elderly white, black and Hispanic Americans. *Vaccine*. 2012; 30(48):6927–34. [PubMed: 22939908]
22. Freed GL, Clark SJ, Butchart AT, Singer DC, Davis MM. Parental vaccine safety concerns in 2009. *Pediatrics*. 2010; 125(4):654–9. [PubMed: 20194286]
23. Shui IM, Weintraub ES, Gust DA. Parents concerned about vaccine safety: Differences in race/ethnicity and attitudes. *Am J Prev Med*. 2006; 31(3):244–51. [PubMed: 16905036]
24. Darden PM, Thompson DM, Roberts JR, et al. Reasons for not vaccinating adolescents: National Immunization Survey of Teens, 2008–2010. *Pediatrics*. 2013; 131(4):645–51. [PubMed: 23509163]
25. Freed GL, Clark SJ, Butchart AT, Singer DC, Davis MM. Sources and perceived credibility of vaccine-safety information for parents. *Pediatrics*. 2011; 127 (Suppl 1):S107–12. [PubMed: 21502236]
26. Stockwell MS, Irigoyen M, Andres Martinez R, Findley SE. Failure to return: parental, practice, and social factors affecting missed immunization visits for urban children. *Clin Pediatr (Phila)*. 2014; 53(5):420–7. [PubMed: 24647698]

27. Smith PJ, Santoli JM, Chu SY, Ochoa DQ, Rodewald LE. The association between having a medical home and vaccination coverage among children eligible for the vaccines for children program. *Pediatrics*. 2005; 116(1):130–9. [PubMed: 15995043]
28. Szilagyi PG, Rand CM, McLaurin J, et al. Delivering adolescent vaccinations in the medical home: a new era? *Pediatrics*. 2008; 121 (Suppl 1):S15–24. [PubMed: 18174317]
29. Rand CM, Szilagyi PG, Yoo BK, Auinger P, Albertin C, Coleman MS. Additional visit burden for universal influenza vaccination of US school-aged children and adolescents. *Arch Pediatr Adolesc Med*. 2008; 162(11):1048–55. [PubMed: 18981353]
30. Stockwell MS, Fiks AG. Utilizing health information technology to improve vaccine communication and coverage. *Hum Vaccin Immunother*. 2013; 9(8):1802–11. [PubMed: 23807361]
31. Vawdrey DK, Natarajan K, Kanter AS, Hripcsak G, Kuperman GJ, Stockwell MS. Informatics lessons from using a novel immunization information system. *Studies in health technology and informatics*. 2013; 192:589–93. [PubMed: 23920624]
32. Birmingham E, Catallozzi M, Findley SE, Vawdrey DK, Kukafka R, Stockwell MS. FluAlert: a qualitative evaluation of providers' desired characteristics and concerns regarding computerized influenza vaccination alerts. *Prev Med*. 2011; 52(3–4):274–7. [PubMed: 21276811]
33. Fiks AG, Grundmeier RW, Biggs LM, Localio AR, Alessandrini EA. Impact of clinical alerts within an electronic health record on routine childhood immunization in an urban pediatric population. *Pediatrics*. 2007; 120(4):707–14. [PubMed: 17908756]
34. Stockwell MS, Kharbanda EO, Martinez RA, Vargas CY, Vawdrey DK, Camargo S. Effect of a text messaging intervention on influenza vaccination in an urban, low-income pediatric and adolescent population: a randomized controlled trial. *JAMA*. 2012; 307(16):1702–8. [PubMed: 22535855]
35. Daley MF, Steiner JF, Brayden RM, Xu S, Morrison S, Kempe A. Immunization registry-based recall for a new vaccine. *Ambul Pediatr*. 2002; 2(6):438–43. [PubMed: 12437389]
36. Irigoyen MM, Findley S, Wang D, et al. Challenges and successes of immunization registry reminders at inner-city practices. *Ambul Pediatr*. 2006; 6(2):100–4. [PubMed: 16530147]
37. LeBaron CW, Starnes DM, Rask KJ. The impact of reminder-recall interventions on low vaccination coverage in an inner-city population. *Arch Pediatr Adolesc Med*. 2004; 158(3):255–61. [PubMed: 14993085]
38. Hofstetter AM, Vargas CY, Kennedy A, Kitayama K, Stockwell MS. Parental and provider preferences and concerns regarding text message reminder/recall for early childhood vaccinations. *Prev Med*. 2013; 57(2):75–80. [PubMed: 23624252]

Table 1
Factors impacting influenza vaccination of children requiring two doses, 2010–2011 season (n=128)

Factor ^a	Total % (n)	0 Doses % (n)	1 Dose % (n)	2 Doses % (n)	0 vs. 1 doses, P value	1 vs. 2 doses, P value	0 vs. 1 vs. 2 doses, P value
Child							
<i>Age</i>							
6–23 months	2 (2)	50 (1)	0 (0)	50 (1)	1.0	<0.05	0.14
24–59 months	75 (96)	61 (58)	31 (30)	8 (8)			
5–8 years	23 (30)	67 (20)	33 (10)	0 (0)			
<i>Insurance</i>							
Public	90 (115)	60 (69)	33 (38)	7 (8)	0.33	0.46	0.44
Private/other	10 (13)	77 (10)	15 (2)	8 (1)			
<i>Two-dose eligibility^{b,c}</i>					--	0.22	0.08
Seasonal vaccine history	38 (47)	72 (34)	19 (9)	9 (4)			
H1N1 vaccine history	63 (81)	56 (45)	38 (31)	6 (5)			
Caregiver							
<i>Race/ethnicity</i>							
Latino	98 (125)	61 (76)	32 (40)	7 (9)	0.55	N/A	0.64
Non-Latino black	2 (3)	100 (3)	0 (0)	0 (0)			
<i>Language</i>							
Spanish	72 (92)	58 (53)	35 (32)	8 (7)	0.14	1.0	0.32
English/other	28 (36)	72 (26)	22 (8)	6 (2)			
<i>Nativity</i>							
U.S. born	22 (28)	68 (19)	25 (7)	7 (2)	0.41	0.66	0.72
Non-U.S. born	78 (100)	60 (60)	33 (33)	7 (7)			
<i>Education</i>							
high school	62 (80)	55 (44)	38 (30)	8 (6)	<0.05	0.68	0.11
> high school	38 (48)	73 (35)	21 (10)	6 (3)			
<i>Influenza infection knowledge</i>							
Caused by bacteria	76 (92)	62 (57)	30 (28)	8 (7)	0.70	1.0	0.94
Not caused by bacteria	24 (29)	59 (17)	34 (10)	7 (2)			
<i>Two dose requirement knowledge</i>							
					0.30	0.27	0.33

Factor ^a	Total % (n)	0 Doses % (n)	1 Dose % (n)	2 Doses % (n)	0 vs. 1 doses, P value	1 vs. 2 doses, P value	0 vs. 1 vs. 2 doses, P value
Yes	48 (59)	63 (37)	27 (16)	10 (6)			
No	52 (64)	58 (37)	38 (24)	5 (3)			
<i>Main reason for vaccination decision</i>							
Effective influenza vaccine	52 (63)	35 (22)	54 (34)	11 (7)	<0.001	0.60	<0.001
All other reasons	48 (59)	88 (52)	8 (5)	3 (2)			
<i>Influenza vaccine safety concern</i>							
Very or somewhat concerned	44 (55)	73 (40)	25 (14)	2 (1)	0.14	0.24	<0.05
A little or not at all unconcerned	56 (70)	54 (38)	34 (24)	11 (8)			
Provider							
<i>Discussed influenza vaccination^d</i>							
Yes	64 (82)	57 (47)	32 (26)	11 (9)	0.56	<0.05	<0.05
No	36 (46)	70 (32)	30 (14)	0 (0)			
<i>Told caregiver when to return for 2nd dose^{c,d}</i>							
Yes	61 (17)	--	65 (11)	35 (6)	--	0.05	0.05
No	39 (11)	--	100 (11)	0 (0)			
Practice Type							
Hospital-affiliated practice	22 (28)	43 (12)	46 (13)	11 (3)	<0.05	1.0	0.07
Other community-based practice	78 (98)	66 (65)	28 (27)	6 (6)			

^aData unavailable for some factors.

^bRequired two doses based on inadequate number of prior seasonal vaccine doses or no H1N1 vaccine in 2009–10 season.

^cDid not assess 0 vs. 1 dose since primarily of interest in 1 vs. 2 dose analyses.

^dBy parent/caregiver report.