

Pediatric Tuberculosis in the United States, 1993–2017

Slide 1

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Surveillance, Epidemiology, and Outbreak Investigations Branch

Division of Tuberculosis Elimination

Slide 2 – Background: Pediatric Tuberculosis

Tuberculosis (TB) is a reportable condition in all United States jurisdictions, and TB cases are reported to the Centers for Disease Control and Prevention (CDC) in a standard format by public health authorities throughout the United States. These reports are summarized for pediatric cases in this slide set, for the years 1993 through 2017.

Pediatric TB is defined as TB disease in a person <15 years old. Pediatric TB is a public health problem of special significance. When children have TB disease, it often indicates recent transmission (because they are young and the amount of time they could have been infected is limited) and usually primary disease from infection within the past 3–12 months. In comparison, adult TB disease often reflects reactivation of remotely acquired infection.

The pediatric age group (<15 years) can be divided into four groups that reflect age-dependent differences in TB pathophysiology that have been noted historically:

Age < 1 year: Infancy. Cases in this age group represent the most recent transmission and also are slightly more likely to be the severe forms of disease that were uniformly fatal before the discovery of chemotherapy.

Age 1–4 years: Toddler/preschool. In this transitional age group, primary pulmonary TB is the most common form, and self-resolution of recent infection is a greater possibility.

Age 5–9 years: Primary School age. In this age group, primary pulmonary TB is the expected form of disease, but rare instances of contagious adult form/reactivation disease are reported.

Age 10–14 years: Early adolescence. Another transitional period, where disease patterns more similar to adult forms become more prevalent.

In 2017, there were 9,105 cases of TB reported among all age groups, 429 (4.7%) were pediatric. There were 53 (0.6%) cases among infants, 175 (1.9%) cases among the toddlers/preschoolers, 93 (1.0%) cases among children primary school age and 108 (1.2%) cases among children in early adolescence.

Slide 3 – U.S. TB Cases, All Ages, by Age Group, 1993–2017

Since 1993, the number of TB cases in the United States has been decreasing for each age group. The relative changes are less apparent for the two younger age groups because the number of cases is smaller.

Slide 4 – U.S. TB Case Rates*, All Ages, by Age Group, 1993–2017

When the TB case rates are shown on a logarithmic scale, the relative trends can be compared by inspection. Straight lines with a negative (i.e., downward) slope demonstrate a constant decline (i.e., exponential decay or rate of decrease). The pattern for the pediatric age group (<15yrs) shows that the TB rate is lower than the rates for the other groups but is declining at about the same rate. The average annual percent change for the <15 years old group is 3.2%. In 2017, the case rate for the pediatric age groups experienced an increase for the first time in approximately 15 years although, due to the small number of cases associated with pediatric TB compared to other age groups, this does not necessarily represent a new trend.

*Cases per 100,000 Person-Years

Slide 5 – U.S. Pediatric TB Cases by Age Group, 1993–2017

Overall, the number of TB cases in all pediatric age groups has decreased, 1993–2017. The most dramatic drop has been among the toddler/preschool group (age 1–4 years).

Slide 6 – U.S. Pediatric TB Case Rates* by Age Group, 1993–2017

The population-adjusted rates for the infant (<1 year) age group and the toddler/preschool (1–4 years) age group have been consistently higher than the rates for the primary school age (5–9 years) group and the early adolescence (10–14 years) group. All groups had similar degrees of decline from 1993 to present.

In 2017, there was an increase in the number of pediatric TB cases overall, especially among the school age and early adolescent age groups, which impacted the case rate for these pediatric age groups.

*Cases per 100,000 Person-Years

Slide 7- Number U.S. Pediatric TB Cases among U.S.-Born and Non-U.S.-Born* Children, 1993-2017

In contrast to overall U.S. TB cases, where two-thirds of cases are among non-U.S.-born persons, only about one-quarter of pediatric cases are among non-U.S.-born children, and the fraction has been fairly stable (21-30%) since 1993.

*Non-U.S.-born refers to persons born outside the United States or its territories or not born to a U.S. citizen

Slide 8 – U.S.-Born Pediatric TB Cases by Race/Ethnicity, 1994–2017

Among U.S.-born pediatric patients by the standard categories of race and ethnicity, the great number of cases since 1998 has been among U.S.-born Hispanic children. In 2017, increase seen among among Hispanic and Asian, non-Hispanic children.

Slide 9 – U.S.-Born Pediatric TB Case Rates* by Race/Ethnicity, 1994–2017

A very different picture emerges when the case counts are population adjusted to annual rates. From 1994 through the present, the rates among all U.S.-born pediatric age groups have been decreasing and the rates for all groups except white, non-Hispanic are similar. The slope of the annual rates for white, non-Hispanic are similar to other race-ethnicities although the magnitude of rates are significantly lower. In 2017, the case rate among U.S.-born white non-Hispanics experienced a noticeable decrease. The American Indian/Alaska Native group has varied over these years due to small denominators.

*Cases per 100,000 Person-Years

Slide 10 – Non-U.S.–Born Pediatric TB Cases by Race-Ethnicity, 1994–2017

Among non-U.S.–born pediatric patients by the standard categories of race and ethnicity, the greatest number of pediatric TB cases from 1994 through 2007 occurred among Hispanic children. However, since 2008 the greatest number of pediatric cases has been among Asian, non-Hispanic and black, non-Hispanic children.

Slide 11 – Non-U.S.–Born Pediatric TB Case Rates* by Race-Ethnicity, 1994–2017

Although the non-U.S.–born white non-Hispanic case rate was lower than the rate for the other race-ethnicities, the magnitude of the difference was much smaller than for the U.S.-born white non-Hispanic group. Although the case rate in non-U.S.–born white non-Hispanics has been declining since 1994, in 2017, this group did experience a large drop in case rate compared to prior years. The decline in case rates has been variable for other race-ethnicities although each has declined since 1994.

*Cases per 100,000 Person-Years

Slide 12 – Pediatric TB Cases among U.S.-Born Children, by Age Group, 1994–2017

Many more cases have been diagnosed in U.S.-born children age 1–4 than among any other U.S.-born pediatric age group. However, this discrepancy has narrowed since 1994. Even with this decline in cases among the U.S.-born toddler/preschooler group, the number of cases is still roughly twice the number of the next highest group (age 5–9 years).

Slide 13 – Pediatric TB Case Rates* among U.S.-born Children, by Age Group, 1994–2017

The age <1 year and the age 1-4 year groups had consistently higher rates than did the age 5-9 and age 10-14 among U.S.-born persons.

*Cases per 100,000 Person-Years

Slide 14 – Pediatric TB Cases among Non-U.S.–Born* Children by Age Group, 1994–2017

The number of cases among all non-U.S.–Born pediatric age groups has dropped significantly since 1994. The infant age group has consistently had only a few cases.

Slide 15 – Pediatric TB Case Rates* among Non-U.S.–Born Children by Age Group, 1994–2017**

All non-U.S.–born age groups TB rates were consistently about 10 times higher than the same age groups among U.S.-born children. Rates for the infant age group were very inconsistent because of small numbers of cases.

*Cases per 100,000 Person-Years

** Non-U.S.–born refers to persons born outside the United States or its territories or not born to a U.S. citizen

Slide 16 – Top Six Countries of Birth for U.S. Pediatric TB Cases, 1993–2017

In 1993, approximately 45% of all non-U.S.–born pediatric patients were born in Mexico. This has changed dramatically so that the number of Mexican-born pediatric cases is now similar to those of the other top five countries for TB cases in the United States.

Slide 17 – Number of U.S. Pediatric TB Cases among U.S.-Born Children by Parent/Guardian Status, 2010–2017

The ability to identify the origin of birth for parents/guardians of pediatric cases of TB has only been available for all jurisdictions since 2010. As you can see from the graph above, the majority of U.S.-born pediatric TB since 2010 has been among patients whose primary parents/guardians were non-U.S.–born.

Slide 18 – U.S. Pediatric TB Case Rates by State, 2013–2017

Alaska, Arkansas, District of Columbia, Georgia, Hawaii, Minnesota, Nevada and Texas have the highest pediatric TB case rates over the last five years.

Slide 19 – 2009 TB Case Verification Criteria

Reports of TB are counted according to a set of criteria (the “case definition”) which is specific to the United States. Only incident (or new) cases that are diagnosed in the United States are included, and cases are verified by three levels of certainty, depending on the types of information that are available to healthcare practitioners and public health authorities. The verification of cases is an interactive process between healthcare practitioners and public health authorities and between public health authorities and CDC.

The verification of cases is especially important when considering the epidemiology of TB in children, because a smaller fraction of cases among this age group are confirmed by bacteriology. Therefore, the statistics for children are more sensitive to changes in medical practice and notification than they are for adults.

Slide 20 – U.S. Pediatric TB Cases by Case Verification Criteria, 1993–2017

Unlike adult TB cases, more than half of pediatric TB cases are verified by the clinical case definition only, and a quarter of cases have bacteriological (laboratory) confirmation. Medical provider diagnosis in the absence of meeting complete clinical or laboratory verification criteria has accounted for over 20% of cases since 1993. It is much more difficult to obtain a sputum culture from pediatric patients, leading to the difference in mode for verifying cases in this age group. Furthermore, these proportions are different for the pediatric age subgroups defined earlier.

Historically, a majority of pediatric TB cases are verified by the clinical case definition. Medical provider diagnosis as a method of case verification has decreased significantly since 1993 and in 2017 was the method of verification in just over 10% of cases. Verification by smear or NAA test was minimal among pediatric cases.

Slide 21 – U.S. Pediatric TB Cases by Case Verification Criteria and Age Group, Summed and Averaged Over 2013–2017

Provider diagnosis is common for all the pediatric age groups, but least common in the early adolescent group (age 10–14). Laboratory confirmation is most common for the infant age group (age <1) and least common for the school-age group (age 5–9).

Slide 22 – U.S. Pediatric TB Cases by Site of Disease, 1993–2017

TB typically is a pulmonary disease, but the infection can manifest in any organ system. More than a quarter of pediatric cases involved an extrapulmonary site. Of these sites, disease in the lymphatic system was most common. This proportion is similar in adults, however, the percentage of cases with extrapulmonary only disease in adults tends to be slightly lower than for pediatric TB.

Slide 23 – U.S. Pediatric TB Cases by Site of Disease and Age Group, Summed and Averaged Over 2013–2017

The fraction of pediatric TB cases with extrapulmonary involvement varied by the age subgroups. The early adolescent group (age 10–14 years) had the highest percentage of extrapulmonary disease, but the infant group (age < 1 years) had a higher percentage of combined pulmonary and extrapulmonary disease.

Slide 24 – Percentage of TB Cases in Children with Any Extrapulmonary Involvement by Age Group (Age <5), Summed and Averaged Over 2013–2017

Among extrapulmonary cases, lymphatic TB is the most common site of disease for all the pediatric age groups, except for infancy age group (age <1) where meningeal disease is most common. Meningeal disease is common in both infancy and pre-school age (age 1-4).

Slide 25 – Percentage of TB Cases in Children with Any Extrapulmonary Involvement by Age Group (Ages 5–14), Summed and Averaged Over 2013–2017

Meningeal disease is not very common for school age group (age 5-9) and the early adolescent group (age 10-14) where other sites of disease are more common (after lymphatic sites) than any other specific extrapulmonary site of disease. Among all pediatric age groups, bone and joint and miliary disease are the least common specified sites of disease.

Slide 26 – U.S. Pediatric TB Cases by Reason Evaluated, 2010*–2017

Among all pediatric age groups, the highest percentage of cases was found through contact investigations, followed by TB symptoms and an abnormal chest x-ray. The other reasons evaluated represented less than five percent each among pediatric TB cases.

*Reason evaluated was not collected by all reporting areas until 2010

Slide 27 – U.S. Pediatric TB Cases by Reason Evaluated by Age Group (Age <5), Summed and Averaged Over 2010*–2017

When examined by pediatric age group, however, the results are varied. The largest number of pediatric TB patients identified in contact investigations were in the infant group, gradually reducing with the lowest percentage of cases found by contact investigation in the early adolescent group.

*Reason evaluated was not collected by all reporting areas until 2010

Slide 28 – U.S. Pediatric TB Cases by Reason Evaluated by Age Group (Ages 5–14), Summed and Averaged Over 2010*–2017

The early adolescent group had the highest percentage of cases identified by TB symptoms among any of the pediatric groups.

*Reason evaluated was not collected by all reporting areas until 2010

Slide 29- Number of Culture-Confirmed U.S. Pediatric TB Cases with Drug Resistance, 1993–2016

Drug resistance results are possible only for TB cases that are confirmed by culture results; the counts shown here are based on those cases. The percentage of pediatric cases with resistance to at least one drug increased through 2005. Since then, the percentage has varied between 11–21%. However, the percentage of cases with multidrug resistance (MDR), that is, resistance to at least isoniazid and rifampin, has varied from 0–2% since 1999. There have been no instances of MDR TB since 2014 among pediatric cases.

Slide 30 – Number of U.S. Pediatric TB Cases by Type of Therapy, 1993–2015

The American Thoracic Society, the American Academy of Pediatrics, and CDC strongly recommend directly observed therapy (DOT) for all pediatric TB patients. DOT means that the ingestion of each dose of medication is observed by a trained worker, who should not be a family member. The fraction of pediatric cases with at least partial DOT reported has increased since 1993. The chart above does not distinguish between in-person and video (electronic) DOT. Information on DOT is reported at case completion, which can be up to two years after initial case report.

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For more information, contact CDC
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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention