Seasonal Influenza Vaccination Reminders for Children with High-Risk Conditions

A Registry-Based Randomized Trial

Kevin J. Dombkowski, DrPH, MS, Laura B. Harrington, MPH, Shiming Dong, MS, Sarah J. Clark, MPH

Background: Children with chronic conditions have an increased risk of complications from influenza and have low influenza vaccination rates.

Purpose: To assess the feasibility and effectiveness of using a statewide immunization information system (IIS) for seasonal influenza vaccine reminders from local health departments (LHDs) targeting children with high-risk conditions.

Design: A randomized community intervention.

Setting/participants: The study was conducted in a population of 3618 children aged 24–60 months with a high-risk condition residing in three Michigan counties. Children were identified using a statewide IIS in October 2008.

Intervention: Children were randomized to intervention (reminder) or control (no reminder) groups. Reminders for seasonal influenza vaccination were mailed by LHDs in November 2008.

Main outcome measures: Feasibility of notification (address validity, address deliverability) was assessed (November 2008–February 2009), and frequencies of notification feasibility measures were determined (analyses conducted in 2010). Effectiveness of notification (seasonal influenza vaccine receipt) was assessed using bivariate logistic regression.

Results: Among 3618 children with a high-risk condition, 2730 (75.5%) had not received a 2008–2009 influenza vaccination and were eligible at the time of notification. Among children assigned to the reminder group ($n=1374$), 42.6% had an address determined to be either invalid, undeliverable, or both. Among those with valid addresses ($n=2001$), a greater percentage of children with deliverable reminders received at least one influenza vaccination (30.8%) during the outcome observation period than did children assigned to no reminder (24.3%, OR=1.39, 95% CI=1.13, 1.72); children with an undeliverable reminder had an influenza vaccination rate (22.8%) similar to children assigned to no reminder.

Conclusions: Receipt of a reminder was positively associated with seasonal influenza vaccination. However, more than 40% of children assigned to receive a reminder were determined to have an invalid or undeliverable address, emphasizing the need for increased quality of IIS contact information.

Trial registration: This study is registered at www.ClinicalTrials.gov NCT01431183.

(Am J Prev Med 2012;42(1):71–75)

Background

Children with chronic conditions have an increased risk of complications from influenza.[1–3] For decades, the Advisory Committee on Immunization Practices (ACIP)[4] has recommended that children with chronic conditions receive seasonal influenza vaccination. These recommendations have expanded

From the Child Health Evaluation and Research (CHEAR) Unit, Division of General Pediatrics, University of Michigan, Ann Arbor, Michigan

Address correspondence to: Kevin J. Dombkowski, DrPH, MS, University of Michigan, Division of General Pediatrics, 300 N. Ingalls Room 6D05, Ann Arbor MI 48109-5456. E-mail: kjd@med.umich.edu.

0749-3797/$36.00

doi: 10.1016/j.amepre.2011.09.028

over the years to include all children aged 6 months to 18 years; children with high-risk conditions including chronic pulmonary, cardiovascular, renal, hepatic, and other conditions remain a priority group for influenza vaccination.[5] Despite the increased risk of complications, children with high-risk conditions such as asthma historically have had low influenza vaccination rates; missed opportunities are known to contribute to low influenza vaccination rates.[6–13]

Reminder notifications are considered an effective strategy to prompt individuals to seek vaccinations[14] and have been demonstrated to reduce missed opportunities and increase influenza vaccination rates among patients with high-risk conditions.[15–17] Because prior studies focused on reminder notices sent by private providers, the effectiveness of registry-based notifications initiated by local health departments (LHDs) is unknown. A barrier to LHD notifications historically has been the inability of LHDs to identify children with high-risk conditions. However, recent expansion of Michigan's statewide immunization information system (IIS) encompassed an identifier for children with high-risk conditions, based on Medicaid and other state health data. The objective of the present study was to assess the feasibility and effectiveness of using the Michigan Care Improvement Registry (MCIR), a statewide IIS, for seasonal influenza vaccine reminders from LHDs targeting children with high-risk conditions.

Methods

Setting and Participants

The source population was identified using MCIR (October 9, 2008) and included children aged 24–60 months with high-risk conditions living in three county LHD jurisdictions with primarily English-speaking households (≥90%); all were currently or previously enrolled in Medicaid. Within each LHD jurisdiction, eligible children were sorted by a random number, with half assigned to the intervention (reminder) group and half to the control (no-reminder) group. Following randomization, two groups of children were deemed ineligible: those who had already received a seasonal influenza vaccination in fall 2008, and those ineligible for MCIR reminder/recall notices (i.e., were opted out by a responsible party, deceased, or flagged as "moved or gone elsewhere").

Influenza reminder notices were generated using MCIR, a statewide IIS with data on ≥95% of children aged 0–6 years.[18] Among its reminder/recall capabilities, MCIR is designed to target influenza vaccination reminder notices to children with high-risk conditions using a child-specific indicator. At the time of the current study, the MCIR high-risk indicator included children identified through ICD-9 diagnosis codes reported in Michigan Medicaid-paid claims as having conditions consistent with ACIP influenza vaccination recommendations; details are described elsewhere.[19]

Mailed Reminder Intervention

English-language reminder notices were generated during the first week of November 2008 for children with high-risk conditions in each participating LHD jurisdiction. Reminder letters outlined the importance of annual influenza vaccination, especially among people with chronic conditions, and encouraged parents to contact their child's physician or the local health department. Reminder notices were sent via first-class postal mail, marked "return service requested" to facilitate the tracking of undeliverable letters for the feasibility assessment.

Because letters were not mailed for the control group, the validity of mailing addresses was evaluated retrospectively using the U.S. Postal Service's (USPS's) National Change of Address $(NCOA)^{Link}$ process, matching on MCIR responsible party (e.g., parent) name and address.[20] Children were classified as having an undeliverable mailing address if they (1) could not be standardized using the $NCOA^{Link}$ process; (2) had a change of address filed prior to the influenza vaccination reminder mailing date that did not include a forwarding mailing address; (3) had an address change filed ≥12 months prior to the reminder mailing date (would not be forwarded by the USPS); or (4) had an out-of-Michigan forwarding address. For consistency, the intervention group's mailing addresses were also assessed using the NCOA process.

Main Outcome Measures

Primary outcomes were reminder feasibility and effectiveness. Feasibility of reminder delivery was evaluated from two perspectives, through letters returned by the USPS as undeliverable and through the $(NCOA)^{Link}$ results. Effectiveness was based on the outcome of one or more seasonal influenza vaccination doses being entered into MCIR during the outcome observation period (November 2008–February 2009).

Statistical Analysis

Demographics, influenza vaccination history, and $NCOA^{Link}$ address validity were compared between reminder groups using chi-square analyses. Post-notification frequencies of influenza dose entry into MCIR was assessed by group assignment; influenza vaccination history (one or more influenza vaccination doses in any prior season); and demographic characteristics. ORs and 95% CIs were estimated using unadjusted bivariate logistic regression to assess the association between predictor variables (group assignment, influenza vaccination history, and demographic characteristics) and entry of at least one influenza vaccination into MCIR during the outcome observation period. Analyses were conducted using SAS, version 9.1. This study was approved by the University of Michigan and Michigan Department of Community Health (MDCH) IRBs.

Results

A total of 3618 children with one or more high-risk conditions were identified in MCIR (Figure 1). Following randomization, 687 children (19.0%) were excluded who had already received an influenza vaccination in Fall 2008 prior to the reminder notification. Also excluded were 201 children (5.6%) not eligible for MCIR reminder notification (e.g., were deceased, opted out). Excluded chil-

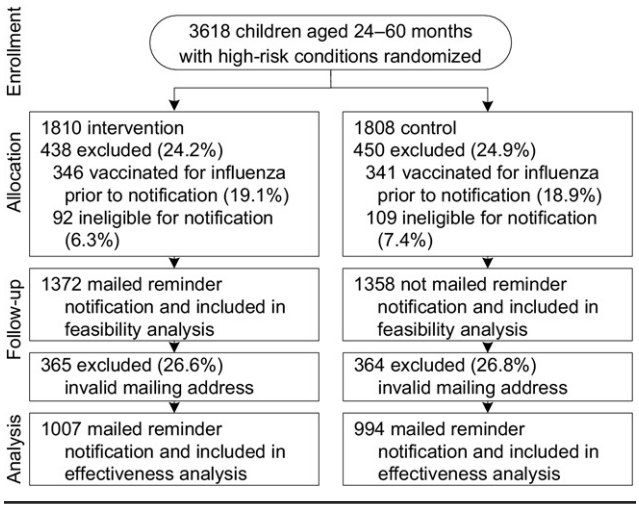

Figure 1. Source population and notification assignment of children with high-risk conditions

dren did not differ between assignment groups based on prior influenza vaccination ($p=0.84$) or ineligibility for MCIR notification ($p=0.48$). For the remaining children, demographic characteristics, including history of influenza vaccination, location of historical influenza vaccination, current Medicaid enrollment, age, and gender, were not different based on group assignment ($p>0.05$).

Among the 2730 included in the feasibility assessment, 729 (26.7%) were determined retrospectively by the NCOA^{Link} process to have had an invalid mailing address; address validity was not associated with group assignment ($\chi^2=0.69$, $p=0.41$). Within the intervention group, 42.6% of the 1372 mailed reminder notices were deemed invalid, by the NCOA^{Link} process alone (13.4%); by a returned letter (16.0%); or by both methods (13.2%).

The 2001 children with valid addresses were included in the effectiveness analyses; there were no differences in demographic characteristics between the intervention and control groups. Most children had received at least one influenza vaccination in a previous year (66.4%) and were enrolled in Medicaid at the time of notification (88.2%). In total, 26.7% of children eligible for notification effectiveness analyses had at least one influenza vaccination entered into MCIR during the outcome observation period. Median time to vaccination was 25 days after notification, with no difference by group assignment (range=23–26 days).

The percentage of children who received at least one influenza vaccination post-notification was higher among children with a deliverable reminder (30.8%) than among those assigned to receive no reminder (24.3%, Table 1) or children with an undeliverable reminder (22.8%). Receipt of influenza vaccination in a previous influenza season and current Medicaid enrollment were associated with the subsequent receipt of influenza vaccination but did not serve as confounders or effect measure modifiers of the primary association of interest between notification and influenza vaccination. Among the total randomized population (N=3618), the overall influenza vaccination rate was 40.5%, representing 1465 children with at least one vaccination entered into MCIR between October 2008 and February 2009.

Discussion

The current study provides a unique perspective on influenza vaccination reminder effectiveness among children with high-risk conditions who were identified using a statewide IIS. Those sent reminder notices were more likely to receive influenza vaccination compared to their counterparts who did not receive reminders. Although earlier studies[15–17] identified children with high-risk conditions among patients seen in private offices and clinics, the present study utilized the high-risk indicator in a statewide IIS, demonstrating the feasibility of population-based reminders.

Prior studies[21,22] indicate that although providers may fail to recognize children with high-risk conditions or to

Table 1. Entry of at least one influenza dose into MCIR by demographic characteristics ($n=2001$)[a]

Characteristic	*n* (%)	Unadjusted OR (95% CI)
Influenza reminder		
None	994 (24.3)	ref
Mailed, delivered	788 (30.8)	1.39 (1.13, 1.72)
Mailed, returned undeliverable	219 (22.8)	0.92 (0.65, 1.31)
Influenza vaccination in any prior year		
No	673 (16.1)	ref
Yes	1328 (32.1)	2.47 (1.95, 3.13)
Current Medicaid enrollment		
No	236 (17.4)	ref
Yes	1765 (27.9)	1.84 (1.30, 2.62)
Age (months)		
≥24–<36	643 (27.5)	ref
≥36–<48	695 (26.2)	0.93 (0.73, 1.19)
≥48–<60	663 (26.4)	0.94 (0.74, 1.21)
Gender		
Male	1126 (27.8)	ref
Female	875 (25.3)	0.88 (0.72, 1.07)

[a]Entry in MCIR following notification, November 2008–February 2009
MCIR, Michigan Care Improvement Registry

recommend influenza vaccination, they have a positive overall view of using an automated high-risk condition indicator in a statewide IIS.[19] The results from the current study confirm previous reports[15–17] indicating that children with a high-risk condition receiving a mailed reminder have a higher rate of seasonal influenza immunization compared with their counterparts who are not notified. This finding is consistent with recent recommendations endorsing reminder/recall[14] and IIS[23] and may have important implications for health departments or Medicaid health plans. The current finding that more than 40% of addresses were inadequate for postal mail delivery highlights the importance of successful contact of children with high-risk conditions. Children with undeliverable addresses had a similar rate of seasonal influenza immunization as those never sent a reminder, suggesting a potential benefit to improving contact information in statewide IIS.

The current study has several potential limitations. Although children were randomly assigned to intervention and control groups for this study, the degree to which they received reminders from health plans or other providers during the study period is unknown. It is also possible that some influenza vaccination doses were not recorded in MCIR. However, there is no reason to expect that either additional reminders or under-reporting to MCIR varied based on group assignment.

In addition, the identification of high-risk conditions in MCIR is contingent on the accuracy and completeness of Medicaid administrative claims data used to identify in MCIR children with these conditions. An important strength of the present study is the use of the NCOA^{Link} methodology, allowing the assessment of the impact of invalid addresses for both recall and no recall groups. Without this process, undeliverable reminders would have been identified only for the intervention group from envelopes physically returned by the USPS, yielding uneven estimates of address deficiencies.

Conclusion

Many children with high-risk conditions do not receive seasonal influenza vaccination. Although it was found that mailed reminders encouraging influenza vaccination among children with high-risk conditions were modestly effective, efforts to improve the accuracy of parent contact information could maximize the effect of influenza vaccine reminders. Future studies should explore mechanisms to improve the timeliness and accuracy of parent contact information in statewide IIS.

This study was supported by CDC Cooperative Agreement #1U01IP000132-01. The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the funding agency. The authors gratefully acknowledge the cooperation of the immunization staff of the Kalamazoo, Kent, and Ottawa County, Michigan health departments.

No financial disclosures were reported by the authors of this paper.

References

1. Bhat N, Wright JG, Broder KR, et al. Influenza Special Investigations Team. Influenza-associated deaths among children in the U.S., 2003–2004. N Engl J Med 2005;353(24):2559–67.
2. Neuzil KM, Wright PF, Mitchel EF Jr, Griffin MR. The burden of influenza illness in children with asthma and other chronic medical conditions. J Pediatr 2000;137(6):856–64.
3. Erhart LM, Rangel MC, Lu PJ, Singleton JA. Prevalence and characteristics of children at increased risk for complications from influenza, U.S., 2000. J Pediatr 2004;144(2):191–5.
4. Surgeon General's Advisory Committee on Influenza. Recommendations for influenza immunization and control in the civilian population. Washington DC: U.S. Public Health Service; 1962:Suppl. 1–7.
5. Fiore AE, Uyeki TM, Broder K, et al. Centers for Disease Control and Prevention (CDC). 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.
6. Kramarz P, DeStefano F, Gargiullo PM, et al. Influenza vaccination in children with asthma in health maintenance organizations. Vaccine Safety Datalink Team. Vaccine 2000;18(21):2288–94.
7. Daley MF, Beaty BL, Barrow J, et al. Missed opportunities for influenza vaccination in children with chronic medical conditions. Arch Pediatr Adolesc Med 2005;159(10):986–91.
8. Szilagyi PG, Rodewald LE. Missed opportunities for influenza vaccination among children with asthma. Pediatr Infect Dis J 1992;11(9):705–8.
9. Gnanasekaran SK, Finkelstein JA, Lozano P, Farber HJ, Chi FW, Lieu TA. Influenza vaccination among children with asthma in Medicaid managed care. Ambul Pediatr 2006;6(1):1–7.
10. Chung EK, Casey R, Pinto-Martin JA, Pawlowski NA, Bell LM. Routine and influenza vaccination rates in children with asthma. Ann Allergy Asthma Immunol 1998;80(4):318–22.
11. CDC. Influenza vaccination coverage among children with asthma—U.S., 2004–05 influenza season. MMWR Morb Mortal Wkly Rep 2007;56(9):193–6.
12. Nakamura MM, Lee GM. Influenza vaccination in adolescents with high-risk conditions. Pediatrics 2008;122(5):920–8.
13. Dombkowski KJ, Davis MM, Cohn LM, Clark SJ. Effect of missed opportunities on influenza vaccination rates among children with asthma. Arch Pediatr Adolesc Med 2006;160(9):966–71.
14. Task Force on Community Preventive Services. Guide to Community Preventive Services. Universally recommended vaccinations: client reminder & recall systems. www.thecommunityguide.org/vaccines/universally/clientreminder.html.
15. Daley MF, Barrow J, Pearson K, et al. Identification and recall of children with chronic medical conditions for influenza vaccination. Pediatrics 2004;113(1 Pt 1):e26–33.
16. Gaglani M, Riggs M, Kamenicky C, Glezen WP. A computerized reminder strategy is effective for annual influenza immunization of children with asthma or reactive airway disease. Pediatr Infect Dis J 2001;20(12):1155–60.
17. Szilagyi PG, Rodewald LE, Savageau J, Yoos L, Doane C. Improving influenza vaccination rates in children with asthma: a test of a comput-

erized reminder system and an analysis of factors predicting vaccination compliance. Pediatrics 1992;90(6):871–5.
18. CDC. Progress in immunization information systems—U.S., 2009. MMWR Morb Mortal Wkly Rep 2011;60(1):10–2.
19. Dombkowski KJ, Leung SW, Clark SJ. Provider attitudes regarding use of an immunization information system to identify children with asthma for influenza vaccination. J Public Health Manag Pract 2007;13(6):567–71.
20. U.S. Postal Service. NCOA Link Systems. ribbs.usps.gov/index.cfm?page=ncoalink.
21. Rickert D, Santoli J, Shefer A, Myrick A, Yusuf H. Influenza vaccination of high-risk children: what the providers say. Am J Prev Med 2006;30(2):111–8.
22. Dombkowski KJ, Leung SW, Clark SJ. Physician perspectives regarding annual influenza vaccination among children with asthma. Ambul Pediatr 2008;8(5):294–9.
23. The Community Guide. Universally recommended vaccinations: immunization information systems. Task force finding and rationale statement. www.thecommunityguide.org/vaccines/universally/RRimminfosystems.html.