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Source: *Infection Control and Hospital Epidemiology*, Vol. 31, No. 10 (October 2010), pp. 1070-1073

Published by: [The University of Chicago Press](#) on behalf of [The Society for Healthcare Epidemiology of America](#)

Stable URL: <http://www.jstor.org/stable/10.1086/656563>

Accessed: 10/06/2011 13:04

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## CONCISE COMMUNICATION

## Influenza Vaccination of Household Contacts of Newborns: A Hospital-Based Strategy to Increase Vaccination Rates

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We implemented a hospital-based influenza vaccination program for household contacts of newborns. Among mothers not vaccinated prenatally, 44.7% were vaccinated through the program, as were 25.7% of fathers. A hospital-based program provided opportunities for vaccination of household contacts of newborns, thereby facilitating better adherence to national vaccination guidelines.

*Infect Control Hosp Epidemiol* 2010; 31(10):1070-1073

There is no influenza vaccine licensed for administration to infants aged less than 6 months, despite reports of elevated rates of influenza-associated hospitalization and mortality for this age cohort.<sup>1-6</sup> Consequently, the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention recommends a “cocooning” prevention strategy, whereby household contacts are vaccinated to reduce the risk for transmission of the influenza virus to infants.<sup>7</sup> Vaccination of household contacts of newborns remains an unmet challenge: nationally, rates of influenza vaccination coverage among pregnant women and household contacts of persons at high risk are 24% and 19.5%–24.8%, respectively.<sup>8</sup> These low rates underscore the need for novel strategies to increase rates of vaccination among newborns’ household contacts. Consequently, we implemented a hospital-based program for administering influenza vaccine to household contacts of newborns. Our study analyzed the effect of the hospital-based influenza vaccination program for this population and identified predictors for influenza vaccination among new mothers.

### METHODS

The program was conducted during the period from October 2007 through February 2008 at the postpartum unit of Durham Regional Hospital, located in Durham, North Carolina. Preservative-free, trivalent inactivated influenza vaccine was offered to new mothers and household contacts of newborns. The vaccine was provided free to all, but an administration

fee was billed to new mothers alone. A stand-alone standing order for trivalent inactivated influenza vaccine that did not require an individual physician’s signature was used. Postpartum nursing staff gave new mothers informational packets containing a letter introducing the program, coupons for free trivalent inactivated influenza vaccine for household contacts of newborns, and an influenza vaccine information statement. The vaccine was administered to new mothers by hospital nursing staff in the postpartum unit and to household contacts by a part-time research nurse in a room adjacent to the postpartum unit. New mothers and household contacts were permitted to receive trivalent inactivated influenza vaccine from the program either during the newborn’s hospitalization or after the newborn was discharged. Additional components of the vaccination program included educational sessions with the medical and nursing staff; promotional materials, such as posters and buttons; and vaccine reminders mailed after delivery.

The primary study outcome was influenza vaccination coverage for new mothers and other household contacts of newborns both before and after delivery. Household contacts were defined as persons who lived or resided in the household, as enumerated by new mothers. Vaccine receipt was determined by use of sequential maternal interviews, including an in-person hospital-based interview on the day of the mother’s discharge and a follow-up telephone interview that occurred 6–8 weeks later. After obtaining written informed consent from mothers, the interviewer conducted the 15-minute in-person interview to obtain demographic and contact information; history of prenatal care and delivery, high-risk medical conditions, and prenatal influenza vaccination; and information regarding household contacts, including age, relationship, and influenza vaccination status for all household members. The brief follow-up interview was performed to obtain updated influenza vaccination information for new mothers and household contacts.

Continuous baseline characteristics are presented as median values with interquartile ranges. Categorical baseline variables were compared using the Mantel-Haenszel  $\chi^2$  test for ordinal variables (education level), the Fisher exact test for infrequently occurring variables (medical history), or a likelihood ratio  $\chi^2$  test (all others). Analyses were conducted using SAS, version 8.2 (SAS Institute). This study was approved by the institutional review board of Duke University Health System and was registered with ClinicalTrials.gov (identifier: NCT00570037).

### RESULTS

During the study period, there were 904 deliveries (including 14 sets of twins) to 890 mothers. Informational packets were

TABLE 1. Baseline Maternal Characteristics and Influenza Vaccination Rates According to Time Period Stratified by Patient Group for Women Delivering at Durham Regional Hospital, Durham, North Carolina (October 2007–February 2008)

Patient group	All patients ( <i>n</i> = 238)	Patients who received influenza vaccination	
		Before delivery	During entire perinatal period
All		97/237 (41)	165/237 (70)
Age			
Median (IQR), years	29 (25–33)		
<30 years	129/237 (54)	53/129 (41)	82/129 (64)
≥30 years	108/237 (46)	44/108 (41)	83/108 (77) <sup>a</sup>
Ethnicity			
Hispanic	8/238 (3)	2/8 (25)	6/8 (75)
Non-Hispanic	230/238 (97)	95/230 (41)	159/230 (69)
Race			
African American	73/236 (31)	23/73 (32) <sup>b</sup>	49/73 (67)
White	141/236 (60)	66/141 (47)	101/141 (72)
Asian	11/236 (5)	5/11 (45)	7/11 (64)
Other	11/236 (5)	1/11 (9)	6/11 (55)
Primary insurance			
Private or managed care	179/238 (75)	74/179 (41)	127/179 (71)
Medicaid	56/238 (24)	21/56 (38)	36/56 (64)
None	3/238 (1)	2/3 (67)	2/3 (67)
Education			
≥1 year of postgraduate study	66/238 (28)	31/66 (47)	55/66 (83)
College graduation	72/238 (30)	26/72 (36)	46/72 (64)
High school graduation, GED, or some college	91/238 (38)	33/91 (36)	56/91 (62)
Grade 12 or less	9/238 (4)	7/9 (78)	8/9 (89)
Marital status			
Unmarried	71/238 (30)	22/71 (31)	45/71 (63)
Married	167/238 (70)	75/167 (45)	120/167 (72)
Location of prenatal care			
Health department or community health center	25/235 (11)	15/25 (60)	18/25 (72)
Private office	210/235 (89)	82/210 (39) <sup>c</sup>	146/210 (70)
Employed in healthcare profession			
Yes	58/238 (24)	27/58 (47)	45/58 (78)
No	180/238 (76)	70/180 (39)	120/180 (67)
Asthma			
Yes	31/238 (13)	9/31 (29)	18/31 (58)
No	207/238 (87)	88/207 (43)	147/207 (71)
Cardiac condition			
Yes	10/238 (4)	4/10 (40)	7/10 (70)
No	228/238 (96)	93/228 (41)	158/228 (69)
Medical condition interfering with breathing			
Yes	9/238 (4)	2/9 (22)	5/9 (56)
No	229/238 (96)	95/229 (41)	160/229 (70)

NOTE. Data are proportion (%) of patients, unless otherwise indicated. GED, general educational development; IQR, interquartile range.

<sup>a</sup> *P* = .03.

<sup>b</sup> *P* = .02.

<sup>c</sup> *P* = .05.

distributed to 733 postpartum women (82%), and 364 women (41%) were approached in random order for a postpartum interview on the day of discharge. Of the mothers approached, 238 (65%) were interviewed in the hospital, and 194 (82%) of these received a follow-up interview. The ma-

majority of women were white (141 [60%] of 236), married (167 [70%] of 238), and privately insured (179 [75%] of 238), had a college or some postgraduate education (138 [58%] of 238), and received prenatal care from a private obstetrical care provider (210 [89%] of 235) (Table 1). A large proportion

TABLE 2. Influenza Vaccination Rates According to Time of Vaccine Administration for Household Contacts of Newborns Delivered at Durham Regional Hospital, Durham, North Carolina (October 2007–February 2008)

Relationship of household contact to newborn	Influenza vaccination rate, no. (%)			
	Before delivery	After delivery and before discharge	After discharge	Total
Mother ( <i>n</i> = 238)	97 (40.8)	63 (26.5)	5 (2.1)	165 (69.3)
Father ( <i>n</i> = 206)	46 (22.3)	53 (25.7)	10 (4.9)	109 (52.9)
Sibling ( <i>n</i> = 172)	57 (33.1)	12 (7.0)	20 (11.6)	89 (51.7)
Other relative ( <i>n</i> = 98)	18 (18.4)	7 (7.1)	5 (5.1)	30 (30.6)
Unrelated individual ( <i>n</i> = 4)	1 (25.0)	0 (0.0)	0 (0.0)	1 (25.0)
All contacts ( <i>n</i> = 718)	219 (30.5)	135 (18.8)	40 (5.6)	394 (54.9)

were employed in the healthcare professions (58 [24%] of 238), and a substantial proportion reported having asthma or a lung condition (31 [13%] of 238).

Whereas 124 of the 238 women (52.1%) reported being offered a flu shot during pregnancy, 97 women (40.8%) reported receiving one before delivery (Table 2). Among the 141 women who reported that they did not receive a flu vaccine during pregnancy, 63 (44.7%) received one during their hospitalization and 5 (3.5%) received one after discharge, either at the hospital or elsewhere. Women reported that 53 of 206 fathers (25.7%), 12 of 172 siblings (7.0%), and 7 of 98 other relatives (7.1%) received a flu shot at the delivery hospital prior to discharge of the newborn. Among all 718 household contacts, 219 (30.5%) were vaccinated prior to the newborn's birth, 135 (18.8%) were vaccinated in the birthing hospital prior to the newborn's discharge, and 40 (5.6%) were vaccinated after the newborn's discharge.

When compared with women who received prenatal care in a private provider office, women who received prenatal care at a public health department or community health center were more likely to receive an influenza vaccine during the prenatal period (15 [60%] of 25 women vs 82 [39%] of 210 women;  $P = .05$ ) (Table 1). These observed differences in coverage rates among women who received prenatal care in varied settings were not present when vaccination that occurred during the hospitalization and postdischarge period was combined with vaccination during the prenatal period. Likewise, observed differences in vaccination rates among racial groups were smaller when the entire perinatal period was considered, rather than only the prenatal period. Overall influenza vaccination rates for the prenatal and postpartum period were higher for women aged 30 years or more than for younger women (83 [77%] of 108 women vs 82 [64%] of 129 women;  $P = .03$ ). Age-related differences in vaccine coverage were not observed when only prenatal vaccination was assessed.

## DISCUSSION

We implemented a hospital-based influenza vaccination program for household contacts of newborns, which, combined

with vaccination efforts by community healthcare providers, was able to achieve a 54.9% vaccination rate among all household contacts of newborns. Furthermore, offering vaccine to all postpartum women mitigated differences in vaccine coverage that we observed among different racial groups and among women who received prenatal care in different settings. We obtained coverage rates that were greater than nationally reported rates among pregnant women and household contacts but were less than those observed in intervention programs for parents of newborns receiving intensive care.<sup>9</sup> Factors likely influencing the differences in vaccination rate between parents of our healthy newborn population and parents of sick newborns include the differences in length of hospital stay, the presence of both parents during the course of care, and a higher motivation to receive vaccination to protect a critically ill newborn. Media reports of a mismatch between the strains of influenza virus circulating in the community and the strains contained in the vaccine may also have adversely affected our vaccination efforts.<sup>10</sup>

In summary, influenza vaccination of household contacts of newborns as a part of postpartum hospital care should be considered as an approach to implementing "cocooning" vaccination strategies. Administering influenza vaccine in the hospital afforded household contacts protection from influenza at a point in time earlier than when they may otherwise have received influenza vaccine, thereby potentially affording newborns a longer period of time during which they are "cocooned." Unlike for mothers and siblings, many of whom have vaccination opportunities during prenatal care or as part of a childhood vaccination program, for many new fathers, the hospital program that we implemented may have provided their only contact with the medical system and an opportunity for influenza vaccination.

## ACKNOWLEDGMENTS

We acknowledge the work and dedication of the following study staff: Luis Ballon, BS; Kathlene Chmielewski, AS; Beth Patterson, RN, BSN; and Diane Wingo, RN. We also acknowledge the assistance of Amanda McMillan in preparing the manuscript.

*Financial support.* Centers for Disease Control and Prevention cooperative agreement with Duke University (5U01IP00074-02).

*Potential conflicts of interest.* E.B.W. reports that he is a member of the speakers' bureau for Sanofi Pasteur and has conducted clinical trials for Sanofi Pasteur, GlaxoSmithKline, Novartis, and Medimmune. R.J.D. reports that she has conducted clinical trials for CSL. G.K.S. reports that she is a member of the speakers' bureau and has conducted clinical research for GlaxoSmithKline. All of the named companies manufacture influenza vaccines. All other authors report no conflicts of interest relevant to this article.

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Received April 26, 2010; accepted July 7, 2010; electronically published August 30, 2010.

The views in this article are those of the authors and do not necessarily represent those of the Centers for Disease Control and Prevention, US Department of Health and Human Services.

Presented in part: 48th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy/Infectious Diseases Society of America 46th Annual Meeting; Washington, DC; October 25–28, 2008; Abstract G1-1209; and the 43rd National Immunization Conference; Dallas, Texas; March 30–April 2, 2009; Abstract 24.

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