

Epidemiology of Pediatric Tuberculosis in the United States, 1993–2015

Slide 1

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Surveillance, Epidemiology, and Outbreak Investigations Branch

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Slide 2 - Pediatric Tuberculosis Background

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 2015.

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. In 2015, there were 9,557 cases of TB reported among all age groups, 440 (4.6%) were pediatric. There were 244 (2.55%) cases among children 0–4 and 196 (2.05%) cases among children 5–14.

Slide 3 - 2009 TB Case Definition and Verification

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 4 - TB Cases, All Ages, by Age Group, 1993–2015

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. However, since 2013, patients 45 and older have experienced a slight increase in cases.

Slide 5 - TB Case Rates*, All Ages, by Age Group, 1993–2015

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 overall United States (dark blue line), 1993–2000, is a good example of this. 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 3.4%. Most age groups experienced a decline in rates from 1993 through 2013. However, there has been a leveling of incidence rates since 2013.

Slide 6 - Percentage of Pediatric TB Cases by Age Group, 1993–2015

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.

Slide 7 - Pediatric TB Cases by Age Group, 1993–2015

Overall, the number of TB cases in all pediatric age groups has decreased, 1993–2015. The most dramatic drop has been among the toddler/preschool group (age 1–4 years). However, the number of cases in each pediatric age group has leveled off over the past 3-4 years.

Slide 8 – Pediatric TB Case Rates* by Age Groups, 1993–2015

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.

Slide 9 - Pediatric TB Cases by Race/Ethnicity, 1993–2015

By the standard categories of race and ethnicity, the greatest number of cases since 1998 has been among Hispanic children.

Slide 10 - Pediatric TB Case Rates* by Race/Ethnicity, 1993–2015

A very different picture emerges when the case counts are population adjusted to annual rates. From 1993 through 2006 the rates among all groups except white, non-Hispanic, are similar, and the trends (i.e., slopes of the trend lines) for decreasing rates also are similar. Beginning in 2007 the rates for pediatric cases among Asian persons becomes slightly higher than for the other race and ethnicity categories. Rates are not shown for American Indian/Alaska Native children because the small case counts and small denominators give an unstable trend line. Rates for all groups except Asians have leveled over the past three years.

Slide 11 - Pediatric TB Case Rates* among U.S.-born and Foreign-born Children, 1994-2015

Important patterns of rate trends are shown by the comparison of the age groups separated into U.S.-born and foreign-born.

- The U.S.-born < 1 year and the 1-4 year age groups had consistently lower rates than did the same age groups among foreign-born persons. Rates vary widely among foreign-born < 1 year due to small numbers of cases.

Slide 12 - Pediatric TB Case Rates* among U.S.-born and Foreign-born Children, 1994-2015

TB rates for the 5-9 year age group and the 10-14 year age group among foreign-born children were consistently about 10 times higher than for the same age groups among U.S.-born children.

Slide 13 - Number and Percentage of Pediatric TB Cases by U.S. and Foreign Birth, 1993–2015

In contrast to overall U.S. TB cases, where two-thirds of cases are among foreign-born persons, only about one-quarter of pediatric cases are among foreign-born children, and the fraction has been fairly stable (23 - 29%) since 1993. How many U.S.-born children had foreign-born parents could not be differentiated by surveillance methods until 2009.

Slide 14 - Number of Pediatric TB Cases with Foreign Birth by Birth Country*, 1993–2015

The top countries of origin for all foreign-born pediatric TB cases during 1993 – 2015 are Mexico, Philippines, Somalia, Vietnam, Haiti, and Ethiopia.

Slide 15- Percentage of Pediatric TB Cases with Foreign Birth by Birth Country, 1993-2015

The top countries of origin for foreign-born pediatric TB cases during 1993 were Mexico, followed by the Philippines, Vietnam, Haiti, Somalia and Ethiopia, respectively. By 2015, Myanmar had replaced Mexico as the country with the highest percentage of foreign-born pediatric TB cases. Although several of the countries from 1993 remain the top countries with pediatric TB, there has been diversity in the origin of these cases since 1993. The number of foreign born pediatric cases in 2015 is only about one fourth of the cases in 1993.

Slide 16 - States with the Greatest Percentage of Total Pediatric TB Cases, 1993–2015

The state with the greatest percentage of pediatric TB cases, 1993–2015, is California, with 24% of the cases during the interval. This is similar to the distribution of total TB cases across all age groups.

Slide 17 - States with Greatest Numbers of Pediatric TB Cases, 1993–2015

Of the six states with the greatest numbers of pediatric cases, 1993–2015, California, Texas, Georgia and Illinois exceed the overall U.S. percentage of cases that were in the pediatric age group; 6.0%. All six states equaled or exceeded the overall U.S. annual incidence rate for pediatric TB: 1.5 per 100,000 population.

Slide 18 - States with Greatest Percentage of Pediatric TB cases, 1993–2015

However, the states with the greatest numbers of pediatric cases are not in the list of those with the greatest time-averaged percentage of their cases in the pediatric age group, which is headed by Alaska.

Slide 19 - States with Greatest Rate of Pediatric TB Cases, 1993–2015

Alaska also reported the greatest incidence rate of pediatric TB, followed by the District of Columbia.

Slide 20 - Pediatric TB Cases by Case Verification Criteria*, 1993–2015

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. The decision of a medical provider, which has the least specific verification criteria, accounts for less than a quarter of the cases. 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 that were defined for earlier slides in this series.

Slide 21 - Pediatric TB Cases by Case Verification Criteria and Age Group, 1993–2015

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 infancy age group (age <1) and least common for the school-age group (age 5–9).

Slide 22 - Pediatric TB Cases by Site of Disease, 1993–2015

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.

Slide 23 - Pediatric TB Cases by Site of Disease and Age Group, 1993–2015

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, 1993–2015

When the extrapulmonary sites are compared by age group, disease in the lymphatic system was the most common form in all age groups except the infant age group (age <1 years). Disseminated disease, represented by miliary TB, and disease of the central nervous system (meningeal) were more common in the younger age groups, while bone and joint disease was most common in the early adolescent group (age 10–14 years).

Slide 25 - Percentage of TB Cases in Children Age < 1 Year with Any Extrapulmonary Involvement*, 1993–2015

Foreign-born infants under 1 year of age with extrapulmonary TB had a higher percentage of TB of the lymphatic system than U.S.-born children. U.S.-born children had a higher percentage of disease in the central nervous system (meningeal). The reasons for these differences are unknown.

Slide 26 - Percentage of TB Cases in Children Age 1–4 Years with Any Extrapulmonary Involvement*, 1993–2015

Differences for the older age groups are less pronounced. For the toddler/preschool group (age 1 – 4 years), disease of the central nervous system (meningeal) was greater for U.S.-born children than for foreign-born children, but the difference was not as pronounced as it was for infants.

Slide 27 - Percentage of TB Cases in Children Age 5–9 Years with Any Extrapulmonary Involvement*, 1993–2015

The patterns for extrapulmonary TB in school age children (age 5–9 years) were similar to those of the toddler/pre-school age group, with a slightly greater percentage for lymphatic disease in both U.S.-born and foreign-born children.

Slide 28 - Percentage of TB Cases in Children Age 10–14 Years with Any Extrapulmonary Involvement*, 1993–2015

Among children 10–14 years old, the fraction of total cases that were extrapulmonary was slightly greater than for the younger age groups, with a small but persistent predominance in U.S.-born children. Lymphatic sites were diminished somewhat and all other categories accounted for the overall increase.

Slide 29 - Pediatric TB Cases by HIV Status, 1993–2014*

TB is an indicator disease for HIV infection, but the rate of testing in pediatric TB cases that is reported with surveillance results is low: less than 27%. Of the subset of cases that included an HIV test result, 3.3% had a positive result.

All TB patients, regardless of age, should be offered opt-out testing for HIV infection, in accordance with national guidelines. Results are shown through 2014 only because of delays in reporting HIV status for all patients.

Slide 30 - Number and Percent of Culture-confirmed Pediatric TB Cases with Drug Resistance, 1993–2014

Drug resistance results are possible only for TB cases that are confirmed by culture results; the rates that are 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 10 – 25%, before leveling off in 2014, the most recent year with complete reporting. However, the percentage of cases with multidrug resistance (MDR), that is, resistance to at least isoniazid and rifampin, has remained stable at 1-2%.

Slide 31 - Pediatric TB Cases by Use of Directly Observed Therapy (DOT), 1993–2013

The American Thoracic Society, the American Academy of Pediatrics, and CDC strongly recommend directly observed therapy (DOT) for all 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. Information on DOT is reported at case completion, which can be up to two years after initial case report.

Slide 32 – Percentage of Pediatric TB Cases by Treatment Outcome 1993–2013

The treatment-completion rate was high: 95.6% averaged over the years for which final treatment data were available. Death was an uncommon reason for the end of treatment, although the death rate of 0.5% is greater than expected for a population in this age group. (For all age groups in the United States, death was the reason that therapy was stopped for approximately 7% of TB patients.)

Slide 33 - Deaths Occurring Among Pediatric TB Cases, by Age Group, 1993–2013

However, death associated with a report of TB was more common for the youngest age group, infants. For the statistics shown here, death at the time of diagnosis (i.e., before treatment was started) and during treatment were combined. Cause of death was not included in TB case reports for the full time period analyzed.