

ORIGINAL ARTICLE

Seasonal Influenza Vaccine Compliance among Hospital-Based and Nonhospital-Based Healthcare Workers

Terri Rebmann, PhD, RN, CIC;¹ Kathleen S. Wright, EdD, MPH;² John Anthony, MT(ASCP), CIC;³ Richard C. Knaup, BA;³ Eleanor B. Peters, MSPH, MA³

BACKGROUND. Influenza vaccination among nonhospital healthcare workers (HCWs) is imperative, but only limited data are available for factors affecting their compliance.

OBJECTIVE. To examine the factors influencing influenza vaccine compliance among hospital and nonhospital HCWs.

DESIGN AND SETTING. A vaccine compliance questionnaire was administered to HCWs working in myriad healthcare settings in March–June 2011.

METHODS. Online and paper surveys were used to assess compliance with the 2010/2011, 2009/2010, and H1N1 influenza vaccines and to examine factors that predicted the uptake of the 2010/2011 seasonal influenza vaccine.

RESULTS. In all, 3,188 HCWs completed the survey; half of these ($n = 1,719$) reported no hospital work time. Compliance rates for all 3 vaccines were significantly higher ($P < .001$) among hospital versus nonhospital HCWs. In logistic regression stratified by hospital versus nonhospital setting, and when controlling for demographics and past behavior, the determinants of vaccination against the 2010/2011 seasonal influenza among nonhospital-based HCWs included having a mandatory vaccination policy, perceived importance, no fear of vaccine adverse effects, free and on-site access, and perceived susceptibility to influenza. Determinants of hospital-based HCW vaccine compliance included having a mandatory vaccination policy, belief that HCWs should be vaccinated every year, occupational health encouragement, perceived importance of vaccination, on-site access, and no fear of vaccine adverse effects. The strongest predictor of compliance for both worker groups was existence of a mandatory vaccination policy.

CONCLUSIONS. The reasons for vaccine uptake among nonhospital-based versus hospital-based HCWs differed. Targeted interventions should be aimed at workers in these settings to increase their vaccine compliance, including implementing a mandatory vaccination policy.

Infect Control Hosp Epidemiol 2012;33(3):243-249

Multiple organizations and agencies, including the Centers for Disease Control and Prevention (CDC),¹ the Advisory Committee on Immunization Practices, and the Society for Healthcare Epidemiology of America (SHEA), recommend that healthcare workers (HCWs) be vaccinated against influenza each year. Influenza vaccination of HCWs has been shown to not only decrease employee sick leave² but also decrease morbidity and mortality among patients.³⁻⁵ Conversely, nonvaccinated HCWs have been associated with disease spread in healthcare settings.^{6,7} SHEA has stated that HCW influenza vaccination is an essential patient safety and employee health practice and that noncompliance should not be tolerated.⁸

The CDC has reported that HCW influenza vaccination rates have steadily increased over the last decade,⁹ and some healthcare agencies or systems have begun implementing declination and/or mandatory vaccination policies to further in-

crease compliance.¹⁰⁻¹² Despite this, studies^{9,13-15} indicate that HCW influenza vaccination rates remain below the Healthy People 2020 objective of reaching 90% coverage.¹⁶ Studies examining HCW influenza vaccination uptake have reported various factors that influence compliance: age,^{9,17,18} sex,¹⁸ having direct patient contact,¹⁹ work setting (hospital vs nonhospital),^{9,12} requiring signed declination forms or having a mandatory vaccination policy,^{8,10-13,15} work status (full vs part time),²⁰ access to vaccine on site at work,^{9,13} vaccine provided for free,^{9,13,14} education related to influenza vaccine,¹⁴ perceived vaccine efficacy,^{9,13,17} leadership support,¹³ perceived seriousness of influenza,^{9,13} fear of vaccine adverse effects,^{13,17} fear of needles,^{12,17} fear of getting influenza from the vaccine,¹² past behavior,²⁰ anticipated regret,²⁰ and professional norm.²⁰ Although researchers have evaluated a multitude of factors that influence HCW vaccine uptake, most studies have examined only hospital-based workers.^{13-15,18-20} Of those studies

Affiliations: 1. Institute of Biosecurity, School of Public Health, Saint Louis University, Saint Louis, Missouri; 2. Heartland Center for Public Health Preparedness, School of Public Health, Saint Louis University, Saint Louis, Missouri; 3. Saint Louis County Department of Health, Saint Louis, Missouri. Received October 5, 2011; accepted November 11, 2011; electronically published January 10, 2012.

© 2012 by The Society for Healthcare Epidemiology of America. All rights reserved. 0899-823X/2012/3303-0007\$15.00. DOI: 10.1086/664057

that examined both hospital and nonhospital HCW immunization compliance, most did not compare hospital with nonhospital staff,^{10,11} or overall uptake rates were compared but factors that might influence the difference in rates were not examined.^{9,11} Only 1 vaccine compliance study focused on a nonhospital setting, and it examined only public health HCWs.¹⁷ HCWs in nonhospital settings such as long-term care facilities provide treatment to immunocompromised patients and others at high risk of experiencing influenza-related morbidity or mortality. Research indicates that vaccinating HCWs in these settings can decrease patient morbidity and mortality and is preferable to vaccinating the frail elderly.²¹ It is critical to examine the factors influencing vaccine uptake among HCWs in nonhospital settings to determine whether nonhospital workers have different attitudes and beliefs about immunization compared with hospital-based workers, so that targeted interventions can be developed to increase compliance.

PURPOSE

The purposes of this study were to (a) determine immunization rates for the 2010/2011 seasonal influenza vaccine, the pandemic 2009 H1N1 influenza A vaccine (H1N1 influenza vaccine), and the 2009/2010 seasonal influenza vaccine among hospital and nonhospital-based HCWs and (b) determine predictors for compliance with the 2010/2011 seasonal influenza vaccine.

METHODS

This study consisted of a survey that was provided to healthcare workers in the Saint Louis region in April–June 2011, with recruitment focusing on nonhospital workers. The survey was administered through Qualtrics, an online program; paper surveys were also provided to subjects or agencies that did not have Internet access. Subjects were recruited using 2 methods: (a) 2 recruitment postcards (sent 2 weeks apart) were mailed to licensed HCWs, using addresses obtained from the Missouri Division of Professional Registration, and (b) 2 recruitment e-mails (sent 2 weeks apart) were distributed to members of healthcare profession organizations and/or nonhospital agencies. In all, 69 organizations and agencies assisted with subject recruitment (a list of participating organizations and agencies is available upon request). The Saint Louis University Institutional Review Board approved this study.

Instrument

Surveys used in earlier studies examining influenza vaccine compliance were used as the basis for this questionnaire.^{15,17,18,20} In addition, questions were added that were specific to the purposes of this study. A group of 10 US influenza vaccine researchers provided feedback on content validity. The content validity index (CVI) was computed for each item;²² no items had a CVI below 0.80, and so none were deleted.²² The final survey contained 31 questions plus de-

mographic items. Twenty Saint Louis–area healthcare workers pilot-tested the instrument. The survey assessed the following: (a) vaccine uptake of the 3 vaccines of interest, (b) the employer's influenza vaccination policy, (c) perceived barriers to vaccination, (d) attitudes and beliefs about influenza vaccines, and (e) intent to receive vaccination during the upcoming 2011/2012 influenza season. Instrument temporal stability was assessed, using a 2-week test retest procedure among 163 HCWs. The questionnaire had good temporal stability, with correlation coefficients varying from 0.74 to 0.94.

Data Analysis

The Statistical Package for the Social Sciences (SPSS), version 19.0, was used for all analyses. Descriptive statistics were computed for each question and used to describe vaccine compliance, employer's policy on influenza vaccination, and HCWs' attitudes and beliefs about influenza vaccine. McNemar tests were used to compare compliance rates across the 3 types of vaccine. The χ^2 tests were used to compare vaccine compliance rates when comparing dichotomous groups (eg, hospital vs nonhospital worker). A Kruskal Wallis 1-way analysis of variance test (KW) was used to evaluate the relationship of seasonal influenza vaccine compliance by nonhospital work setting; significant findings were followed by Mann-Whitney *U* post hoc tests.

Hierarchical logistic regression, stratified by hospital versus nonhospital work setting, was used to determine a predictive model for 2010/2011 seasonal influenza vaccination uptake behavior.²³ Good model fit, indicated by a nonsignificant χ^2 value, was calculated with the Hosmer and Lemeshow goodness-of-fit test.²⁴ Nonsignificant variables, such as patient contact versus no patient contact, were not included in the final models; only final models are reported.

RESULTS

In all, 3,188 HCWs responded to the survey, a response rate of 43.8% among nonhospital agencies or organizations. The majority of respondents were female (81.3%, $n = 2,538$); white (86.4%, $n = 2,701$); nurses or nurse practitioners (43.8%, $n = 1,370$), physicians or physician assistants (9.1%, $n = 285$), or nonlicensed workers (15.1%, $n = 472$); and had a bachelor's degree or less education (66.6%, $n = 2,183$). About half reported that they work at a hospital at least 25% of the time (46.2%, $n = 1,506$). For the purposes of this study, nonhospital workers were defined as HCWs who reported that they never work in a hospital (53.9%, $n = 1,719$).

Vaccine Compliance

HCW compliance was highest for the 2010/2011 seasonal influenza vaccine (78.9%, $n = 2,514$), followed by the 2009/2010 seasonal influenza vaccine (74.9%, $n = 2,383$), and it was lowest for the H1N1 influenza vaccine (63.3%, $n = 2,017$); these differences in compliance were highly statistically

significant ($P < .001$) for all 3 comparisons (2010/2011 vs H1N1, 2010/2011 vs 2009/2010, and 2009/2010 vs H1N1). Three-quarters (75.5%, $n = 2,406$) of HCWs surveyed reported that they plan to receive the 2011/2012 seasonal influenza vaccine, 13.8% ($n = 441$) indicated that they will not receive the vaccination, and 10.7% ($n = 340$) had not decided yet. Hospital-based HCWs were significantly more likely ($\chi^2 = 55$, $P < .001$) to report an intent to receive vaccination (82.1%, $n = 1,205$) compared with nonhospital-based HCWs (69.8%, $n = 1,200$).

2010/2011 Seasonal Influenza Vaccine

Almost all of the HCWs who received the 2010/2011 seasonal influenza vaccine (97.7%, $n = 2,454$) reported receiving the vaccine via intramuscular injection (IM). Few (20.4%, $n = 511$) were offered a choice regarding the vaccine administration method. Of those who expressed a preferred vaccine delivery method ($n = 2,754$), most (82.2%, $n = 2,189$) reported a preference for the IM vaccine. Of the 2010/2011 vaccinated HCWs (78.9%, $n = 2,514$), the majority reported receiving the vaccine free of charge from their employer or another source (87.6%, $n = 2,198$). Hospital-based HCWs were significantly more likely ($\chi^2 = 89.3$, $P < .001$) to receive the vaccine for free (93.7%, $n = 1,207$) compared with nonhospital-based HCWs (81.3%, $n = 991$). Most reported that the 2010/2011 seasonal influenza vaccine was offered to them on site (80.9%, $n = 2,565$). Hospital-based HCWs were significantly more likely ($\chi^2 = 244.3$, $P < .001$) to report that the vaccine was available on site (92.7%, $n = 1,357$), compared with nonhospital-based HCWs (70.8%, $n = 1,208$).

Mandatory Vaccination Policy

Less than a third (30.5%, $n = 966$) of those surveyed reported that their employer had a mandatory vaccination policy related to the 2010/2011 seasonal influenza vaccine. Hospital-based HCWs were significantly more likely ($\chi^2 = 559.8$, $P < .001$) to report that their employer mandated vaccination (51.3%, $n = 752$), compared with nonhospital-based HCWs (12.5%, $n = 214$). HCWs who reported that their employer had a mandatory vaccination policy were asked to describe the extent to which this policy was enforced; participants could select multiple ways in which enforcement occurred. Most (63.7%, $n = 615$) reported that the mandatory vaccination policy was not enforced. Among HCWs who reported an enforced policy (36.3%, $n = 351$), the following types of enforcement were reported: 56.7% ($n = 199$) fired staff for noncompliance, 55.8% ($n = 196$) required that nonvaccinated staff wear a mask during all patient care activities during the influenza season, 5.7% ($n = 20$) required that nonvaccinated staff attend an influenza counseling session, and 5.4% ($n = 19$) held paychecks until compliance was proven.

HCWs whose employers did not have mandatory vaccination policies ($n = 2,206$) were asked to report the extent

to which they were informed of or encouraged to receive seasonal influenza vaccine. Most of these (66.9%, $n = 1,469$) reported that vaccination was encouraged, 17.5% ($n = 385$) were informed about the vaccine but not encouraged to receive it, and 15.5% were neither encouraged to receive the vaccine nor informed about it. Many (61.2%, $n = 1,349$) reported that their occupational health nurse encouraged vaccination. Of those who work for agencies that have an infection preventionist (IP; 62%, $n = 1,969$), 81.9% ($n = 924$) reported that the IP encouraged vaccination.

Healthcare Worker Attitudes and Beliefs Regarding Influenza Vaccine

HCWs' attitudes and beliefs regarding seasonal influenza vaccine are reported in Table 1. HCWs' attitudes and beliefs toward the influenza vaccine differed significantly when vaccinated HCWs employed in a nonhospital setting were compared with those who were not vaccinated (see Table 1). Nonhospital-based vaccinated HCWs were significantly more likely than those who were not vaccinated to agree that influenza is a serious disease ($\chi^2 = 121.9$, $P < .001$), that HCWs should be vaccinated every year ($\chi^2 = 621.0$, $P < .001$), that employment should be dependent on vaccination ($\chi^2 = 107.8$, $P < .001$), that nonimmunized HCWs play a role in influenza transmission ($\chi^2 = 337.0$, $P < .001$), that vaccination is important to them ($\chi^2 = 872.0$, $P < .001$), that they would receive the vaccine every year if it was offered for free ($\chi^2 = 738.0$, $P < .001$) and/or free and on site ($\chi^2 = 754.5$, $P < .001$), and that public health can be trusted to produce a safe vaccine ($\chi^2 = 336.3$, $P < .001$; see Table 1). Nonhospital-based vaccinated HCWs were significantly less likely than nonvaccinated ones to agree that influenza vaccine has a lot of adverse effects ($\chi^2 = 194.8$, $P < .001$), that they are afraid of influenza vaccine adverse effects ($\chi^2 = 329.5$, $P < .001$), and that they are less susceptible to influenza because their immune system has become built up from years of working in healthcare ($\chi^2 = 80.6$, $P < .001$; see Table 1).

Determinants of 2010/2011 Seasonal Influenza Vaccination

As mentioned previously, 78.9% of the respondents reported receiving the 2010/2011 seasonal influenza vaccine. There was no difference between vaccine compliance and those who reported having contact with patients versus those who had no patient contact. Hospital-based HCWs were significantly more likely than nonhospital HCWs to be vaccinated ($\chi^2 = 138$, $P < .001$). Differences in vaccine compliance were also found across work settings when only nonhospital workers were examined (KW = 32.0, $P < .001$); HCWs in public health departments had significantly higher uptake rates than HCWs in all other nonhospital settings; laboratory-based HCWs had significantly lower compliance rates compared with those in all other nonhospital settings (see Table 2).

For the hierarchical logistical regression, subjects were stratified by hospital versus nonhospital work setting because of

TABLE 1. Vaccinated versus Nonvaccinated Workers' Attitudes and Beliefs about Seasonal Influenza Vaccines

Statement	All respondents (N = 3,188)		Nonhospital workers only (N = 1,719)				P value, ^a vaccinated vs nonvaccinated
	% that strongly agreed or agreed	n	Vaccinated (N = 1,221)		Unvaccinated (N = 498)		
			% that strongly agreed or agreed	n	% that strongly agreed or agreed	n	
Seasonal influenza is a serious disease that can cause death	83.3	2,620	87.2	1,050	63.7	313	<.001
Healthcare workers (HCWs) should be vaccinated against influenza every year	75.1	2,360	90.0	1,080	30.5	150	<.001
It is important to me to get vaccinated every year	71.0	2,233	89.1	1,072	15.1	74	<.001
I would receive the influenza vaccine every year if it was free	73.0	2,296	88.5	1,065	21.2	104	<.001
I would receive the influenza vaccine every year if it was free and on site	74.1	2,330	89.8	1,078	22.4	110	<.001
All HCWs should receive influenza vaccine or risk losing their job	30.1	947	31.8	382	7.8	38	<.001
Seasonal influenza vaccine has a lot of adverse effects	14.5	455	7.6	91	34.6	169	<.001
I am afraid of seasonal influenza vaccine adverse effects	15.0	472	5.7	69	41.5	203	<.001
I trust public health authorities when they say influenza vaccine is safe	62.4	1,962	73.7	886	25.5	125	<.001
HCWs can play a role in influenza transmission if not vaccinated	79.5	2,499	89.2	1,073	48.0	235	<.001
My immune system is built up; I am not likely to get influenza	10.7	336	7.3	88	22.9	112	<.001

^a Determined by the χ^2 test.

the significant uptake rate difference between the 2 groups. After controlling for sex, age, race, occupation, and past behavior (2009/2010 seasonal influenza and/or H1N1 vaccination), the determinants of 2010/2011 seasonal influenza vaccination among nonhospital-based healthcare workers were as follows (in order of decreasing importance): extent to which the employer had a mandatory vaccination policy or encouraged immunization, perceived importance of vaccination, decreased fear of adverse effects, having access to free vaccine, having access to the vaccine on site, and perceived susceptibility to influenza (ie, not perceiving that their immune system is "built up" from working in the healthcare field). After controlling for sex, age, race, occupation, and past behavior, the determinants of 2010/2011 seasonal influenza vaccination among hospital-based healthcare workers were as follows (in order of decreasing importance): being

employed by an agency with a mandatory vaccination policy, belief that HCWs should be vaccinated every year, being encouraged by occupational health to get vaccinated, perceived importance of vaccination, having access to the vaccine on site, and not fearing the adverse effects of immunization. The final models correctly classified 78% of the nonhospital respondents and 68% of the hospital-based workers (see Table 3).

DISCUSSION

The findings of this study indicate that many Saint Louis-region HCWs are receiving the influenza vaccine, regardless of whether they work for a hospital or a nonhospital facility or agency. Influenza vaccine compliance for the 2010/2011 season was found to be higher among participants in

TABLE 2. 2010/2011 Seasonal Influenza Vaccine Compliance by Work Setting (Nonhospital Workers Only)

Work setting	N	Mean ^a	SD	Kruskal-Wallis
Public health	50	0.90	0.30	32.0 ^b
Ambulatory surgery center	22	0.82	0.40	
Home health	146	0.75	0.44	
School or university	160	0.73	0.45	
Physician's office	497	0.72	0.45	
Long-term care or skilled nursing	209	0.70	0.46	
Urgent care	40	0.70	0.46	
Pharmacy or industry	194	0.67	0.47	
Outpatient clinic or diagnostics	250	0.66	0.48	
Laboratory	22	0.36	0.49	
Other	109	0.79	0.41	

^a Answers were scored as follows: 0 = no, 1 = yes. A significant difference (as determined by the Mann-Whitney *U* test) was observed between the public health group and all groups except ambulatory surgery; a significant difference was observed between the lab group and all other groups.

^b $P < .001$.

this study than those in a national study conducted by the CDC covering the same influenza vaccine period (63.5% compliance per the CDC vs 78.9% in this study),⁹ with the exception of laboratory-based HCWs, who reported only a 36% uptake rate. Despite the higher vaccination rate found for most HCWs in this study, immunization compliance for Saint Louis HCWs still remains well below the target of 90% uptake outlined in Healthy People 2020.¹⁶ It is essential that public health and healthcare agencies continue to work toward higher influenza vaccine uptake among HCWs in all healthcare settings.

This study found that few HCWs work for an agency that has a mandatory vaccination policy. Despite this, having a mandatory vaccination policy was the strongest predictor of HCW vaccine uptake. Similar to other published studies, the findings from this survey demonstrate the profound impact that mandatory vaccination policies can have on vaccine uptake among HCWs;^{10,11} implementing such a policy should be a priority for all healthcare agencies. SHEA endorses the mandatory vaccination of HCWs in all healthcare settings and asserts that annual vaccination should be a condition of employment.⁸

In the absence of or in conjunction with a mandatory vaccination policy, other interventions can be implemented to increase HCW vaccine compliance. Three such interventions include encouraging staff to be vaccinated, decreasing barriers to vaccination, and education campaign implementation. An interesting finding from this study was that even without a mandatory vaccination policy, encouragement from one's employer to be vaccinated made a significant difference in worker vaccination rates. This speaks to the need for healthcare administrators to be proactive in encouraging vac-

ination among their workers, a factor that has been reported by other researchers as being effective in increasing uptake rates.¹³ Similar to other published research, this study found that decreasing cost and access barriers to vaccination were associated with higher uptake rates.^{9,13,14} Healthcare agencies should provide free vaccination on site to their staff whenever possible to increase compliance. This is even more critical in nonhospital settings, as cost and access were more significant barriers to vaccination among these HCWs compared with among hospital-based workers. Education campaigns can also be effective interventions in increasing vaccine uptake.¹⁴ Findings from this study indicate that the components of a vaccine education campaign should be targeted to the work setting, with different information provided to nonhospital-based workers compared with that aimed at hospital-based HCWs. Information provided in the education campaign should reflect the HCWs' attitudes and beliefs as reported in this study. Similar to previous research, this study found that past behavior was a strong determinant for influenza vaccination.^{20,25,26} This finding reinforces the need to promote compliance behavior among HCWs who have never been vaccinated, since uptake behavior increases the likelihood that vaccination compliance will continue.

A few limitations of this study must be noted. They include the potential issues of responder and/or social desirability biases. It is likely that responders compared with nonresponders were more interested in influenza vaccination, and this could have resulted in a bias toward respondents who have high vaccination uptake rates. It is also possible that respondents believed that vaccine uptake was the preferred answer or response; however, given that the survey was anonymous, this bias should be minimized. One final limitation is that only Saint Louis-based HCWs were included in this study; thus, the findings may not be generalizable to all HCWs nationwide. A nationwide study with similar findings⁹ (ie, hospital-based workers reported higher compliance rates compared with nonhospital-based workers) provides evidence that these results can be considered generalizable outside of Saint Louis or Missouri. Further studies should be conducted to verify these results for other parts of the United States or in other countries.

CONCLUSION

Influenza vaccination of healthcare workers is an essential component of an infection prevention program to decrease influenza transmission in all healthcare settings. Despite this, studies indicate that vaccine compliance is not at the targeted 90% uptake delineated in Healthy People 2020.¹⁶ Interventions to increase worker vaccine compliance include instituting a mandatory vaccination policy, encouraging staff to be vaccinated, providing free vaccines on site, and promoting ongoing uptake behavior through an annual education campaign that targets workers' attitudes and beliefs about vaccination. Findings from this study should be used to develop

TABLE 3. Factors Related to Healthcare Worker 2010/2011 Seasonal Influenza Vaccination Rates from Logistic Regression

Variable	Hospital-based workers		Nonhospital workers	
	OR (95% CI)	P	OR (95% CI)	P
Female vs male	2.2 (0.97–5.1)	NS	1.0 (0.56–1.8)	NS
Age ≤ 30 vs older HCWs				
31–40	0.31 (0.07–1.3)	NS	1.8 (0.26–1.2)	NS
41–50	0.45 (0.12–1.7)	NS	2.3 (0.20–0.98)	<.05
51–60	0.57 (0.15–2.2)	NS	2.6 (0.17–0.85)	<.05
≥61	0.30 (0.08–1.2)	NS	3.3 (0.13–0.68)	<.01
White vs nonwhite				
African American	1.4 (0.53–3.6)	NS	1.2 (0.61–2.3)	NS
Other	2.0 (0.58–6.7)	NS	1.3 (0.50–3.5)	NS
Less or no past immunization vs full vaccine compliance				
Received H1N1 influenza vaccine but not 09/10 seasonal vaccine	2.6 (0.13–1.1)	NS	1.4 (0.32–1.6)	NS
Received 09/10 seasonal influenza vaccine but not H1N1 vaccine	1.1 (0.48–2.7)	NS	1.3 (0.44–1.3)	NS
Received 09/10 seasonal influenza vaccine and H1N1 vaccine	11.1 (0.05–0.17)	<.001	16.7 (0.04–0.11)	<.001
No enforcement or mention of vaccination vs intervention				
Mandatory vaccination policy	32.0 (8.4–118.7)	<.001	21.0 (6.7–64.4)	<.001
Vaccination highly encouraged	3.3 (1.0–11.0)	.05	2.3 (1.5–5.8)	<.01
Informed about vaccine only	1.1 (0.30–4.0)	NS	0.80 (0.43–1.5)	NS
Perceived importance of vaccination	2.9 (1.1–7.6)	<.05	7.6 (4.3–13.3)	<.001
No fear of influenza vaccine adverse effects	2.0 (1.1–3.7)	<.05	4.0 (2.3–7.1)	<.001
Would take vaccine if free of charge	2.0 (0.90–4.5)	NS	3.3 (1.9–5.7)	<.001
Vaccine was offered on site at work	2.9 (1.1–7.3)	<.05	2.7 (1.6–4.5)	<.001
Perceived susceptibility to influenza	1.2 (0.60–2.3)	NS	2.4 (1.3–4.2)	<.01
Belief that HCWs should receive influenza vaccine every year	4.3 (0.11–0.50)	<.001	1.5 (0.86–2.8)	NS
Occupational health encouraged vaccination	2.9 (1.3–6.7)	.01	1.4 (0.84–2.2)	NS

NOTE. Controlling for occupation, sex, age, race, and past behavior. For those occupation categories not listed on table, all were nonsignificant (NS) in final model. OR, odds ratio; CI, confidence interval.

a comprehensive influenza vaccination program and education campaign for hospital and nonhospital healthcare settings.

ACKNOWLEDGMENTS

Financial support. This study was funded by the Saint Louis County Health Department.

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

Address correspondence to Terri Rebmann, PhD, RN, CIC, Associate Professor, Division of Environmental and Occupational Health, Institute for Biosecurity, Saint Louis University, School of Public Health, 3545 Lafayette Avenue, Room 463, Saint Louis, Missouri 63104 (rebmann@slu.edu).

REFERENCES

- Centers for Disease Control and Prevention. *Influenza vaccination information for health care workers: 2011*. <http://www.cdc.gov/flu/HealthcareWorkers.htm>. Accessed September 17, 2011.
- Salgado CD, Farr BM, Hall KK, Hayden FG. Influenza in the acute hospital setting. *Lancet Infect Dis* 2002;2:145.
- Carman WF, Elder AG, Wallace LA, et al. Effects of influenza vaccination of health-care workers on mortality of elderly people in long-term care: a randomised controlled trial. *Lancet* 2000; 355:93–97.
- Lemaitre M, Meret T, Rothan-Tondeur M, et al. Effect of influenza vaccination of nursing home staff on mortality of residents: a cluster-randomised trial. *J Am Geriatr Soc* 2009;57: 1580–1586.
- Potter J, Stott DJ, Roberts MA, et al. Influenza vaccination of healthcare workers in long-term-care hospitals reduces the mortality of elderly patients. *J Infect Dis* 1997;175:1–6.
- Schepetiuk S, Papnaoum K, Qiao M. Spread of influenza A virus infection in hospitalized patients with cancer. *Aust N Z J Med* 1998;28:475–476.
- Weingarten S, Friedlander M, Rascon D, Ault M, Morgan M, Meyer RD. Influenza surveillance in an acute-care hospital. *Arch Intern Med* 1988;148:113–116.
- Talbot TR, Babcock H, Caplan AL, et al. Revised SHEA position paper: influenza vaccination of healthcare personnel. *Infect Control Hosp Epidemiol* 2010;31:987–995.
- Centers for Disease Control and Prevention. Influenza vaccination coverage among health-care personnel: United States, 2010–11 influenza season. *Morb Mortal Wkly Rep* 2011;60: 1973–1077.
- Babcock HM, Gemeinhart N, Jones M, Dunagan WC, Woeltje KE. Mandatory influenza vaccination of healthcare workers: translating policy to practice. *Clin Infect Dis* 2010;50:459–464.
- Rakita RM, Hagar BA, Crome P, Lammert JK. Mandatory in-

- fluenza vaccination of healthcare workers: a 5-year study. *Infect Control Hosp Epidemiol* 2010;31:881–888.
12. Ribner BS, Hall C, Steinberg JP, et al. Use of a mandatory declination form in a program for influenza vaccination of healthcare workers. *Infect Control Hosp Epidemiol* 2008;29:302–308.
 13. Ajenjo MC, Woeltje KF, Babcock HM, Gemeinhart N, Jones M, Fraser VJ. Influenza vaccination among healthcare workers: ten-year experience of a large healthcare organization. *Infect Control Hosp Epidemiol* 2010;31:233–240.
 14. Polgreen PM, Chen Y, Beekmann SE, et al. Elements of influenza vaccination programs that predict higher vaccination rates: results of an emerging infections network survey. *Clin Infect Dis* 2008;46:14–19.
 15. Polgreen PM, Septimus EJ, Parry MF, et al. Relationship of influenza vaccination declination statements and influenza vaccination rates for healthcare workers in 22 U.S. hospitals. *Infect Control Hosp Epidemiol* 2008;29:675–677.
 16. U.S. Department of Health and Human Services. *Healthy People 2020 objective topic areas and page numbers: 2011*. <http://www.healthypeople.gov/2020/topicsobjectives2020/pdfs/HP2020objectives.pdf>. Accessed September 17, 2011.
 17. Millner VS, Eichold BH, Franks RD, Johnson GD. Influenza vaccination acceptance and refusal rates among health care personnel. *Southern Med J* 2010;103:993–998.
 18. Zimmerman RK, Nowalk MP, Lin CJ, et al. Factorial design for improving influenza vaccination among employees of a large health system. *Infect Control Hosp Epidemiol* 2009;30:691–697.
 19. Tao X, Giampino J, Dooley DA, Humphrey FE, Baron DM, Bernacki EJ. Description of an influenza vaccination campaign and use of a randomized survey to determine participation rates. *Infect Control Hosp Epidemiol* 2010;31:151–157.
 20. Godin G, Vezina-Im L, Naccache H. Determinants of influenza vaccination among healthcare workers. *Infect Control Hosp Epidemiol* 2010;31:689–693.
 21. Potter J, Stott DJ, Roberts MA, et al. Influenza vaccination of healthcare workers in long-term care hospitals reduces the mortality of elderly patients. *J Infect Dis* 1997;175:1–6.
 22. Lynn MR. Determination and quantification of content validity. *Nurs Res* 1986;35:382–385.
 23. Stevens JP. *Applied Multivariate Statistics for the Social Sciences*. 4th ed. Mahwah, NJ: Lawrence Erlbaum, 2002.
 24. Hosmer DW, Lemeshow, S. *Applied Logistic Regression*. 2nd ed. New York: Wiley, 2000.
 25. Mok E, Yeung SH, Chan MF. Prevalence of influenza vaccination and correlates of intention to be vaccinated among Hong Kong Chinese. *Pub Health Nurs* 2006;23:506–515.
 26. Trivalle C, Okenge E, Hamon B, Taillandier J, Falissard B. Factors that influence influenza vaccination among healthcare workers in a French geriatric hospital. *Infect Control Hosp Epidemiol* 2006;27:1278–1280.