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Tuberculosis among Healthcare Personnel, United States, 2010–2016

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Abstract

We describe characteristics of U.S. healthcare personnel (HCP) diagnosed with tuberculosis (TB). Among 64,770 adults with TB during 2010–2016, 2,460 (4%) were HCP. HCP with TB were more likely to be born outside of the United States, and less likely to have TB attributed to recent transmission, than non-HCP.

Birth in a country with high TB morbidity is a major risk factor for tuberculosis (TB) in the United States.^{1,2} National surveillance data from 1995–2007 estimated the rate of TB among non-U.S.-born healthcare personnel (HCP) in the United States as 10 times higher than among U.S.-born HCP.³ Recent TB transmission has been estimated to account for approximately 15% of TB cases diagnosed in the United States, but has not been examined for HCP versus other adults.^{4,5} We examined national surveillance data from 2010–2016 to describe characteristics of HCP with TB in the United States.

Methods

TB is a notifiable disease in all 50 states and the District of Columbia. Data are collected by health departments and submitted to the Centers for Disease Control and Prevention (CDC) via the Report of Verified Case of TB (RVCT), which includes demographic, clinical, and outcome characteristics of TB cases.² Variables are defined in the RVCT Instruction Manual; HCP include “any paid or unpaid persons who worked in a healthcare setting within 12 months prior to TB diagnosis” (HCP data were collected using the terminology “healthcare worker”).⁶ TB genotyping results are analyzed to attribute cases to recent transmission, using a previously published plausible source case method.^{5,7}

We included TB cases reported from January 1, 2010 through December 31, 2016 among persons ≥ 18 years. Demographic, clinical, and risk factors were compared using descriptive

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statistics and P-values. Analyses were conducted using SAS, version 9.3 (SAS Institute, Cary, NC). This project was determined by CDC and Emory University to be public health surveillance not requiring human subjects research review.

Results

Demographics, site of disease, and drug resistance

Among 64,770 TB cases reported among persons 18 years during 2010–2016, 2,460 (4%) were HCP and 62,310 (96%) were other adults (Table 1). Compared with other adults with TB, HCP were more likely to be female, younger, and have been born outside of the United States (75% v. 67%). HCP were more likely to self-report non-Hispanic black (31% v. 22%) or Asian (44% v. 32%) race. HCP were more likely to have extrapulmonary (extrapulmonary only or extrapulmonary and pulmonary) TB disease (38% v. 30%) or resistance to any TB medications (12% v. 9%), particularly among HCP born outside of the United States. Isoniazid-mono-resistant TB was more common among non-HCP, while multidrug-resistant (resistant to at least isoniazid and rifampin) TB was more common among HCP. Of 16 extensively drug-resistant (resistant to at least isoniazid, rifampin, any fluoroquinolone and at least one of amikacin, kanamycin, or capreomycin) TB cases reported during 2010–2016, none occurred among HCP.

TB disease risk factors

HCP were less likely to report a previous diagnosis of TB (4% v. 5%) than other adults, although HCP born outside the United States were more likely to report previous TB disease than U.S.-born HCP (4% v. 2%, Table 1). HCP were less likely to report TB risk factors such as diabetes (12% v. 16%), homelessness (1% v. 6%), excess alcohol use (3% v. 12%), or drug use (2% v. 8%) compared with other adults. HIV infection (6%) was similar among all adults; HCP were more likely to report tumor necrosis factor alpha-antagonist use (1.3% v. 0.6%) and less likely to have end-stage renal disease (1% v. 2%). HCP born outside the United States were less likely to have non-HIV immunosuppression (4% v. 6%), excess alcohol use (2% v. 7%), or drug use (1% v. 6%) than U.S.-born HCP.

Clinical characteristics and outcomes of TB disease

Cases among HCP were less likely to be attributed to recent transmission based on genotyping results (10% v. 14%) for other adults), although HCP were more likely to report contact with an infectious TB patient within the last 2 years (7% v. 5%) or noncompletion of treatment for latent TB infection (LTBI) (5% v. 3%). HCP were more likely to have a positive TST result (40% v. 34%), with similar positive IGRA results (39% v. 35%) as other adults. Non-U.S.-born HCP were more likely to have a positive IGRA result in the absence of TST testing (29% v. 23%), or no documented TST or IGRA testing at the time of diagnosis (24% v. 19%), than U.S.-born HCP (Online Table 1). Among patients with any pulmonary TB, HCP were less likely to have a positive sputum smear result (41% v. 49%), positive cavitory chest radiograph (26% v. 29%), or positive nucleic acid amplification test (45% v. 47%). HCP were more likely to self-administer TB therapy (48% v. 37%), convert to negative sputum culture <60 days after starting treatment (76% v. 69%), and complete TB treatment (95% v. 87%) than other adults. Use of directly-observed treatment for TB disease,

and completion of TB treatment, did not significantly differ between U.S.-born and non-U.S.-born HCP; however, non-U.S.-born HCP were more likely to convert to negative culture in <60 days (81% v. 70%) among sputum culture-positive patients.

Tuberculosis Rates among HCP in the United States

Using U.S. Census Bureau population estimates for HCP for 2010–2016 (i.e., annual average of 11.5 million U.S.-born HCP and 2.4 million non-U.S.-born HCP), the estimated average annual TB incidence was 2.5 cases per 100,000 HCP (range 2.0–3.0), similar to the average national TB case rate of 3.2 cases per 100,000 persons (range 2.9–3.6), during the time period.^{2,8} Akin to national disparities in TB rates by nativity, average incidence for non-US-born HCP was 10.8 cases per 100,000 population (range 8.6–12.7) compared with 0.8 cases per 100,000 population (range 0.6–1.1) for U.S.-born HCP.^{2,8}

Discussion

Compared with other adults with TB, HCP were more likely to be women, non-U.S.-born, have extrapulmonary TB, have drug-resistant TB, convert sputum in <60 days, and complete TB treatment. Except for birth outside the United States, contact with an infectious TB case, and use of tumor necrosis factor-alpha antagonists, HCP reported lower prevalence of TB risk factors than other adults with TB. Genotyping data did not suggest greater prevalence of TB attributed to recent transmission compared with other adults, nor were TB incidence rates higher among HCP than the general population.

The proportion of HCP with TB who were born outside of the United States during 1995–2007 was 55%, compared with 75% during 2011–2016, and 68% of all TB cases nationally in 2016 occurring among persons born outside of the United States.^{2,3} Medical and social risk factors for TB among HCP are rare. HCP are infectious for a shorter time period, as evidenced by sputum conversion, have a lower proportion of cases attributed to recent transmission, and have better treatment outcomes compared with other adults; these findings are reassuring. However, non U.S.-born HCP are more likely to have extrapulmonary TB, which might delay diagnosis, and drug-resistant TB, which can complicate treatment. HCP are more likely to report a positive TST or IGRA result than other adults, and to report prior incomplete treatment for LTBI, which might represent missed opportunities to prevent TB. Recently updated recommendations indicate improved completion rates with newer shorter treatment regimens for LTBI, and clinical guidelines support use of IGRA over TST when applicable.^{9,10} By testing and more importantly, treating HCP for LTBI, progress can be made towards TB elimination in the United States.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Characteristics of persons with tuberculosis by healthcare personnel status and by origin of birth among healthcare personnel, among individuals 18 years or older, United States, 2010–2016

Table 1.

Characteristic	Persons with tuberculosis (TB) (n = 64,770)		Healthcare personnel (HCP) with TB (n = 2,460)		P-value ^a	U.S.-born (N = 627) n (%)	P-value ^a
	HCPs (N = 2,460) n (%)	Other adults (N = 62,310) n (%)	HCPs (N = 2,460) n (%)	Non-U.S.-born ^b (N = 1,833) n (%)			
Sex							
Male	742 (30)	39,158 (63)	144 (23)	598 (33)	Reference	144 (23)	Reference
Female	1,718 (70)	23,144 (37)	483 (77)	1,235 (67)	<0.0001	483 (77)	<0.0001
Age group, years							
18–35	900 (37)	17,593 (28)	232 (37)	668 (36)	Reference	232 (37)	Reference
36–54	1,039 (42)	19,062 (31)	236 (38)	803 (44)	0.1746	236 (38)	0.1159
55	521 (21)	25,655 (41)	159 (25)	362 (20)	<0.0001	159 (25)	0.0538
Race/ethnicity							
White, non-Hispanic	283 (12)	9,460 (15)	215 (34)	68 (4)	Reference	215 (34)	Reference
Black, non-Hispanic	770 (31)	13,415 (22)	239 (38)	531 (29)	<0.0001	239 (38)	<0.0001
Hispanic	276 (11)	17,632 (28)	103 (16)	173 (9)	<0.0001	103 (16)	<0.0001
Asian	1,081 (44)	20,040 (32)	40 (6)	1,041 (57)	<0.0001	40 (6)	<0.0001
Other ^c	47 (2)	1,595 (3)	29 (5)	18 (1)	0.9247	29 (5)	0.0390
Site of disease							
Pulmonary TB only	1,512 (61)	43,353 (70)	454 (72)	1,058 (58)	Reference	454 (72)	Reference
Extrapulmonary TB only	692 (28)	12,686 (20)	118 (19)	574 (31)	<0.0001	118 (19)	<0.0001
Concurrent pulmonary and extrapulmonary TB	253 (10)	6,228 (10)	54 (9)	199 (11)	0.0275	54 (9)	0.0048
TST result at time of TB diagnosis							
Negative	144 (6)	6,011 (10)	66 (11)	78 (4)	Reference	66 (11)	Reference
Positive	974 (40)	21,044 (34)	269 (43)	705 (38)	<0.0001	269 (43)	<0.0001
Not performed/unknown/indeterminate	1,342 (55)	35,255 (57)	292 (46)	1,050 (57)	<0.0001	292 (46)	<0.0001
IGRA result at time of TB diagnosis							
Negative	151 (6)	3,993 (6)	54 (9)	97 (5)	Reference	54 (9)	Reference
Positive	955 (39)	21,756 (35)	232 (37)	723 (39)	0.0946	232 (37)	0.0028
Not performed/unknown/indeterminate	1,354 (55)	36,561 (59)	341 (54)	1,013 (55)	0.8110	341 (54)	0.0051

Characteristic	Persons with tuberculosis (TB) (n = 64,770)		Healthcare personnel (HCP) with TB (n = 2,460)		P-value ^a	U.S.-born (N = 627) n (%)	P-value ^a
	HCPs (N = 2,460) n (%)	Other adults (N = 62,310) n (%)	Non-U.S.-born ^b (N = 1,833) n (%)	U.S.-born (N = 627) n (%)			
Culture for <i>Mycobacterium tuberculosis</i>							
Negative	492 (20)	11,265 (18)	351 (19)	141 (22)	Reference	Reference	Reference
Positive	1,901 (77)	49,644 (80)	1,438 (78)	463 (74)	0.0108	0.0502	0.0502
Not performed/unknown	67 (3)	1,401 (2)	44 (2)	23 (4)	0.4959	0.3389	0.3389
Findings among patients with any pulmonary TB							
Sputum smear							
Negative	922/1,765 (52)	22,040/49,581 (44)	669/1,257 (53)	253/508 (50)	Reference	Reference	Reference
Positive	723/1,765 (41)	24,133/49,581 (49)	516/1,257 (41)	207/508 (41)	<0.0001	0.5934	0.5934
Not performed/unknown	120/1,765 (7)	3,408/49,581 (7)	72/1,257 (6)	48/508 (9)	0.0807	0.0043	0.0043
Cavitary chest radiograph ^d							
Negative	1,163/1,576 (74)	31,764/44,957 (71)	854/1,112 (77)	309/464 (67)	Reference	Reference	Reference
Positive	406/1,576 (26)	12,932/44,957 (29)	253/1,112 (23)	153/464 (33)	0.0086	<0.0001	<0.0001
Nucleic acid amplification result							
Negative	194/1,765 (11)	4,714/49,581 (10)	134/1,257 (11)	60/508 (12)	Reference	Reference	Reference
Positive	797/1,765 (45)	23,224/49,581 (47)	578/1,257 (46)	219/508 (43)	0.0259	0.3380	0.3380
Not performed/unknown/indeterminate	774/1,765 (44)	21,643/49,581 (44)	545/1,257 (43)	229/508 (45)	0.0861	0.7151	0.7151
Initial drug resistance ^e							
Susceptible to isoniazid and rifampin	1,641/1,867 (88)	44,057/48,649 (91)	1,213/1,412 (86)	428/455 (94)	Reference	Reference	Reference
Resistance to any drug (total)	226/1,867 (12)	4,592/48,649 (9)	199/1,412 (14)	27/455 (6)	0.0001	<0.0001	<0.0001
Isoniazid monoresistance	177/226 (78)	3,828/4,592 (83)	156/199 (78)	21/27 (78)	0.0074	<0.0001	<0.0001
Multidrug resistance (MDR)	46/226 (20)	614/592 (13)	41/199 (21)	5/27 (19)	<0.0001	0.0198	0.0198
Recent transmission ^f							
No	1,343/1,500 (90)	33,530/38,881 (86)	1,067/1,155 (92)	276/345 (80)	Reference	Reference	Reference
Yes	157/1,500 (10)	5,351/38,881 (14)	88/1,155 (8)	69/345 (20)	0.0003	<0.0001	<0.0001
Risk factors ^g							
Previous diagnosis of TB	87 (4)	3,200 (5)	76 (4)	11 (2)	0.0004	0.0050	0.0050
HIV positive at time of diagnosis	138 (6)	3,754 (6)	106 (6)	32 (5)	0.3164	0.3999	0.3999
Excess alcohol use (within the past year)	76 (3)	7,486 (12)	31 (2)	45 (7)	<0.0001	<0.0001	<0.0001

Characteristic	Persons with tuberculosis (TB) (n = 64,770)		Healthcare personnel (HCP) with TB (n = 2,460)		P-value ^a	U.S.-born (N = 627) n (%)	P-value ^a
	HCPs (N = 2,460) n (%)	Other adults (N = 62,310) n (%)	Non-U.S.-born ^b (N = 1,833) n (%)	U.S.-born (N = 627) n (%)			
Drug use (within the past year)	45 (2)	4,974 (8)	10 (1)	35 (6)	<0.0001		<0.0001
Homeless in the year preceding diagnosis	21 (1)	3,624 (6)	10 (1)	11 (2)	<0.0001		0.0046
Reported diabetes (type I or II)	296 (12)	9,679 (16)	226 (12)	70 (11)	<0.0001		0.4388
Reported immunosuppression other than HIV	107 (4)	2,783 (4)	67 (4)	40 (6)	0.7832		0.0039
Reported contact of infectious TB patient	160 (7)	3,406 (5)	85 (5)	75 (12)	0.0269		<0.0001
Reported noncompletion of LTBI treatment	122 (5)	1,558 (3)	84 (5)	38 (6)	<0.0001		0.1412
Reported end-stage renal disease/chronic renal failure	18 (1)	1,455 (2)	11 (1)	7 (1)	<0.0001		0.1904
Reported TNF-alpha antagonist therapy	31 (1)	362 (<1)	24 (1)	7 (1)	<0.0001		0.7086
Method of TB treatment ^{h, i}							
Directly observed therapy (DOT)	910/1,803 (51)	26,704/43,902 (61)	656/1,338 (49)	254/465 (55)	Reference		Reference
Self-administered therapy (SAT)	291/1,803 (16)	3,698/43,902 (8)	224/1,338 (17)	67/465 (14)	<0.0001		0.1010
Both DOT and SAT	570/1,803 (32)	12,659/43,902 (29)	434/1,338 (32)	136/465 (29)	<0.0001		0.0851
Treatment outcome ^{h, i}							
Did not complete TB therapy	74/1,803 (4)	5,409/43,902 (12)	50/1,338 (4)	24/465 (5)	Reference		Reference
Completed TB therapy	1,721/1,803 (95)	38,216/43,902 (87)	1,284/1,338 (96)	437/465 (94)	<0.0001		0.1747
Sputum conversion ^{k, j}							
60 days	182/767 (24)	6,779/21,518 (32)	116/555 (19)	66/212 (30)	Reference		Reference
<60 days	585/767 (76)	14,739/21,518 (69)	439/555 (81)	146/212 (70)	<0.0001		0.0029

NOTE. Data are no. (%) or proportion (%) of persons with TB, unless otherwise indicated. Sum of percentages may not equal 100% due to rounding. TB, tuberculosis; HCP, healthcare personnel; HIV, human immunodeficiency virus; TST, tuberculin skin test; IGRA, interferon gamma release assay; LTBI, latent TB infection.

^aP-values were calculated using Fisher's exact test when cell sizes were <5.

^bBirth outside of the United States.

^cIncludes multiple races and non-Hispanic American Indian/Alaska Native, or Native Hawaiian/Pacific Islander.

^dAnalysis was limited to those who had an initial positive radiograph/computed tomography (CT) scan or other imaging study abnormality consistent with TB.

^eAnalysis was limited to those with a positive culture result and an isolate that had drug resistance results reported. MDR = resistance to at least isoniazid and rifampin.

^fRecent transmission is based on a plausible-source case method that includes the following five characteristics: *M. tuberculosis* genotype, an infectious form of TB disease, patient who is 10 years old, diagnosis within 2 years before the given case, and residential location within 10 miles of a given case.⁵⁻⁷

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^gP-values represent the comparison of each risk factor vs. non-risk factor; missing or unknown entries accounted for <1% of each risk factor.

^hAnalysis was limited to those who were alive at time of diagnosis, had documented initial TB treatment, and analyzed through 2014 to provide a 2-year follow-up on all cases.

ⁱMissing/unknown (< 2%) not shown.

^jAnalysis was limited to those who had an initial positive sputum culture result, had documented sputum conversion, and analyzed through 2014 to provide a 2-year follow-up on all cases.