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Assessment of Declines in Reported Tuberculosis Cases—Georgia and Pennsylvania, 2009

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2 figures, 1 table omitted

IN 2009, THE LARGEST SINGLE-YEAR PERcentage decrease in tuberculosis (TB) cases was reported since national TB surveillance began in the United States in 1953. Overall, TB rates decreased 11.4% to 3.8 cases per 100,000 population, compared with an average annual decline of 3.8% each year since 2000.[1,2] Georgia and Pennsylvania were among 36 states reporting decreases from 2008; TB case rates fell 14.3% (from 4.9 to 4.2) in Georgia and 38.7% (from 3.1 to 1.9) in Pennsylvania. Concerned about the possibility of unidentified TB cases, the Georgia Division of Public Health and the Pennsylvania Department of Health, in collaboration with CDC, conducted investigations centering on four hypotheses for the declines: (1) surveillance artifact, (2) underreporting, (3) underdiagnosis, and (4) actual decline. This report summarizes the results of those investigations, which found no evidence of surveillance artifact, underreporting, or underdiagnosis substantial enough to account for the magnitude of the declines. Instead, a decrease in the number of laboratory-confirmed *Mycobacterium tuberculosis* complex diagnoses and a decrease in the percentage of suspected TB cases ultimately counted as meeting the TB case definition; both suggested a true decline in TB in 2009. The population groups with the largest declines were foreign-born persons and children. Continued TB surveillance, including vigilance in suspecting, diagnosing, and reporting TB cases to public health departments, will help clarify the cause of this decline and determine long-term TB trends in the United States.

The investigations in the two states were conducted during March—May 2010 and included systematically assessing changes in TB surveillance practices, cross-matching health department data with records from reporting entities and secondary sources, reviewing laboratory records, and analyzing state TB registries for epidemiologic changes. Reports of suspected TB cases sent by health-care providers and laboratories to public health departments in Georgia and Pennsylvania are entered into Georgia's State Electronic Notifiable Disease Surveillance System (SENDSS) and Pennsylvania's version of the National Electronic Disease Surveillance System (PA-NEDSS). In Pennsylvania, electronic reports also are downloaded automatically from laboratory databases into PA-NEDSS. Once a report is investigated locally, designated health department officials determine whether it meets Council of State and Territorial Epidemiologists criteria to be counted as a case.*

To assess for surveillance artifact (i.e., whether case counts were artificially low as a result of changes or delays in reporting, investigating, or counting, including changes in criteria for counting reports as cases) in 2009, public health staff members in both states were interviewed, and trend analyses of SENDSS and PA-NEDSS data were conducted. The number of suspected TB case reports, the proportion of those reports ultimately counted as cases, and selected surveillance quality measures (e.g., mean time from initial report to count inclusion) were evaluated for 2008-2009 in Georgia and 2007-2009 in Pennsylvania (where 2007 was the comparison year because delayed counting of cases first reported in 2005-2007 was known to have inflated the 2008 case count artificially). In Georgia, officials in the 13 counties with declines of three or more reported cases provided their independent case counts to determine concordance with SENDSS. In addition, paper reports not yet entered into SENDSS were reviewed to identify additional cases. Similarly, suspected TB reports included in PA-NEDSS that had not been counted as cases were reexamined if they had laboratory or clinical characteristics suggestive of TB.

To assess for underreporting, SENDSS and PA-NEDSS records were cross-matched with line lists from different sources of patients with potential TB diagnoses in 2008 and 2009. Both state public health laboratories participated, as did the City of Philadelphia public health laboratory and 43 (46%) of 92 licensed private laboratories in Georgia and 131 (81%) of 161 in Pennsylvania that provided these data as part of a survey. Additional cross-matching in Georgia included infection-control records from the 13 Atlanta hospitals that reported the most cases of TB. Records of patients with a TB-related code from the *International Classification of Diseases, Ninth Revision* (ICD-9)† in the state's hospital discharge database, but not in SENDSS (i.e., unmatched patients), also were assessed further.

To assess for underdiagnosis, the public health laboratories serving the two states ran systematic queries on the total number of patients who had specimens tested for *M. tuberculosis* complex (e.g., *M. tuberculosis, M. bovis, or M. africanum*) by culture or by nucleic acid amplification testing and the proportion with *M. tuberculosis* complex confirmed by either test. Investigators also assessed whether any changes in laboratory policies or practices might account for the unexpected drop in reported TB. Similar data were gathered via a survey sent to licensed private laboratories in the two states. In Georgia, 57 (62%) of 92 private laboratories responded with these data, as did 131 (81%) of 161 in Penn-

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sylvania. Nonresponding laboratories in Pennsylvania did not have fewer PA-NEDSS reports in 2009 compared with 2008; in Georgia, such changes could not be assessed. In addition, TB diagnosis trends in the hospital discharge records provided by the Pennsylvania Health Care Cost Containment Council for Southeastern Pennsylvania, which covers approximately 40% of the state's population,[3] were examined; ICD-9 codes were used to identify possible TB-related hospitalizations.

To assess the evidence supporting an actual decline in TB, Georgia and Pennsylvania TB cases counted in 2009 were compared with 2008 cases for changes in patient characteristics that could affect the likelihood of having laboratory-confirmed TB (e.g., age and site of disease). Linear regression of log-transformed case counts during 1999-2009 was used to determine the expected numbers of cases among U.S.-born and foreign-born persons; observed numbers outside the 95% prediction interval were considered significant.

Investigation of Surveillance Artifact

No changes or delays in surveillance practices were found in Georgia. Excluding results of overseas TB screening in newly arriving immigrants, the number of suspected TB reports in 2008 was comparable to that in 2009. The mean numbers of days between initial report, entry into SENDSS, and inclusion in the state case count also were comparable. However, despite no changes in the criteria for counting suspected TB as cases, the percentage of initial reports ultimately counted as cases declined, from 77% (478 of 623) in 2008 to 66% (415 of 619) in 2009. The independent counts in the 13 counties with the largest declines were concordant with SENDSS data; one uncounted TB case was found among paper reports not yet entered into SENDSS.

Similarly, surveillance practices in Pennsylvania did not appear to change substantially in 2009. Delayed counting of cases first reported during 2005-2007 is known to have artificially inflated the 2008 case count in Pennsylvania. One suspected TB report from 2005, three from 2006, and 48 from 2007 were not counted as cases until 2008. However, even after adjusting Pennsylvania's 2008 case count for this known surveillance artifact (i.e., subtracting 52 cases), a 30% annual decline was still observed in 2009, and the number of suspected TB reports to public health authorities remained stable. The mean number of days between initial report and investigation was comparable during 2007-2009. However, as in Georgia, the percentage of initial reports ultimately counted as TB cases declined from 14% (276 of 1,995) in 2007 to 12% (236 of 2,030) in 2009. (Pennsylvania has a larger number of suspected TB reports, compared with Georgia, because of automatic downloads from laboratory databases into PA-NEDSS.) Among the suspected TB reports not counted as cases in Pennsylvania in 2009, a total of 409 met the criteria for further investigation, but only six were determined to be verified and countable.

Investigation of Underreporting

In Georgia, the SENDSS cross-match with line lists of patients with positive TB results from the state public health laboratory, 43 private laboratories, and 13 hospitals detected no unreported cases. Among patients with TB ICD-9 codes in the hospital discharge database, 45% (244 of 539) in 2008 and 43% (178 of 416) in 2009 (fourth quarter data unavailable) were not found in SENDSS. Seventy-three of these 422 unmatched patients were selected for further review based on having ICD-9 codes that corresponded to countable TB for >50% of hospital records.‡ Further medical review was possible for 28 (85%) of 33 unmatched records in 2008 and for 37 (93%) of 40 in 2009. One unreported 2009 case (culture-negative TB pleurisy) was found.

In Pennsylvania, the PA-NEDSS cross-match with line lists of patients with positive *M. tuberculosis* complex results from public health laboratories and from 58 private laboratories found 13 potentially unreported cases, of which none proved to be countable (seven were in non-Pennsylvania residents, and six were nontuberculous mycobacteria).

Investigation of Underdiagnosis

Review of 2008 and 2009 laboratory data in both states showed that the total number of patients who had specimens tested for mycobacteria increased in the public health laboratories (i.e., 4.7% in Georgia and 11.6% in Pennsylvania), but the proportion of patients with specimens that tested positive for *M. tuberculosis* complex decreased 19.8% in the Georgia State Public Health Laboratory and 28.8% in Pennsylvania public health laboratories. In the 10 private laboratories that provided these data in response to the Georgia survey, a parallel decline was noted. Among 131 private laboratories responding to the Pennsylvania survey, similar numbers of specimens were received for *M. tuberculosis* complex testing annually during 2007-2009, but the proportion that tested positive for *M. tuberculosis* complex decreased 36% from 2008 to 2009. In neither state were changes noted in the types of specimens processed or in the methods or procedures (at public health labs) for laboratory diagnosis of TB.

Analysis of the southeastern Pennsylvania hospital discharge dataset showed that the total number of inpatient hospitalizations was stable, with 707,601; 699,893; and 696,846 discharges in 2007, 2008, and 2009, respectively. Time-trend analysis revealed that the percentage of all hospitalizations with either pulmonary or extrapulmonary TB as a primary or secondary diagnosis was approximately 0.04% each year; further subset analyses by TB-related ICD-9 codes revealed no other TB diagnosis-related changes during this period.

Evidence Suggesting Actual Declines in TB

Because the investigations in Georgia and Pennsylvania found little evidence to support the first three hypotheses for the decline in reported TB cases, more consideration was given to whether the surveillance findings represented an actual decline in 2009. The relative proportions of counted TB cases that met the national case definition based on laboratory criteria essentially were unchanged: from 362

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(76%) of Georgia's 478 TB cases in 2008 to 303 (73%) of 415 in 2009, and from 214 (78%) of Pennsylvania's 276 TB cases in 2007 to 190 (81%) of 236 in 2009. In both states, the declines noted from 2008 to 2009 by site of disease appeared approximately consistent (i.e., a 15% decline in pulmonary and 13% decline in extrapulmonary in Georgia, with declines of 36% and 45%, respectively, in Pennsylvania). Also in both states, children aged <15 years were the age group that experienced the largest decrease in reported TB cases (by 38% in Georgia and 79% in Pennsylvania) in 2009. Linear regression analysis of cases during 1999-2009 showed that observed case counts among foreign born-persons declined significantly in both states in 2009. Based on the prediction interval for the number of TB cases reported among foreign-born persons, Georgia would have expected 182-247, but observed 176; Pennsylvania would have expected 131-239, but observed 127. Among U.S.-born persons, smaller declines were not statistically significant. For U.S.-born persons, the 235 observed cases were within the 201-295 prediction interval in Georgia, and 108 observed cases were within the 94-197 prediction interval in Pennsylvania.

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CDC Editorial Note: After unexpected declines in 2009 in the number of TB cases reported in Georgia and Pennsylvania, investigations in the two states applied an extensive systematic approach to assess whether the declines were actual. Although the investigations did not reexamine every initial report of suspected TB to determine whether it was or was not counted properly, hundreds of such reports and thousands of statewide hospital and laboratory records were reexamined, ultimately finding only two uncounted cases in Georgia and six in Pennsylvania that should have been counted in 2009; of these eight cases, all except one Georgia case had been reported to public health authorities but not recorded in the surveillance system. The results of these investigations provide strong evidence against underreporting as the cause for the decline. The results are similar to those of a previous study of TB case-reporting completeness in seven U.S. states during 1994-1995, which found few unreported cases.[4]

The investigations determined that, whereas the number of positive TB results declined, the total number of individual patients and specimens tested for TB remained stable or increased in the public health laboratories serving the two states. A similar trend in the states' private laboratories also suggested that the decline in TB diagnoses in Georgia and Pennsylvania was not the consequence of health-care providers' failing to consider a diagnosis of TB in 2009. Pennsylvania's stable percentage of hospitalizations with TB-related diagnoses during 2007-2009 provides further evidence against underdiagnosis and might suggest a decline in less severe manifestations of TB disease that do not require hospitalization.

The findings in this report are subject to at least three limitations. First, this investigation could not examine whether underdiagnosis occurred because of failure of patients to seek medical attention for TB symptoms. For example, factors affecting patient access to medical care, such as immigration status or financial constraints, were not assessed.[5] Second, neither state assessed underdiagnosis or underreporting at outpatient provider sites where patients with less severe disease might have been managed. Finally, one of the methods used to assess whether hospitals might have underreported TB cases relied on how well ICD-9 codes corresponded to known TB cases without medical record reviews to test the validity of the ICD-9 code itself.

The findings in both Georgia and Pennsylvania of a decrease in the percentage of suspected TB reports that ultimately were counted as cases and a decrease in the proportion of tested specimens yielding *M. tuberculosis* complex support an actual decline in incident TB disease in 2009. The decreased proportion of laboratory-confirmed TB cannot be explained by a commensurate increase in the types of cases typically associated with culture-negative TB (e.g., pediatric or extrapulmonary TB[6,7]). Children experienced the largest decline in reported TB, a finding suggesting either less TB transmission or changes in immigration patterns. Similarly, the decline in TB cases among foreign-born persons might reflect an actual decline because of changes in migration following the economic downturn (i.e., decreased immigration or increased emigration of job-seekers) or improved preimmigration TB detection and treatment among U.S.-bound immigrants per

What is already known on this topic?

In 2009, tuberculosis (TB) incidence in the United States decreased to 3.8 cases per 100,000 population, the lowest recorded rate since national TB surveillance began in 1953. The 11.4% decrease from 2008 was the greatest single-year decrease ever recorded.

What is added by this report?

Findings from systematic investigations in Georgia and Pennsylvania, two states that experienced unexpectedly large decreases in TB incidence in 2009, indicate that the decline in new TB disease in those states appeared actual and not attributable to surveillance artifact, health-care provider underdiagnosis, or underreporting.

What are the implications for public health practice?

The TB surveillance systems in Georgia and Pennsylvania appear to be functioning appropriately. Current efforts to diagnose, treat, and report TB cases should be vigorously maintained as the United States moves closer to the goal of TB elimination.

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CDC's technical instructions for prevention and treatment of TB among immigrants.[8] Varying implementation dates and the small number of cases in Georgia and Pennsylvania from countries that have implemented the revised instructions prevented an assessment of the impact of these overseas screening changes.

Although recent changes in migration patterns or in overseas TB screening of new immigrants are possible explanations for an actual U.S. decline in TB in 2009, clinicians and health systems should maintain vigilance for TB and promptly report new TB cases to public health authorities. A decline because of delayed diagnosis resulting from obstacles to care also remains a possibility, although preliminary 2010 TB surveillance data did not demonstrate a compensatory increase in the number of cases.[9] Monitoring for patients with more advanced disease is important to prevent worse morbidity and increased mortality from TB. Continued analyses of new public health surveillance and other data sources will help to better discern long-term trends in TB in the United States.

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9 Available.

*Available at http://www.cdc.gov/osels/ph_surveillance/nndss/casedef/tuberculosis_current.htm.

†ICD-9 codes (http://www.cdc.gov/nchs/icd/icd9.htm) for TB are 010-019; code 011 is specific for pulmonary TB disease.

‡Georgia investigators estimated which ICD-9 codes corresponded to countable TB on the basis of the counted 2008-2009 TB cases (i.e., known to have TB) in SENDSS. First, they recorded the frequency of all the TB-related ICD-9 codes that appeared in hospital discharge records. For each ICD-9 code with a frequency greater than three, the numerator for the estimate was the number of hospital records with that ICD-9 code that also matched a counted TB case in SENDSS, and the denominator was the total number of records with that ICD-9 code. The discharge diagnosis codes estimated to correspond to countable TB for >50% of records were 011.2, 011.23, 011.24, 011.26, 011.6, 011.63, 011.64, 011.66, 011.91, 011.92, 011.93, 011.94, 011.96, 012.0, 012.04, 013.0, 013.04, 015.53, 017.2, and 018.9.

Recommended Immunization Schedules for Persons Aged 0 Through 18 Years—United States, 2011

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EACH YEAR, THE ADVISORY COMMITTEE ON Immunization Practices (ACIP) publishes immunization schedules for persons aged 0 through 18 years. These schedules summarize recommendations for currently licensed vaccines for children aged 18 years and younger and include recommendations in effect as of December 21, 2010. Changes to the previous schedules[1] include the following (**FIGURES 1**, **2**, and **TABLE**):

- Guidance has been added for the hepatitis B vaccine schedule for children who did not receive a birth dose.[2]
- Information on use of 13-valent pneumococcal conjugate vaccine has been added.[3]
- Guidance has been added for administration of 1 or 2 doses of seasonal influenza vaccine based upon the child's history of monovalent 2009 H1N1 vaccination.[4]
- Use of tetanus and diphtheria toxoids, and acellular pertussis (Tdap) vaccine among children aged 7 through 10 years who are incompletely vaccinated against pertussis is addressed, and reference to a specified interval between tetanus and diphtheria toxoids (Td) and Tdap vaccination has been removed.[5]
- Footnotes for the use of human papillomavirus (HPV) vaccine have been condensed.
- A routine 2-dose schedule of quadrivalent meningococcal conjugate vaccine (MCV4) for certain persons at high risk for meningococcal disease, and recommendations for a booster dose of MCV4 have been added.[6]
- Guidance for use of *Haemophilus influenzae* type b (Hib) vaccine in persons aged 5 years and older in the catch-up schedule has been condensed.

The National Childhood Vaccine Injury Act requires that health-care providers provide parents or patients with copies of Vaccine Information Statements before administering each dose of the vaccines listed in the schedules. Additional information is available from state health departments and from CDC at http://www.cdc.gov/vaccines/pubs/vis/default.htm.

Detailed recommendations for using vaccines are available from ACIP statements (available at http://www.cdc.gov/vaccines/pubs/acip-list.htm) and the 2009 Red Book.[7] Guidance regarding the Vaccine Adverse Event Reporting System form is available online (http://www.vaers.hhs.gov) or by telephone (800-822-7967).

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The recommended immunization schedules for persons aged 0 through 18 years and the catch-up immunization schedule for 2011 have been approved by the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, and the American Academy of Family Physicians.

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