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World TB Day — March 24, 2019

World TB Day is observed each year on March 24. This observance provides an opportunity to raise awareness about tuberculosis (TB) and the measures needed to find, treat, and prevent this devastating disease.

In 2018, a provisional total of 9,029 TB cases were reported in the United States (incidence = 2.8 cases per 100,000 persons) (*1*), a decline from the 9,094 cases reported in 2017 and the lowest number of cases on record in the United States since reporting began in 1953. Increased diagnosis and treatment of latent TB infection remains essential to eliminating TB in the United States.

Worldwide, an estimated 10 million cases of TB were reported in 2017, a decline of 1.8% from 2016. Approximately 1.57 million persons died from TB in 2017, a 3.9% decrease from 2016 (*2*). The implementation of effective strategies, including expansion of TB preventive treatment, defined in the global setting as treatment for those who might be infected with TB and are at risk for progressing to TB disease, including persons living with human immunodeficiency virus infection, is necessary to reach global targets.

CDC is working with domestic and global partners to diagnose and treat TB in the United States and around the world. Additional information about World TB Day and CDC's TB activities is available at https://www.cdc.gov/tb/worldtbday.

References

1. Talwar A, Tsang CA, Price SF, et al. Tuberculosis—United States, 2018. MMWR Morb Mortal Wkly Rep 2019;68:257–62.
2. MacNeil A, Glaziou P, Sismanidis C, et al. Global epidemiology of tuberculosis and progress towards achieving global targets — 2017. MMWR Morb Mortal Wkly Rep 2019;68:263–6.

Tuberculosis — United States, 2018

Amish Talwar, MD[1,2]; Clarisse A. Tsang, MPH[1]; Sandy F. Price[1]; Robert H. Pratt[1]; William L. Walker, DVM, PhD[1]; Kristine M. Schmit, MD[1]; Adam J. Langer, DVM[1]

In 2018, a total of 9,029 new tuberculosis (TB) cases were reported in the United States, representing a 0.7% decrease from 2017.* The U.S. TB incidence in 2018 (2.8 per 100,000 persons) represented a 1.3% decrease from 2017; the rate among non–U.S.-born persons was >14 times that in U.S.-born persons. This report summarizes provisional TB surveillance data reported to CDC's National Tuberculosis Surveillance System (NTSS) through 2018. Although the total number of cases and incidence are the lowest ever reported in the United States, a recent model predicted that the U.S. TB elimination goal (annual incidence of <1 case per 1 million persons) will not be attained in the 21st century without greatly increased investment in detection and treatment of latent TB infection (LTBI) (*1*). Programs to identify, test, and treat populations at high risk for TB remain important to eliminating TB in the United States.

Health departments in the 50 states and District of Columbia (DC) electronically report provisional case data that meet the national TB surveillance case definition to CDC.† Data reported include demographic information (e.g., birth date,

* This report is limited to National Tuberculosis Surveillance System provisional data as of February 11, 2019. Updated data will be available in CDC's annual TB surveillance report later this year.
† https://www.cdc.gov/tb/programs/rvct/instructionmanual.pdf.

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sex, self-reported race/ethnicity, and country of birth), clinical information (e.g., reason for TB evaluation, anatomic site of disease, test results, and therapy administered), and information on TB risk factors (e.g., human immunodeficiency virus [HIV] infection status, history of homelessness, and residence in a congregate setting). According to U.S. Census Bureau definitions, a "U.S.-born" person is classified as one born in the United States or a U.S. territory or born abroad to a U.S. citizen parent. Race/ethnicity data are collected and reported using federal classification standards; Hispanics/Latinos can be of any race, and all other reported race categories are non-Hispanic/Latino. CDC derived the denominators used to calculate national and state TB incidence from July 2018 U.S. Census Bureau population estimates (*2*) and the denominators used to calculate TB incidence by national origin and race/ethnicity from July 2018 Current Population Survey data (*3*). The number of reported TB cases and TB incidence (cases per 100,000 persons) for 2017 and 2018, as well as the percent changes from 2017 to 2018, were calculated for the 50 states and DC and for each U.S. Census Bureau division. The numbers of TB cases and TB incidence per 100,000 persons were calculated by national origin and race/ethnicity for 2015–2018.

TB incidence declined 1.3% from 2017 to 2018 and an average of 1.6% per year during the last 4 years (2014–2018), a slower pace of decline than the 4.7% annual decline during 2010–2014.[§] State-specific TB incidence for 2018 ranged from 0.2 per 100,000 in Wyoming to 8.5 in Alaska, with a median rate of 1.9 (Table 1). Ten states (Alaska, California, Florida, Hawaii, Maryland, Massachusetts, Minnesota, New Jersey, New York, and Texas) and DC reported TB incidence above the national rate. As has been the case for over 2 decades, four states (California, Florida, New York, and Texas) accounted for approximately half of the reported cases of TB in the United States.

Among the 9,029 TB cases reported in the United States in 2018, approximately two thirds (6,276 [69.5%]) occurred in non–U.S.-born persons, whereas 2,662 (29.5%) occurred in U.S.-born persons; 91 (1.0%) cases occurred in persons for whom no national origin was documented (Table 2). This distribution is similar to that in 2017, when 6,392 (70.3%) cases occurred in non–U.S.-born persons, 2,693 (29.6%) occurred in U.S.-born persons, and 9 (0.1%) occurred in persons for whom no national origin was documented. TB incidence among non–U.S.-born persons (14.2 cases per 100,000) decreased by 3.8% from 2017 to 2018, and the incidence among U.S.-born persons (1.0 cases per 100,000) decreased by 1.8% (Figure).[¶]

[§] These calculations are based on unrounded annual TB incidence rates.

[¶] The decrease in overall incidence does not fall within the range of decreases by national origin because, although the denominators used to calculate both rates increased from 2017 to 2018, the denominator used for rates by national origin (according to Current Population Survey data) increased by an additional 705,000 persons, compared with the denominator used to calculate the overall rate (according to U.S. Census Bureau data). This resulted in a larger calculated decrease in rate by national origin, compared with the overall rate.

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TABLE 1. Tuberculosis (TB) case counts and incidence with annual percent changes, by U.S. Census division and state/district — 50 states and the District of Columbia, 2017 and 2018

Census division/ State	No. of reported TB cases*			TB incidence†		
	2017	2018	% Change	2017	2018	% Change§
Division 1: New England						
Connecticut	63	51	-19.0	1.8	1.4	-19.0
Maine	14	14	0.0	1.0	1.0	-0.2
Massachusetts	209	200	-4.3	3.0	2.9	-4.8
New Hampshire	19	12	-36.8	1.4	0.9	-37.2
Rhode Island	13	20	53.8	1.2	1.9	53.7
Vermont	3	5	66.7	0.5	0.8	66.2
Total	**321**	**302**	**-5.9**	**2.2**	**2.0**	**-6.2**
Division 2: Middle Atlantic						
New Jersey	283	290	2.5	3.2	3.3	2.2
New York	800	750	-6.3	4.1	3.8	-6.0
Pennsylvania	192	212	10.4	1.5	1.7	10.3
Total	**1,275**	**1,252**	**-1.8**	**3.1**	**3.0**	**-1.8**
Division 3: East North Central						
Illinois	335	319	-4.8	2.6	2.5	-4.4
Indiana	100	116	16.0	1.5	1.7	15.4
Michigan	133	109	-18.0	1.3	1.1	-18.2
Ohio	149	178	19.5	1.3	1.5	19.2
Wisconsin	49	49	0.0	0.8	0.8	-0.4
Total	**766**	**771**	**0.7**	**1.6**	**1.6**	**0.5**
Division 4: West North Central						
Iowa	47	49	4.3	1.5	1.6	3.8
Kansas	29	28	-3.4	1.0	1.0	-3.5
Minnesota	178	172	-3.4	3.2	3.1	-4.1
Missouri	87	82	-5.7	1.4	1.3	-6.0
Nebraska	21	27	28.6	1.1	1.4	27.8
North Dakota	14	13	-7.1	1.9	1.7	-7.7
South Dakota	14	12	-14.3	1.6	1.4	-15.2
Total	**390**	**383**	**-1.8**	**1.8**	**1.8**	**-2.3**
Division 5: South Atlantic						
Delaware	15	22	46.7	1.6	2.3	45.1
District of Columbia	36	36	0.0	5.2	5.1	-1.0
Florida	549	591	7.7	2.6	2.8	6.0
Georgia	293	273	-6.8	2.8	2.6	-7.8
Maryland	207	207	0.0	3.4	3.4	-0.3
North Carolina	213	196	-8.0	2.1	1.9	-9.0
South Carolina	101	86	-14.9	2.0	1.7	-15.9
Virginia	204	205	0.5	2.4	2.4	-0.1
West Virginia	16	7	-56.3	0.9	0.4	-56.0
Total	**1,634**	**1,623**	**-0.7**	**2.5**	**2.5**	**-1.7**
Division 6: East South Central						
Alabama	120	91	-24.2	2.5	1.9	-24.4
Kentucky	65	65	0.0	1.5	1.5	-0.3
Mississippi	52	80	53.8	1.7	2.7	54.0
Tennessee	127	140	10.2	1.9	2.1	9.2
Total	**364**	**376**	**3.3**	**1.9**	**2.0**	**2.8**
Division 7: West South Central						
Arkansas	85	79	-7.1	2.8	2.6	-7.4
Louisiana	141	105	-25.5	3.0	2.3	-25.4
Oklahoma	54	74	37.0	1.4	1.9	36.7
Texas	1,127	1,129	0.2	4.0	3.9	-1.1
Total	**1,407**	**1,387**	**-1.4**	**3.5**	**3.4**	**-2.4**
Division 8: Mountain						
Arizona	188	178	-5.3	2.7	2.5	-6.9
Colorado	84	64	-23.8	1.5	1.1	-24.9
Idaho	10	15	50.0	0.6	0.9	47.0
Montana	3	5	66.7	0.3	0.5	65.2
Nevada	80	69	-13.8	2.7	2.3	-15.5
New Mexico	37	41	10.8	1.8	2.0	10.7
Utah	29	18	-37.9	0.9	0.6	-39.1
Wyoming	2	1	-50.0	0.3	0.2	-49.9
Total	**433**	**391**	**-9.7**	**1.8**	**1.6**	**-11.1**
Division 9: Pacific						
Alaska	53	63	18.9	7.2	8.5	19.2
California	2,059	2,091	1.6	5.2	5.3	1.1
Hawaii	116	120	3.4	8.1	8.4	3.7
Oregon	69	81	17.4	1.7	1.9	16.2
Washington	207	189	-8.7	2.8	2.5	-10.0
Total	**2,504**	**2,544**	**1.6**	**4.7**	**4.8**	**1.0**
United States	**9,094**	**9,029**	**-0.7**	**2.8**	**2.8**	**-1.3**

* Case counts were based on data from the National Tuberculosis Surveillance System as of February 11, 2019.

† Cases per 100,000 persons. TB incidence was calculated using denominators from U.S. Census Bureau midyear population estimates.

§ Percentage change in incidence was calculated using unrounded rate for 2017 and 2018.

Among non–U.S.-born persons with TB, incidence in 2018 was highest among Asians, followed by Native Hawaiians/Pacific Islanders, non-Hispanic blacks (blacks), Hispanics, and American Indian/Alaska Natives, and was lowest among non-Hispanic whites (whites) (Table 2). Among TB cases in non–U.S.-born persons, incidence decreased from 2017 to 2018 among Asians, blacks, and whites, but increased in Hispanics. The top five countries of birth of non–U.S.-born persons with TB were Mexico (1,195 cases; 19.0% of all non–U.S.-born cases), Philippines (781; 12.4%), India (616; 9.8%), Vietnam (503; 8.0%), and China (374; 6.0%). Among TB cases in non–U.S.-born persons, 2,905 (46.3%) were diagnosed ≥10 years after the patient first arrived in the United States.

The highest TB incidence for U.S.-born persons occurred among Native Hawaiians/Pacific Islanders, followed by American Indians/Alaska Natives, blacks, Asians, and Hispanics, and was lowest in whites (Table 2). Among U.S.-born persons, TB incidence decreased from 2017 to 2018 among blacks, but remained stable among Asians, Hispanics, and whites.

During 2018, 4.1% of TB cases were reported among persons who experienced homelessness within the year preceding diagnosis, 3.3% among residents of a correctional facility at the time of diagnosis, and 1.6% among residents of a long-term care facility at the time of diagnosis.** Among cases diagnosed in persons who experienced homelessness and among residents of long-term care facilities, 60.8% and 56.8%, respectively, were in persons who were U.S.-born,

** Percentages are calculated using cases with complete data for each of these three individual variables.

TABLE 2. Newly diagnosed tuberculosis (TB) case counts and incidence,* by national origin and race/ethnicity — United States, 2015–2018†

U.S. population group	No. of cases (incidence) 2015	2016	2017	2018
U.S.-born§				
Hispanic	660 (1.8)	603 (1.6)	591 (1.5)	582 (1.5)
White, non-Hispanic	984 (0.5)	910 (0.5)	797 (0.4)	801 (0.4)
Black, non-Hispanic	1,142 (3.3)	1,066 (3.0)	1,008 (2.9)	938 (2.6)
Asian	138 (2.1)	146 (2.1)	134 (1.9)	139 (1.9)
American Indian/ Alaska Native	144 (7.0)	110 (5.1)	92 (3.8)	102 (4.0)
Native Hawaiian/ Pacific Islander	42 (6.1)	31 (4.3)	46 (6.7)	42 (5.6)
Multiple or unknown race/Ethnicity	25 (—¶)	23 (—¶)	25 (—¶)	58 (—¶)
Total U.S.-born	**3,135 (1.1)**	**2,889 (1.0)**	**2,693 (1.0)**	**2,662 (1.0)**
Non–U.S.-born				
Hispanic	2,036 (10.4)	1,990 (10.1)	1,973 (10.0)	2,006 (10.1)
White, non-Hispanic	258 (3.4)	286 (3.8)	268 (3.5)	251 (3.1)
Black, non-Hispanic	858 (23.2)	914 (22.7)	901 (22.2)	829 (19.9)
Asian	3,157 (29.7)	3,051 (27.2)	3,126 (27.3)	2,993 (25.4)
American Indian/ Alaska Native	1 (1.9)	1 (2.9)	2 (2.9)	3 (5.2)
Native Hawaiian/ Pacific Islander	60 (18.6)	47 (13.0)	66 (22.4)	74 (25.0)
Multiple or unknown race/Ethnicity	37 (—¶)	68 (—¶)	56 (—¶)	120 (—¶)
Total non–U.S.-born	**6,407 (15.3)**	**6,357 (14.7)**	**6,392 (14.7)**	**6,276 (14.2)**
Unknown national origin	5 (—¶)	7 (—¶)	9 (—¶)	91 (—¶)
Overall total	**9,547 (3.0)**	**9,253 (2.9)**	**9,094 (2.8)**	**9,029 (2.8)**

* Incidence was calculated as cases per 100,000 persons.
† Case counts were based on data from the National Tuberculosis Surveillance System as of February 11, 2019. The Current Population Survey (https://www.census.gov/programs-surveys/cps.html) provides the population denominators used to calculate TB incidence rate according to national origin and racial/ethnic group.
§ U.S.-born persons were born in the United States or U.S. territories (American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Puerto Rico, and U.S. Virgin Islands) or born elsewhere to a U.S. citizen. Non–U.S.-born persons were born outside the United States (or the U.S. territories), and include those born in the sovereign freely associated states (Federated States of Micronesia, Marshall Islands, and Palau) (unless one or both parents were U.S. citizens).
¶ Incidence was not calculated for these categories.

whereas among residents of a correctional facility, only 33.6% were U.S.-born. HIV status was known for 85.3% of TB cases reported in 2018. Overall, 5.3% of TB patients with known HIV status were coinfected with HIV, including 8.6% among persons aged 25–44 years.

Initial drug-susceptibility testing for at least isoniazid and rifampin was performed for 73.5% of all TB cases (and 93.8% of culture-confirmed cases) in 2017, the most recent year for which complete data are available.†† Among the 6,684 TB cases reported in 2017 with available drug-susceptibility testing results, 128 (1.9%) were multidrug-resistant TB.§§ Of these multidrug-resistant TB cases, 110 (85.9%) were in non–U.S.-born persons; 26 (20.3%) multidrug-resistant TB patients reported a previous episode of TB. Three cases of extensively drug-resistant TB¶¶ were reported, all of which occurred in non–U.S.-born persons.

Summary

What is already known about this topic?

The number of tuberculosis (TB) cases and incidence in the United States have steadily declined since 1993.

What is added by this report?

U.S. TB incidence in 2018 (2.8 cases per 100,000 persons) was the lowest ever reported. Non–U.S.-born persons accounted for approximately two thirds of cases.

What are the implications for public health practice?

The current decline in TB incidence is insufficient to eliminate TB in the United States in the 21st century. TB elimination will require enhanced surveillance, detection, and treatment. Focusing on populations that are at increased risk for latent TB infection will be important in achieving TB elimination.

Discussion

In 2018, the provisional TB case count and incidence for the United States declined slightly, compared with those in 2017. Lower counts and incidences were seen in U.S.-born persons as well as in non–U.S.-born persons, who continue to represent a large majority of TB cases and have an incidence >14 times that of U.S.-born persons.

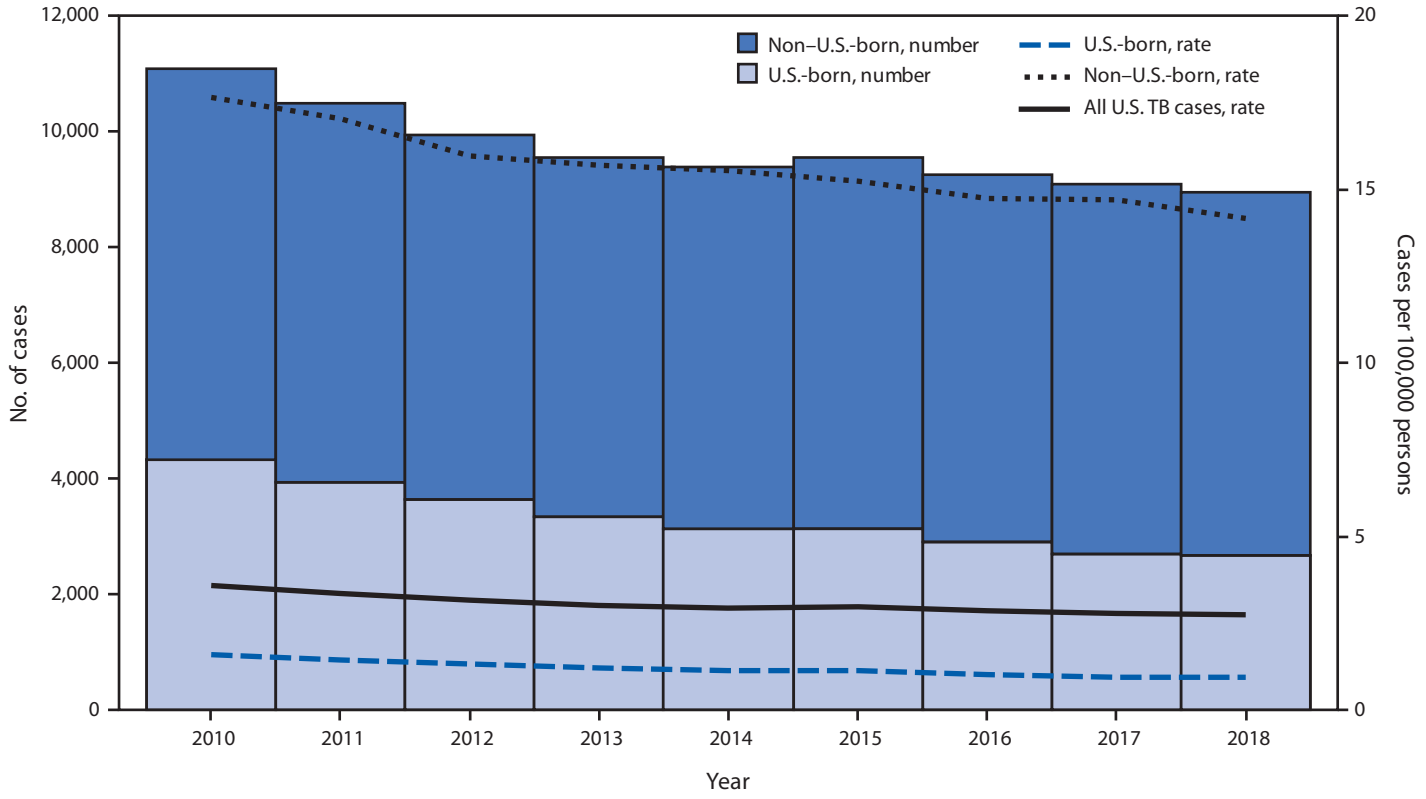
In 2018, approximately half (46.3%) of TB cases in non–U.S.-born persons received a TB diagnosis ≥10 years after first arriving in the United States, consistent with a published estimate that reactivation of remotely acquired LTBI has been responsible for >80% of domestic TB cases (*4*). Therefore, TB elimination will require a concerted effort to enhance surveillance, detection, and treatment for LTBI among populations at increased risk.

Between 3.1% and 5.0% of the U.S. population has LTBI (*5*,*6*). Without treatment, 5%–10% of persons with LTBI will develop TB disease in their lifetime (*7*). CDC and the U.S. Preventive Services Task Force recommend testing populations that are at increased risk for TB, including persons born in or who frequently travel to countries where TB is prevalent and

†† Because information on initial drug-susceptibility testing for isoniazid and rifampin is only available for 66.5% of all TB cases in 2018 (and 86.1% of culture-confirmed cases), more complete data from 2017 are presented instead. Culture-confirmed cases are defined as cases that were culture-positive on a specimen collected within 2 weeks of start of TB treatment.

§§ A case of TB caused by a strain of *Mycobacterium tuberculosis* that is resistant to at least isoniazid and rifampin.
¶¶ A case of TB caused by a strain of *Mycobacterium tuberculosis* that is resistant to isoniazid and rifampin as well as any fluoroquinolone and at least one of three injectable second-line drugs (i.e., amikacin, kanamycin, or capreomycin).

FIGURE. Number of tuberculosis (TB) cases and TB incidence, by national origin*,† — United States, 2010–2018



* Number of cases among non–U.S.-born and U.S.-born persons and associated incidence exclude cases with unknown country of origin. Incidence for all U.S. TB cases includes cases with unknown country of origin.

† Incidence for non–U.S.-born and U.S.-born persons calculated using population estimates from Current Population Survey. Incidence for all persons with TB diagnosed in the United States calculated using population estimates from U.S. Census Bureau.

persons who currently live, or previously lived, in congregate settings. CDC also recommends testing for TB in health care workers and others who work in places where there is a high risk of TB transmission, persons who are contacts of a person with infectious TB disease, and immunocompromised persons, who have a higher risk for developing TB disease once infected (*8*). According to one model, increased uptake of LTBI screening and treatment among populations at higher risk for TB would result in an incidence of 26 new infections per million by 2050 (*1*). Detection of LTBI can be improved by the preferential use of interferon-γ release assays over the tuberculin skin test, especially in persons with a history of Bacillus Calmette-Guérin vaccination or who are unlikely to return to have their tuberculin skin test read (*9*). In addition, the adoption of shorter, safer, and more convenient LTBI treatment regimens continues to be critical in improving treatment initiation and completion (*10*). Therefore, CDC recommends either 3 months of once-weekly rifapentine plus isoniazid or 4 months of daily rifampin for treatment of LTBI; these regimens may be used instead of longer courses of isoniazid alone (*10*). Given that the estimated prevalence of LTBI is higher among non–U.S.-born persons (*6*) and that rates of TB disease are much higher in this group, the detection and treatment of LTBI among non–U.S.-born persons should be prioritized. CDC is working with its state and local partners to develop an LTBI surveillance system to track effectiveness of public health measures to address LTBI.

The findings in this report are subject to at least two limitations. First, this analysis is limited to the reported provisional number of TB cases and incidence for 2018. Second, incidences are calculated using estimated population numbers as denominators.***

TB case counts and incidence in the United States in 2018 are the lowest ever reported, but this progress has slowed recently. To achieve TB elimination, the United States must expand detection and treatment of LTBI and TB disease. TB is a global problem, and its elimination will depend on cooperative measures to detect and treat LTBI and TB disease around the world.

*** The second and third references provide information on population estimates used to calculate denominators.

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Corresponding author: Amish Talwar, atalwar@cdc.gov, 404-718-7207.

[1]Division of Tuberculosis Elimination, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [2]Epidemic Intelligence Service, CDC.

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References

1. Menzies NA, Cohen T, Hill AN, et al. Prospects for tuberculosis elimination in the United States: results of a transmission dynamic model. Am J Epidemiol 2018;187:2011–20. https://doi.org/10.1093/aje/kwy094
2. US Census Bureau. National population totals and components of change: 2010–2018. Washington, DC: US Census Bureau; 2018. https://www.census.gov/data/datasets/time-series/demo/popest/2010s-national-total.html
3. US Census Bureau. TheDataWeb. Washington, DC: US Census Bureau; 2018. https://dataferrett.census.gov
4. Yuen CM, Kammerer JS, Marks K, Navin TR, France AM. Recent transmission of tuberculosis—United States, 2011–2014. PLoS One 2016;11:e0153728. https://doi.org/10.1371/journal.pone.0153728
5. Haddad MB, Raz KM, Lash TL, et al. Simple estimates for local prevalence of latent tuberculosis infection, United States, 2011–2015. Emerg Infect Dis 2018;24:1930–3. https://doi.org/10.3201/eid2410.180716
6. Miramontes R, Hill AN, Yelk Woodruff RS, et al. Tuberculosis infection in the United States: prevalence estimates from the National Health and Nutrition Examination Survey, 2011–2012. PLoS One 2015;10:e0140881. https://doi.org/10.1371/journal.pone.0140881
7. CDC. The difference between latent TB infection and TB disease. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. https://www.cdc.gov/tb/publications/factsheets/general/ltbiandactivetb.htm
8. CDC. Latent TB infection testing and treatment: summary of U.S. recommendations. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/tb/publications/ltbi/pdf/CDC-USPSTF-LTBI-Testing-Treatment-Recommendations-508.pdf
9. Lewinsohn DM, Leonard MK, LoBue PA, et al. Official American Thoracic Society/Infectious Diseases Society of America/Centers for Disease Control and Prevention clinical practice guidelines: diagnosis of tuberculosis in adults and children. Clin Infect Dis 2017;64:111–5. https://doi.org/10.1093/cid/ciw778
10. CDC. Treatment regimens for latent TB infection (LTBI). Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/tb/topic/treatment/ltbi.htm

Global Epidemiology of Tuberculosis and Progress Toward Achieving Global Targets — 2017

Adam MacNeil, PhD[1]; Philippe Glaziou, MD[2]; Charalambos Sismanidis, PhD[2]; Susan Maloney, MD[1]; Katherine Floyd, PhD[2]

Worldwide, tuberculosis (TB) is the leading cause of death from a single infectious disease agent (*1*) and the leading cause of death among persons living with human immunodeficiency virus (HIV) infection, accounting for approximately 40% of deaths in this population (*2*). The United Nations' (UN) Sustainable Development Goals (*3*) and the World Health Organization's (WHO's) End TB Strategy (*4*) have defined ambitious targets for 2020–2035, including a 35% reduction in the absolute number of TB deaths and a 20% reduction in TB incidence by 2020, compared with 2015 (*4*). Since 2000, WHO has produced annual TB estimates for all countries (*1*). Global and regional disease estimates were evaluated for 2017 to determine progress toward meeting targets. In 2017, an estimated 10 million incident cases of TB and 1.57 million TB deaths occurred, representing 1.8% and 3.9% declines, respectively, from 2016. Numbers of TB cases and disease incidence were highest in the WHO South-East Asia and Africa regions, and 9% of cases occurred among persons with HIV infection. Rifampicin-resistant (RR) or multidrug-resistant (MDR) (resistance to at least both isoniazid and rifampicin) TB occurred among 3.6% and 18% of new and previously treated TB cases, respectively (5.6% among all cases). Overall progress in global TB elimination was modest in 2017, consistent with that in recent years (*1*); intensified efforts to improve TB diagnosis, treatment, and prevention are required to meet global targets for 2020–2035.

TB data are reported to WHO annually by 194 member states and are reviewed and validated in collaboration with reporting entities. For countries in which case notifications did not capture all incident cases that occurred within a year (based on a standardized checklist), special studies, including TB prevalence surveys (*5*) or inventory studies (*6*), contributed to incidence estimates. For each country, 2017 disease incidence (per 100,000 HIV-negative persons and per 100 persons with HIV infection) and confidence intervals were estimated from 1) TB prevalence surveys; 2) notifications adjusted by a standard factor to account for underreporting, overdiagnosis, and underdiagnosis; 3) national inventory studies that measure the level of underreporting of detected TB cases, combined with capture-recapture modeling (*6*); and 4) national case notification data supplemented with expert opinion about case-detection gaps. Among HIV-negative persons, TB mortality estimates were based on cause of death data from civil registration and vital statistics, mortality surveys, or the product of TB incidence and case fatality. Among persons with HIV infection, TB mortality was derived from the product of incidence among persons with HIV infection and case fatality (*1*). Data on persons receiving TB preventive treatment, reported to WHO, were compared with estimates of eligible persons.

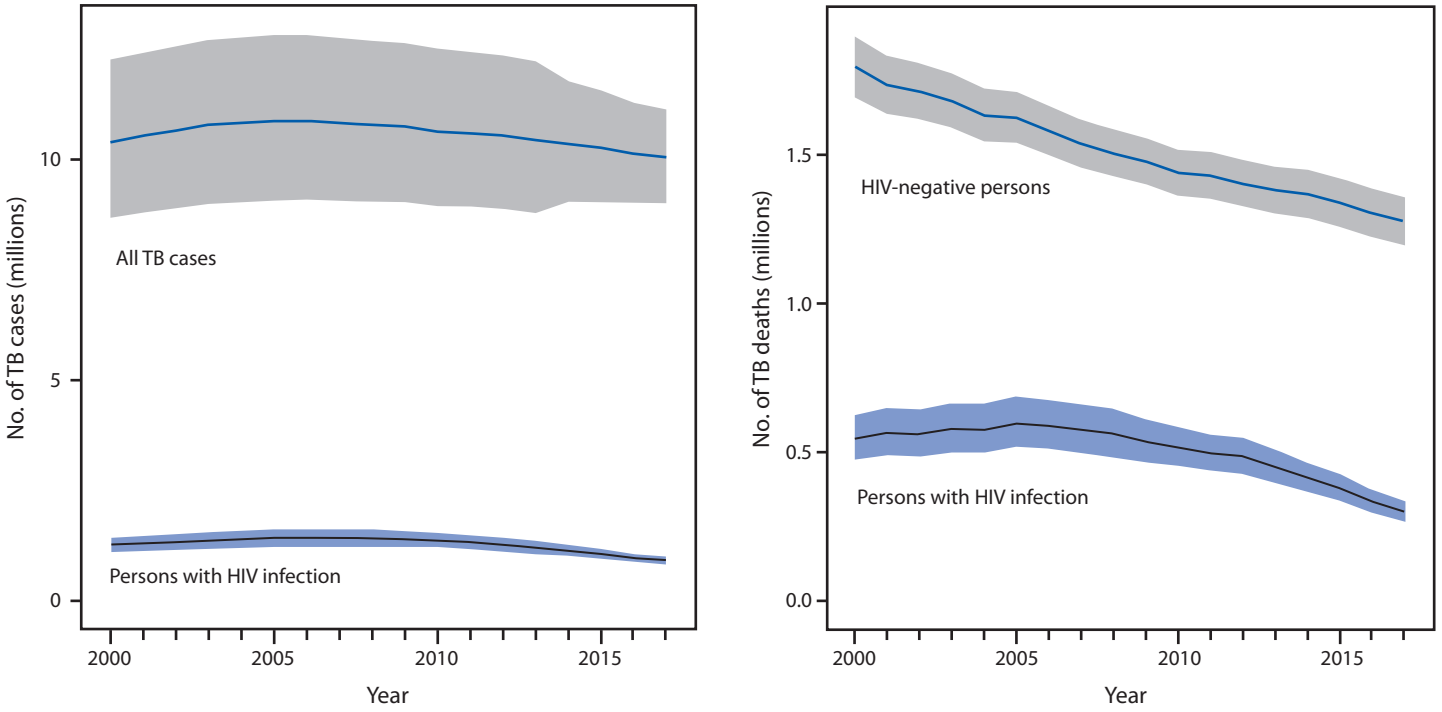
Global TB Disease

In 2017, an estimated 10 million incident cases of TB occurred (133 cases per 100,000 population), a 1.8% decline from 2016 (Figure 1). Incidence has declined by an average of 1.5% per year since 2000. Estimated TB deaths declined 3.9%, from 1.64 million in 2016 to 1.57 million in 2017 (case fatality = 15.7%; 0.5% decline from 2016) (Figure 1). Among persons with HIV infection, an estimated 920,000 incident TB cases occurred in 2017, accounting for 9% of TB cases. Among this group, the estimated annual TB incidences in 2000, 2016, and 2017 were 4.5%, 2.6%, and 2.4%, respectively; in 2017, an estimated 300,000 TB deaths among persons with HIV infection occurred (case fatality = 32.6%). Overall, an estimated 558,000 incident cases of RR or MDR TB occurred in 2017, representing 5.6% of all TB cases, 3.6% of newly diagnosed TB cases, and 18% of previously treated cases. An estimated 230,000 persons died of either RR or MDR TB (case fatality = 41%).

Regional Epidemiology of TB

The WHO regions of South-East Asia and Africa accounted for nearly 70% of overall global TB. Although total case numbers were higher in South-East Asia, overall incidence was similar in both regions (226 per 100,000 [South-East Asia], 237 [Africa]) (Table). Most high-incidence countries in 2017 were located in these two regions (Figure 2); however, the proportion of TB cases among persons with HIV infection in Africa (27%) was higher than that in South-East Asia (3%). Although the overall incidence of TB in the WHO European region was relatively low, the proportion of TB cases with RR or MDR TB in this region (40%) was substantially higher than that in all other regions (range = 3.6%–6.3%).

FIGURE 1. Trend in the estimated number of total tuberculosis (TB) incident cases and TB incident cases among persons with human immunodeficiency virus (HIV) infection, and trend in the estimated number of TB deaths among HIV-negative persons and persons with HIV infection, by year — worldwide, 2000–2017



Use of TB Preventive Treatment

TB preventive treatment (TPT) (most commonly daily isoniazid for ≥6 months) has been found to prevent TB disease among persons who might be infected with TB and are at risk for progressing to TB disease. Current recommendations include providing TPT to persons with HIV infection (in which isoniazid has been shown to result in a 37% reduction in all-cause mortality) (*7*) and to all household contacts of patients with bacteriologically confirmed pulmonary TB disease (previously recommended only for children aged <5 years) (*7*,*8*).* In 2017, 67 and 138 countries reported data on use of TPT among eligible persons with HIV infection and children aged <5 years, respectively. Among these countries, approximately 960,000 persons with HIV received TPT (estimated coverage = 36%), similar to the number reported in 2014 (930,000). Approximately 292,000 eligible children aged <5 years received TPT in 2017, representing 23% of the estimated number of children in this group eligible for TPT.

* Latent TB infection testing by tuberculin skin test or interferon γ-release assay is not a requirement for initiating preventive treatment in persons with HIV infection or in household contacts aged <5 years. Persons should be screened to rule-out active TB disease before TB preventive treatment initiation.

Discussion

In 2017, estimated TB incidence and the total number of TB deaths declined slightly worldwide; however, WHO estimates indicate that the rates of these declines are not sufficient to meet 2020 milestones (*1*). Substantial annual reductions in TB incidence and the number of TB deaths will be necessary to meet the U.N. Sustainable Development Goals and WHO End TB Strategy targets for 2030 and 2035.

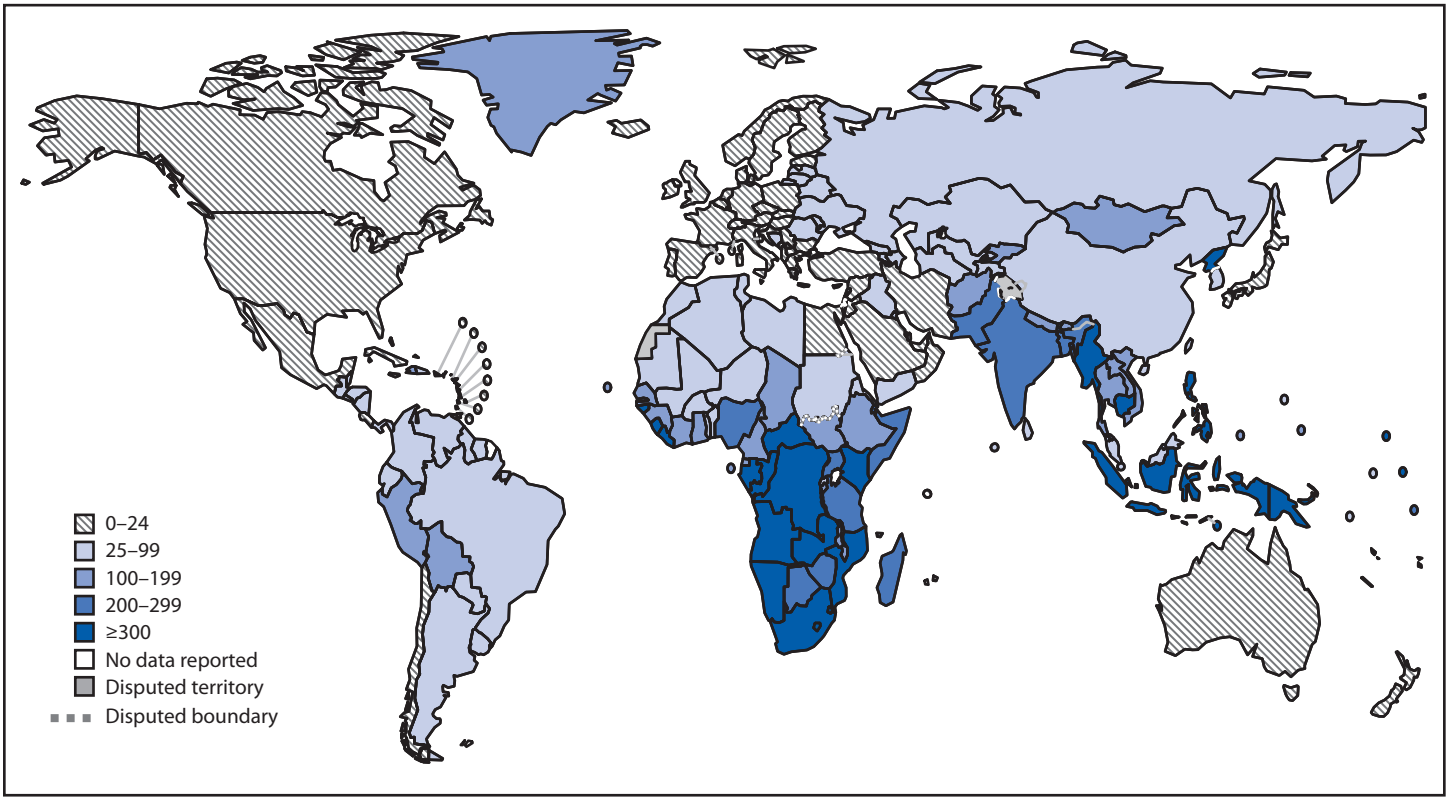
The epidemiology of TB varies geographically by WHO region. In Africa, which has the highest regional prevalence of HIV infection, coinfection with HIV is a significant factor in the TB epidemic and associated mortality, and TB case fatality is highest in this region. In South-East Asia, TB incidence is similar to that in Africa; however, low HIV infection prevalence suggests that other factors, such as undernutrition or poverty, might be driving the epidemic in this region. RR or MDR TB strains present challenges in treating TB (*9*). RR or MDR TB is a major problem in Europe, where the proportion of overall cases that are RR or MDR TB is five to 10 times higher than that in all other regions. The heterogeneous regional epidemiology of TB indicates that enhanced elimination strategies based on region-specific risk factors (e.g., screening for TB among persons with HIV infection and groups at high risk, addressing poverty and malnutrition, and testing for and treating drug-resistant TB) are needed.

TABLE. Estimated number of incident tuberculosis (TB) cases, incidence, and percentage of deaths among all TB cases, TB cases among persons with human immunodeficiency virus (HIV) infection, and rifampicin-resistant (RR) or multidrug-resistant (MDR) TB cases, by World Health Organization (WHO) region — 2017

	All TB cases			TB cases among persons with HIV infection			RR or MDR TB cases		
WHO region	No. (x1,000)	Incidence*	Deaths, no. (x1,000) (fatality[§])	No. (x1,000)	Incidence[†]	Deaths, no. (x1,000) (fatality[§])	No. (x1,000)	Incidence*	% RR or MDR among all TB cases
Global (all regions)	**10,000**	**133**	**1,570 (15.7)**	**920**	**2.4**	**300 (32.6)**	**558**	**7.4**	**5.6**
African	2,480	237	665 (26.8)	663	2.5	252 (38.0)	90	8.6	3.6
Americas	282	28	24 (8.5)	30	0.87	6 (20)	11	1.1	3.9
Eastern Mediterranean	771	113	92 (11.9)	9.8	2.5	3 (30.6)	41	6.0	5.3
European	273	30	29 (10.6)	33	1.4	5 (15.2)	109	12.0	40.0
South-East Asia	4,440	226	666 (15.0)	152	4.2	28 (18.4)	192	9.7	4.3
Western Pacific	1,800	94	97 (5.4)	31	2	5 (16.1)	114	6.0	6.3

* Cases per 100,000 population.
† Cases per 100 persons with HIV infection.
§ Per 100 TB cases.

FIGURE 2. Annual tuberculosis incidence (per 100,000 population), by region — worldwide, 2017



Successful treatment of persons with RR or MDR TB disease remains challenging, as evidenced by the high case fatality rate among RR or MDR TB patients. Two new oral treatments, delamanid and bedaquiline, have demonstrated favorable efficacy and safety profiles for treating drug-resistant TB strains (*9*). The End TB Strategy recommends ≥90% treatment coverage with new TB drugs by 2025 (*4*), thereby supporting increased use of delamanid and bedaquiline.

An estimated one quarter of the world's population has latent TB infection and is at risk for future TB disease (*10*), which has potential to be averted by TPT (*7*,*8*). Available data indicate relatively slow uptake of TPT and a stagnation in TPT administration among persons with HIV infection in recent years (*1*); current TPT coverage falls well below the End TB Strategy target level of ≥90% coverage by 2025 (*4*). In addition to the traditional TPT regimen of ≥6 months of daily isoniazid, the recently released WHO guidelines on latent TB

Summary

What is already known about this topic?

Worldwide, tuberculosis (TB) is the leading cause of death from a single infectious disease agent and the leading cause of death among persons living with human immunodeficiency virus (HIV) infection.

What is added by this report?

In 2017, an estimated 10 million incident TB cases and 1.6 million TB deaths occurred, representing reductions of 1.8% and 3.9% from 2016, respectively. TB epidemiology varied by World Health Organization region.

What are the implications for public health practice?

Innovative approaches to case finding, scale-up of TB preventive treatment, use of newer TB treatment regimens, and prevention and control of HIV will contribute to decreasing TB.

infection treatment support a once weekly isoniazid-rifapentine (3HP) regimen for 3 months for both adults and children (*8*). Although the rifapentine component of 3HP is substantially more expensive than conventional isoniazid regimens, the ease of use, improved adherence rates, and comparable safety and efficacy of 3HP have the potential to increase TPT coverage.

The findings in this report are subject to at least two limitations. First underlying data quality, particularly for surveillance, might affect the accuracy of estimates. Second, the differing methodologies used to generate country-level estimates might affect the comparability of estimates between regions and countries.

Current epidemiologic estimates demonstrate only modest progress in eliminating TB, as measured by incident disease, mortality, and drug resistance, and the rates of decline in these measures must increase if initial 2020 targets are to be met (*1*). Intensified efforts to improve TB diagnosis, treatment, and prevention are required to meet global targets for 2020–2035. Innovative approaches to case finding, scale-up of TPT, especially among populations at high risk, use of newer TB treatment regimens, prevention and control of HIV infection, as well as interventions tailored to specific epidemiologic contexts, will contribute to decreasing TB.

Acknowledgments

World Health Organization member states.

Corresponding author: Adam MacNeil, aho3@cdc.gov, 404-639-8169.

[1]Division of Global HIV and TB, Center for Global Health, CDC; [2]Tuberculosis Monitoring and Evaluation, Global Tuberculosis Programme, World Health Organization, Geneva, Switzerland.

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References

1. World Health Organization. Global tuberculosis report 2018. Geneva, Switzerland: World Health Organization; 2018. https://www.who.int/tb/publications/global_report/en/
2. Gupta RK, Lucas SB, Fielding KL, Lawn SD. Prevalence of tuberculosis in post-mortem studies of HIV-infected adults and children in resource-limited settings: a systematic review and meta-analysis. AIDS 2015;29:1987–2002. https://doi.org/10.1097/QAD.0000000000000802
3. United Nations. Sustainable development goals. New York, NY: United Nations; 2016. https://sustainabledevelopment.un.org
4. World Health Organization. The end TB strategy. Geneva, Switzerland: World Health Organization; 2015. https://www.who.int/tb/strategy/end-tb/en/
5. World Health Organization. Tuberculosis prevalence surveys: a handbook. Geneva, Switzerland: World Health Organization; 2011. https://www.who.int/tb/advisory_bodies/impact_measurement_taskforce/resources_documents/thelimebook/en/
6. World Health Organization. Assessing tuberculosis under-reporting through inventory studies. Geneva, Switzerland: World Health Organization; 2012. https://www.who.int/tb/publications/inventory_studies/en/
7. Badje A, Moh R, Gabillard D, et al.; Temprano ANRS 12136 Study Group. Effect of isoniazid preventive therapy on risk of death in west African, HIV-infected adults with high CD4 cell counts: long-term follow-up of the Temprano ANRS 12136 trial. Lancet Glob Health 2017;5:e1080–9. https://doi.org/10.1016/S2214-109X(17)30372-8
8. World Health Organization. Latent TB infection: updated and consolidated guidelines for programmatic management. Geneva, Switzerland: World Health Organization; 2018. https://www.who.int/tb/publications/2018/latent-tuberculosis-infection/en/
9. World Health Organization. Companion handbook to the WHO guidelines for the programmatic management of drug-resistant tuberculosis. Geneva, Switzerland: World Health Organization; 2014. https://www.who.int/tb/publications/pmdt_companionhandbook/en/
10. Houben RM, Dodd PJ. The global burden of latent tuberculosis infection: a re-estimation using mathematical modelling. PLoS Med 2016;13:e1002152. https://doi.org/10.1371/journal.pmed.1002152

Vital Signs: HIV Transmission Along the Continuum of Care — United States, 2016

Zihao Li, PhD[1]; David W. Purcell, JD, PhD[1]; Stephanie L. Sansom, PhD[1]; Demorah Hayes, MA[1]; H. Irene Hall, PhD[1]

On March 18, 2019, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Abstract

Background: In 2016, an estimated 1.1 million persons had human immunodeficiency virus (HIV) infection in the United States; 38,700 were new infections. Knowledge of HIV infection status, behavior change, and antiretroviral therapy (ART) all prevent HIV transmission. Persons who achieve and maintain viral suppression (achieved by most persons within 6 months of starting ART) can live long, healthy lives and pose effectively no risk of HIV transmission to their sexual partners.

Methods: A model was used to estimate transmission rates in 2016 along the HIV continuum of care. Data for sexual and needle-sharing behaviors were obtained from National HIV Behavioral Surveillance. Estimated HIV prevalence, incidence, receipt of care, and viral suppression were obtained from National HIV Surveillance System data.

Results: Overall, the HIV transmission rate was 3.5 per 100 person-years in 2016. Along the HIV continuum of care, the transmission rates from persons who were 1) acutely infected and unaware of their infection, 2) non-acutely infected and unaware, 3) aware of HIV infection but not in care, 4) receiving HIV care but not virally suppressed, and 5) taking ART and virally suppressed were 16.1, 8.4, 6.6, 6.1, and 0 per 100 person-years, respectively. The percentages of all transmissions generated by each group were 4.0%, 33.6%, 42.6%, 19.8%, and 0%, respectively.

Conclusion: Approximately 80% of new HIV transmissions are from persons who do not know they have HIV infection or are not receiving regular care. Going forward, increasing the percentage of persons with HIV infection who have achieved viral suppression and do not transmit HIV will be critical for ending the HIV epidemic in the United States.

Introduction

Medical treatment has substantially improved the health, quality of life, and life expectancy of persons with HIV infection (*1*). The benefits of treatment are maximized with suppression of the virus (<200 copies of HIV/mL of blood on the most recent viral load test), which benefits health and decreases rates of transmission. Four recent studies found that viral suppression prevented sexual transmission of HIV (*2*–*5*). Together, these prospective studies found no HIV transmissions attributable to sex between HIV-discordant couples when the partner with HIV infection was on treatment and maintained viral suppression, despite documenting tens of thousands of acts of condomless sex in which the HIV-negative partner was not using preexposure prophylaxis. These findings indicate that HIV transmission can become a rare event if persons with infection can obtain treatment and achieve and maintain viral suppression. Today's treatment regimens are simpler than those prescribed in the past, sometimes requiring only single-tablet formulations, with fewer side effects; most persons with HIV infection can achieve viral suppression within 6 months of initiating treatment. These findings also provide an important scientific underpinning to the new federal initiative headed by the U.S. Department of Health and Human Services (HHS) to end the HIV epidemic in the United States within 10 years (*6*).

Despite the availability of effective treatment, many of the 1.1 million persons with HIV infection in the United States are not effectively treated (*7*,*8*). In 2015, among all persons with HIV infection, 14.5% did not have a diagnosis, 37.2% were not in care,* and 48.9% were not virally suppressed (*7*). In addition, sexual and injection-drug–associated risk behaviors varied with knowledge of HIV infection status and access to care (*9*,*10*). Lack of effective treatment results in worse outcomes for persons with HIV infection and higher rates of HIV transmission and was associated with 38,700 new HIV infections in 2016 (*8*). To focus national and local prevention efforts to eliminate HIV, CDC used a model to estimate the number of persons and HIV transmissions at each step along the continuum of care.

* Receipt of medical care is defined as one or more tests (CD4 or viral load) in the measurement year. The percentage of persons with HIV infection who are in care is obtained by multiplying the percentage with diagnosed infection by percentage in care among persons with diagnosed HIV infection.

Summary

What is already known about this topic?

Recent studies have demonstrated no human immunodeficiency virus (HIV) sexual transmission by persons whose infection is treated and who have achieved and sustain viral suppression. New estimates are needed to understand remaining sources of HIV transmissions.

What is added by this report?

An HIV transmission model indicated that, along the HIV care continuum, transmissions arise from persons with HIV infection who have not received a diagnosis or who have a diagnosed infection that is not controlled.

What are the implications for public health practice?

To control the spread of HIV in the United States, HIV infection must be diagnosed early and persons with HIV infection quickly engaged in sustained care and treatment.

Methods

CDC updated the Progression and Transmission of HIV (PATH 2.0) model to estimate 2016 U.S. transmission rates by step along the HIV care continuum, population risk group, and age group (*9*). Mutually exclusive population risk groups included 1) men who have sex with men (MSM), 2) persons who inject drugs (men and women), 3) MSM who inject drugs, and 4) heterosexual men and women. PATH 2.0 tracked persons with HIV infection and their stage of disease (as measured by viral load and CD4 counts) as they moved along the HIV care continuum. Persons formed main and casual sexual partnerships as well as injection partnerships, with chances of transmission determined by sexual behaviors, injection risk behaviors, partnership preference, and viral load suppression status. Transmissions were tracked weekly in the acute stage (up to 3 months after HIV infection) and monthly thereafter. Persons newly infected with HIV were incorporated into the model.

Model inputs included behavioral data from National HIV Behavioral Surveillance and epidemiologic and clinical data from the National HIV Surveillance System. For persons in the model with viral suppression, the reduction in transmission rate was 100%[†] (*2*–*5*). Based on population risk group and the cumulative amount of time spent in each age group and care-continuum step, the model estimated the number of infections each subgroup generated. The transmission rates (number of transmissions per 100 person-years) of a subgroup in a particular year were calculated by dividing the number of new infections generated by persons in that subgroup by the amount of time all persons spent in the subgroup and multiplying by 100. The trends in overall transmission rates estimated by the model were compared with the percentage of persons virally suppressed based on national HIV surveillance data.

[†] No data are available on the efficacy of viral suppression on reducing HIV transmission from injection drug use; 100% efficacy was assumed based on trial results for sexual transmission efficacy. Sensitivity analyses using an efficacy for injection-related transmission of 50%, 76%, and 90% resulted in transmission rates per 100 person-years of 0.13, 0.06, and 0.03, respectively.

Results

The overall estimated HIV transmission rate in 2016 was 3.5 new infections per 100 person-years (Table). The rates of transmission decreased with progression along the HIV continuum of care. Persons who were acutely infected and unaware of their infection had the highest transmission rate (16.1), followed by persons who were non-acutely infected and unaware (8.4), those aware of their HIV infection but not in care (6.6), and those receiving HIV care but not virally suppressed (6.1). The rate was zero among those taking ART and virally suppressed. The percentage of all transmissions generated by each group was 4.0%, 33.6%, 42.6%, 19.8%, and 0%, respectively (Figure 1).

Among estimated transmissions in 2016, 73.0% were from MSM, 9.7% from persons who inject drugs, 5.3% from MSM who inject drugs, and 12.0% from heterosexuals. The highest transmission rate (4.4 per 100 person-years) was among MSM, followed by MSM who inject drugs (3.8), men who inject drugs (3.6), heterosexual men (2.7), women who inject drugs (2.2), and heterosexual women (1.2). In general, the transmission rate was higher among younger persons and was highest among those aged 13–24 years (5.1). However, because of the size of the population, persons aged ≥55 years generated the largest percentage of new infections (29.4%). The model estimated a decline in overall transmission rate (from 4.5 to 3.5 per 100 person-years) from 2010 through 2016 that corresponded to a steady increase in viral suppression over those years (Figure 2).

Discussion

The PATH 2.0 model estimated that HIV transmissions in 2016 occurred primarily from persons with HIV infection who did not know they were infected and persons with diagnosed HIV infection who were not in care; together, these two groups accounted for approximately 80% of new infections. Those who were in care but had not achieved viral suppression accounted for approximately 20% of transmissions. To end the HIV epidemic in the United States, the HHS initiative directs a path forward for success (*6*). First, early detection of HIV infection must be improved (*11*). Second, once HIV infection is identified, rapid entry into care and prevention services is crucial to ensure achievement of viral suppression as quickly as possible. Modeling studies indicate that viral suppression is critical for decreasing HIV incidence (*12*).

TABLE. Estimated number of persons with human immunodeficiency virus (HIV) infection and transmissions, by selected characteristics — United States, 2016

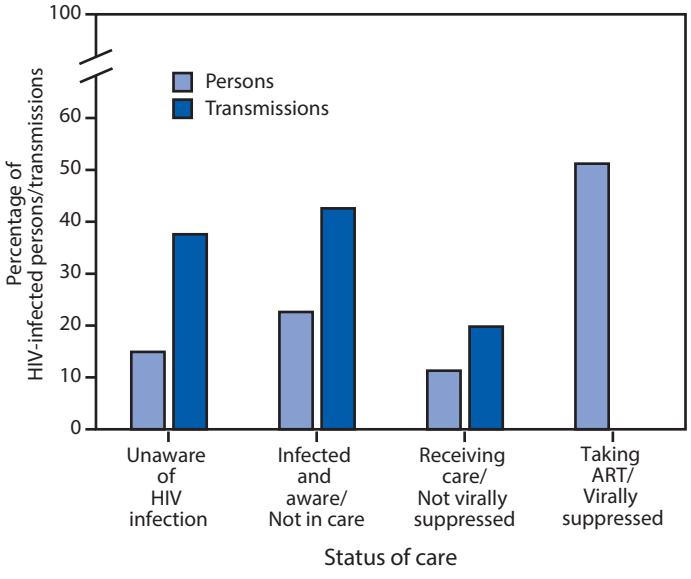
Characteristic	Transmission rate*	Persons in subgroup† no. (%)	Transmissions generated§ no. (%)
HIV care continuum			
Unaware of HIV infection			
Acutely infected and unaware	16.1	9,600 (0.9)	1,500 (4.0)
Non-acutely infected and unaware	8.4	154,400 (14.0)	13,000 (33.6)
Aware of HIV infection			
Not in care	6.6	249,700 (22.6)	16,500 (42.6)
Receiving HIV care but not virally suppressed	6.1	125,300 (11.3)	7,700 (19.8)
Taking ART and virally suppressed	0.0	565,800 (51.2)	0 (0.0)
Population risk group¶			
MSM	4.4	645,600 (58.4)	28,300 (73.0)
Men who inject drugs	3.6	77,500 (7.1)	2,800 (7.2)
Women who inject drugs	2.2	46,600 (4.2)	1,000 (2.6)
MSM who inject drugs	3.8	53,400 (4.8)	2,100 (5.3)
Heterosexual men	2.7	87,500 (7.9)	2,400 (6.1)
Heterosexual women	1.2	194,200 (17.6)	2,300 (5.8)
Age group (yrs)			
13–24	5.1	65,200 (5.9)	3,300 (8.5)
25–34	4.6	160,900 (14.6)	7,300 (19.0)
35–44	3.9	214,800 (19.4)	8,400 (21.8)
45–54	3.2	258,500 (23.4)	8,200 (21.3)
≥55	2.8	405,500 (36.7)	11,400 (29.4)
Total	**3.5**	**1,104,900 (100)**	**38,700 (100)**

Abbreviations: ART = antiretroviral therapy; MSM = men who have sex with men.
* Number of transmissions per 100 person-years.
† The number of persons in each subgroup in the model, averaged over 12 months and rounded to the nearest 100. Numbers might not sum to total because of rounding.
§ Generated from model and rounded to the nearest 100. Numbers might not sum to total because of rounding.
¶ MSM and persons who inject drugs can transmit sexually to men and women; persons who inject drugs can also transmit via injection drug use.

Providers play an important role in this effort by screening patients for HIV infection, actively linking and engaging persons with HIV infection into ongoing, comprehensive care, and emphasizing the importance of achieving and maintaining viral suppression for personal health and prevention benefits. Routine testing and targeted HIV testing are complementary approaches to addressing the 38% of transmissions that occurred from the estimated 15% of persons with undiagnosed HIV infection, by increasing awareness of HIV infection status and diagnosing infection sooner. Initial diagnosis is a necessary step to obtaining the benefits of HIV treatment and other psychosocial resources; however, the median interval between infection and diagnosis is 3 years (*11*). CDC recommends routine screening of all Americans aged 13–64 years at least once in their life and at least annual testing for those at high risk for acquiring HIV (*13*). Providers must work with their patients to ensure that HIV screening occurs in accordance with CDC guidelines. In addition, community partners can provide testing aimed at persons who are less likely to interact with the health care system on a regular basis. Together, these approaches can reduce undiagnosed HIV infection in the United States and thereby decrease transmission from persons with undiagnosed infection.

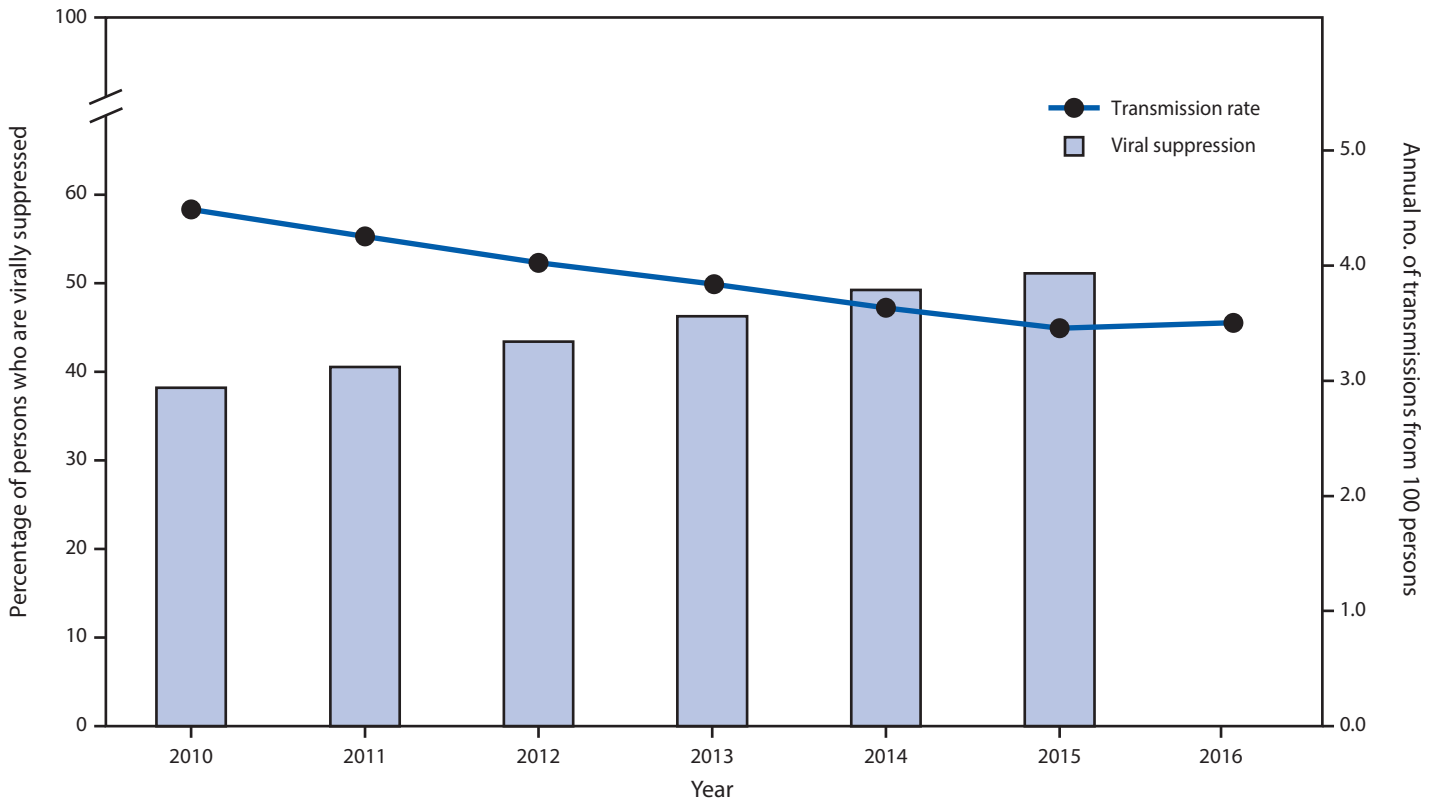
To address the 43% of transmissions that occur from the 23% of persons who have diagnosed infection and are not in

FIGURE 1. Percentage of persons* with human immunodeficiency virus (HIV) infection and percentage of transmissions along the continuum of HIV care† — United States, 2016§,¶



Abbreviation: ART = antiretroviral therapy.
* Percentage of persons in each subgroup averaged over 12 months in the model.
† Receipt of medical care was defined as one or more test (CD4 or viral load) in 2016.
§ Viral suppression was defined as <200 copies of HIV/mL of blood on the most recent viral load test.
¶ Unaware of HIV infection includes acutely infected and non-acutely infected persons unaware of their HIV infection.

FIGURE 2. Percentage of persons with human immunodeficiency virus (HIV) infection who are virally suppressed* and HIV transmission rate† — United States, 2010–2016§



* Viral suppression among persons with HIV infection; percentage obtained by multiplying the percentage with infection by the percentage virally suppressed among persons with diagnosed HIV infection. Viral suppression was defined as <200 copies of HIV/mL of blood on the most recent viral load test.
† Generated from model. Measured in number of transmissions per 100 person-years (i.e., annual number of transmissions from 100 persons).
§ 2016 viral suppression data is not yet available.

care, improvements in rapid linkage to and retention in care are needed. Continued engagement in care might be difficult for some persons because of barriers that include lack of insurance, housing, transportation, or other resources; stigma and discrimination; mental health and substance use issues; and lack of trust in the medical system (*14*). These patients can benefit from tailored support services. Research on patterns of care over time could provide a better understanding of factors associated with patient dropout from care (*15*). Patients might respond well to knowledge of the personal and preventive benefits of treatment. Community efforts to increase public awareness of the benefits of viral suppression might help decrease stigma and make staying in care easier (*16*).

Helping patients adhere to treatment is important in addressing the 20% of infections that occur from the 11% of persons with HIV infection who are in care but not virally suppressed. Among persons with HIV infection who are in clinical care, approximately 80% were virally suppressed at their most recent visit (*17*,*18*), but about one third did not sustain viral suppression over a year (*17*,*18*). A tailored approach aimed at the barriers that are most relevant for the patient are important to improving adherence to medications and ultimately achieving and sustaining viral suppression.§

Among population risk groups within the model, most transmissions were from MSM because of the high proportion of persons with HIV infection who are MSM, the higher risk of transmission associated with anal sex, and high HIV infection prevalence among MSM. The highest transmission rate was among persons aged 13–24 years, and the highest number of transmissions were from persons aged ≥55 years, because of the larger number of persons living with HIV infection in this age group.

The findings in this report are subject to at least five limitations. First, PATH 2.0 required data on the sexual and injection behaviors of persons with HIV infection, and such data were limited (e.g., available data often were not stratified by age and disease stage) and mostly based on self-report. Second, although CDC assumed no injection drug use transmissions from persons who were virally suppressed, no data exist on the efficacy of viral suppression in reducing HIV transmission

§ https://www.cdc.gov/actagainstaids/campaigns/pic/index.html.

from injection drug use. Third, the model does not account for differences in prevalences of awareness of HIV infection and viral suppression by age. Thus, transmission rate estimates among younger persons might be underestimated, because data show a higher percentage of persons with HIV infection who were unaware of their infection (*8*) and a lower percentage with viral suppression among the younger age groups (*7*). Fourth, the model included 23,000 persons to represent the 1.1 million persons with HIV infection in the United States, and, for computational feasibility, the results obtained were scaled up to match current incidence. However, results were similar when a larger number of persons were input into the model. Finally, the model conservatively restricted reductions in transmission attributable to reduced viral load to those who achieved viral suppression. Some data indicate that, in general, persons with lower viral loads have a lower risk of transmission, even in the absence of viral suppression. However, data to determine viral loads over time for persons out of care or with undiagnosed HIV infection do not exist.

Although the prevalence of viral suppression among persons with HIV infection has been increasing, and the number of new infections and transmission rates have been decreasing in the United States, faster rates of change are needed to end the HIV epidemic in the United States. To accelerate progress, persons with HIV infection must receive a diagnosis soon after infection, begin treatment rapidly after diagnosis, adhere to treatment, and receive support services that help achieve and sustain viral suppression. Providers should screen patients for HIV infection at least once and test some patients more frequently; rapidly link, engage, or re-engage patients into comprehensive HIV care; and encourage patients to sustain viral suppression for their own health and because of the tremendous prevention benefits. In addition, many persons with HIV infection find it important to know that maintaining viral suppression prevents sexual transmission to partners and sharing this knowledge more generally might decrease the stigma associated with HIV infection and help engage patients in consistent care.

Acknowledgments

Paul Farnham, Yao-Hsuan Chen, Division of HIV/AIDS Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; Chaitra Gopalappa, University of Massachusetts, Amherst.

Corresponding author: Stephanie L. Sansom, SSansom@cdc.gov, 404-639-6152.

[1]Division of HIV/AIDS Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

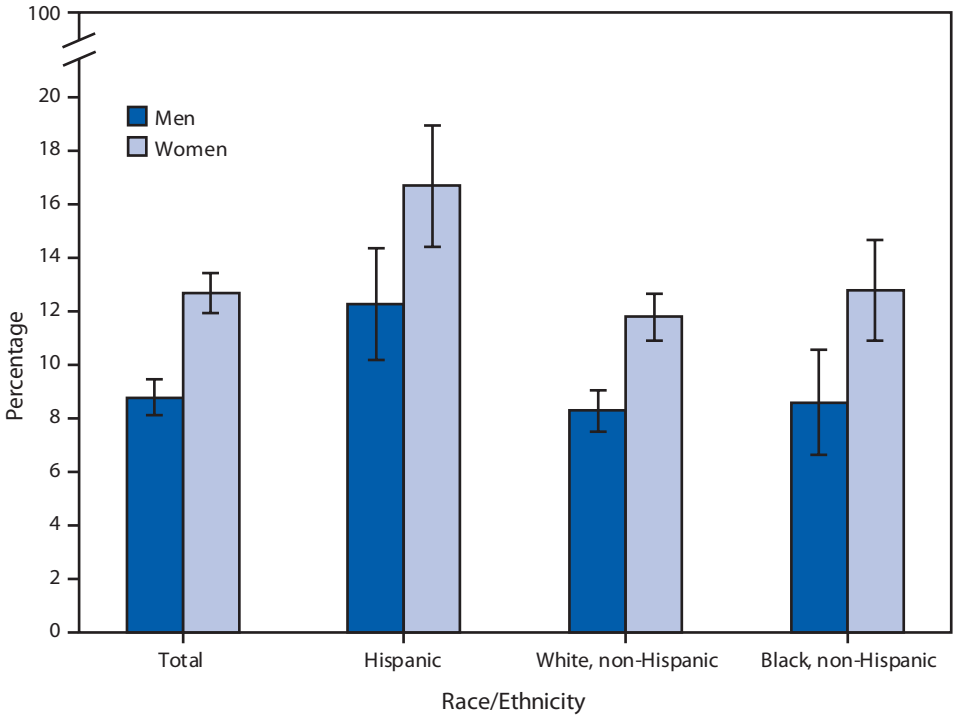
1. Farnham PG, Gopalappa C, Sansom SL, et al. Updates of lifetime costs of care and quality-of-life estimates for HIV-infected persons in the United States: late versus early diagnosis and entry into care. J Acquir Immune Defic Syndr 2013;64:183–9. https://doi.org/10.1097/QAI.0b013e3182973966
2. Bavinton BR, Pinto AN, Phanuphak N, et al.; Opposites Attract Study Group. Viral suppression and HIV transmission in serodiscordant male couples: an international, prospective, observational, cohort study. Lancet HIV 2018;5:e438–47. https://doi.org/10.1016/S2352-3018(18)30132-2
3. Cohen MS, Chen YQ, McCauley M, et al.; HPTN 052 Study Team. Antiretroviral therapy for the prevention of HIV-1 transmission. N Engl J Med 2016;375:830–9. https://doi.org/10.1056/NEJMoa1600693
4. Rodger AJ, Cambiano V, Bruun T, et al.; PARTNER Study Group. Sexual activity without condoms and risk of HIV transmission in serodifferent couples when the HIV-positive partner is using suppressive antiretroviral therapy. JAMA 2016;316:171–81. https://doi.org/10.1001/jama.2016.5148
5. Rodger A, Cambiano V, Bruun T, et al. Risk of HIV transmission through condomless sex in MSM couples with suppressive ART: the PARTNER2 Study extended results in gay men [abstract]. Presented at AIDS 2018: 22nd International AIDS Conference, Amsterdam, Netherlands, July 23–27, 2018.
6. Fauci AS, Redfield RR, Sigounas G, et al. Ending the HIV epidemic: a plan for the United States. JAMA 2019. Epub February 7, 2019. https://jamanetwork.com/journals/jama/fullarticle/2724455
7. CDC. Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 dependent areas, 2016. HIV surveillance supplemental report vol. 23, no. 4. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-supplemental-report-vol-23-4.pdf
8. CDC. Estimated HIV incidence and prevalence in the United States, 2010–2016. HIV surveillance supplemental report vol. 24, no. 1. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html
9. Gopalappa C, Farnham PG, Chen YH, Sansom SL. Progression and Transmission of HIV/AIDS (PATH 2.0). Med Decis Making 2017;37:224–33. https://doi.org/10.1177/0272989X16668509
10. CDC. HIV infection, risk, prevention, and testing behaviors among persons who inject drugs–national HIV behavioral surveillance: injection drug use, 20 U.S. cities, 2015. HIV surveillance special report no.18. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html
11. Dailey AF, Hoots BE, Hall HI, et al. Vital signs: human immunodeficiency virus testing and diagnosis delays—United States. MMWR Morb Mortal Wkly Rep 2017;66:1300–6. https://doi.org/10.15585/mmwr.mm6647e1
12. Uzun Jacobson E, Hicks KA, Tucker EL, Farnham PG, Sansom SL. Effects of reaching national goals on HIV incidence, by race and ethnicity, in the United States. J Public Health Manag Pract 2018;24:E1–8. https://doi.org/10.1097/PHH.0000000000000717
13. Branson BM, Handsfield HH, Lampe MA, et al. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep 2006;55(No. RR-14).
14. Yehia BR, Stewart L, Momplaisir F, et al. Barriers and facilitators to patient retention in HIV care. BMC Infect Dis 2015;15:246–55. https://doi.org/10.1186/s12879-015-0990-0
15. Lee H, Wu XK, Genberg BL, et al.; Centers for AIDS Research Network of Integrated Clinical Systems (CNICS) Investigators. Beyond binary retention in HIV care: predictors of the dynamic processes of patient engagement, disengagement, and re-entry into care in a US clinical cohort. AIDS 2018;32:2217–25. https://doi.org/10.1097/QAD.0000000000001936

16. The Lancet HIV. U=U taking off in 2017. Lancet HIV 2017;4:e475. https://doi.org/10.1016/S2352-3018(17)30183-2
17. CDC. Behavioral and clinical characteristics of persons receiving medical care for HIV infection—Medical Monitoring Project, United States, 2014 cycle (June 2014–May 2015). HIV surveillance special report no. 17. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-hssr-mmp-2014.pdf
18. Marks G, Patel U, Stirratt MJ, et al. Single viral load measurements overestimate stable viral suppression among HIV patients in care: clinical and public health implications. J Acquir Immune Defic Syndr 2016;73:205–12. https://doi.org/10.1097/QAI.0000000000001036

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage* of Adults Aged ≥18 Years Who Reported That They Needed Dental Care During the Past 12 Months But Didn't Get It Because They Couldn't Afford It,† by Sex, Race, and Hispanic Origin§ — National Health Interview Survey, 2017¶



* With 95% confidence intervals indicated with error bars.
† Based on a question that asked respondents "During the past 12 months, was there any time when you needed any of the following but didn't get it because you couldn't afford it: Dental care (including check-ups)?" Persons who said they did not know or refused to answer were considered unknown and not included in the analysis.
§ Categories shown are for Hispanic adults, who might be of any race or combination of races, and non-Hispanic adults who selected one racial group; not all racial groups are shown. Percentages shown for "Total" are based on all adults aged ≥18 years.
¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population aged ≥18 years and are age-adjusted using the projected 2000 U.S. population as the standard population and four age groups: 18–44, 45–64, 65–74, and ≥75 years.

In 2017, more women (12.7%) than men (8.8%) reported that at some time during the past 12 months they needed dental care but didn't get it because they couldn't afford it. This pattern was consistent within each racial/ethnic group: Hispanic, non-Hispanic white, and non-Hispanic black. Among both men and women, Hispanic adults were most likely to have unmet needs for dental care because they couldn't afford it. Nearly 17% of Hispanic women could not afford to meet their dental care needs, compared with 12.8% of non-Hispanic black women and 11.8% of non-Hispanic white women; 12.3% of Hispanic men had unmet dental care needs, compared with 8.6% of non-Hispanic black men and 8.3% of non-Hispanic white men.

Source: Tables of Summary Health Statistics, 2017. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/NHIS/SHS/2017_SHS_Table_A-19.pdf.

Reported by: Debra L. Blackwell, PhD, DBlackwell@cdc.gov, 301-458-4103; Maria A. Villarroel, PhD.

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