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Tuberculosis — United States, 2022

Kimberly R. Schildknecht, MPH[1,2]; Robert H. Pratt[2]; Pei-Jean I. Feng, MPH[2]; Sandy F. Price[2]; Julie L. Self, PhD[2]

Incidence of reported tuberculosis (TB) decreased gradually in the United States during 1993–2019, reaching 2.7 cases per 100,000 persons in 2019. Incidence substantially declined in 2020 to 2.2, coinciding with the COVID-19 pandemic (*1*). Proposed explanations for the decline include delayed or missed TB diagnoses, changes in migration and travel, and mortality among persons susceptible to TB reactivation (*1*). Disparities (e.g., by race and ethnicity) in TB incidence have been described (*2*). During 2021, TB incidence partially rebounded (to 2.4) but remained substantially below that during prepandemic years, raising concerns about ongoing delayed diagnoses (*1*). During 2022, the 50 U.S. states and the District of Columbia (DC) provisionally reported 8,300 TB cases to the National Tuberculosis Surveillance System. TB incidence was calculated using midyear population estimates and stratified by birth origin and by race and ethnicity. During 2022, TB incidence increased slightly to 2.5 although it remained lower than during prepandemic years.* Compared with that in 2021, TB epidemiology in 2022 was characterized by more cases among non–U.S.-born persons newly arrived in the United States; higher TB incidence among non-Hispanic American Indian or Alaska Native (AI/AN) and non-Hispanic Native Hawaiian or other Pacific Islander (NH/OPI) persons and persons aged ≤4 and 15–24 years; and slightly lower incidence among persons aged ≥65 years. TB incidence appears to be returning to prepandemic levels. TB disparities persist; addressing these disparities requires timely TB diagnosis and treatment to interrupt transmission and prevention of TB through treatment of latent TB infection (LTBI).

Health departments in the 50 U.S. states and DC electronically report verified TB cases to CDC based on the Council of State and Territorial Epidemiologists' surveillance case definition.† Midyear U.S. Census Bureau population estimates§ are used to calculate national, state-level, and age-stratified TB incidence. Persons with TB are grouped by self-reported race and ethnicity according to federal guidelines.¶ Persons reporting Hispanic ethnicity are categorized as Hispanic or

*This report is limited to National Tuberculosis Surveillance System data provisionally reported by the 50 U.S. states and DC as of March 6, 2023. Updated data will be available in CDC's annual TB surveillance report later in 2023.

† TB cases are verified based on the case definition for public health surveillance, which includes laboratory criteria, clinical criteria, or provider diagnosis. https://ndc.services.cdc.gov/case-definitions/tuberculosis-2009/

§ Short-term projections from the monthly population estimates by age, sex, race, and Hispanic origin were used for 2022 population, 2021 vintage population estimates were used for 2021 and 2020, and 2010 vintage population estimates were used for 2012–2019. https://www.census.gov/programs-surveys/popest/data/tables.html; https://www.census.gov/programs-surveys/popest/data/tables.2019.List_58029271.html#list-tab-List_58029271

¶ https://www.census.gov/topics/population/race/about.html

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Latino (Hispanic) irrespective of race. Non-Hispanic persons are categorized by race; non-Hispanic persons who reported more than one race are categorized as "multiple race." Midyear population estimates from the Current Population Survey** are used to calculate incidence by U.S. birth origin (U.S.-born versus non–U.S.-born)†† and by race and ethnicity. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.§§

During 2022, 8,300 TB cases were reported in the United States, compared with 7,874 during 2021. TB incidence during 2022 increased slightly to 2.5 per 100,000 persons, compared with 2.4 during 2021. Consistent with previous years (*1*), in 2022, California reported the highest number of TB cases (1,843) and Alaska reported the highest TB incidence (13.1) (Table 1).

In 2022, 73% (6,009 of 8,248 TB cases in persons for whom birth origin was known) of TB cases occurred among non–U.S.-born persons,¶¶ compared with 72% in 2021. Among U.S.-born persons, TB incidence was 0.8 during both 2021 and 2022; among non–U.S.-born persons, incidence increased slightly from 12.6 in 2021 to 12.8 in 2022 (Figure) (Table 2). Among 2,239 U.S.-born persons with TB in 2022, 673 (30%) identified as non-Hispanic Black or African American (Black), 578 (26%) as Hispanic, 568 (25%) as non-Hispanic White (White), 182 (8%) as non-Hispanic Asian (Asian), 110 (5%) as AI/AN, and 52 (2%) as NH/OPI; 76 (3%) identified as multiple race or had unknown race and ethnicity. Among these groups, incidence was highest among NH/OPI persons (6.6), followed by AI/AN (4.4), Asian (2.2), and Black persons (1.9) and was lowest among White persons (0.3). Compared with that in 2021, incidence in 2022 increased 63% among Asian persons, 26% among NH/OPI persons, 16% among AI/AN persons, and 7% among Hispanic persons. Incidence declined 9% among Black persons, and 10% among White persons.***

In 2022, 6,009 TB cases occurred among non–U.S.-born persons; >80% of these cases were among Asian (2,632; 44%) or Hispanic (2,194; 37%) persons. The remaining cases occurred among Black (625; 10%), White (276; 5%), and NH/OPI (103; 2%) persons, and multiple race persons or persons whose race and ethnicity were unknown (177; 3%). In 2022, similar to that among U.S.-born persons, the highest TB incidence among non–U.S.-born persons (27.8) was

** https://www.census.gov/programs-surveys/cps.html

†† A person is considered U.S.-born if eligible for U.S. citizenship at birth, regardless of place of birth. Birth origin was missing or unknown for 232 (2.8%) cases during 2022. Among those, 180 (77.6%) had country of birth reported, and birth origin was defined as U.S.-born for persons reporting birth in the United States or U.S. territories and as non–U.S.-born for persons born outside the United States and its territories.

§§ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

¶¶ Proportions using birth origin are calculated excluding those with missing data.

*** Percentage change is calculated from unrounded numbers. For demographic groups with small populations (e.g., non–U.S.-born AI/AN persons), changes in incidence rates should be interpreted cautiously because of the increased volatility of these rates.

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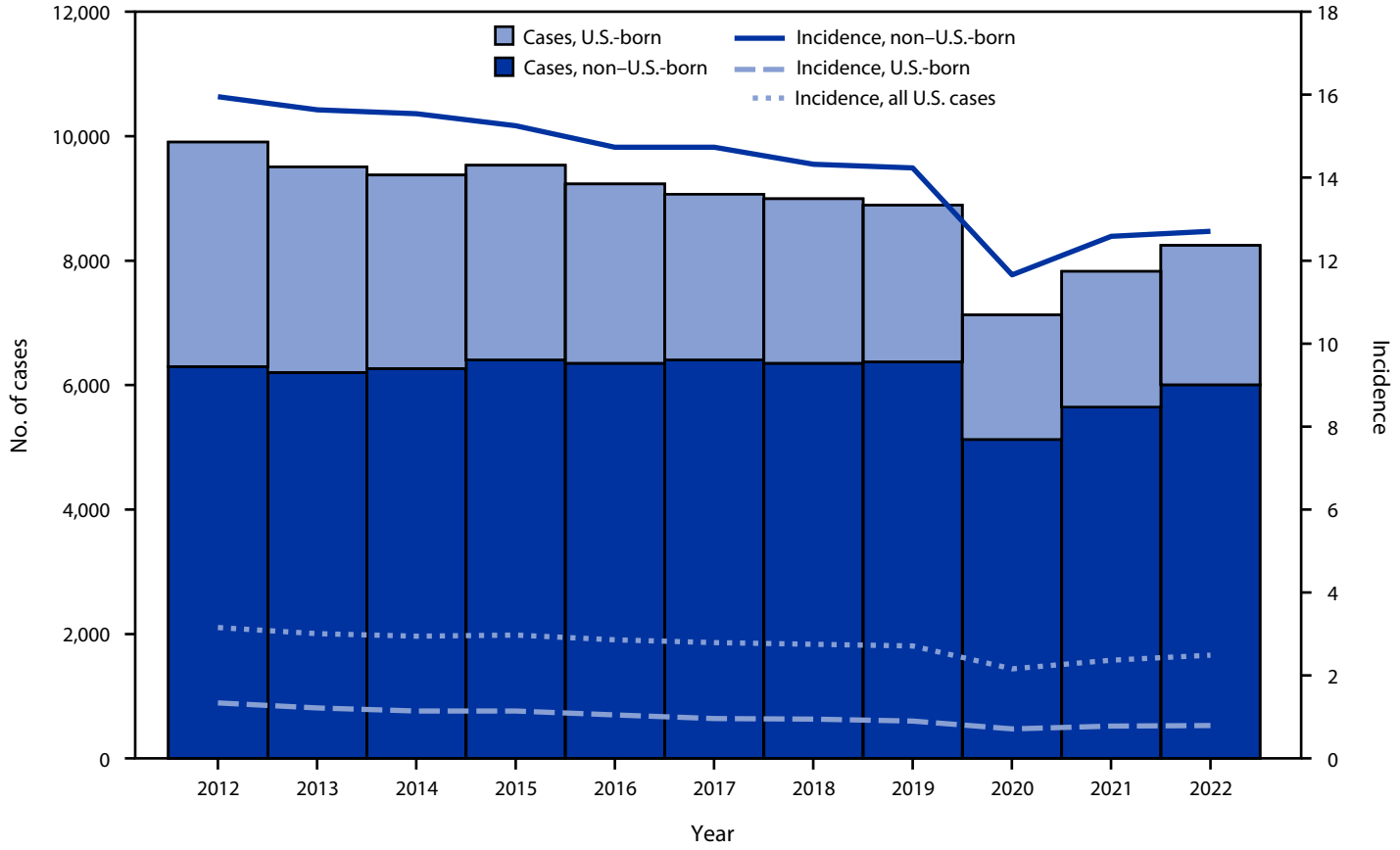
TABLE 1. Number of tuberculosis disease cases and tuberculosis incidence, by jurisdiction — National Tuberculosis Surveillance System, United States, 2019–2022

	No. of cases*				Incidence†			
Jurisdiction	**2019**	**2020**	**2021**	**2022**	**2019**	**2020**	**2021**	**2022**
Alabama	87	72	91	66	1.8	1.4	1.8	1.3
Alaska	58	58	58	96	7.9	7.9	7.9	13.1
Arizona	183	136	129	154	2.5	1.9	1.8	2.1
Arkansas	64	59	69	69	2.1	2.0	2.3	2.3
California	2,110	1,703	1,749	1,843	5.4	4.3	4.5	4.7
Colorado	66	52	58	57	1.1	0.9	1.0	1.0
Connecticut	67	54	54	67	1.9	1.5	1.5	1.8
Delaware	19	17	41	13	1.9	1.7	4.1	1.3
District of Columbia	24	19	18	15	3.4	2.8	2.7	2.2
Florida	558	412	500	536	2.6	1.9	2.3	2.4
Georgia	302	220	222	256	2.8	2.1	2.1	2.3
Hawaii	99	92	106	101	7.0	6.3	7.3	7.0
Idaho	7	8	5	11	0.4	0.4	0.3	0.6
Illinois	326	216	254	298	2.6	1.7	2.0	2.4
Indiana	108	92	127	99	1.6	1.4	1.9	1.4
Iowa	52	39	49	60	1.6	1.2	1.5	1.9
Kansas	37	37	43	52	1.3	1.3	1.5	1.8
Kentucky	65	66	57	70	1.5	1.5	1.3	1.6
Louisiana	88	99	86	89	1.9	2.1	1.9	1.9
Maine	18	17	14	20	1.3	1.2	1.0	1.4
Maryland	209	149	197	152	3.5	2.4	3.2	2.5
Massachusetts	178	142	151	153	2.6	2.0	2.2	2.2
Michigan	131	101	137	120	1.3	1.0	1.4	1.2
Minnesota	148	117	134	132	2.6	2.0	2.3	2.3
Mississippi	57	43	46	54	1.9	1.5	1.6	1.8
Missouri	70	79	77	69	1.1	1.3	1.2	1.1
Montana	2	4	3	6	0.2	0.4	0.3	0.5
Nebraska	17	33	22	28	0.9	1.7	1.1	1.4
Nevada	53	57	61	62	1.7	1.8	1.9	2.0
New Hampshire	6	12	12	11	0.4	0.9	0.9	0.8
New Jersey	309	245	289	286	3.5	2.6	3.1	3.1
New Mexico	41	29	24	30	2.0	1.4	1.1	1.4
New York	746	605	683	714	3.8	3.0	3.4	3.6
North Carolina	185	159	178	163	1.8	1.5	1.7	1.5
North Dakota	18	10	15	5	2.4	1.3	1.9	0.6
Ohio	149	132	151	148	1.3	1.1	1.3	1.3
Oklahoma	73	67	69	80	1.8	1.7	1.7	2.0
Oregon	70	67	79	70	1.7	1.6	1.9	1.7
Pennsylvania	198	157	166	173	1.5	1.2	1.3	1.3
Rhode Island	14	7	17	17	1.3	0.6	1.5	1.6
South Carolina	80	67	87	101	1.6	1.3	1.7	1.9
South Dakota	16	16	12	10	1.8	1.8	1.3	1.1
Tennessee	129	113	84	107	1.9	1.6	1.2	1.5
Texas	1,154	879	996	1,089	4.0	3.0	3.4	3.6
Utah	27	29	17	33	0.8	0.9	0.5	1.0
Vermont	4	3	3	3	0.6	0.5	0.5	0.5
Virginia	191	169	160	195	2.2	2.0	1.8	2.2
Washington	221	163	199	253	2.9	2.1	2.6	3.2
West Virginia	9	13	6	11	0.5	0.7	0.3	0.6
Wisconsin	51	35	66	52	0.9	0.6	1.1	0.9
Wyoming	1	0	3	1	0.2	0	0.5	0.2
Total	**8,895**	**7,170**	**7,874**	**8,300**	**2.7**	**2.2**	**2.4**	**2.5**

* Case counts are based on data reported to the National Tuberculosis Surveillance System as of March 6, 2023.

† Incidence is calculated as cases per 100,000 persons using midyear population estimates from the U.S. Census Bureau. Short-term projections from the monthly population estimates by age, sex, race, and Hispanic origin were used for 2022 population, 2021 vintage population estimates were used for 2021 and 2020, and 2010 vintage population estimates were used for 2019. https://www.census.gov/programs-surveys/popest/data/tables.html; https://www.census.gov/programs-surveys/popest/data/tables.2019.List_58029271.html#list-tab-List_58029271

FIGURE. Tuberculosis disease cases* and incidence,† by patient U.S. birth origin status§,¶ — National Tuberculosis Surveillance System, United States, 2012–2022



* Case counts are based on data from the National Tuberculosis Surveillance System as of March 6, 2023.
† Cases per 100,000 persons. The Current Population Survey provides the population denominators used to calculate tuberculosis incidence according to national origin and racial and ethnic group. https://www.census.gov/programs-surveys/cps.html (Accessed February 3, 2023).
§ A person is considered U.S.-born if eligible for U.S. citizenship at birth, regardless of place of birth. Birth origin was missing or unknown for 232 (2.8%) cases during 2022. Among those, 180 (77.6%) had country of birth reported, and birth origin was defined as U.S.-born for persons reporting birth in the United States or U.S. territories and as non–U.S.-born for persons born outside the United States and its territories.
¶ Persons for whom birth origin was unknown (range = 2 [2012] to 52 [2022]) were excluded.

among NH/OPI persons. The next highest incidence (22.0) occurred among Asian persons, followed by Black (13.7), Hispanic (10.1), AI/AN (4.3) and White (3.4) persons. Among these groups, the largest increase in incidence from 2021 to 2022 (221%) occurred among AI/AN persons, followed by NH/OPI (20%), Hispanic (13%), and White (7%) persons. Incidence declined 12% among Black persons and 7% among Asian persons in 2022.

Among non–U.S.-born persons with TB in 2022, 16.5% (992) received a diagnosis <1 year after their initial arrival in the United States, compared with 9.8% (553) during 2021. A slightly lower number and percentage of persons with newly diagnosed TB were living in the United States for >10 years in 2022 (2,821; 46.9%) compared with 2021 (2,845; 50.2%).

By age group, TB incidence in 2022 was highest among persons aged ≥65 years (3.9), followed by persons aged 45–64 (2.9), 25–44 (2.7), 15–24 (1.9), ≤4 (1.1), and 5–14 years (0.4). Compared with 2021, 2022 had the largest increase in incidence among persons aged ≤4 (28.8%) and 15–24 years (23.7%); persons aged ≥65 years were the only group that experienced a decrease (1.8%). Among 84.7% of persons with TB that had a known HIV status, 4.7% were coinfected in 2022 compared with 4.3% in 2021. Among persons with TB, increased percentages reported experiencing homelessness within 12 months preceding diagnosis (4.8%) and residing in a correctional facility (3.5%) or long-term care facility (1.7%) at the time of diagnosis in 2022, compared with 2021 (Table 2).†††

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

TABLE 2. Demographic and risk characteristics of persons with tuberculosis and number and incidence of tuberculosis cases — National Tuberculosis Surveillance System, United States, 2021–2022

Characteristic	No. of TB cases* (%)†			TB incidence§		
	2021	2022	% Change 2021 to 2022	2021	2022	% Change 2021 to 2022
Total	**7,874**	**8,300**	**5.4**	**2.4**	**2.5**	**5.0**
Age group, yrs						
≤4	160 (2.0)	202 (2.4)	26.3	0.8	1.1	28.8
5–14	156 (2.0)	161 (1.9)	3.2	0.4	0.4	4.4
15–24	676 (8.6)	840 (10.1)	24.3	1.6	1.9	23.7
25–44	2,265 (28.8)	2,431 (29.3)	7.3	2.5	2.7	7.1
45–64	2,409 (30.6)	2,419 (29.2)	0.4	2.9	2.9	1.1
≥65	2,208 (28.0)	2,244 (27.0)	1.6	4.0	3.9	−1.8
Birth origin,¶ race and ethnicity						
U.S.-born						
AI/AN, non-Hispanic	86 (3.9)	110 (4.9)	27.9	3.8	4.4	15.8
Asian, non-Hispanic	112 (5.1)	182 (8.1)	62.5	1.4	2.2	63.2
Black or African American, non-Hispanic	743 (34.1)	673 (30.1)	−9.4	2.0	1.9	−9.1
NH/OPI, non-Hispanic	40 (1.8)	52 (2.3)	30.0	5.2	6.6	26.2
White, non-Hispanic	634 (29.1)	568 (25.4)	−10.4	0.3	0.3	−10.4
Hispanic or Latino	539 (24.7)	578 (25.8)	7.2	1.3	1.4	6.6
Unknown race and ethnicity or multiple races	28 (1.3)	76 (3.4)	NA	NA	NA	NA
Subtotal	**2,182 (100.0)**	**2,239 (100.0)**	**2.6**	**0.8**	**0.8**	**2.4**
Non–U.S.-born						
AI/AN, non-Hispanic	1 (0)	2 (0)	100.0	1.3	4.3	221.3
Asian, non-Hispanic	2,709 (47.8)	2,632 (43.8)	−2.8	23.8	22.0	−7.5
Black or African American, non-Hispanic	674 (11.9)	625 (10.4)	−7.3	15.5	13.7	−11.6
NH/OPI, non-Hispanic	75 (1.3)	103 (1.7)	37.3	23.3	27.8	19.5
White, non-Hispanic	249 (4.4)	276 (4.6)	10.8	3.2	3.4	7.4
Hispanic or Latino	1,847 (32.6)	2,194 (36.5)	18.8	8.9	10.1	12.6
Unknown race and ethnicity or multiple races	109 (1.9)	177 (2.9)	NA	NA	NA	NA
Subtotal	**5,664 (100.0)**	**6,009 (100.0)**	**6.1**	**12.6**	**12.8**	**1.1**
Unknown birth origin**	28 (0.4)	52 (0.6)	NA	NA	NA	NA
Interval from initial U.S. arrival to TB diagnosis, yrs						
<1	553 (9.8)	992 (16.5)	79.4	NA	NA	NA
1–10	1,642 (29.0)	1,528 (25.4)	−6.9	NA	NA	NA
>10	2,845 (50.2)	2,821 (46.9)	−0.8	NA	NA	NA
Unknown	624 (11.0)	668 (11.1)	7.1	NA	NA	NA
HIV-positive at time of diagnosis	302 (4.3)	327 (4.7)	8.3	NA	NA	NA
Experienced homelessness during previous year	352 (4.5)	380 (4.8)	8.0	NA	NA	NA
Correctional facility resident at diagnosis	178 (2.3)	286 (3.5)	60.7	NA	NA	NA
Long-term care facility resident at diagnosis	109 (1.4)	139 (1.7)	27.5	NA	NA	NA

Abbreviations: AI/AN = American Indian or Alaska Native; NA = not applicable; NH/OPI = Native Hawaiian or other Pacific Islander; TB = tuberculosis.

* Case counts are based on data reported to the National Tuberculosis Surveillance System as of March 6, 2023.

† Percentages are calculated only among patients with available data, except for the years after U.S. arrival. Age was missing or unknown for zero cases in 2021 and three cases in 2022; origin of birth remained missing or unknown for 28 cases in 2021 and 52 cases in 2022; race and ethnicity was missing or unknown for 56 cases in 2021 and 175 cases in 2022; HIV testing results were missing or unknown for 842 cases in 2021 and 1,270 cases in 2022; whether a person was experiencing homelessness was missing or unknown for 60 cases in 2021 and 301 cases in 2022; whether a person was residing in a correctional facility was missing or unknown for 92 cases in 2021 and 215 cases in 2022; and whether a person was residing in a long-term care facility was missing or unknown for 81 cases in 2021 and 215 cases in 2022.

§ Incidence is calculated as cases per 100,000 persons using midyear population estimates from the U.S. Census Bureau. Short-term projections from the monthly population estimates by age, sex, race, and Hispanic origin were used for 2022 population, 2021 vintage population estimates were used for 2021 and 2020, and 2010 vintage population estimates were used for 2019. https://www.census.gov/programs-surveys/popest/data/tables.html; https://www.census.gov/programs-surveys/popest/data/tables.2019.List_58029271.html#list-tab-List_58029271

¶ A person is considered U.S.-born if eligible for U.S. citizenship at birth, regardless of place of birth. Birth origin was missing or unknown for 232 (2.8%) cases during 2022. Among those, 180 (77.6%) had country of birth reported, and birth origin was defined as U.S.-born for persons reporting birth in the United States or U.S. territories and as non–U.S.-born for persons born outside the United States and its territories.

** Excluded from race and ethnicity subtotals.

Discussion

U.S. TB incidence increased during 2022, compared with that during 2020 and 2021, but remained lower than incidence during the prepandemic years; after a substantial 20.2% decline in 2020 and partial rebound (9.8% increase) in 2021 (*1*), incidence appears to be returning to prepandemic levels among U.S.-born and non–U.S.-born populations.

COVID-19–associated mortality was high among persons aged ≥65 years, which might account, in part, for the lower TB incidence observed among that population (*3*). Even though the decrease in TB incidence was small, reduction of the population aged ≥65 years at risk for TB might have similar effects on TB incidence in future years. The increase in TB incidence among children aged ≤4 years might represent both recent transmission in the United States and infection in countries with higher TB incidence. An analysis of TB incidence among indigenous persons during 2009–2019 found a higher prevalence of underlying chronic medical conditions, and TB incidence was at least 10 times higher among AI/AN and NH/OPI persons than among White persons (*2*). These factors likely contributed to the higher TB incidence in these populations in this report. Among non–U.S.-born persons with TB, the higher proportion reported <1 year after arrival in the United States might reflect greater migration from higher TB incidence areas than what existed at the beginning of the pandemic.[§§§]

Although preventing TB transmission in the United States remains a priority, >80% of U.S. TB cases are attributed to reactivation of LTBI (*1*). To achieve TB elimination in the United States, the U.S. Preventive Services Task Force recommends testing and treatment among populations at higher risk for LTBI, including non–U.S.-born persons and persons in congregate living settings (*4*). To treat LTBI, CDC recommends short-course (3- or 4-month), rifamycin-based regimens (*5*). Shorter regimens are also available to treat TB: in 2022, CDC recommended a 4-month treatment regimen for drug-susceptible pulmonary TB as an alternative to the standard 6-month regimen (*6*). Shorter treatment durations improve treatment adherence and completion (*5,6*).

Higher TB incidence among AI/AN and NH/OPI persons represents an ongoing health disparity (*2*) in the United States. Alaska reported an increase of TB in 2022 and identified Alaska Native persons as among those at highest risk for TB (*7*). CDC is working to raise awareness about TB and LTBI among communities at risk for TB and their health care providers through the Think. Test. Treat TB campaign,[¶¶¶] which offers resources in multiple languages for general audiences and health care providers.[****] CDC also partners with community health clinics and organizations, including the TB Elimination Alliance,[††††] to address TB health disparities through education and innovation.

Higher proportions of TB cases among persons experiencing homelessness or residing in correctional or long-term care facilities might be partially explained by transmission events in congregate settings. For example, gaps in TB infection control practices when resources were diverted to COVID-19 prevention and control efforts likely led to a TB outbreak in at least one state's prison system during 2021–2022 (*8*).

The findings in this report are subject to at least two limitations. First, this analysis and case counts are based on provisional 2022 TB surveillance data and might change. Second, rates are calculated with population estimates that are subject to future refinement.

Knowledge of the effects of the COVID-19 pandemic on U.S. TB epidemiology is evolving. As COVID-19 incidence declines, TB remains an important public health challenge characterized by persistent inequities, particularly among AI/AN and NH/OPI populations, persons experiencing homelessness, and persons who are incarcerated. Timely detection and treatment of TB and LTBI among persons at risk are needed to achieve TB elimination in the United States.

Summary

What is already known about this topic?

During the early COVID-19 pandemic (2020), U.S. incidence of reported tuberculosis (TB) substantially declined. Incidence partially rebounded in 2021 but remained lower than incidence during prepandemic years.

What is added by this report?

During 2022, reported TB incidence increased slightly. Among non–U.S.-born persons with TB, the proportion who had recently arrived in the United States increased. Higher TB incidence among American Indian or Alaska Native and Native Hawaiian or other Pacific Islander persons compared with other race and ethnicity groups represents an ongoing health disparity.

What are the implications for public health practice?

TB incidence is returning to prepandemic levels. TB diagnosis and treatment to interrupt transmission and prevention of TB through treatment of latent TB infection are critical to U.S. TB elimination efforts.

[§§§] https://www.census.gov/library/stories/2022/12/net-international-migration-returns-to-pre-pandemic-levels.html
[¶¶¶] https://www.cdc.gov/thinktesttreattb

[****] https://www.cdc.gov/thinktesttreattb/resources.html
[††††] https://tbeliminationalliance.org/

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Corresponding author: Kimberly R. Schildknecht, trg8@cdc.gov.

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

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Retaining Patients with Drug-Resistant Tuberculosis on Treatment During the COVID-19 Pandemic — Dharavi, Mumbai, India, 2020–2022

Mangala D. Gomare, MBBS[1]; Sampada Bhide, MD[2]; Rajesh Deshmukh, MBBS[3]; Satish Kaipilyawar, MBBS[2]; Varsha Puri, MBBS[1]; Patrick K. Moonan, DrPH[3]; Dilip K. Khetade, MBBS[1]; Melissa Nyendak, MD[3]; Vijay Yeldandi, MD[2]; Jonathan P. Smith, PhD[3]; James L. Tobias, MS[3]; Anand Date, MD[3]; Rajendra Joshi, MBBS[4]; Ravinder Kumar, MBBS[4]; Christine S. Ho, MD[3]

Mumbai, India's second largest city, has one of the highest prevalences of drug-resistant tuberculosis* (DRTB) in the world. Treatment for DRTB takes longer and is more complicated than treatment for drug-susceptible tuberculosis (TB). Approximately 300 persons receive a new DRTB diagnosis each year in Mumbai's Dharavi slum†; historically, fewer than one half of these patients complete DRTB treatment. As nationwide restrictions to mitigate the COVID-19 pandemic were implemented, a program to facilitate uninterrupted DRTB care for patients receiving treatment was also implemented. A comprehensive tool and risk assessment provided support to DRTB patients and linked those who relocated outside of Dharavi during the pandemic to DRTB care at their destination. During May 2020–September 2022, a total of 973 persons received DRTB treatment in Dharavi, including 255 (26%) who relocated during treatment. Overall, 25 (3%) DRTB patients were lost to follow-up, a rate substantially lower than the rate before the pandemic (18%). Proactive planning and implementation of simple tools retained patients on treatment during periods of travel restrictions and relocations, improving programmatic outcomes. This approach might aid public health programs serving migrant populations or patients receiving treatment for DRTB during public health emergencies.

Mumbai, the capital of the state of Maharashtra, is India's second most populous city. Within Mumbai, the Dharavi slum is the largest slum in Asia and one of the most densely populated areas in the world (1 million persons in 0.8 square miles [approximately 2.1 sq km]) and is a temporary home to persons seeking informal employment from across India.§ In 2019, Dharavi reported 265 DRTB patients, one of the highest concentrations of DRTB patients in the world; however, fewer than one half successfully finished treatment¶ (*1*,*2*). Low DRTB treatment completion is likely the consequence of the complexity of treating DRTB compared with that of treating drug-susceptible TB, including longer treatment durations, need for second-line drug regimens, more frequent drug-related adverse events, a higher prevalence of treatment relapse, and higher mortality (*3*).

In response to the COVID-19 pandemic in India, a series of government-enforced nationwide travel restrictions limited local, intrastate, and interstate movement during March 23–May 31, 2020, and January 27–April 30, 2021. Because of the large number of COVID-19 cases in Maharashtra, the state government extended these restrictions until June 15, 2021, during which time, movement was periodically allowed. During impending movement restrictions, many labor migrants from Dharavi, lacking a stable source of income, relocated to their permanent residences in India, traveling by foot, train, or bus (*4*).

Brihanmumbai Municipal Corporation (the governing civic body of Mumbai), CDC, and Society for Health Allied Research and Education (SHARE) India (a not-for-profit organization) implemented a public health intervention embedded within existing programmatic TB services to improve treatment outcomes and prevent treatment interruptions and migration-associated losses to follow-up. First, to establish and maintain care for DRTB patients** throughout the pandemic, a comprehensive risk assessment tool was developed that collected addresses (including permanent residence), telephone numbers of family members and close contacts, as well as potential travel routes. Destination sites and transit routes were mapped using collected information on common modes of travel. DRTB patients planning to relocate could apprise the project field coordinators of their plans during routine field encounters and make necessary preparations to continue treatment at their destination. Next, trained field coordinators, working with family members, governmental and nongovernmental organizations, community health workers, and district TB officers, used standard operating procedures to implement a series of interventions that included frequent patient contacting, active adverse events monitoring, and prompt attention

* A *Mycobacterium tuberculosis* isolate that is resistant to isoniazid or rifampin; resistance to additional TB medications can also be present.

† Defined as "a compact settlement of at least 20 households with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions." https://mohua.gov.in/upload/uploadfiles/files/9Slum_Report_NBO(2).pdf

§ https://sra.gov.in/page/innerpage/about-drp.php

¶ https://tbcindia.gov.in/showfile.php?lid=3538

** Treatment for DRTB was in accordance with the India national programmatic guidelines for drug-resistant TB. https://tbcindia.gov.in/showfile.php?lid=3590

to patients' concerns to ensure continuity of care during and after relocation. For patients remaining within Dharavi, these interventions, implemented by field coordinators (who were exempted from travel restrictions), provided health services that included making telephone calls, home visits, treatment adherence counseling, and guidance for persons considering migration. For patients who had migrated, field coordinators informed the Dharavi TB program and telephoned patients and their destination TB programs to coordinate care. Visits and calls occurred every 2 weeks for the first 2 months and then monthly until treatment was completed. Routine TB services, which relied on patients coming to the TB clinic monthly and self-reporting treatment concerns and adverse events, were disrupted during the pandemic because of staff member reassignments and shortages. In response to the disruption, field coordinators visited patient homes to proactively monitor progress based on the schedule in the package of interventions (Box) and provided a 3-month supply of medications to patients for self-administration. In addition, the program connected persons to supplemental nutritional and monetary aid from governmental and nongovernmental programs. Address and travel information collected as part of the risk assessments aided in the identification of potential migrants. Migrants leaving Dharavi were provided a 1-month supply of medication to cover the potential travel period, and patients were connected with destination TB programs for continuation of care. Field coordinators counseled those who had already migrated to restart treatment in coordination with the destination TB program staff members. Participation was voluntary, and all participants had privacy and confidentiality protections. CDC provided funding and technical support; SHARE India was the implementing partner and provided the field coordinators. This intervention was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[††]

During May 2020–September 2022, a total of 1,007 persons registered for DRTB treatment in Dharavi, and 973 (97%) initiated treatment, including 743 patients starting new treatment, and 230 who were already on treatment. The average age of DRTB patients was 28 years (range = 4–88 years), and 541 (56%) were female. Overall, 255 (26%) persons with DRTB relocated during treatment (Table). Among those who relocated, 70 (27%) informed program staff members of a planned relocation, and the remaining 185 persons (73%) were discovered to have relocated through discussions with household members during household visits or telephone calls. Among patients who relocated, 185 (73%) returned to Dharavi by January 2023 (cyclical migrants),[§§] and 70 (28%) permanently relocated (permanent migrants).[¶¶] The 255 patients who relocated moved to 14 states and Union Territories in India. Migrants traveled a median of 662 miles (1,065 km) (range = 7.5–1,317 miles [12–2,120 km]). Relocation was more common during the periods of May–June 2020 and April–June 2021) (Figure).

As of January 25, 2023, among all 973 Dharavi DRTB patients, 536 (55%) were receiving DRTB treatment; 360 (37%) had completed treatment; and 52 (5%) had died

BOX. Package of interventions for drug-resistant tuberculosis patients — Dharavi, Mumbai, India, May 2020–September 2022

Treatment administration
- Every 2 weeks for the first 2 months of treatment
- After the first 2 months, every month until the end of treatment

Location of treatment
- At patient's home by telephone or in-person visit
- At TB unit or clinic

Persons who administer treatment
- In Dharavi
  - Dharavi district TB staff members
  - TB field coordinators
  - DRTB patients or their family members
- Outside of Dharavi (to patients who have traveled)
  - District TB staff members at the patient's destination
  - DRTB patients or their family members

Activities conducted by field coordinators and TB staff members
- Collect contact information for permanent residence, family members, and relatives
- Counsel patient about treatment adherence
- Monitor for adverse events
- Link to food and monetary initiatives
- Connect migrating DRTB patients, Dharavi TB program, and TB program staff members at permanent residence

Abbreviations: DRTB = drug-resistant tuberculosis; TB = tuberculosis.

[††] 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

[§§] A migrant who left Dharavi but returned and reinstated DRTB treatment under the Dharavi TB program. A cyclical migrant might have relocated and returned several times, but eventually remained under treatment by the Dharavi TB program.

[¶¶] A migrant who relocated from Dharavi and transferred out. Permanent migrants might have relocated and returned to Dharavi several times, but ultimately left and transferred out.

TABLE. Treatment outcomes among persons with drug-resistant tuberculosis — Dharavi slum,* Mumbai, India, May 2020–September 2022

	No. (%)†				
			Migrants§		
Treatment outcome	DRTB patients	Nonmigrants	All	Cyclical¶	Permanent**
Receiving DRTB treatment as of January 25, 2023	536 (55.1)	432 (60.2)	104 (40.8)	68 (36.8)	36 (51.4)
Treatment success††	360 (37.0)	237 (33.0)	123 (48.2)	100 (54.1)	23 (32.9)
Died	52 (5.3)	38 (5.3)	14 (5.5)	7 (3.8)	7 (10.0)
Lost to follow-up§§	25 (2.6)	11 (1.5)	14 (5.5)	10 (5.4)	4 (5.7)
Total	**973 (100.0)**	**718 (73.8)¶¶**	**255 (26.2)¶¶**	**185 (72.5)*****	**70 (27.5)*****

Abbreviations: DRTB = drug-resistant tuberculosis; TB = tuberculosis.

* Defined as "a compact settlement of at least 20 households with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions." https://mohua.gov.in/upload/uploadfiles/files/9Slum_Report_NBO(2).pdf

† Column percentage.

§ Persons who moved away from their usual place of residence.

¶ Migrants who left Dharavi but returned and reinstated DRTB treatment under the Dharavi TB program. Cyclical migrants might have relocated and returned several times, but eventually remained under treatment by the Dharavi TB program.

** Migrants who transferred out of Dharavi. Permanent migrants might have relocated and returned to Dharavi several times, but ultimately left and transferred out.

†† Confirmation of microbiologic TB cure or TB treatment completion.

§§ Did not start TB treatment or treatment interrupted for ≥2 consecutive months.

¶¶ Among all DRTB patients.

*** Among all migrants.

(Table). Overall, 540 (55%) patients reported 2,592 separate episodes of adverse events and were referred for medical evaluation; all but 101 (4%) episodes were resolved with medications for symptoms, adjustment in TB medications, or without intervention. All DRTB patients were signed up to receive governmental monetary support and referred for nongovernmental nutritional support. Only 25 (3%) of all Dharavi DRTB patients were lost to follow-up during the program's implementation. Among the 255 patients who migrated, 104 (41%) were receiving treatment, 123 (48%) had completed treatment successfully, 14 (6%) had died, and 14 (6%) were lost to follow-up. The proportion of patients lost to follow-up was low among both cyclical (5%) and permanent migrants (6%), suggesting that the intervention measures were effective in both populations.

Summary

What is already known about this topic?

Treatment for drug-resistant tuberculosis (DRTB) takes longer and is more complicated than treatment for drug-susceptible tuberculosis. The Dharavi slum in Mumbai, India has one of the highest concentrations of DRTB patients in the world. The COVID-19 pandemic disrupted TB care and treatment.

What is added by this report?

During the pandemic, many persons with DRTB in Dharavi relocated, threatening continuity of care. Patient-focused interventions facilitated successful treatment retention and improved programmatic outcomes.

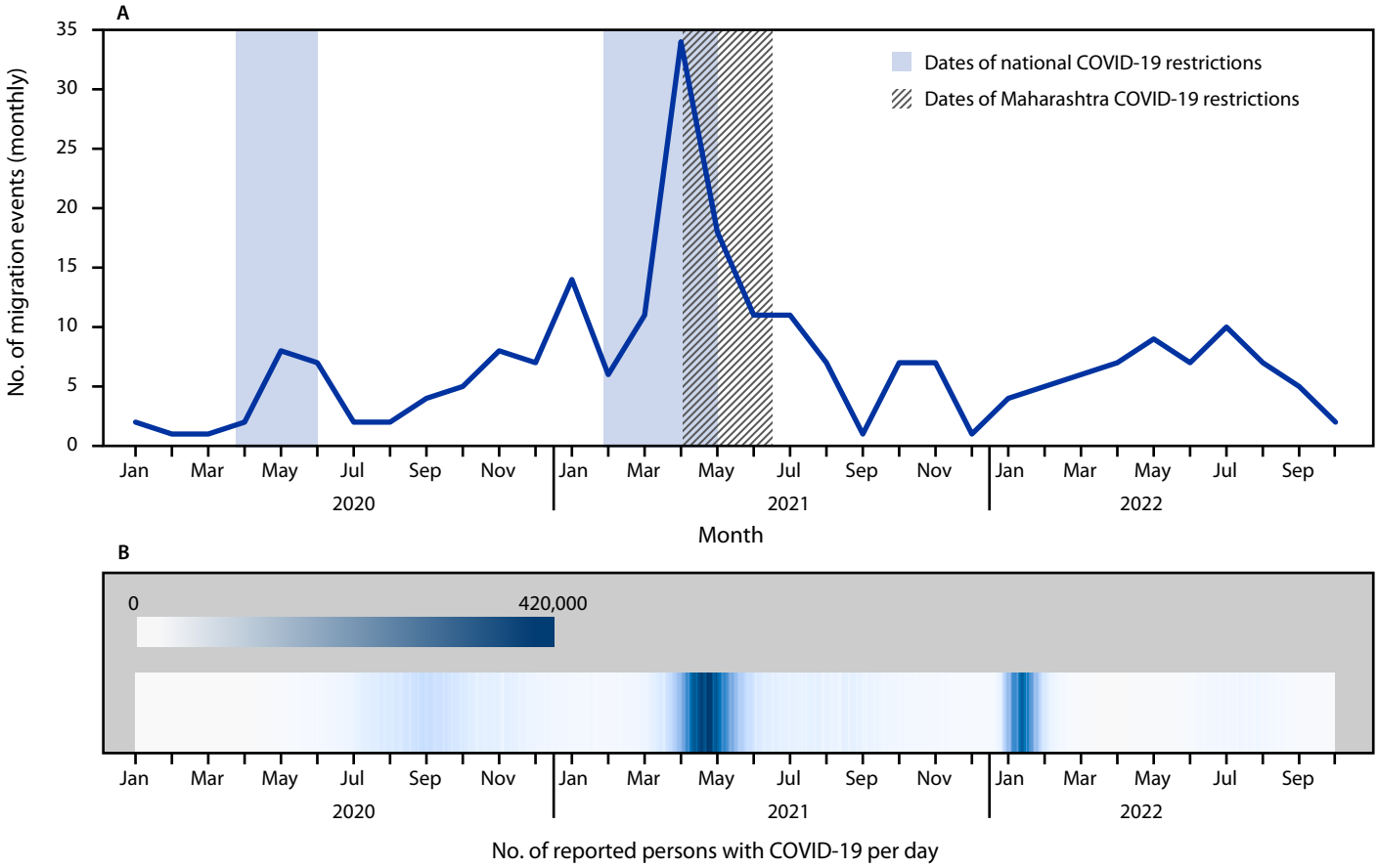
What are the implications for public health practice?

Planning and implementation of simple tools helped to retain migrants on DRTB treatment during periods of COVID-19 restrictions and relocations; this approach might aid programs to serve persons on treatment for DRTB during public health emergencies, including migrant populations.

Discussion

In countries such as India with high TB prevalence, clinics rely upon patients to collect their medicines monthly and self-report adverse events. By providing for the frequent contacting of patients, active monitoring of adverse events, and prompt addressing of concerns, this comprehensive package of interventions, integrated into routine programmatic care for DRTB treatment, facilitated continuity of care and improved treatment outcomes among patients from Dharavi during the COVID-19 pandemic. Nationwide, COVID-19 restrictions brought economic and logistic challenges to retaining DRTB patients in treatment. Implementation of the initial national travel restrictions in March 2020 resulted in many industries shutting down, leaving workers without wages. In anticipation of the restrictions, or after restrictions were lifted, many labor migrants traveled to and from Dharavi (*4*). During the peak of the COVID-19 pandemic, the Brihanmumbai Municipal Corporation TB program was concerned that contact with persons with DRTB would be lost during migration, or that they might default on treatment, resulting in untreated DRTB and potential transmission in communities throughout India. Working across states and sectors, a network of field coordinators and District TB Officers mitigated treatment interruption, monitored for adverse events, referred patients reporting

FIGURE. Number of monthly migration events of patients with drug-resistant tuberculosis, COVID-19 travel restrictions (A),[*,†] and daily numbers of COVID-19 cases[§] (B) — Dharavi, Mumbai, India, January 2020–October 17, 2022



* https://cdn.s3waas.gov.in/s3d18f655c3fce66ca401d5f38b48c89af/uploads/2020/03/2020032839.pdf
† https://csmia.adaniairports.com/pdf/covid-19/20210530-gom-order-break-the-chain.pdf
§ https://covid19.who.int/ (Accessed February 13, 2023).

adverse events, and connected DRTB patients to additional resources when needed. For this effort, staff members and field coordinators pivoted to use of telephones, to which most patients, their family members, or their neighbor had access. Recognizing that loss of wages was an important driving factor for the migration, field coordinators linked DRTB patients to additional nutritional and monetary support provided by government and nongovernment organizations. DRTB patients planning to relocate were encouraged to inform staff members during routine field encounters; only 3% of DRTB patients were lost to follow-up during the program's implementation, a rate substantially lower than that before the COVID-19 pandemic (18%) (*2*).

Ensuring continuity of TB treatment is a priority during times of public health emergencies. Studies have described successful maintenance of TB treatment services for patients during natural disasters such as floods in Kerala, India (*5*), during hurricanes in the United States (*6*,*7*) and Puerto Rico (*8*), and after an earthquake in Haiti (*9*). In each of these circumstances, coordination across agencies and programs, accurate contact information, and dispensation of additional medication were necessary to ensure retention of TB patients. In the case of COVID-19, the scale and length of disruption was not localized to one geographic area; local and national travel restrictions added enormous challenges for provision of TB services.

The strategy implemented in Dharavi to retain DRTB patients for treatment was successful because it focused on addressing the difficulties of DRTB treatment for the patient by actively monitoring for treatment challenges. This was a simple but effective strategy, deployed under demanding circumstances; akin to other disruptive events, expanded coordination was needed to facilitate continuity of patient care (*5*–*9*).

The findings in this report are subject to at least two limitations. First, because many of the patient support activities occurred over the telephone, assessment of treatment adherence might have been overestimated. Second, strained health systems and staffing shortages meant that TB test results were delayed, which might have affected categorization of treatment outcomes. Thus, the proportion of patients that remained on DRTB treatment might be overestimated.

During public health emergencies, challenges to DRTB treatment completion are common, especially among persons who subsist on low wages and those without a social or financial safety net. The approach implemented in Dharavi has been adopted by the Brihanmumbai Municipal Corporation in other densely populated, poor urban settings to improve DRTB treatment and care and might aid public health programs that serve migrant populations or DRTB patients during public health emergencies.

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Corresponding author: Christine S. Ho, gtb9@cdc.gov.

[1]Brihanmumbai Municipal Corporation, Mumbai, India; [2]Society for Health Allied Research and Education (SHARE) India, Hyderabad, India; [3]Division of Global HIV and TB Response, Center for Global Health, CDC; [4]Central TB Division, Ministry of Health and Family Welfare, Government of India, New Delhi, India.

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Tuberculosis Outbreak in a State Prison System — Washington, 2021–2022

Randy M. Stalter, PhD[1,2]; Monica Pecha, MPH[2]; Lana Dov, MSN[2]; David Miller[2]; Zainab Ghazal, MBChB[3]; Jonathan Wortham, MD[4]; Sandy Althomsons, MHS[4]; Molly Deutsch-Feldman, PhD[1,4]; Rebekah Stewart, MSN, MPH[4]; Derrick Felix[4]; Sophia Hsu, MSN, MPH[4]; Lara B. Strick, MD[3,5]

During 2014–2020, no tuberculosis (TB) cases were reported within the Washington state prison system. However, during July 2021–June 2022, 25 TB cases were reported among persons incarcerated or formerly incarcerated in two Washington state prisons. Phylogenetic analyses of whole genome sequencing data indicated that *Mycobacterium tuberculosis* isolates from all 11 patients with culture-confirmed TB were closely related, suggesting that these cases represented a single outbreak. The median infectious period for 12 patients who were considered likely contagious was 170 days. As of November 15, 2022, the Washington State Department of Corrections (WADOC) and Washington State Department of Health (WADOH), with technical assistance from CDC, had identified 3,075 contacts among incarcerated residents and staff members at five state prisons, and 244 contacts without a known TB history received a diagnosis of latent TB infection (LTBI). Persons who were evaluated for TB disease were isolated; those receiving a diagnosis of TB then initiated antituberculosis therapy. Persons with LTBI were offered treatment to prevent progression to TB disease. This ongoing TB outbreak is the largest in Washington in 20 years. Suspension of annual TB screening while limited resources were redirected toward the COVID-19 response resulted in delayed case detection that facilitated TB transmission. In addition, fear of isolation might discourage residents and staff members from reporting symptoms, which likely also leads to delayed TB diagnoses. Continued close collaboration between WADOC and WADOH is needed to end this outbreak and prevent future outbreaks.

Investigation and Results

During July–August 2021, one incarcerated person with TB disease and two others with LTBI were identified in a single Washington state prison (facility A). A subsequent source investigation conducted by WADOC in collaboration with WADOH identified one additional person at facility A with TB disease and 27 persons with LTBI. None of the persons who received a diagnosis during July–August 2021 experienced clinical characteristics associated with infectiousness (e.g., sputum smear positivity). This finding led to concern by WADOH and WADOC that these cases might represent transmission associated with a person with undiagnosed infectious TB disease elsewhere within the prison system or who was recently released from prison. During December 2021–January 2022, three persons incarcerated at another Washington state prison (facility B) received a diagnosis of TB disease, including a person who had been released into the community and another who had been transferred to a third facility (facility C). WADOC and WADOH requested CDC assistance to facilitate ongoing outbreak investigation efforts; CDC deployed a team to Washington on February 7, 2022. Outbreak cases, defined as clinically diagnosed or laboratory-confirmed pulmonary or extrapulmonary TB disease in persons who were incarcerated or had worked in WADOC since September 2019, were identified through facility-based testing and medical evaluations. Clinical chart reviews and provider interviews were used to characterize cases and estimate infectious periods according to CDC guidelines (*1*). Because of staff member and resident movement among prison facilities as well as releases into the community, the ongoing investigation has thus far included all 12 WADOC prisons and most of Washington's local health jurisdictions. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.*

As of November 15, 2022, a total of 25 cases† of TB disease among incarcerated persons had been reported to WADOH and were connected to the outbreak; the most recent case was reported on June 23, 2022 (Figure). No cases of TB disease were identified among prison staff members. Nineteen persons received a diagnosis of pulmonary TB disease with or without extrapulmonary TB. All 25 patients received a chest radiograph or computed tomography scan, and their sputum specimens were tested; none had cavitary findings on imaging, and four had a positive acid-fast bacilli smear. Isolates from all 11 culture-confirmed cases were closely related by whole genome single nucleotide polymorphism analysis, consistent with epidemiologic data suggesting recent transmission. Contact investigations were initiated at five facilities for 12 persons with TB disease who were considered likely to be contagious: the 11 persons with positive cultures and one additional person with a negative culture but with symptomatic pulmonary disease and clinically important chest radiograph findings. The median estimated infectious period for these 12 patients was 170 days (range = 91–391 days). The person with the longest

* 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

† Since this report was finalized on November 15, 2022, two additional TB disease cases have been identified among incarcerated residents in WADOC facilities, bringing the total number of outbreak-related cases to 27 at the date of publication.

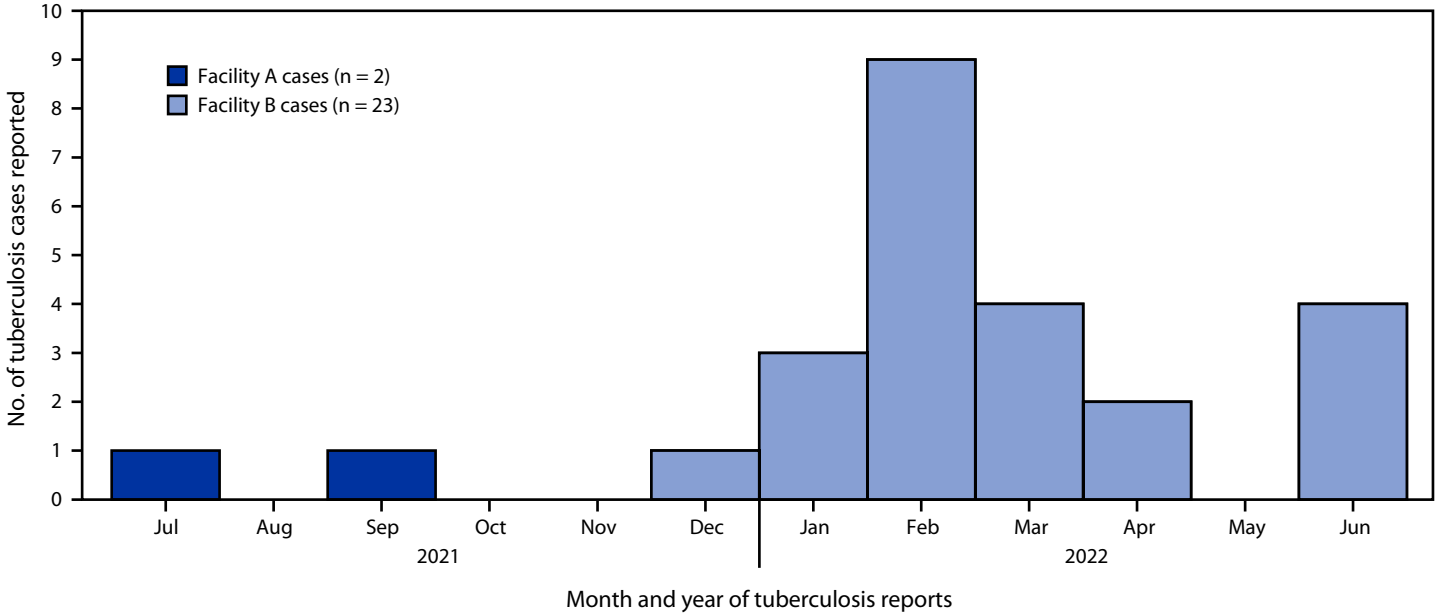
infectious period was likely the first to develop infectious TB (i.e., estimated infectious period start date was January 1, 2021) and resided in facilities A and B during the infectious period. During the initial source investigation in August 2021, this person received a negative tuberculin skin test (TST) result and did not disclose symptoms, despite chart notes indicating a chronic cough and weight loss that began around July 2021. The person had a history of untreated LTBI, but this was not noted at the time. Therefore, a chest radiograph was not performed until a subsequent TB screening was conducted at facility B in January 2022; the radiograph findings were then reported to be abnormal.

A contact of a patient with TB was defined as an incarcerated person or staff member who had been in the same location on the same day as the patient during the patient's estimated infectious period. As of November 15, 2022, a total of 2,644 residents in five facilities and 431 staff members in four facilities were identified as contacts. Among 2,093 (79.2%) resident-contacts and 135 (31.3%) staff-member–contacts who had no evidence of previous TB infection or disease and were tested within a WADOC facility since January 1, 2021, 237 (11.3%), and seven (5.2%), respectively, received positive TB test results.

Public Health Response

After confirming the initial cases identified at facility A (in July 2021) and facility B (in December 2021), WADOC, in collaboration with WADOH, initiated TB screenings of incarcerated persons and staff members within facilities A, B, and C. Beginning in February 2022, CDC's technical assistance team provided additional support for contact investigations by incorporating WADOC data on overnight locations and daily movements, staff member schedules, and clinical risk factors. Most persons born in the United States received testing using TSTs, and most persons not born in the United States received testing using interferon-gamma release assays. Following CDC guidelines for TB exposure, a TST result with ≥5 mm of induration in a specimen from a contact was considered positive (*1*). Persons with newly identified TB infection and persons with a previous positive TB test result or TB symptoms (irrespective of test result) were referred for chest radiography and clinical evaluation for TB disease. Persons who were being evaluated for TB disease were isolated and, if they received a TB diagnosis, initiated 4–6 months of antituberculosis therapy. For persons with LTBI, a 3-month isoniazid and rifapentine therapy was the preferred regimen. However, because of nationwide shortages of rifamycins, treatment was delayed for some persons; those persons who were considerably immunosuppressed from a medical condition or medication use were offered a 9-month isoniazid regimen to prevent delays in treatment because of their increased risk for progression to TB disease. Informational sessions on TB prevention and treatment were held for residents, their families, and facility personnel.

FIGURE. Outbreak-related tuberculosis cases reported by Washington State Department of Corrections to the Washington State Department of Health among persons who were incarcerated at two facilities, by month — Washington, July 2021–June 2022



Discussion

This is the first recorded TB outbreak in WADOC and the largest TB outbreak in Washington in 20 years. Multiple factors complicated case diagnosis and likely contributed to outbreak-associated transmission. First, annual TB testing of residents had been suspended at WADOC facilities, in some instances for up to 2 years, as WADOC redirected resources toward COVID-19 prevention and control. Although TB outbreaks in state prison systems before the COVID-19 pandemic had become uncommon (*2*), and WADOC had had no TB cases for approximately 5 years, these findings suggest that interruptions in routine TB prevention measures can facilitate *M. tuberculosis* transmission within correctional settings. Second, diagnostic delays contributed to outbreak-associated transmission because patients were contagious for longer periods; on-site and community clinicians did not promptly diagnose TB in two patients who were later found to have pulmonary TB disease, despite their having compatible symptoms. One of these patients was the person who had been transferred from facility A to facility B while contagious. Delayed detection of TB cases in low-incidence settings is a frequent contributor to outbreaks in the United States (*3*,*4*). The relative rarity of TB disease before the outbreak, the overlap of common TB symptoms with those of COVID-19, and a coincident COVID-19 outbreak within the prison system might have also contributed (*5*). In addition, fear of physical and social isolation among residents and potential social isolation and loss of work hours for staff members were likely disincentives to reporting symptoms or consenting to TB testing once screenings were initiated for many persons.

Outbreak response requires prompt diagnosis of TB disease, isolation of contagious persons, treatment of disease to cure, and prevention of disease through treating LTBI (*6*–*8*). During the outbreak response, nationwide shortages of rifamycins (*9*), cornerstones of preferred LTBI treatment regimens, led to delays in treatment initiation for some persons. During these shortages, alternative isoniazid monotherapy LTBI treatment regimens were prescribed only for persons at high risk for TB progression, because these regimens are longer in duration and are associated with increased risk for liver toxicity (*8*,*10*). Within WADOC, fully reinstating routine screening for TB symptoms and testing for LTBI and TB disease, raising TB awareness among incarcerated persons, staff members, and medical personnel, and implementing policies to reinforce symptom reporting and TB testing could facilitate earlier detection and intervention. In addition, establishing and maintaining efficient data management systems is important for managing contact investigations of this scale, actions for which state prisons are not always equipped or funded. Therefore, ongoing strong collaborations between correctional systems and health departments are needed to end this outbreak and prevent future outbreaks.

Summary

What is already known about this topic?

Tuberculosis (TB) outbreaks in state prisons are uncommon. During 2014–2020, no TB cases were reported within the Washington state prison system.

What is added by this report?

During 2021–2022, a total of 25 TB cases were reported among persons incarcerated in two Washington state prisons. An additional 244 resident-contacts and staff-member–contacts without known TB histories in five facilities received a diagnosis of latent TB infection.

What are the implications for public health practice?

This is Washington's largest TB outbreak in 20 years. Transmission was facilitated by prolonged case infectiousness and suspension of annual screenings because clinical resources were diverted to the COVID-19 pandemic response. Close collaborations between corrections departments and public health officials will be critical for ending this outbreak and preventing future TB outbreaks.

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Corresponding author: Randy M. Stalter, rhq4@cdc.gov.

[1]Epidemic Intelligence Service, CDC; [2]Washington State Department of Health; [3]Washington State Department of Corrections; [4]Division of Tuberculosis Elimination, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, CDC; [5]University of Washington, Seattle, Washington.

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Recommendations for Use of Video Directly Observed Therapy During Tuberculosis Treatment — United States, 2023

Joan M. Mangan, PhD[1]; Rachel S. Woodruff, MPH[1]; Carla A. Winston, PhD[1]; Scott A. Nabity, MD[1]; Maryam B. Haddad, PhD[1]; Meredith G. Dixon, MD[1]; Farah M. Parvez, MD[1]; Carissa Sera-Josef, MS[1]; LaTweika A. T. Salmon-Trejo, MPH[1]; Chee Kin Lam, MS, MPH[1]

U.S. clinical practice guidelines recommend directly observed therapy (DOT) as the standard of care for tuberculosis (TB) treatment (*1*). DOT, during which a health care worker observes a patient ingesting the TB medications, has typically been conducted in person. Video DOT (vDOT) uses video-enabled devices to facilitate remote interactions between patients and health care workers to promote medication adherence and clinical monitoring. Published systematic reviews, a published meta-analysis, and a literature search through 2022 demonstrate that vDOT is associated with a higher proportion of medication doses being observed and similar proportions of cases with treatment completion and microbiologic resolution when compared with in-person DOT (*2*–*5*). Based on this evidence, CDC has updated the recommendation for DOT during TB treatment to include vDOT as an equivalent alternative to in-person DOT. vDOT can assist health department TB programs meet the U.S. standard of care for patients undergoing TB treatment, while using resources efficiently.

Background

The 2016 U.S. clinical practice guidelines for TB treatment recommend DOT as the standard of care (*1*). During DOT, a health care worker observes patients ingest their medications, monitors them for adverse events, and provides social support (e.g., personal connection, encouragement, advice, or assistance navigating challenges that occur with illness). Typically, DOT has involved meeting in person at a mutually agreed-upon location within the community or in a clinical setting; however, participation in DOT in person can be logistically challenging. Scheduling can interfere with patients' employment, schooling, or other daily activities, and arranging transportation for DOT can be difficult. With community-based DOT, the daily arrival and departure of health care workers might also prompt unwelcome questions from neighbors or coworkers or result in the creation of stigma for the patient. Moreover, in-person DOT might not always be feasible during inclement weather, natural disasters, or a pandemic.

vDOT (also known as video DOT) allows persons undergoing TB treatment the opportunity to use video-enabled phones, tablets, or computers to remotely interact with health care workers in real time (synchronous) or through recorded videos (asynchronous). CDC reviewed published evidence on vDOT compared with in-person DOT for TB treatment adherence, completion, and microbiologic resolution to update the 2016 clinical practice guidelines (*1*). This update is for organizations and providers responsible for providing care for and monitoring treatment of persons with diagnosed TB in the United States and affiliated areas. Additional considerations, concerns, and limitations are available.*

Methods

CDC developed these guidelines based on evidence presented by a systematic review and a meta-analysis that included studies published from the time the searched databases were initially available through January 2021 (*2*). An additional search of articles published during February 1, 2021–May 13, 2022, was conducted to identify subsequent studies that were not included in the systematic review and meta-analysis. The search of articles listed in PubMed, Embase, and Cochrane databases was conducted using the keywords "tuberculosis" and "directly observed therapy"; "directly observed treatment"; "video observed"; "video supported"; "adherence"; "treatment completion"; or "cell-," "smart-," or "tele-" "phone." Studies were excluded if they did not report data for treatment adherence, treatment completion, or microbiologic testing; did not have a comparison group; or focused on the use of text message reminders or device-facilitated monitoring without video capability (e.g., medication containers with wireless sensors or ingestible sensors). Studies were also excluded if they compared vDOT with self-administered therapy or reported populations undergoing TB treatment in an inpatient, institutional, or medically supervised residential setting (e.g., a rehabilitation center). Two reviewers screened article abstracts for exclusion criteria and then independently documented participant demographics, DOT methods, doses scheduled for DOT, medication adherence, and treatment outcomes from retained articles that met inclusion criteria. Studies involving persons of any age, any sex, and from any upper-middle– to high-income country with a diagnosis (or suspected diagnosis) of TB, including pulmonary disease, extrapulmonary disease, and drug-resistant TB, undergoing treatment in an outpatient setting were included (*6*). The Methods Manual for Community

* https://www.cdc.gov/tb/topic/treatment/vDOT.htm

Guide Systematic Reviews provided a framework for data collection from retained articles (*7*). Consistent with the evidence quality tools used in the published meta-analysis, retained articles were reviewed with the Revised Tool for Assessing Risk of Bias in Randomized Trials, the Newcastle-Ottawa Scale and Agency for Healthcare Research and Quality Standards (*2*,*6*–*9*). During May–September 2022, CDC reviewed the evidence and drafted recommendations. These recommendations were reviewed favorably by external TB subject matter experts and were presented for public comment during the December 2022 Advisory Council for the Elimination of Tuberculosis[†] meeting. Comments supported the updated recommendations without further modifications.

Rationale and Evidence

Literature Review. Two systematic reviews that assessed technology interventions for TB treatment were identified (*2*,*3*). The first review combined vDOT, text reminders, and medication monitoring boxes for comparison with in-person DOT (*3*); because of the combination of interventions assessed, this review was excluded. The second review, a meta-analysis comparing vDOT with in-person DOT, assessed treatment adherence, treatment completion, and microbiologic resolution (*2*). This published meta-analysis was used as supporting evidence and as the starting point for an updated literature search. The updated literature search yielded five articles published after the meta-analysis, two of which were retained as supporting evidence (*4*,*5*). Three articles were excluded for the following reasons: two did not include a comparison group (*10*,*11*), and one reported previously published data (*12*) included in the meta-analysis (*2*).

Evidence Summary

Treatment Adherence. The meta-analysis (*2*), one randomized controlled trial (RCT) (*4*), and one prospective observational study (*5*) examined the proportion of medication doses observed by TB program staff members (Table). The meta-analysis defined treatment adherence as observation of ≥80% of prescribed doses. The RCT and observational study defined adherence as the observed proportion of total prescribed doses. The meta-analysis and observational study found higher adherence among patients on vDOT than among those receiving in-person DOT (78.8% versus 27.2%, and 68.4% versus 53.9%, respectively). The observational study focused on doses taken Monday through Friday (*5*). Per program practice, if a patient using vDOT missed a weekday dose and submitted additional videos on the weekend, these doses were included in the weekly adherence count. The RCT found that vDOT was as effective as in-person DOT at achieving observed doses (89.8% versus 87.2%) (*4*).

Treatment Completion. The meta-analysis (*2*) defined completion of treatment as not prematurely stopping treatment or being lost to follow-up. The observational study (*5*) defined completion based on a set number of target doses (Table). Treatment completion was similar among patients receiving vDOT and in-person DOT (79.0% versus 68.2%, respectively, in the meta-analysis, and 96% versus 90%, respectively, in the observational study). The RCT did not evaluate treatment completion (*4*).

Microbiologic Resolution. The meta-analysis (*2*) and observational study (*5*) reported results for microbiologic resolution, the principal prognostic indicator for TB treatment response. The RCT did not evaluate microbiologic outcomes (*4*). Meta-analysis results were based on radiography and negative sputum smear test results by the last month of treatment and on at least one previous occasion. The observational study reported microbiologic resolution as the mean number of days to culture conversion (i.e., time between treatment start date and date of first negative culture result, after which no further positive culture results were obtained). Microbiologic resolution was similar between patients receiving vDOT and in-person DOT (93.0% versus 87.8%, respectively, in the meta-analysis, and a mean of 48 days versus 47 days, respectively, to culture conversion in the observational study).

Updated Recommendation

Missed doses of medication or treatment interruptions can lead to suboptimal drug concentrations, acquired drug resistance, longer treatment times, TB treatment failure, and recurrence of TB disease. For these reasons, CDC continues to recommend DOT as the standard of care for all persons prescribed TB treatment; however, based on the evidence summary, this report updates the 2016 CDC U.S. clinical practice guidelines (*1*) to state that vDOT should be considered equivalent to in-person DOT.

Considerations

Decisions regarding the use of vDOT or in-person DOT during TB treatment are best made when health care providers and patients work in partnership to discuss the potential benefits and drawbacks of both DOT approaches. Topics to address in shared decision-making discussions include the patient's health care needs, social conditions, preferences, regular access to video-enabled devices and the Internet, insurance reimbursement (as applicable), confidentiality and privacy, as well as program capacities and provider preferences. For patients receiving injectable medications, experiencing circumstances

[†] https://www.cdc.gov/faca/committees/pdfs/acet/acet-minutes-20221213-14-508.pdf

TABLE. Summary of evidence for the use of video directly observed therapy in the treatment of tuberculosis — United States, 2023

Publication	Study design	Setting and location	DOT modalities compared	Study population	Outcome	Definition	Descriptive result	Statistical measure	Conclusion
Truong CB, Tanni KA, Qian J.*	Systematic review and meta-analysis	TB program settings in Australia, China, Moldova, United Kingdom, and United States	Synchronous or asynchronous vDOT compared with community or clinic-based in-person DOT	Patients being treated for TB or LTBI for 4–9 mos	Adherence	Patient took ≥80% of prescribed doses	vDOT 360/457 (78.8%) patients: in-person DOT 106/390 (27.2%) patients	RR (95% CI) = 2.79 (2.26 to 3.45)	Better outcome with vDOT compared with in-person DOT
					Treatment completion	Patient did not prematurely stop treatment or was not lost to follow-up	vDOT 124/157 (79.0%) patients; in-person DOT 436/639 (68.2%) patients	RR (95% CI) = 1.33 (0.73 to 2.43)	vDOT and in-person DOT are equivalent
					Microbiologic resolution	Radiography and negative sputum smear in the last month of treatment and on one or more previous occasions among patients who were sputum smear positive at beginning of treatment	vDOT 304/327 (93.0%) patients; in-person DOT 289/329 (87.8%) patients	RR (95% CI) = 1.06 (1.01 to 1.11)	Better outcome with vDOT compared with in-person DOT
Perry A, Chitnis A, Chin A, et al.†	Prospective observational study	Urban TB program, Alameda County Public Health Department, California	Asynchronous vDOT compared with community-based in-person DOT	Patients receiving care for TB treatment during 2018–2020	Adherence	Proportion of total prescribed doses verified by observation with weekend and holiday self-administration§	vDOT 68.4% of doses; in-person DOT 53.9% of doses	p<0.001	Better outcome with vDOT compared with in-person DOT
					Treatment completion	Treatment completion and success were based on ingesting a set number of target doses	vDOT 96% of patients; in-person DOT 90% of patients	p = 0.326	vDOT and in-person DOT are equivalent
					Microbiologic resolution	Mean days to culture conversion among patients who were sputum smear positive at beginning of treatment	vDOT 48 days; in-person DOT 47 days	p = 0.843	vDOT and in-person DOT are equivalent
Burzynski J, Mangan JM, Lam CK, et al.¶	Randomized controlled trial	Urban TB program in four clinics, NYC DOHMH, New York	Synchronous and asynchronous vDOT compared with community and clinic-based in-person DOT	173 patients in 8-wk crossover periods	Adherence	Percentage of medication doses participants were observed to completely ingest	vDOT 89.8% of doses; in-person DOT 87.2% of doses**	Percentage difference†† (95% CI) = −2.6% (−4.8% to −0.3%)	vDOT and in-person DOT are equivalent (trial used a noninferiority design)

Abbreviations: DOT = directly observed therapy; LTBI = latent tuberculosis infection; MITT = modified intention to treat; NYC DOHMH = New York City Department of Health and Mental Hygiene; RR = risk ratio; TB = tuberculosis; vDOT = video directly observed therapy.

* https://doi.org/10.1016/j.amepre.2021.10.013

† https://doi.org/10.5588/ijtld.21.0170

§ Study focused on doses taken Monday through Friday. Per program practice, if a patient using vDOT missed a weekday dose and submitted additional videos on the weekend, these were included in counts to confirm adherence for 5 of 7 days of the week. CDC notes this approach to quantifying treatment adherence could potentially bias results in favor of vDOT.

¶ This study did not evaluate treatment completion or microbiologic resolution. https://doi.org/10.1001/jamanetworkopen.2021.44210

** Results from the MITT analysis. Empirical, per-protocol, and per-protocol 85% analyses were also conducted and had noninferiority results consistent with those from the MITT analysis.

†† Calculated by subtracting the percentage of completed doses observed with electronic DOT from the percentage with in-person DOT.

that they and their providers decide would benefit from additional monitoring, or who are unable to use vDOT technology, in-person DOT is likely the better treatment option.

Discussion

This update of CDC recommendations is based on evidence that vDOT is associated with a higher proportion of medication doses being observed and similar rates of TB treatment completion and microbiologic resolution when compared with in-person DOT. These data, combined with research that has demonstrated vDOT can conserve time and costs for patients and programs (*13*,*14*), improve patient satisfaction with DOT (*14*), and provide opportunities to monitor adherence when in-person DOT is not feasible (*5*), highlight the utility of vDOT to sustain patient care and treatment.

Summary

What is already known about this topic?

Directly observed therapy (DOT) for tuberculosis treatment involves observing a patient ingest medication, monitoring the patient for adverse events, and providing support for treatment completion. DOT has typically been conducted in person; however, scheduling in-person DOT can present logistical challenges.

What is added by this report?

Based on published evidence evaluating treatment adherence and completion and microbiologic resolution of disease, CDC recommends video DOT (vDOT) as equivalent to in-person DOT for persons undergoing treatment for diagnosed tuberculosis.

What are the implications for public health practice?

vDOT can assist health department tuberculosis programs meet the U.S. standard of care for patients undergoing tuberculosis treatment, while using resources efficiently.

To date, few RCTs and cohort studies of vDOT have been conducted. Studies have been heterogenous with respect to video type (synchronous versus asynchronous) and location of in-person DOT (clinic versus community). In addition, published studies have been conducted in urban and suburban settings, with adults, and in locations with broad Internet availability. Thus, additional evaluation of vDOT implementation in more diverse settings and with diverse populations will address evidence gaps and expand the current knowledge base. Moreover, technology has evolved rapidly during the past decade, and this evolution will likely continue, adding to the evidence and further guiding best practices for the use of vDOT to support patients in their treatment adherence. CDC will continue to monitor relevant reports and update this guidance as necessary.

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Corresponding author: Joan M. Mangan, bpy4@cdc.gov.

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

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Vital Signs: Progress Toward Eliminating HIV as a Global Public Health Threat Through Scale-Up of Antiretroviral Therapy and Health System Strengthening Supported by the U.S. President's Emergency Plan for AIDS Relief — Worldwide, 2004–2022

Helen M. Chun, MD[1,*]; Emilio Dirlikov, PhD[1,*]; Mackenzie Hurlston Cox, MSPH[1]; Michelle Williams Sherlock, MPH[1]; Yaa Obeng-Aduasare, MPH[1]; Kimi Sato, MPH[1]; Andrew C. Voetsch, PhD[1]; Abraham D. Ater, DrPH[1]; Erin Rottinghaus Romano, PhD[1]; Hank Tomlinson, PhD[1]; Surbhi Modi, MD[1]; Angeli Achrekar, DrPH[2]; John Nkengasong, PhD[2]; CDC Global HIV Working Group

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Abstract

Introduction: In 2004, the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), with CDC as a major U.S. government implementing agency, began providing HIV antiretroviral therapy (ART) worldwide. Through suppression of HIV viral load, effective ART reduces morbidity and mortality among persons with HIV infection and prevents vertical and sexual transmission.

Methods: To describe program impact, data were analyzed from all PEPFAR programs and from six countries that have conducted nationally representative Population-based HIV Impact Assessment (PHIA) surveys, including PEPFAR programmatic data on the number of persons with HIV infection receiving PEPFAR-supported ART (2004–2022), rates of viral load coverage (the proportion of eligible persons with HIV infection who received a viral load test) and viral load suppression (proportion of persons who received a viral load test with <1,000 HIV copies per mL of blood) (2015–2022), and population viral load suppression rates in six countries that had two PHIA surveys conducted during 2015–2021. To assess health system strengthening, data on workforce and laboratory systems were analyzed.

Results: By September 2022, approximately 20 million persons with HIV infection in 54 countries were receiving PEPFAR-supported ART (62% CDC-supported); this number increased 300-fold from the 66,550 reported in September 2004. During 2015–2022, viral load coverage more than tripled, from 24% to 80%, and viral load suppression increased from 80% to 95%. Despite increases in viral load suppression rates and health system strengthening investments, variability exists in viral load coverage among some subpopulations (children aged <10 years, males, pregnant women, men who have sex with men [MSM], persons in prisons and other closed settings [persons in prisons], and transgender persons) and in viral load suppression among other subpopulations (pregnant and breastfeeding women, persons in prisons, and persons aged <20 years).

Conclusions and implications for public health practice: Since 2004, PEPFAR has scaled up effective ART to approximately 20 million persons with HIV infection in 54 countries. To eliminate HIV as a global public health threat, achievements must be sustained and expanded to reach all subpopulations. CDC and PEPFAR remain committed to tackling HIV while strengthening public health systems and global health security.

Introduction

The U.S. President's Emergency Plan for AIDS Relief (PEPFAR) was announced in January 2003 and remains the largest commitment by any nation to address a single disease. PEPFAR's core aim is to address health inequities in access to HIV services. The initial goal was to prevent 7 million infections, treat 2 million persons, and provide humane care for persons suffering from AIDS and for children orphaned by AIDS.[†] At the time, approximately 30 million persons with HIV infection were estimated to live on the African continent, including 3 million children and adolescents aged <15 years; however, only 50,000 were receiving antiretroviral therapy (ART).[§] Since 2004, PEPFAR has supported partner governments' expansion of ART delivery while strengthening health systems. Through viral load suppression, effective ART reduces morbidity and mortality among persons with HIV infection (*1*); it also prevents vertical

[*] These authors contributed equally to this report.
[†] https://www.state.gov/pepfar/

[§] https://www.washingtonpost.com/wp-srv/onpolitics/transcripts/bushtext_012803.html

transmission from mothers with HIV infection to their infants if the mother is on ART and the HIV-exposed infant receives prophylaxis; and prevents sexual transmission when viral load is undetectable (<200 copies per mL of blood) (*2*–*5*).

PEPFAR, led and coordinated by the U.S. Department of State, uses a whole-of-government approach for global HIV/AIDS response, implemented by seven U.S. government departments and agencies, including CDC.[¶] As the U.S. agency responsible for protecting public health, CDC couples its core area investments in public health workforce development, surveillance, and laboratory capacity with scientific and technical expertise and data-driven approaches to fight the global HIV epidemic and other threats to global health security.[**]

PEPFAR supports the Sustainable Development Goals and the Joint United Nations Programme on HIV/AIDS' (UNAIDS) fast-track strategy to end the AIDS epidemic as a global threat by 2030: that 95% of persons with HIV infection know their status, that 95% of those with known status receive ART, and that 95% of those receiving ART achieve viral load suppression.[††] Worldwide in 2021, an estimated 38.4 million persons had HIV infection; 650,000 AIDS-related deaths and 1.5 million new infections occurred.[§§] An estimated 28.7 million persons with HIV infection were receiving ART, and among those receiving ART, an estimated 92% had suppressed viral loads. To assess PEPFAR-supported program impact and health system–strengthening investments, programmatic data from all PEPFAR programs and survey data for six countries with more than one Population-based HIV Impact Assessment (PHIA) survey were analyzed.[¶¶]

Methods

To describe program impact, PEPFAR Monitoring, Evaluation, and Reporting[***] programmatic data were analyzed by age, sex, and subpopulation (pregnant or breastfeeding women and key populations, including female sex workers, men who have sex with men (MSM), transgender persons, persons who inject drugs, and persons in prisons), and proportion of CDC contribution; analyses were stratified by fiscal year (October–September).[†††] Before October 2018, persons with HIV infection receiving PEPFAR-supported ART were defined as persons currently receiving ART and for whom ≤90 days had elapsed after missing a scheduled ART pickup; in October 2018, this definition changed to persons currently receiving ART for whom ≤28 days had elapsed after missing a scheduled ART pickup. A proxy rate for viral load coverage was calculated as the percentage of persons with HIV infection receiving ART for ≥6 months with documented receipt of a viral load test within the previous 12 months. As an indicator of ART effectiveness, viral load suppression was defined as <1,000 HIV copies per mL of blood, and the viral load suppression rate was calculated as the number of persons with HIV infection with viral load suppression among those who received a viral load test. Using data from the PEPFAR-supported, CDC-led PHIA surveys, population viral load suppression rates by sex and age group (15–24, 25–34, 35–49, and ≥50 years) were analyzed for six countries (Eswatini, Lesotho, Malawi, Uganda, Zambia, and Zimbabwe) that completed two surveys during 2015–2021.[§§§]

PEPFAR Monitoring, Evaluation, and Reporting data were analyzed to describe health system strengthening investments. The workforce includes the number of health care workers (including lay, clinical, pharmacy, and laboratory workers) who provide HIV- or tuberculosis (TB)-related prevention, treatment, or other HIV-related services in community, clinic, or other settings. Molecular testing capacity was defined as the existence of a facility with dedicated infrastructure and staff members trained to conduct HIV early infant diagnosis, viral load, or TB molecular diagnostic testing. Laboratory continuous quality improvement enrollment was defined

¶ https://www.state.gov/about-us-pepfar/

** https://www.cdc.gov/globalhivtb/index.html

†† https://www.unaids.org/en/resources/documents/2022/in-danger-global-aids-update; https://www.unaids.org/en/resources/fact-sheet

§§ https://www.unaids.org/en/resources/campaigns/World-AIDS-Day-Report-2014

¶¶ https://www.cdc.gov/globalhivtb/what-we-do/phia/phia.html

*** https://www.state.gov/wp-content/uploads/2021/09/FY22-MER-2.6-Indicator-Reference-Guide.pdf

††† For persons with HIV infection receiving PEPFAR-supported ART, overall data were available for 2004–2022; data by agency were analyzed for 2010–2022; and data by age, sex, and key population were analyzed for 2022. For viral load, overall data were available for 2015–2022; data by age, sex, and among pregnant or breastfeeding women were available for 2017–2022; data on key populations were available for 2020–2022; and data were not available to calculate viral load proxy coverage among breastfeeding women. Data on human resources to support HIV and TB services were available for 2022. Data on laboratory capacity were available for 2017–2022. PEPFAR indicators are disaggregated by biologic sex (male or female), where applicable.

§§§ Population viral load suppression rate was calculated as the number of persons with HIV infection with viral load suppression (<1,000 HIV copies per mL of blood) among all persons identified with HIV infection. PHIA survey data sets are available for public download from the PHIA Project team portal (https://phia-data.icap.columbia.edu/datasets). Eswatini: survey 1 was conducted during 2016–2017, and survey 2 during 2021; Lesotho: survey 1 was conducted during 2016–2017, and survey 2 during 2020; Malawi: survey 1 was conducted during 2015–2016, and survey 2 during 2020–2021; Uganda: survey 1 was conducted during 2016–2017, and survey 2 during 2020–2021; Zambia: survey 1 was conducted during 2016, and survey 2 during 2021; and Zimbabwe: survey 1 was conducted during 2015–2016, and survey 2 during 2021.

as participation in activities aimed at ensuring diagnostic accuracy and reliability supported by a recognized laboratory continuous quality improvement program. Accreditation was defined as achieving the highest standard of clinical laboratory quality as assessed by a nationally, regionally, or internationally recognized accrediting body. This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.¶¶¶

Results

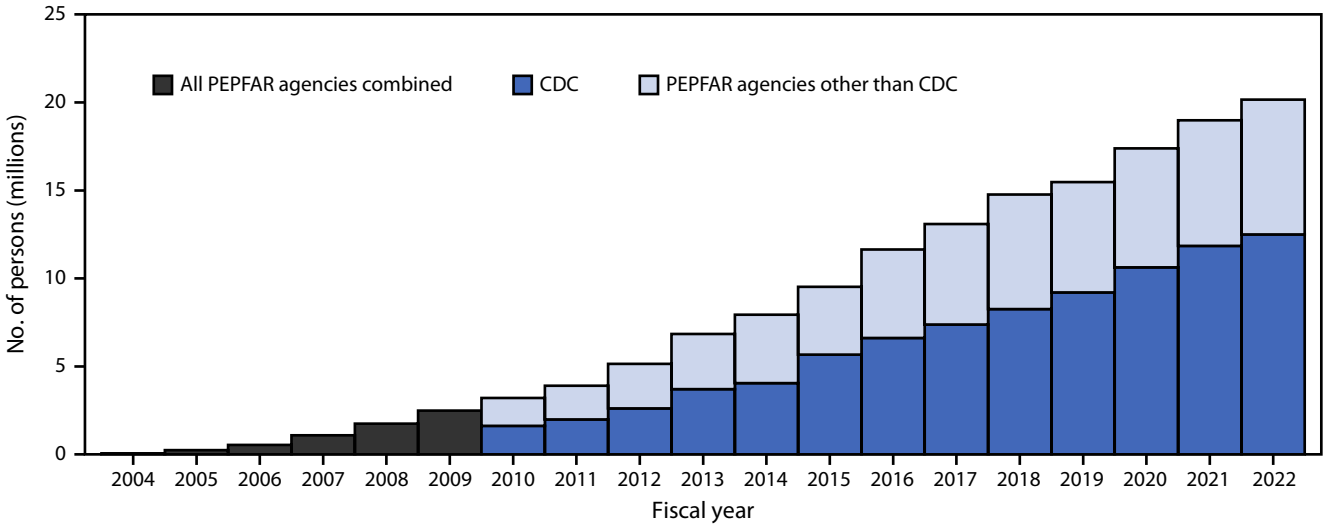
During 2004–2022, the number of persons with HIV infection receiving PEPFAR-supported ART increased 300-fold, from 66,550 to 20,166,110, in 54 countries (Figure 1). During 2015–2022, the annual number of persons with HIV infection who received a viral load test increased 605%, from 2,109,749 to 14,875,130, and the overall viral load coverage rate increased 233%, from 24% (2,109,749 of 8,806,300 eligible persons who received a viral load test) to 80% (14,875,130 of 18,573,406) (Figure 2) (Table 1). During 2017–2022, viral load coverage rates increased to approximately 75% among women, men, and persons aged <10, 10–19, and ≥20 years; among pregnant women, viral load coverage increased 72%, from 18% to 31%. During 2020–2022, viral load coverage increased from 70% to 85% among female sex workers, from 62% to 83% among persons who inject drugs, and from 64% to 78% among MSM. Among transgender persons, viral load coverage decreased 6%, from 71% to 67%, and among persons in prisons, coverage decreased 24%, from 75% to 57%.

During 2015–2022, the viral load suppression rate among those receiving testing increased from 80% (1,691,232 persons with viral load suppression of 2,109,749 who received a viral load test) to 95% (14,146,647 of 14,875,130) (Figure 2). During 2017–2022, the viral load suppression rate increased among women, men, persons aged <10, 10–19, and ≥20 years, pregnant women, and breastfeeding women. Males, females, and those aged ≥20 years reached viral load suppression rates of ≥95% in 2022 (Table 1). By 2022, the viral load suppression rate among female sex workers, MSM, transgender persons, and persons who inject drugs reached ≥95%, but among persons in prisons, remained unchanged, at 93%.

PHIA survey results demonstrated increased population viral load suppression rates in all six assessed countries, with overall viral load suppression rates in the first and second surveys ranging from 59.2% (Zambia) to 73.1% (Eswatini) and

¶¶¶ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE 1. Cumulative number of persons with HIV infection receiving antiretroviral therapy supported by the U.S. President's Emergency Plan for AIDS Relief,* by CDC and other agencies† — worldwide,§ fiscal years 2004–2022¶



Abbreviations: ART = antiretroviral therapy; PEPFAR = U.S. President's Emergency Plan for AIDS Relief.

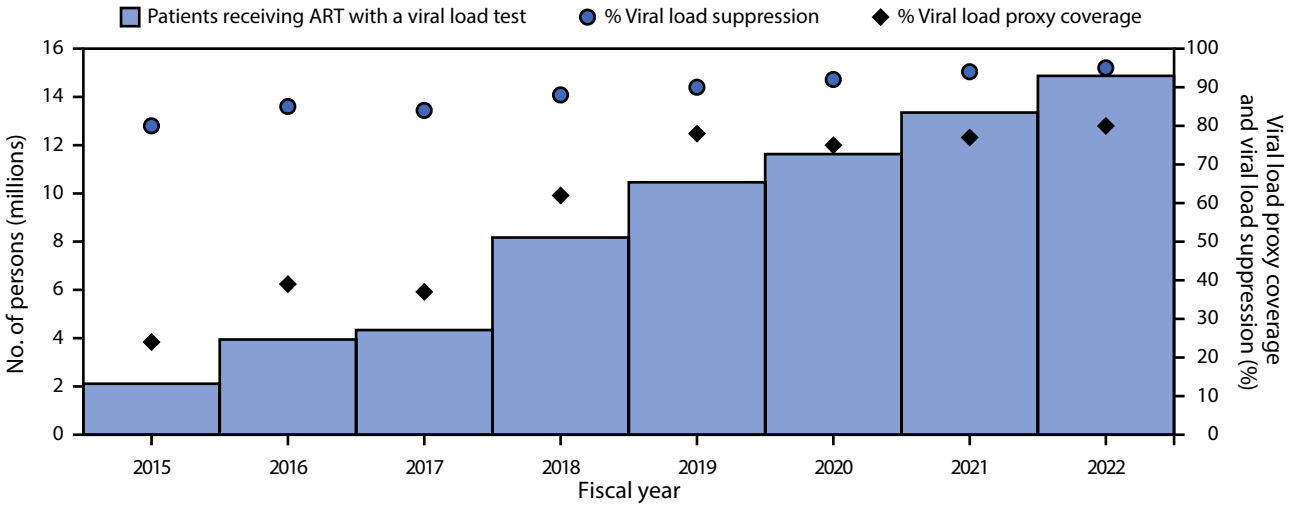
* Data on support provided by CDC and other PEPFAR agencies available for fiscal years 2010–2022.

† PEPFAR agencies include the U.S. Agency for International Development, the U.S. Department of Health and Human Services and its agencies (CDC, Health Resources and Service Administration, and National Institutes of Health), the U.S. Department of Defense, the Peace Corps, the U.S. Department of Labor, the U.S. Department of Commerce, and the U.S. Department of the Treasury.

§ As of September 30, 2022: Angola, Benin, Botswana, Brazil, Burkina Faso, Burma, Burundi, Cameroon, Colombia, Cote d'Ivoire, Democratic Republic of the Congo, Dominican Republic, El Salvador, Eswatini, Ethiopia, Ghana, Guatemala, Haiti, Honduras, India, Indonesia, Jamaica, Kazakhstan, Kenya, Kyrgyzstan, Laos, Lesotho, Liberia, Malawi, Mali, Mozambique, Namibia, Nepal, Nicaragua, Nigeria, Panama, Papua New Guinea, Peru, Philippines, Rwanda, Senegal, Sierra Leone, South Africa, South Sudan, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Uganda, Ukraine, Vietnam, Zambia, and Zimbabwe.

¶ Fiscal years are October–September.

FIGURE 2. Number of persons with HIV infection receiving antiretroviral therapy supported by the U.S. President's Emergency Plan for AIDS Relief with a viral load test,* viral load proxy coverage rate,† and viral load suppression rate§ — worldwide,¶ fiscal years 2015–2022**



Abbreviations: ART = antiretroviral therapy; PEPFAR = U.S. President's Emergency Plan for AIDS Relief.

* Viral load test result documented in the patient record or laboratory information system.

† Proxy viral load coverage rate was calculated as the percentage of persons with HIV infection receiving ART for ≥6 months with documented receipt of a viral load test within the preceding 12 months.

§ Viral load suppression was defined as <1,000 HIV copies per mL of blood; suppression rate was calculated as the number of persons with HIV infection with viral load suppression among those who received a viral load test.

¶ As of September 30, 2022: Angola, Benin, Botswana, Brazil, Burkina Faso, Burma, Burundi, Cameroon, Colombia, Cote d'Ivoire, Democratic Republic of the Congo, Dominican Republic, El Salvador, Eswatini, Ethiopia, Ghana, Guatemala, Haiti, Honduras, India, Indonesia, Jamaica, Kazakhstan, Kenya, Kyrgyzstan, Laos, Lesotho, Liberia, Malawi, Mali, Mozambique, Namibia, Nepal, Nicaragua, Nigeria, Panama, Papua New Guinea, Peru, Philippines, Rwanda, Senegal, Sierra Leone, South Africa, South Sudan, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Uganda, Ukraine, Vietnam, Zambia, and Zimbabwe.

** Fiscal years are October–September.

75.4% (Uganda) to 88.6% (Eswatini), respectively (Table 2). Across all surveys, with few exceptions, population viral load suppression rates were higher in older than in younger persons, and higher in women than in men.

In 2022, the PEPFAR-supported workforce included 371,760 health care workers in approximately 70,000 community, clinic, or other settings. During 2017–2022, the number of PEPFAR-supported facilities with a molecular laboratory increased by 115%, from 926 to 1,995; the number of PEPFAR-supported facilities with one or more laboratory enrolled in a continuous quality improvement program increased by 112%, from 795 to 1,687; and those that were accredited increased by 194%, from 103 to 303.

In 2010, approximately one half of persons with HIV infection receiving PEPFAR-supported ART received services through CDC implementing partners (Figure 1). By September 2022, CDC implementing partners supported 62% (12,566,736 of 20,166,110 persons with HIV infection receiving PEPFAR-supported ART) of the PEPFAR total. Among the total PEPFAR-supported workforce in 2022, 42% were supported through CDC implementing partners.

Discussion

The cumulative program impact of PEPFAR among 54 countries reached approximately 20.2 million persons with HIV infection with lifesaving ART by September 2022, a 300-fold increase from 2004. PEPFAR-supported ART is effective, as demonstrated by program data indicating that the UNAIDS target for viral load suppression was achieved in 2022, and by PHIA survey data indicating increased viral load suppression rates at the population level (i.e., not restricted to persons with HIV infection receiving PEPFAR-supported ART). By providing effective ART, PEPFAR's investments have helped avert new HIV infections (*6*) and have led to sustained declines in all-cause mortality.**** For example, in Uganda, the first PEPFAR-supported country, ART scale-up since 2004 has helped to avert an estimated 500,000 infections, including approximately 230,000 infections among HIV-exposed infants, and 600,000 HIV-related deaths (*7*). In Eswatini, national HIV incidence decreased by nearly one half and viral load suppression doubled during 2011–2016 (*8*).

**** https://www.kff.org/global-health-policy/issue-brief/assessing-pepfars-impact-analysis-of-mortality-in-pepfar-countries/; https://www.state.gov/pepfar/

TABLE 1. Summary of programmatic data on viral load testing,* proxy viral load coverage,† and viral load suppression,§ by age group, sex, and subpopulation — worldwide, fiscal years 2015–2022¶

Characteristic (program fiscal years, 2015–2022)¶	Baseline programmatic data**			Programmatic data from September 30, 2022			Change§§ in VL proxy coverage, baseline–2022, %	Change¶¶ in VL suppression, baseline–2022, %
	No. of eligible†† persons receiving VL test/total eligible persons	VL proxy coverage rate, %	VL suppression rate, %	No. of eligible†† persons receiving VL test/total eligible persons	VL proxy coverage rate, %	VL suppression rate, %		
Overall	**2,109,749/8,806,300**	**24**	**80**	**14,875,130/18,573,406**	**80**	**95**	**233**	**19**
Age group, yrs (2017–2022)								
<10	147,143/313,426	47	67	249,530/314,058	79	84	68	25
10–19	240,705/496,053	49	68	620,686/729,305	85	88	73	29
≥20	3,649,299/8,403,258	43	86	13,941,086/17,202,330	81	96	88	12
Unknown***	249,150/2,832,066	9	88	63,828/327,713	19	94	111	7
Sex††† (2017–2022)								
Female	2,760,201/7,695,526	36	86	9,768,760/12,034,211	81	95	125	10
Male	1,339,638/4,029,411	33	84	5,106,370/6,539,195	78	95	136	13
Pregnant and breastfeeding women with HIV infection§§§ (2017–2022)								
Pregnant women	80,652/438,315	18	95	150,818/487,608	31	92	72	−3
Breastfeeding women	82,255	NA	85	399,082	NA	94	—	11
Key populations (2020–2022)								
Female sex workers	58,378/83,095	70	93	199,435/233,652	85	97	21	4
Men who have sex with men	51,317/79,983	64	94	165,352/210,926	78	97	22	3
Persons in prisons and other enclosed settings	18,605/24,821	75	93	22,836/39,805	57	93	−24	0
Persons who inject drugs	33,716/54,394	62	93	79,822/96,228	83	96	34	3
Transgender persons	2,352/3,328	71	89	7,120/10,700	67	96	−6	8

Abbreviations: ART = antiretroviral therapy; NA = not applicable; PEPFAR = U.S. President's Emergency Plan for AIDS Relief; VL = viral load.

* VL test result documented in the patient record or laboratory information system.

† Proxy VL coverage rate was calculated as the percentage of persons with HIV infection who received ART for ≥6 months with documented receipt of a VL test within the preceding 12 months.

§ VL suppression was defined as <1,000 HIV copies per mL of blood; suppression rate was calculated as the number of persons with HIV infection with VL suppression among those who received a VL test.

¶ Each characteristic was calculated using data from the end of the fiscal year from which they were available to the end of fiscal year 2022.

** The year of comparison for each group varied based on the quality and availability of data for analyses and is indicated in the row parentheses.

†† Eligible persons are those who have received ART for ≥6 months, derived from the number of persons receiving PEPFAR-supported ART during the two preceding quarters.

§§ Calculated as ([VL coverage 2022 – VL coverage baseline]/VL coverage baseline) * 100.

¶¶ Calculated as ([VL suppression 2022 – VL suppression baseline]/VL suppression baseline) * 100.

*** The value for age unknown includes 327,713 persons who received ART and were eligible for a VL test, reported in aggregate age groups only (i.e., <15 years and ≥15 years). Because of the proxy nature of the indicator, data reporting discrepancies for age group (<15 years and ≥15 years versus age disaggregates in ≤5-year age bands) might be observed.

††† PEPFAR indicators are disaggregated by biologic sex (male or female), where applicable.

§§§ The number of breastfeeding women receiving ART is not reported in PEPFAR monitoring, evaluation, and reporting.

PEPFAR program impact is founded on strengthened health systems. Improvements in laboratory capacity, including molecular testing and continuous quality improvement activities described in this report, have supported the full HIV cascade of care (*9*), including accurate HIV diagnosis, treatment, and viral load monitoring of ART effectiveness. Investments reflect PEPFAR's commitment to local public health system strengthening for broader pandemic preparedness and response. Under PEPFAR's current 5-year strategy,†††† the United States aims to eliminate the HIV/AIDS pandemic as a public health threat by 2030, while sustainably strengthening public health systems.

Through PEPFAR, CDC is at the forefront of global ART scale-up efforts. CDC receives approximately 50% of PEPFAR funding for HIV treatment and supports approximately 60% of all persons receiving ART through PEPFAR. The PEPFAR-supported CDC-led PHIA surveys have provided rigorous estimates of critical HIV indicators by age group, sex, and subnational geographic units. Other PEPFAR investments achieved through CDC have strengthened surveillance systems, such as health and laboratory information systems for patient and program monitoring, as well as HIV case reporting.

†††† https://www.state.gov/pepfar-five-year-strategy-2022/

TABLE 2. Population viral load suppression prevalence* results from Population-based HIV Impact Assessment surveys in countries supported by the U.S. President's Emergency Plan for AIDS Relief† — six African countries, 2015–2021

Country, age group, yrs	Population viral load suppression rate,%								
	Survey 1			Survey 2			% Change from survey 1 to survey 2		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Eswatini									
All ages	**67.6**	**76.0**	**73.1**	**86.1**	**90.1**	**88.6**	**18.5**	**14.1**	**15.5**
15–24	32.9	55.5	**50.6**	80.5	76.1	**77.1**	47.6	20.6	**26.5**
25–34	54.8	73.5	**68.4**	62.9	85.7	**80.4**	8.1	12.2	**12.0**
35–49	71.5	82.7	**78.5**	88.9	93.8	**91.9**	17.4	11.1	**13.4**
≥50	86.4	85.3	**85.8**	94.3	96.3	**95.3**	7.9	11.0	**9.5**
Lesotho									
All ages	**63.4**	**70.5**	**67.6**	**77.1**	**83.4**	**81.0**	**13.7**	**12.9**	**13.4**
15–24	51.3	50.9	**51.0**	61.7	65.6	**64.7**	10.4	14.7	**13.7**
25–34	46.1	64.6	**57.9**	58.7	77.6	**72.3**	12.6	13.0	**14.4**
35–49	67.5	78.3	**73.3**	78.3	87.8	**83.5**	10.8	9.5	**10.2**
≥50	84.3	80.6	**82.3**	90.7	90.7	**90.7**	6.4	10.1	**8.4**
Malawi									
All ages	**60.9**	**73.1**	**68.3**	**85.5**	**88.4**	**87.3**	**24.6**	**15.3**	**19.0**
15–24	37.2	49.7	**46.0**	75.0	73.2	**73.8**	37.8	23.5	**27.8**
25–34	48.2	70.1	**62.9**	74.0	82.6	**80.1**	25.8	12.5	**17.2**
35–49	66.0	78.5	**73.2**	87.6	92.7	**90.8**	21.6	14.2	**17.6**
≥50	73.7	81.6	**78.0**	90.9	93.0	**92.0**	17.2	11.4	**14.0**
Uganda									
All ages	**53.6**	**62.9**	**59.6**	**69.8**	**78.3**	**75.4**	**16.2**	**15.4**	**15.8**
15–24	32.5	44.9	**42.5**	43.5	57.8	**54.7**	11.0	12.9	**12.2**
25–34	38.7	57.9	**52.6**	51.9	75.0	**68.8**	13.2	17.1	**16.2**
35–49	60.1	71.4	**66.3**	75.1	84.9	**80.9**	15.0	13.5	**14.6**
≥50	65.0	79.4	**73.0**	85.4	90.2	**88.0**	20.4	10.8	**15.0**
Zambia									
All ages	**57.2**	**60.4**	**59.2**	**85.5**	**86.6**	**86.2**	**28.3**	**26.2**	**27.0**
15–24	36.7	33.6	**34.3**	70.1	71.2	**70.9**	33.4	37.6	**36.6**
25–34	36.7	56.1	**50.4**	72.6	83.4	**81.0**	35.9	27.3	**30.6**
35–49	61.8	70.8	**66.9**	87.7	89.9	**89.1**	25.9	19.1	**22.2**
≥50	79.7	73.5	**76.6**	93.0	91.7	**92.3**	13.3	18.2	**15.7**
Zimbabwe									
All ages	**54.1**	**63.8**	**59.8**	**73.0**	**79.8**	**77.3**	**18.9**	**16.0**	**17.5**
15–24	40.1	47.9	**45.3**	49.2	66.2	**60.6**	9.1	18.3	**15.3**
25–34	36.2	54.2	**48.7**	52.4	70.7	**65.7**	16.2	16.5	**17.0**
35–49	55.8	70.5	**63.9**	76.6	82.4	**80.2**	20.8	11.9	**16.3**
≥50	71.6	78.8	**75.1**	84.5	91.0	**88.1**	12.9	12.2	**13.0**

* Viral load suppression was defined as <1,000 copies per mL of blood; suppression rate was calculated as the number of persons with HIV infection with viral load suppression among those who received a viral load test.

† Eswatini: survey 1 was conducted during 2016–2017, and survey 2 during 2021; Lesotho: survey 1 was conducted during 2016–2017, and survey 2 during 2020; Malawi: survey 1 was conducted during 2015–2016, and survey 2 during 2020–2021; Uganda: survey 1 was conducted during 2016–2017, and survey 2 during 2020–2021; Zambia: survey 1 was conducted during 2016, and survey 2 during 2021; and Zimbabwe: survey 1 was conducted during 2015–2016, and survey 2 during 2021.

The PEPFAR laboratory continuous quality improvement program (Strengthening Laboratory Management Toward Accreditation[§§§§]) has provided practical tools for resource-limited settings to improve quality management systems and prepare laboratories for accreditation[¶¶¶¶] (*10*). CDC provides leadership in the use of multiple data sources to continually identify gaps in HIV service delivery for policy and program action (*11*,*12*).

Beyond HIV, PEPFAR investments in public health system strengthening have had additional benefits, including improving global health security. For example, during the COVID-19 pandemic, PEPFAR-supported countries demonstrated the resilience of PEPFAR investments by protecting and advancing HIV response gains (*13*,*14*), while also responding to COVID-19. In Nigeria, an ART surge in nine states supported by CDC through PEPFAR rapidly increased the total number of persons with HIV infection receiving ART by 26% (110,815) during April–September 2020 alone (*15*,*16*). PEPFAR investments have been leveraged for public health emergency response. Workforce investments have trained and

§§§§ https://www.slmta.org

¶¶¶¶ https://www.cdc.gov/globalhealth/stories/2022/cdc-laboratory-program-prepares-countries-COVID-19.html

Summary

What is already known about this topic?

The U.S. President's Emergency Plan for AIDS Relief (PEPFAR) began providing HIV antiretroviral therapy (ART) worldwide in 2004. Through viral load suppression, effective ART improves health outcomes and prevents transmission.

What is added by this report?

By 2022, approximately 20 million persons with HIV infection in 54 countries received PEPFAR-supported ART (62% CDC-supported); this number represents an increase of 300-fold from 66,550 in 2004. During 2015–2022, viral load suppression rates increased from 80% to 95% among those who received testing.

What are the implications for public health practice?

To eliminate HIV as a global public health threat, achievements must be sustained and expanded to reach all subpopulations. PEPFAR remains committed to tackling HIV while strengthening public health systems and global health security.

deployed large numbers of health care workers not only to prevent, diagnose, and treat HIV and provide quality care for persons with HIV infection, but also to identify, track, and contain other health threats such as cholera, Ebola virus disease, and COVID-19.***** During April 2020–March 2021, a total of 109 PEPFAR-supported centralized HIV viral load and early infant diagnosis laboratories and 138 decentralized HIV and TB sites reported conducting approximately 3.4 million SARS-CoV-2 tests in 16 countries (*17*).

Despite these achievements, 10 million persons with HIV infection worldwide (in countries with and without PEPFAR support) were not receiving ART in 2021, and gaps exist among certain subpopulations. Global HIV control cannot be achieved without prioritizing health equity. For example, although overall viral load coverage rates have increased over time, rates were lower among children aged <10 years, males, pregnant women, MSM, persons in prisons, and transgender persons. Similarly, whereas overall viral load suppression rates reached the UNAIDS target of 95% of persons with HIV infection receiving ART, rates were lower among pregnant and breastfeeding women and persons in prisons, and much lower for persons aged <20 years, including children and adolescents with HIV infection. Results from PHIA surveys further highlight lower viral load suppression rates among younger age groups and among men compared with women. Stigma and discrimination remain important barriers to health equity. In sub-Saharan Africa, for example, HIV prevalence among MSM and transgender women is significantly higher than it is in the general population (*18*). Understanding the root causes including structural determinants of health for the observed differences and addressing potential factors leading to health disparities is essential to eliminate HIV as a global public health threat.

The findings in this report are subject to at least six limitations. First, indicator definitions and the systems to collect and report data have evolved over time, which might have affected data quality and results observed. Second, the countries, number of sites reporting, changes in national HIV guidelines (i.e., prevention, treatment, ART initiation criteria, recommended ART regimens, and monitoring), and the ability for persons with HIV infection to access services at any site have also evolved, which might have affected results observed. Third, misclassification of patients in certain subpopulations might have occurred if this information was not disclosed and captured by medical records. Fourth, viral load coverage analyses used aggregate program data, and as such, reported viral load proxy coverage rates could differ from actual viral load coverage rates. Fifth, because some facilities might have more than one laboratory, the number of laboratories might have been underreported. Finally, programmatic data cannot be directly compared with PHIA results, which are derived through representative sampling methods.

Since 2004, PEPFAR has scaled up ART to approximately 20 million persons with HIV infection worldwide, managing a chronic disease at an unprecedented level while strengthening public health systems through workforce, surveillance, and laboratory capacity investments. To eliminate HIV as a global public health threat, achievements in HIV services must be sustained and expanded to reach all subpopulations. PEPFAR remains committed to supporting partner governments to eliminate HIV as a global public health threat while strengthening public health systems and global health security.

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CDC Global HIV Working Group

Simon Agolory, CDC; Josef Amann, CDC; Brittney Baack, CDC; Stephanie Behel, CDC; Anand Date, CDC; Jeff Hanson, CDC; William P. Killam, CDC; Hetal Patel, CDC; Sadhna Patel, CDC; Rituparna Pati, CDC; Laura Porter, CDC; Alicia Warner, CDC; Tadesse Wuhib, CDC; Clement Zeh, CDC; Ana Carolina Faria E Silva Santelli, CDC Brazil Country Office; Giselle Guevara, CDC

***** https://www.state.gov/wp-content/uploads/2021/06/06.23.21-PEPFAR-Technical-Guidance-During-COVID-final.pdf

Caribbean Regional Office; Rosa Elena Morales, CDC Central America Regional Office; Alexandre Kunumboa Ekra, CDC Côte d'Ivoire Country Office; Francois Kitenge, CDC Democratic Republic of the Congo Country Office; Luis Bonilla, CDC Dominican Republic Country Office; Sikhathele Mazibuko, CDC Eswatini Country Office; Tekeste Damena, CDC Ethiopia Country Office; Patrice Joseph, CDC Haiti Country Office; Sunita Upadhyaya, CDC India Country Office; Indira Aitmagambetova, CDC Kazakhstan Country Office; Jane Mwangi, CDC Kenya Country Office; Nazira Usmanova, CDC Kyrgzstan Country Office; Douangchanh Xaymounvong, CDC Laos Country Office; Mugyenyi Asiimwe, CDC Lesotho Country Office; Maida Alice, CDC Malawi Country Office; Gillian Jessina Masamha, CDC Mozambique Country Office; Gram Mutandi, CDC Namibia Country Office; Solomon Odafe, CDC Nigeria Country Office; Lacson Romel, CDC Philippines Country Office; Canisious Musoni, CDC Rwanda Country Office; Mary Mogashoa, CDC South Africa Country Office; Alex Bolo, CDC South Sudan Country Office; Aziz Nabidzhonov, CDC Tajikistan Country Office; George Mgomella, CDC Tanzania Country Office; Rangsima Lolekha, CDC Thailand Country Office; Stella Alamo-Talisuna, CDC Uganda Country Office; Nataliya Podolchak, CDC Ukraine Country Office; Chi K Nguyen, CDC Vietnam Country Office; Silas Quaye, CDC West Africa Regional Program Country Office; Annie Mwila, CDC Zambia Country Office; Ponesai Nyika, CDC Zimbabwe Country Office.

Corresponding author: Helen M. Chun, vgi2@cdc.gov.

[1]Division for Global HIV and TB, Center for Global Health, CDC; [2]Office of the U.S. Global AIDS Coordinator and Health Diplomacy, U.S. Department of State, Washington D.C.

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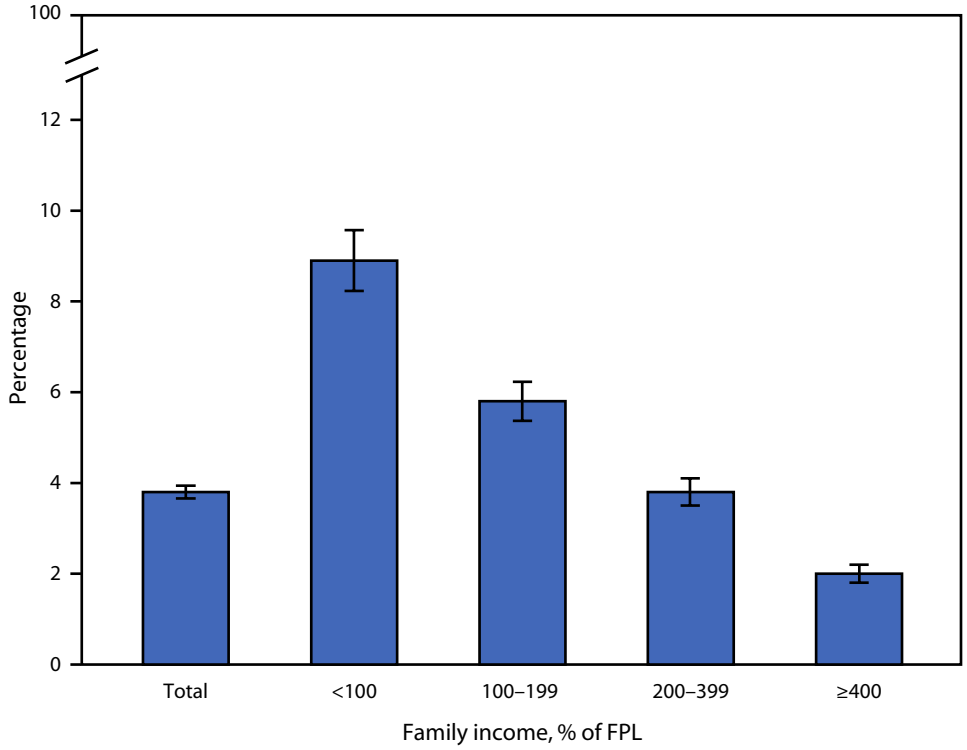
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage* of Adults Aged ≥18 Years with Serious Psychological Distress During the Past 30 Days,† by Family Income§ — National Health Interview Survey, 2021¶



Abbreviation: FPL = federal poverty level.

* Age-adjusted percentages are based on the 2000 U.S. Census Bureau standard population, using age groups 18–44, 45–54, 55–64, 65–74, and ≥75 years, with 95% CIs indicated by error bars.

† Serious psychological distress is based on responses to six questions, "During the past 30 days, how often did you feel 1) so sad that nothing could cheer you up, 2) nervous, 3) restless or fidgety, 4) hopeless, 5) that everything was an effort, or 6) worthless?" The response options "none of the time," "a little of the time," "some of the time," "most of the time," and "all of the time" were each scored from 0–4 points, respectively, and then summed for a total score ranging from 0–24 points. A value of ≥13 was used to define serious psychological distress. Only respondents who answered all six questions were included in the analysis.

§ Family income groups were defined based on family income as a percentage of the federal poverty threshold. Poverty thresholds, which are published by the U.S. Census Bureau, vary by family size and the number of children in the family. Family income was imputed when missing using multiple imputation methodology.

¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population.

In 2021, 3.8% of adults aged ≥18 years had serious psychological distress during the past 30 days. The age-adjusted percentage of adults who had serious psychological distress decreased with increasing family income, from 8.9% of adults with family income <100% of FPL, to 5.8% of adults with family income 100%–199% of FPL, to 3.8% of adults with family income 200%–399% of FPL, and to 2.0% of adults with family income ≥400% of FPL.

Source: National Center for Health Statistics, National Health Interview Survey, 2021. https://www.cdc.gov/nchs/nhis/index.htm

Reported by: Jessly Joy, MPH, oys4@cdc.gov; Johanna M. Alfier, MPH; Deepthi Kandi, MS.

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