

## ORIGINAL ARTICLE

## BRIEF REPORT: Influenza Vaccination and Health Care Workers in the United States

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**OBJECTIVE:** To determine influenza vaccination rates among U.S. health care workers (HCWs) by demographic and occupational categories.

**DESIGN AND PARTICIPANTS:** We analyzed data from the 2000 National Health Interview Survey (NHIS). Weighted multivariable analyses were used to evaluate the association between HCW occupation and other variables potentially related to receipt of influenza vaccination. HCWs were categorized based on standard occupational classifications as health-diagnosing professions, health-assessing professions, health aides, health technicians; or health administrators.

**MAIN INDEPENDENT VARIABLES:** Demographic characteristics and occupation category.

**MAIN OUTCOME VARIABLES:** Receipt of influenza vaccination within 12 months of survey.

**ANALYSIS:** Descriptive statistics and weighted multivariable logistic regression.

**RESULTS:** There were 1,651 HCWs in the final sample. The overall influenza vaccination rate for HCWs was 38%. After weighted multivariable analyses, HCWs who were under 50 (odds ratio [OR] 0.67%, 95% confidence interval [CI]: 0.50 to 0.89, compared with HCWs 50 to 64), black (OR 0.57 95% CI: 0.42, 0.78, compared with white HCWs), or were health aides (OR 0.73%, 95% CI: 0.51, 1.04, compared with health care administrators and administrative support staff) had lower odds of having been vaccinated against influenza.

**CONCLUSIONS:** The overall influenza vaccination rate among HCWs in the United States is low. Workers who are under 50, black, or health aides have the lowest rates of vaccinations. Interventions seeking to improve HCW vaccination rates may need to target these specific subgroups.

**KEY WORDS:** Influenza vaccinations; health care workers; National Health Interview Survey; nosocomial infection; employee health.

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Influenza, the sixth leading cause of death in the U.S., was associated with an average annual mortality rate of over 36,000 between 1990 and 1999.<sup>1</sup> Mortality from influenza is concentrated in the very young, the very old, and the chronically ill.<sup>1</sup> The social costs of influenza include 200 million days of restricted activity, 75 million days of absenteeism,

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Previous presentations: A similar analysis utilizing the 1998 NHIS survey was presented at the 2000 Society of General Internal Medicine Plenary Session.

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22 million health care visits, and 110,000 annual hospitalizations.<sup>1-4</sup>

The Centers for Disease Control and Prevention's Advisory Committee on Immunization practices (ACIP) recommends vaccinating populations at risk or health care workers (HCWs) who have direct patient contact as the best preventive measure against influenza.<sup>3</sup> In response to recent vaccine shortages, the ACIP constructed guidelines that prioritize groups for vaccination during periods of low availability. Health care workers who have direct patient contact are identified as a prioritized group.<sup>5</sup>

Influenza vaccination reduces transmission of influenza. Evidence from several studies, including randomized-controlled trials, demonstrates that vaccinating HCWs against influenza reduces nosocomial infection, worker absenteeism, and increases provider recommendation of vaccinations.<sup>6-14</sup> Despite such evidence and ACIP recommendations, health care institutions report employee vaccination rates that range only from 15% to 40%.<sup>12-14</sup> Past literature that has reported vaccination rates for HCWs have not analyzed whether HCW demographic characteristics or occupational subtype are associated with vaccination rates.<sup>12-14</sup>

We investigated influenza vaccination rates in a nationally representative sample, the sample adult core database of the 2000 National Health Interview Survey (NHIS), in order to estimate national HCW vaccination rates and determine whether these rates vary by demographic or occupational subgroups of HCWs.

## METHODS

National Health Interview Survey is an annual face-to-face survey of the civilian noninstitutionalized population of the United States conducted by the National Center for Health Statistics annually since 1957.<sup>15</sup> The main dependent variable for this analysis, influenza vaccination status, was assessed in the NHIS interview with the question "During the past 12 months, have you had a flu vaccination"? The main independent variables evaluated were HCW demographic characteristics and occupational category. Respondents were considered HCWs if they reported that their principal workplace within the past year was within the health care industry and in either a hospital or nonhospital health care setting. We then grouped HCWs by their occupational classifications using 2000 NHIS

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recode of 1985 revised Standard Occupational Classifications. Health care occupations with low levels of direct patient contact, such as retail or packing, were excluded from the analysis, with the exception of health care administrators and their support staff. Health care administrators and support staff were included to serve as an "internal control group" of workers with presumably high socioeconomic levels but expected low vaccination rates because of low levels of direct patient contact.

The five occupational categories included in the analysis were: health-diagnosing professions; health-assessing and -treating professions; health aides; health technicians and technologists; and administrators and administrative support staff. Health-diagnosing professions and health-assessing and -treating professions are broad occupational categories that predominantly include the occupational categories of interest: physicians and registered nurses, respectively (T. Cosca, BS, written communication, January 3, 2005).

Covariates evaluated included age, gender, race/ethnicity, income, education, region, and chronic health conditions. Age was evaluated in three categories: ages <50 years, 50 to 64 years, and >64 years. Our four racial/ethnic categories were (1) white non-Hispanic, (2) black non-Hispanic, (3) Hispanic, and (4) other. Education was divided into 4 categories: (1) less than high school graduate, (2) high school graduate, (3) some college, or (4) college graduate or higher. Geographical region was categorized as Northeast, Midwest, South, and West. We constructed a chronic health condition variable to represent the conditions for which the ACIP recommends influenza vaccinations.<sup>1</sup> A respondent worker was categorized as having a chronic health condition if he or she reported a diagnosis of congestive heart disease, angina, myocardial infarct-

ion, heart disease, stroke, emphysema, asthma, diabetes, cancer, renal disease, liver disease, or chronic bronchitis.

## ANALYSIS

The Sample Adult Core frequency weight variable was used in our bivariate analyses in order to produce nationally representative estimates of vaccination status. For our weighted multivariable analysis, the sample adult core sampling weight variable was used to account for the NHIS stratified sampling scheme. All models were adjusted for age, sex, race/ethnicity, education, geographic region, and chronic health condition.

## RESULTS

There were 1,651 HCW respondents in the final sample, corresponding to a national estimate of 10,305,843 HCWs. Most were under age the age of 50. More women than men were employed in each occupational category, with the exception of health-diagnosing professions (mainly physicians). Black HCWs were more likely than workers of other racial/ethnic groups to be health aides or technicians (Table 1).

The overall HCW influenza vaccination rate was 35.8%. There were no significant differences between HCWs who did and did not receive influenza vaccination in educational attainment, geographic region, or the presence of a chronic condition.

In unadjusted analyses, health aides had the lowest odds of vaccination receipt (Table 2). Workers who were younger than 50, female, or black had the lowest odds of vaccination within their respective demographic categories. Weighted multivariable analysis revealed similar findings, although only the results for race (black vs. white) and age (<50 vs. 50 to 64) remained statistically significant (Table 2).

**Table 1. Comparison of Demographic Characteristics Among Health Care Workers by Occupation Unweighted, N=1651 (Percentages Weighted)**

Demographics	Health-Diagnosing Professions* (N=125)	Health-Assessing Professions (N=425)	Health Aides (N=398)	Health Technicians (N=230)	Administrators and Administrative Support (N=473)	P-Value
Age (y)						
<50	95 (77)	345 (82)	305 (79)	188 (85)	345 (74)	.0003
50 to 64	22 (16)	76 (17)	84 (20)	37 (13)	115 (23)	
>65	8 (7)	4 (1)	9 (2)	5 (2)	13 (2)	
Gender						
Male	83 (70)	52 (14)	33 (9)	29 (17)	66 (14)	<.0001
Female	42 (30)	373 (86)	365 (91)	201 (83)	407 (86)	
Race						
White non-Hispanic	92 (76)	332 (84)	174 (56)	139 (64)	318 (75)	<.0001
Black non-Hispanic	4 (3)	55 (9)	135 (30)	54 (21)	77 (13)	
Hispanic	8 (4)	26 (4)	73 (9)	29 (9)	67 (9)	
Other	21 (17)	12 (3)	16 (5)	8 (7)	11 (3)	
Education						
Less than high school	0 (0)	6 (1)	87 (21)	5 (2)	15 (2)	<.0001
High school graduate	0 (0)	4 (2)	158 (39)	42 (18)	137 (29)	
Some college	0 (0)	197 (46)	125 (34)	151 (65)	208 (45)	
College graduate or higher	125 (100)	217 (51)	26 (7)	32 (15)	111 (25)	
Region						
Northeast	37 (35)	92 (21)	102 (27)	39 (16)	100 (21)	.01
Midwest	25 (20)	125 (31)	92 (27)	64 (30)	115 (27)	
South	37 (27)	140 (33)	150 (36)	91 (38)	167 (36)	
West	26 (17)	68 (15)	54 (11)	36 (16)	91 (15)	
Chronic condition	19 (18)	109 (26)	115 (28)	65 (27)	133 (29)	.28
Vaccination rate	54 (46)	159 (37)	110 (30)	91 (40)	177 (40)	.03

\*Chiropractors, Dentists, Dietitians, Optometrists, Pharmacists, Physicians and Surgeons, Physician Assistants, Podiatrists.

<sup>†</sup>Registered Nurses, therapists, audiologists, speech-language pathologists.

**Table 2. Weighted Multivariable Models of Influenza Vaccination Among Health Care Workers**

	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Occupation of health care workers		
Administrators/support staff (ref)	—	—
Health-diagnosing professions	1.29 (0.81, 2.03)	1.09 (0.62, 1.93)
Health-assessing professions	0.88 (0.64, 1.21)	0.87 (0.62, 1.22)
Health aides	0.65 (0.46, 0.91)	0.73 (0.51, 1.04)
Health technicians	1.00 (0.67, 1.50)	1.05 (0.69, 1.57)
Age (y)		
< 50 (ref)	—	—
50 to 64	1.47 (1.11, 1.95)	1.50 (1.12, 2.01)
> 65	2.26 (1.08, 4.74)	2.05 (0.92, 4.51)
Female	0.71 (0.52, 0.98)	0.74 (0.52, 1.06)
Race		
White non-Hispanic (ref)	—	—
Black non-Hispanic	0.53 (0.40, 0.69)	0.57 (0.42, 0.78)
Hispanic	0.87 (0.61, 1.24)	0.98 (0.67, 1.44)
Other	0.94 (0.51, 1.73)	1.01 (0.53, 1.95)
Education		
College graduate or higher (ref)	—	—
Some college	0.94 (0.72, 1.22)	1.10 (0.81, 1.51)
High school graduate	0.80 (0.58, 1.10)	0.95 (0.64, 1.40)
Less than high school	0.65 (0.37, 1.11)	0.96 (0.52, 1.77)
Region		
Northeast	—	—
Midwest	1.32 (0.92, 1.89)	1.27 (0.88, 1.82)
South	1.14 (0.80, 1.61)	1.15 (0.81, 1.54)
West	1.02 (0.66, 1.56)	0.87 (0.56, 1.36)
Chronic condition	1.14 (0.87, 1.49)	1.08 (0.81, 1.43)

## DISCUSSION

Our study documents how occupation, age, and race/ethnicity affect the receipt of influenza vaccination of HCWs. We observed low vaccination rates among HCWs who were younger, black, or had the occupation of health aide. Health aides have a substantial amount of direct contact with patients and yet had the lowest rates of vaccination against influenza, placing them at a potentially high risk of propagating nosocomial influenza.

Although HCWs may have access to health care services through insurance or occupational health programs, younger, poorer, and black HCWs may not exhibit high utilization of preventive health care services such as immunization because of preconceptions about the lack of utility in being immunized, cultural barriers to health care, or competing priorities.<sup>16</sup> Our results are consistent with prior studies that have shown low levels of influenza vaccination among blacks<sup>16</sup> and disparities in access to care for poor black HCWs.<sup>17</sup> Improving access to vaccination by incorporating culturally relevant and appropriately targeted educational interventions, improving outreach efforts, or increasing availability of preventive services may help to reduce this disparity.

There are potential limitations to this study. First, the receipt of influenza vaccination was determined by survey and is therefore subject to recall bias. Second, the NHIS categories of health-diagnosing and health-assessing occupations were not exclusively physicians or registered nurses, respectively. The Bureau of Labor and Statistics, which constructs the Standard Occupational Classifications, also conducts biennial employment occupation projections using a taxonomy that is consistent with the Standard Occupational and Industry Codes. In 1998, physicians were approximately 65% of the health-diag-

nosing professions and registered nurses were approximately 73% of the health-assessing and treatment professions category (T. Cosca, personal communication, January 3, 2005).<sup>18</sup> Small differences among occupational categories such as dentists and physicians, nurses, or other health care providers may be obscured because of the broad occupational categories. However, if we assumed that only physicians and nurses were vaccinated within their respective occupational categories, at most 71% of physicians and 51% of nurses would have been vaccinated, rates that fall far short of optimal coverage. Finally, although the sample was restricted, with the exception of administrators, to workers likely to have direct patient contact, physicians, nurses, or other health care providers who do not have direct patient contact could have been included within the sample.

Low vaccination rates may occur either because HCWs do not believe in influenza vaccination efficacy, believe that their own immune system is sufficient, or are concerned about side effects such as Guillain-Barre and injection site pain.<sup>19</sup> Misconceptions about influenza vaccinations have been correlated with HCW refusal of vaccinations in single institution studies.<sup>19</sup> Information and policy regarding the benefits of influenza vaccination, including reduction of nosocomial infection, hospitalizations, and employee absenteeism, must be presented in a manner that is credible.

Active campaigns at the local level using occupational health programs or a vaccination team to provide education, distribute reminder notices, and schedule vaccination times could help increase vaccination rates.<sup>13,20</sup> Further work is needed to identify the best strategies for improving vaccination rates among all HCWs, but especially those who are young or black or work as health aides.

The overall influenza vaccination rate of HCWs in the U.S. is low, particularly among workers who are under 50, black, or health aides. Overcoming barriers to vaccination and improving targeted outreach to subgroups of HCWs, who have direct patient care and low vaccination rates, could reduce the high mortality rates because of influenza.

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## REFERENCES

- General Accounting Office. Flu vaccine problems heighten need to ensure access for high-risk people. General Accounting Office, 2001.
- Brammer TL, Murray EL, Fukuda K, Hall HE, Klimov A, Cox NJ. Surveillance for influenza—United States, 1997–98, 1998–99, and 1999–00 seasons. MMWR Surveill Summ. 2002;51:1–10.
- Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices. MMWR 2005;54:1–40.
- Murphy S. Deaths: final data for 1998 National Vital Statistics Reports, 2000.
- Centers for Disease Control and Prevention (CDC). Experiences with obtaining influenza vaccination among persons in priority groups during a vaccine shortage—United States, October–November, 2000. Morb Mortal Wkly Rep. 2004;53:1153–5.
- Nichol KL. Cost-benefit analysis of a strategy to vaccinate healthy working adults against influenza. Arch Intern Med. 2001;161:749–59.
- Bridges CB, Thompson WW, Meltzer MI, et al. Effectiveness and cost-benefit of influenza vaccination of healthy working adults: a randomized controlled trial. JAMA. 2000;284:1655–63.

8. **Hak E, Buskens E, van Essen GA, et al.** Clinical effectiveness of influenza vaccination in persons younger than 65 years with high-risk medical conditions: the PRISMA study. *Arch Intern Med.* 2005;165:274–80.
9. **Govaert TM, Thijs CT, Masurel N, Sprenger MJ, Dinant GJ, Knotterus JA.** The efficacy of influenza vaccination in elderly individuals. A randomized double-blind placebo-controlled trial. *JAMA.* 1994;272:1661–5.
10. **Simonsen L, Reichert TA, Viboud C, Blackwelder WC, Taylor RJ, Miller MA.** Impact of influenza vaccination on seasonal mortality in the US elderly population. *Arch Intern Med.* 2005;165:265–72.
11. **Frank E, Rothenberg R, Lewis C, Belodoff BF.** Correlates of physicians' prevention-related practices. Findings from the Women Physicians' Health Study. *Arch Fam Med.* 2000;9:359–67.
12. **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;355:93–7.
13. **Potter J, Stott DJ, Roberts MA, et al.** Influenza vaccination of health care workers in long-term-care hospitals reduces the mortality of elderly patients. *J Infect Dis.* 1997;175:1–6.
14. **Simeonsson K, Summers-Bear C, Connolly A.** Influenza vaccination of healthcare workers: institutional strategies for improving rates. *N C Med J.* 2004;65:323–9.
15. **U.S. Department of Health and Human Services, Center for Disease Control and Prevention, National Center for Health Statistics & Division of Health Review Statistics** 2000 National Health Interview Survey (NHIS) public use data release: NHIS survey description, Hyattsville, MD, 2002.
16. **Schneider EC, Cleary PD, Zaslavsky AM, Epstein AM.** Racial disparity in influenza vaccination: does managed care narrow the gap between African Americans and whites? *JAMA.* 2001;286:1455–60.
17. **Himmelstein DU, Lewontin JP, Woolhandler S.** Medical care employment in the United States, 1968 to 1993: the importance of health sector jobs for African Americans and women. *Am J Public Health.* 1996;86:525–8.
18. **Bureau of Labor and Statistics.** Monthly Labor Review, 1999.
19. **Martinello RA, Jones L, Topal JE.** Correlation between healthcare workers' knowledge of influenza vaccine and vaccine receipt. *Infect Control Hosp Epidemiol.* 2003;24:845–7.
20. **Harbarth S, Siegrist C, Schira J, Wunderli W, Pittet D.** Influenza immunization: improving compliance of healthcare workers. *Infect Control Hosp Epidemiol.* 1998;19:337–42.