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## Tdap Vaccination Among Healthcare Personnel—21 States, 2013

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### Abstract

**Introduction:** Outbreaks of pertussis can occur in healthcare settings. Vaccinating healthcare personnel may be helpful in protecting healthcare personnel from pertussis and potentially limiting spread to others in healthcare settings.

**Methods:** Data from 21 states using the 2013 Behavioral Risk Factor Surveillance System industry/occupation module were analyzed in 2016. Tetanus, diphtheria, and acellular pertussis (Tdap) vaccination status was self-reported by healthcare personnel along with their occupation, healthcare setting/industry, demographics, and access to care factors. To compare groups *t*-tests were used. The median state response rate was 44.0%.

**Results:** Among all healthcare personnel, 47.2% were vaccinated for Tdap. Physicians had higher Tdap coverage (66.8%) compared with all other healthcare personnel except nurse practitioners and registered nurses (59.5%) whose coverage did not statistically differ from that of physicians. Tdap vaccination coverage was higher among workers in hospitals (53.3%) than in long-term care facilities (33.3%) and other clinical settings, such as dentist, chiropractor, and optometrist offices (39.3%). Healthcare personnel who were younger, who had higher education, higher annual household income, a personal healthcare provider, and health insurance had higher Tdap vaccination coverage compared with reference groups. Tdap vaccination coverage among 21 states ranged from 30.6% in Mississippi to 65.9% in Washington.

**Conclusions:** Improvement in Tdap vaccination among healthcare personnel is needed to potentially reduce opportunities for spread of pertussis in healthcare settings. On-site workplace

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vaccination, offering vaccines free of charge, and promoting vaccination may increase vaccination among healthcare personnel.

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## INTRODUCTION

*Bordetella pertussis* is a highly communicable bacterial pathogen, and infants are the age group most susceptible to severe infection and death ([www.cdc.gov/pertussis/about/index.html](http://www.cdc.gov/pertussis/about/index.html)).<sup>1</sup> Pertussis outbreaks have been identified in a variety of healthcare settings.<sup>2–4</sup> The Advisory Committee on Immunization Practices recommends a single dose of tetanus, diphtheria, and acellular pertussis (Tdap) vaccine for all adults, including pregnant women during each pregnancy, to protect themselves and reduce the risk for transmitting pertussis to infants too young to be vaccinated.<sup>5,6</sup> To assure high Tdap coverage and disease prevention among healthcare personnel (HCP), patients, and others, the Advisory Committee on Immunization Practices recommends that healthcare employers provide Tdap vaccination to HCP and use approaches that maximize vaccination rates.<sup>6</sup>

Knowledge of Tdap vaccination coverage among HCP can help guide prevention efforts by identifying groups where vaccination coverage improvement is needed. Analyses have shown that vaccinating HCP with Tdap may be a cost-effective strategy to prevent nosocomial spread of pertussis, assuming high vaccine efficacy and secondary case prevention.<sup>7–9</sup> This paper estimates Tdap vaccination among HCP by occupation, industry, demographics, access-to-care characteristics, and by the 21 states in the study.

## METHODS

The Behavioral Risk Factor Surveillance System is an ongoing state-based telephone survey that collects information on health conditions and risk behaviors from non-institutionalized U.S. adults ([www.cdc.gov/brfss/](http://www.cdc.gov/brfss/)); 2013 data were analyzed in 2016. In 2013, a total of 21 states<sup>a,b</sup> included an industry/occupation (I/O) module of two questions asked of employed respondents or those out of work <1 year at interview. The occupation question was: *What kind of work do you/did you do (for example, registered nurse, janitor, cashier, auto mechanic)?* The industry question was: *What kind of business or industry do you/did you work in (for example, hospital, elementary school, clothing manufacturing, restaurant)?* Industry/occupation responses were coded to 2002 Census I/O codes, and converted to equivalent 2002 North American Industry Classification System (NAICS, [www.census.gov/eos/www/naics/](http://www.census.gov/eos/www/naics/)), and 2000 Standard Occupational Classification (SOC, [www.bls.gov/soc/](http://www.bls.gov/soc/)) codes; the I/O methodology has been previously described.<sup>10,11</sup> Analyses were performed on clinical HCP (physicians, nurses, health technologists/technicians, healthcare support occupations, and other health diagnosing and treating practitioners); nonclinical HCP included all other occupations from healthcare settings. Tdap status was

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<sup>a</sup>California, Florida, Illinois, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Utah, Washington, Wisconsin, Wyoming.

<sup>b</sup>Centers for Disease Control and Prevention (CDC), Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Georgia: U.S. DHHS, CDC, 2013. Source: [www.cdc.gov/brfss/questionnaires/index.htm](http://www.cdc.gov/brfss/questionnaires/index.htm). Data from Wyoming Department of Health, Public Health Division, Behavioral Risk Factor Surveillance System, were supported in part by CDC Cooperative Agreement, U58/SO000016-1 through 3 (2011–2013). Data from Washington State Department of Health, Center for Health Statistics, Behavioral Risk Factor Surveillance System were supported in part by CDC Cooperative Agreement, U58/SO000047-1 through 3 (2011–2013).

obtained with the questions: *Since 2005, have you had a tetanus shot?* and *Was this Tdap, the tetanus shot that also has pertussis or whooping cough vaccine?* The median state response rate (American Association for Public Opinion Research Response Rate 4) was 44.0%, ranging from 31.1% in Washington to 59.2% in North Dakota.<sup>12</sup>

The weighted proportion who reported Tdap vaccination since 2005 was calculated. Persons missing demographic/access-to-care data were excluded from the analysis of that particular variable. Among employed persons with I/O codes, 34% were excluded because they did not answer whether their tetanus vaccine included pertussis. Sensitivity analyses were used to calculate the possible range of Tdap estimates assuming those excluded were either all vaccinated or unvaccinated. Predicted marginal estimates were calculated per state, adjusting for industry, occupation, sociodemographic, and access-to-care variables. To test for statistically significant differences between groups *t*-tests were used with  $\alpha=0.05$ . Analyses were performed using SAS, version 9.3 and SUDAAN, version 11.0.

## RESULTS

Tdap vaccination coverage among HCP was 47.2%. Based on sensitivity calculations, Tdap vaccination coverage could have ranged from 38.8% to 56.7%. Physicians and surgeons had higher Tdap coverage (66.8%) compared with health technologists and technicians (50.1%), healthcare support occupations (47.7%), other health diagnosing and treating practitioners (41.4%), and nonclinical occupations (37.1%). Tdap vaccination coverage was higher among workers in hospitals (53.3%) than among workers in other clinical settings (39.3%) and long-term care facilities (33.3%; Table 1).

Tdap vaccination coverage was significantly higher among HCP if they were aged <50 years, had some secondary education, had >\$20,000 annual household income, had a personal healthcare provider, or had medical insurance, compared with reference groups. Tdap coverage was significantly lower among non-Hispanic black compared with non-Hispanic white HCP (Table 2). Unadjusted Tdap vaccination coverage ranged from 30.6% in Mississippi to 65.9% in Washington with a median of 50.4%, whereas adjusted coverage ranged from 30.9% to 65.2% in those states, respectively, resulting in a 19% variance reduction after adjusting for occupation, industry, and sociodemographic and access-to-care variables. The state variable was statistically significant in adjusted analyses (Table 3).

## DISCUSSION

Overall Tdap vaccination coverage among HCP was 47.2%, but differed by occupation and industry, highlighting the need to improve Tdap uptake among HCP. A recent study of hospitals in southern states found that 91.1% of sampled hospitals offered Tdap to their employees.<sup>13</sup> One of the most common reasons for refusing Tdap was not feeling the vaccine was necessary.<sup>13</sup> Healthcare facilities may create policies requiring staff vaccination; in a 2011 U.S. hospital survey, 31% required pertussis vaccination for HCP.<sup>14</sup> Implementing such policies can result in high compliance.<sup>15</sup> Offering vaccines on-site, free of charge, and actively promoting influenza vaccination has been shown to increase

influenza vaccination among HCP ([www.thecommunityguide.org/vaccines/index.html](http://www.thecommunityguide.org/vaccines/index.html)); utilizing these strategies could also increase Tdap coverage.<sup>3</sup>

Nationally, Tdap vaccination coverage among HCP was reported at 40.2% in 2013 from another survey.<sup>16</sup> Findings from this report were similar to previous studies related to Tdap vaccination in the general population<sup>17,18</sup> and HCP,<sup>16</sup> including racial/ethnic vaccination differences.<sup>16</sup> Differences in attitudes toward vaccination, vaccine-seeking behaviors, likelihood of a provider recommendation, and quality of care might contribute to racial/ethnic vaccination differences.<sup>17–23</sup>

Wide variation in state Tdap vaccination was observed among these states, but the variance of estimates was reduced by 19% after adjusting for industry, occupation, and sociodemographic and access-to-care factors. Washington had the highest coverage in this report and also had coverage in the top quintile among the general population the same year; likewise, some states with lower coverage in this report, such as Florida, also had relatively low coverage among the general population.<sup>24</sup> Variation in state coverage could be because of differing medical care delivery infrastructure, population norms, and effectiveness of state and local immunization programs.<sup>25</sup>

### Limitations

This study had several limitations. First, vague responses could not be coded and those who refused to answer the I/O questions (17%–18%) were excluded from estimates. Second, respondents who reported tetanus vaccination but were unable to say whether pertussis was received were excluded, creating a potential for bias. Third, Tdap vaccination was based on self-report and subject to recall bias. Finally, response rates were low.

### CONCLUSIONS

Tdap vaccination protects HCP from pertussis and may potentially reduce transmission to patients and others. This report documents the particular health care settings, occupations, and demographic subgroups where improvement is needed. For groups with low Tdap coverage, further examination of vaccination barriers is warranted.

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**Table 1.**Tdap Vaccination Coverage by Healthcare Occupation and Industry – BRFSS 2013, 21 States<sup>a</sup>

Occupation/occupational setting (2000 SOC code/2002 NAICS code)	n	% <sup>b</sup> (95% CI)
All healthcare personnel combined	10,229	47.2 (45.2, 49.3)
Occupation		
Physicians/surgeons (SOC 29–1060)	616	66.8 (60.1, 72.8)
Nurse practitioners/registered nurses (SOC 29–1111)	2,702	59.5 (55.3, 63.5)
Other health diagnosing and treating practitioners <sup>c</sup> (SOC 29–1000 <sup>d</sup> )	693	<b>41.4 (33.2, 50.1)</b> <sup>e</sup>
Health technologists/technicians <sup>f</sup> (SOC 29–2000 <sup>g</sup> )	939	<b>50.1 (43.7, 56.5)</b> <sup>e</sup>
Healthcare support occupations <sup>h</sup> (SOC 31–0000 <sup>i</sup> )	1,357	<b>47.7 (42.1, 53.4)</b> <sup>e</sup>
Non-clinical occupations (All other SOC <sup>j</sup> )	3,922	<b>37.1 (34.1, 40.2)</b> <sup>e</sup>
Healthcare industry setting		
Hospitals (NAICS 622)	4,129	53.3 (50.2, 56.4)
Outpatient care centers/physician offices (NAICS 6214, 6211)	3,459	49.6 (45.8, 53.4)
Long-term care facilities <sup>k</sup> (NAICS 6216, 6231, 6232, 6233, 6239)	1,811	<b>33.3 (28.7, 38.2)</b> <sup>l</sup>
Other clinical settings <sup>m</sup> (NAICS 6212, 62131, 62132, 6213, 6215, 6219)	830	<b>39.3 (32.8, 46.3)</b> <sup>l</sup>

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>California, Florida, Illinois, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Utah, Washington, Wisconsin, Wyoming.

<sup>b</sup>Weighted proportion of respondents aged ≥ 18 years who reported receiving a Tdap vaccine since 2005.

<sup>c</sup>Including chiropractors, dentists, dietitians, nutritionists, optometrists, pharmacists, physician assistants, podiatrists, therapists (audiologists, occupational therapists, physical therapists, radiation therapists, recreational therapists, respiratory therapists, speech-language pathologists, and other therapists), and other health diagnosing and treating practitioners.

<sup>d</sup>Excluding SOC 29–1060, 29–1111, 29–1131.

<sup>e</sup> $p < 0.05$  by t-test for comparisons within occupation with physicians/surgeons as the reference level.

<sup>f</sup>Including clinical laboratory technologists/technicians, dental hygienists, diagnostic related technologists/technicians, emergency medical technicians and paramedics, health diagnosing and treating practitioner support technicians, medical records and health information technicians, opticians, and other health technologists and technicians.

<sup>g</sup>Excluding SOC 29–2056.

<sup>h</sup>Including nursing, psychiatric, and home health aides, occupational and physical therapist assistants and aides, massage therapists, dental assistants, medical assistants, etc.

<sup>i</sup>Excluding SOC 31–9096.

<sup>j</sup>Includes all other occupations who work in HCP settings (hospitals, outpatient care/physician offices, long-term care facilities, other clinical settings).

<sup>k</sup>Including home healthcare services, nursing care facilities, and residential care facilities (without nursing).

<sup>l</sup> $p < 0.05$  by t-test for comparisons within occupational setting with hospitals as the reference level.

<sup>m</sup>Including dentist, chiropractor, optometrist, and other health practitioner offices; other healthcare services.

Tdap, tetanus, diphtheria, and acellular pertussis; BRFSS, Behavioral Risk Factor Surveillance System; SOC, Standard Occupation Classification ([www.bls.gov/soc/](http://www.bls.gov/soc/)); NAICS, North American Industry Classification System ([www.census.gov/eos/www/naics/](http://www.census.gov/eos/www/naics/))

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**Table 2.**

Tdap Vaccination Coverage Among HCP,<sup>a</sup> by Demographic and Access-to-Care Characteristics – BRFSS 2013, 21 States<sup>b</sup>

Characteristic	n	% <sup>c</sup> (95% CI)
Total	10,229	47.2 (45.2, 49.3)
Age (years)		
18–49 <sup>d</sup>	5,092	51.4 (48.7, 54.2)
50–64	4,220	<b>41.2 (38.0, 44.4)</b> <sup>e</sup>
65	917	<b>36.3 (30.2, 43.0)</b> <sup>e</sup>
Sex		
Male <sup>d</sup>	2,010	45.8 (41.1, 50.6)
Female	8,219	47.7 (45.4, 50.0)
Race/ethnicity		
White, non-Hispanic <sup>d</sup>	8,100	51.3 (49.3, 53.4)
Black, non-Hispanic	879	<b>29.2 (24.1, 34.8)</b> <sup>e</sup>
Hispanic	576	48.7 (40.5, 56.9)
Other, non-Hispanic	569	46.1 (36.7, 55.7)
Education		
Less than high school <sup>d</sup>	203	25.6 (17.2, 36.4)
High school graduate/GED	1,428	31.0 (26.6, 35.8)
Some college/technical school	3,230	<b>49.3 (45.6, 53.0)</b> <sup>e</sup>
College graduate	5,363	<b>53.3 (50.5, 56.0)</b> <sup>e</sup>
Income		
<\$20K <sup>d</sup>	676	32.3 (26.0, 39.2)
\$20K–<\$50K	2,741	<b>40.3 (36.7, 43.9)</b> <sup>e</sup>
\$50K–<\$75K	1,786	<b>49.8 (44.8, 54.7)</b> <sup>e</sup>
\$75K+	4,370	<b>53.1 (49.9, 56.3)</b> <sup>e</sup>
Have personal healthcare provider		
No <sup>d</sup>	1,334	40.6 (35.1, 46.4)
Yes	8,884	<b>48.4 (46.2, 50.6)</b> <sup>e</sup>
Have medical insurance		
No <sup>d</sup>	852	35.9 (28.7, 43.8)
Yes	9,364	<b>48.7 (46.5, 50.8)</b> <sup>e</sup>

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Clinical and nonclinical staff working in hospitals (NAICS 622), outpatient care/physician offices (NAICS 6214, 6211), long-term care facilities (NAICS 6216, 6231, 6232, 6233, 6239), other clinical settings (NAICS 6212, 62131, 62132, 6213, 6215, 6219).

<sup>b</sup>California, Florida, Illinois, Louisiana, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Utah, Washington, Wisconsin, Wyoming.

<sup>c</sup>Weighted proportion of respondents aged 18 years who reported receiving a Tdap vaccine since 2005.

<sup>d</sup>Reference level.

<sup>e</sup> $p < 0.05$  by t-test for comparisons within each variable with the indicated reference level.

Tdap, tetanus, diphtheria, and acellular pertussis; HCP, healthcare personnel; BRFSS, Behavioral Risk Factor Surveillance System; NAICS, North American Industry Classification System; GED, general educational development test

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**Table 3.**Tdap Vaccination Coverage by State Among Healthcare Personnel<sup>a</sup> – BRFSS 2013, 21 States

State	Unadjusted	Adjusted
	% <sup>b</sup> (95% CI)	% <sup>c</sup> (95% CI)
Washington	65.9 (60.8, 70.7)	65.2 (60.1, 70.3)
Minnesota	63.3 (57.4, 68.7)	63.1 (57.7, 68.5)
Wisconsin	62.8 (55.2, 69.8)	61.4 (54.5, 68.2)
Utah	61.2 (56.5, 65.6)	57.8 (52.9, 62.7)
New Hampshire	60.7 (54.3, 66.8)	59.4 (52.6, 66.2)
North Dakota	60.4 (54.0, 66.5)	58.7 (52.2, 65.1)
Nebraska	59.4 (53.2, 65.4)	53.4 (47.4, 59.4)
Oregon	56.2 (48.3, 63.8)	53.3 (44.3, 62.3)
Massachusetts	55.0 (49.9, 59.9)	52.1 (46.4, 57.7)
California	51.9 (43.3, 60.3)	51.9 (44.2, 59.6)
Michigan	50.4 (45.7, 55.2)	49.6 (44.7, 54.4)
Montana	49.3 (43.0, 55.5)	48.9 (42.5, 55.3)
Wyoming	46.5 (37.7, 55.5)	45.8 (37.6, 53.9)
New Mexico	44.6 (38.0, 51.3)	46.2 (38.1, 54.2)
New York	40.0 (32.3, 48.2)	42.0 (34.0, 50.0)
Illinois	39.5 (32.4, 47.0)	40.6 (33.5, 47.7)
Maryland	39.0 (33.3, 45.1)	42.7 (36.3, 49.0)
New Jersey	34.5 (26.4, 43.5)	34.1 (25.2, 43.0)
Florida	31.8 (27.6, 36.3)	31.8 (27.5, 36.1)
Louisiana	31.1 (23.4, 40.1)	32.8 (23.9, 41.6)
Mississippi	30.6 (24.4, 37.6)	30.9 (24.4, 37.5)
Median	50.4	49.6
Range	30.6–65.9	30.9–65.2
Variance	138.1	111.6

<sup>a</sup>Clinical and nonclinical staff working in hospitals (NAICS 622), outpatient care/physician offices (NAICS 6214, 6211), long-term care facilities (NAICS 6216, 6231, 6232, 6233, 6239), other clinical settings (NAICS 6212, 62131, 62132, 6213, 6215, 6219).

<sup>b</sup>Weighted proportion of respondents aged ≥ 18 years who reported receiving a Tdap vaccine since 2005.

<sup>c</sup>Predicted marginal (adjusted for age, sex, race/ethnicity, education, annual household income, whether the respondent has a personal healthcare provider, health insurance, healthcare occupation, and healthcare industry).

Tdap, tetanus, diphtheria, and acellular pertussis; BRFSS, Behavioral Risk Factor Surveillance System; NAICS, North American Industry Classification System