

## Chapter 16: Tetanus

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### I. Disease Description

Tetanus is an acute, potentially fatal disease that is characterized by generalized increased rigidity and convulsive spasms of skeletal muscles. Tetanus is caused by the spore-forming bacterium *Clostridium tetani*. *C. tetani* spores (the dormant form of the organism) are found in soil and in animal and human feces. The spores enter the body through breaks in the skin, and germinate under low-oxygen conditions. Puncture wounds and wounds with a significant amount of tissue injury are more likely to promote germination. The organisms produce a potent toxin tetanospasmin which is absorbed into the bloodstream. The toxin then reaches the nervous system, causing painful and often violent muscular contractions. The muscle stiffness usually first involves the jaw (lockjaw) and neck, and later becomes generalized. Tetanus is a noncommunicable disease—it is not transmitted from one person to another.

### II. Background

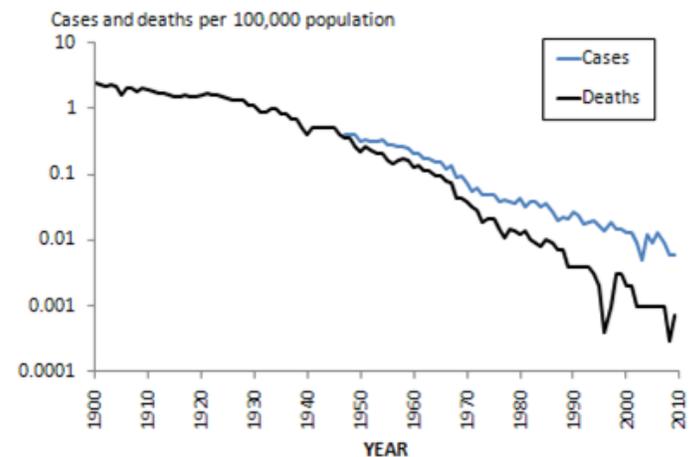
In the United States, the reported mortality due to tetanus has declined at a constant rate since the early 1900s, and documented tetanus incidence has declined since the mid- to late 1940s, when national reporting of tetanus cases began (Figure 1). In 2009, a total of 19 tetanus cases and 2 deaths were reported to the national tetanus surveillance system. Several factors have contributed to the decline in tetanus morbidity and mortality, including the widespread use of tetanus toxoid-containing vaccines since the late 1940s. Other factors include improved wound care management and the use of tetanus immune globulin (TIG) for postexposure prophylaxis in wound treatment and for the treatment of tetanus.

In addition, increased rural-to-urban migration with consequent decreased exposure to tetanus spores may also have contributed to the decline in tetanus mortality noted during the first half of the 20th century.<sup>1</sup>

Tetanus is almost entirely preventable through immunization. Vaccination status was known for 1018 (50%) of 2,044 tetanus cases reported from 1972 to 2009.<sup>2,3</sup> In only 163 (16%) was receipt of three or more doses of tetanus toxoid reported. The remaining patients were either unvaccinated or had received fewer than three doses of tetanus toxoid. Wherever immunization programs are in place, the incidence of tetanus declines and the age distribution of case-patients shifts to reflect underimmunization.<sup>1</sup>

During the period 2001–2008, a total of 233 cases and 26 deaths from tetanus were reported in the United States. Seventy one (30%) were in persons aged 65 years or older, 139 (60%) were in persons aged 20–64 years, and 23 (10%) were in persons younger than 20 years, including one case of neonatal tetanus (Figure 2). The risk of dying from tetanus was five times greater in patients >65 years.<sup>3</sup> During each of these years, coverage among infants and children with at least three doses of DTP/DTaP/diphtheria and tetanus toxoids (DT) was 94% or higher.<sup>4,5</sup> A review of tetanus in U.S. children under age 15 years from 1992 through 2000 found that 11

**Figure 1. Mortality and incidence rates of tetanus reported in the United States, 1900 to 2009**



of the 13 non-neonatal cases occurred in children who were unvaccinated because of religious or philosophic objections.<sup>6</sup>

Rates of coverage with booster doses of tetanus toxoid-containing vaccine decrease with increasing age. In a 2008 survey, 64% of adults aged 18–49 years reported receiving a dose of tetanus toxoid-containing vaccine within the preceding 10 years, compared with

52% of adults 65 years of age or older.<sup>7</sup> Serologic studies of the U.S. population correlate well with vaccination coverage and demonstrate lower immunity levels at older ages. A national population-based seroprevalence survey conducted from 1988 to 1994 found that whereas 20% of adolescents 12–19 years of age lacked protective levels of tetanus antibodies (>0.15 IU/ml), 69% of adults 70 years of age or older lacked protective levels.<sup>8</sup>

Diabetes and intravenous drug use may be risk factors for tetanus. From 1987 to 2008, persons with diabetes accounted for 13% of all reported tetanus cases and 29% of all tetanus deaths.<sup>2,3</sup> The incidence of tetanus among diabetics was more than three times that among non-diabetics.<sup>2</sup> Intravenous drug users accounted for 15% of cases from 2001 to 2008<sup>3</sup> and a cluster of cases was noted in California earlier in the 1990s.<sup>9</sup>

Despite the availability of highly effective tetanus toxoid-containing vaccines, tetanus continues to have a substantial health impact in the world. In 2002, the World Health Organization estimated that 180,000 deaths worldwide were attributable to neonatal tetanus.<sup>10</sup> Neonatal tetanus elimination was defined in 1993 as less than one case of neonatal tetanus for every 1,000 live births per year in each administrative district of a given country.<sup>11</sup> The World Health Organization and its partners (the United Nations Children's Fund and the United Nations Population Fund) are committed to eliminating maternal and neonatal tetanus.

### III. Importance of Rapid Case Identification

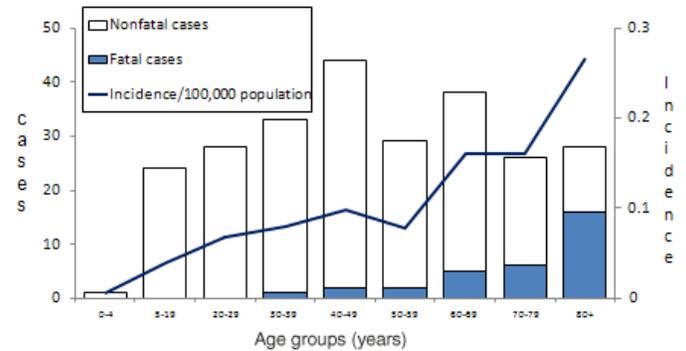
Prompt recognition of tetanus is important clinically because hospitalization and treatment are usually required. Prompt administration of tetanus toxoid and TIG may decrease the severity of the disease. Because tetanus is an uncommon disease, consultation on clinical management may be useful. Diabetes may be a risk factor for tetanus, and outbreaks of tetanus among injection-drug users have occurred.<sup>9</sup>

### IV. Importance of Surveillance

Because tetanus is preventable, the possibility of failure to vaccinate should be investigated in every case. Each case should be used as a case study to determine which factors contributed to the failure, and which measures could be taken to improve the vaccine delivery system and prevent such cases in the future.

Information obtained through surveillance is used to assess progress toward the disease elimination goals. The information is also used to raise awareness of the importance of immunization and to characterize persons or geographic areas in which additional efforts are required to raise vaccination levels and reduce disease incidence.

**Figure 2. Number of reported cases of tetanus, survival status of patients, and average annual incidence rates by age group—United States, 2001–2009.**



## V. Disease Reduction and Vaccine Coverage Goals

Since herd immunity does not play a role in protecting individuals against tetanus, virtually all persons must be vaccinated in order to achieve this goal. Although the *Healthy People 2010* goal for tetanus was to eliminate all tetanus cases among persons under age 35 years in the United States,<sup>12</sup> 56 non-neonatal cases under age 35 years were reported in the U.S. from 2001-2008.

## VI. Case Definition

The following case definition for tetanus was approved by the Council of State and Territorial Epidemiologists (CSTE) and published in 2009.<sup>13</sup>

### *Tetanus clinical case definition*

In the absence of a more likely diagnosis, an acute illness with muscle spasms or hypertonia and diagnosis of tetanus by a health care provider; or death, with tetanus listed on the death certificate as the cause of death or a significant condition contributing to death.

### *Case classification*

**Probable:** A clinically compatible case, as reported by a healthcare professional.

There is no definition for confirmed tetanus.

## VII. Laboratory Testing

There is no diagnostic laboratory test for tetanus; the diagnosis is entirely clinical. *C. tetani* is recovered from wounds in only about 30% of cases, and the organism is sometimes isolated from patients who do not have tetanus. Serologic results obtained before TIG is administered can support susceptibility if they demonstrate very low or undetectable anti-tetanus antibody levels. However, tetanus can occur in the presence of “protective” levels of antitoxin (>0.1 IU by standard ELISA); therefore, serology cannot exclude the diagnosis of tetanus.

## VIII. Reporting

Each state and territory has regulations or laws governing the reporting of diseases and conditions of public health importance.<sup>14</sup> These regulations and laws list the diseases to be reported, and describe those persons or groups responsible for reporting, such as healthcare providers, hospitals, laboratories, schools, daycare and childcare facilities, and other institutions. Persons reporting these conditions should contact their state health department for state-specific reporting requirements. Tetanus is a reportable disease in all states and territories of the United States.

A provisional report should be sent by the state health department to CDC via the National Electronic Telecommunications System for Surveillance (NETSS) or National Electronic Disease Surveillance System (NEDSS), when available, within 14 days of the initial report to the state or local health department. Supplementary information may be sent via NETSS or extended screens, NEDSS investigation screens or on paper forms to CDC (see Appendix 18). Reporting should not be delayed because of incomplete information.

### *Information to collect*

The following data are epidemiologically important and should be collected in the course of case investigation. Additional information may be collected at the direction of the state health department.

- Demographic information
  - Name
  - Address
  - State of residence
  - Date of birth
  - Age
  - Ethnicity
  - Race
  - Occupation
- Reporting source
  - County
  - Earliest date reported

- Clinical
  - Hospitalization and duration of stay
  - Date of onset of symptoms
  - Type of tetanus disease
  - Wound location and management, including receipt of a tetanus toxoid-containing vaccine or TIG
  - Complication and intensive care treatment
  - Pre-existing conditions (e.g., diabetes, chronic otitis media)
  - Outcome (patient survived or died)
  - Date of death
- Treatment
  - Prophylaxis with tetanus toxoid-containing vaccine and TIG
  - Date started
- Vaccine Information
  - Dates of vaccination (prior tetanus toxoid-containing vaccine history)
  - Time since last dose of tetanus toxoid-containing vaccine
  - Maternal vaccination (for neonatal cases)
- Epidemiologic
  - Risk factors for disease (e.g., history of a wound or injury, recent injection drug use, tattooing, or body piercing)
  - For neonatal cases, maternal country or origin and number of years of residence in the United States

## IX. Vaccination

Numerous formulations of tetanus toxoid–containing vaccines are available in the United States. Tetanus and diphtheria toxoids and acellular pertussis (DTaP) and diphtheria and tetanus toxoids (DT) are licensed for infants and children younger than 7 years of age; and tetanus and diphtheria toxoids (Td) and tetanus toxoid (TT) are licensed for children 7 years of age and older and adults. Two tetanus and diphtheria toxoids and acellular pertussis formulation for adolescents and adults (Tdap) were licensed in 2005. Tetanus and diphtheria toxoids and whole-cell pertussis (DTP) vaccine is no longer available for use in the United States. Other pediatric combination vaccines containing tetanus and diphtheria toxoids and acellular pertussis along with other antigens are also available.

Primary tetanus vaccination with DTaP is recommended for all infants and children aged 6 weeks through 6 years who do not have contraindications.<sup>15</sup> DTaP is the preferred vaccine for all doses in the vaccination series (including completion of the series for children who have received one or more doses of whole-cell DTP). Primary vaccination with the DTaP series consists of a three-dose series, administered at ages 2, 4, and 6 months, with a minimum interval of 4 weeks between each of the first three doses. The fourth (first booster) dose is recommended at 15–18 months of age to maintain adequate immunity during preschool years. The fourth dose should be administered 6 months or more after the third dose. If the interval between the third and fourth doses is at least 6 months and the child is unlikely to return for a visit at the recommended age, the fourth dose of DTaP may be administered as early as age 12 months. The fifth (second booster) dose is recommended for children aged 4–6 years to confer continued protection against disease during the early years of schooling. A fifth dose is not necessary if the fourth dose in the series is administered on or after the fourth birthday. Adolescents and adults with a history of incomplete or unknown tetanus vaccination should receive a series of three vaccinations. The preferred schedule is a dose of Tdap, followed by a dose of Td at least 4 weeks after Tdap, and another dose of Td 6–12 months later.<sup>16, 17</sup>

Routine tetanus booster vaccination is recommended for adolescents and adults every 10 years. A single dose of Tdap is recommended for adolescents at age 11–18 years if they have not previously received Tdap.<sup>16</sup> A single dose of Tdap is also recommended for adults age 19 years and older who have not previously received Tdap, to replace the next Td. Adults should receive Td at least every 10 years thereafter.<sup>19</sup> The appropriate use of tetanus toxoid and TIG in wound management (Table 1) is also important for the prevention of tetanus.<sup>16–18</sup>

**Table 1. Guide to tetanus prophylaxis in routine wound management**

| History of adsorbed tetanus toxoid (doses) | Clean minor wounds      |                  | All other wounds*       |                  |
|--|-------------------------|------------------|-------------------------|------------------|
|  | Tdap or Td <sup>†</sup> | TIG <sup>§</sup> | Tdap or Td <sup>†</sup> | TIG <sup>§</sup> |
| <3 or unknown                              | Yes                     | No               | Yes                     | Yes              |
| ≥ 3 doses <sup>¶</sup>                     | No <sup>**</sup>        | No               | No <sup>††</sup>        | No               |

\* Such as (but not limited to) wounds contaminated with dirt, feces, soil, and saliva; puncture wounds; avulsions; and wounds resulting from missiles, crushing, burns, and frostbite.

<sup>†</sup> For children younger than 7 years of age, DTaP is recommended; if pertussis vaccine is contraindicated, DT is given. For persons 7–9 years of age, Td is recommended. For persons >10 years, Tdap is preferred to Td if the patient has never received Tdap and has no contraindication to pertussis vaccine. For persons 7 years of age or older, if Tdap is not available or not indicated because of age, Td is preferred to TT.

<sup>§</sup> TIG is human tetanus immune globulin. Equine tetanus antitoxin should be used when TIG is not available.

<sup>¶</sup> If only three doses of fluid toxoid have been received, a fourth dose of toxoid, preferably an adsorbed toxoid, should be given. Although licensed, fluid tetanus toxoid is rarely used.

<sup>\*\*</sup> Yes, if it has been 10 years or longer since the last dose.

<sup>††</sup> Yes, if it has been 5 years or longer since the last dose. More frequent boosters are not needed and can accentuate side effects.

## X. Enhancing Surveillance

A number of specific activities can improve the detection and reporting of tetanus cases and the comprehensiveness and quality of reporting. Additional activities are listed in Chapter 19, “Enhancing Surveillance.”

### Promoting awareness

Efforts should be made to promote awareness among physicians and infection control practitioners of the need to report suspected cases of tetanus promptly. The completeness of reporting of tetanus mortality to CDC has been estimated at 40%, and completeness of reporting for tetanus morbidity may be even lower.<sup>19</sup> Lack of direct benefits, administrative burdens, and a lack of knowledge of reporting requirements are all thought to contribute to incomplete reporting of infectious diseases by physicians and other healthcare providers.

### Providing feedback

National and statewide surveillance data concerning tetanus should be regularly shared with infection control nurses, hospital epidemiologists, neurologists, and other clinicians; all should be regularly updated concerning reporting requirements. Feedback should also be provided to the persons who reported the cases. Representatives from state and local health departments should attend meetings of infection control nurses and other scientific gatherings to share surveillance data and to discuss the quality and usefulness of surveillance.

### Review of mortality data

Mortality data are available through the vital records systems in all states, and they may be available soon after deaths occur in states using electronic death certificates. Although the number of tetanus cases in the United States is small, each is important and warrants a full investigation. Mortality data should be reviewed each year to identify deaths that may be due to tetanus. Any previously unreported cases identified through this review should be reported. Nationally, the completeness of reporting of tetanus deaths to the vital records system is estimated at 60%.<sup>19</sup>

## XI. Case Investigation

The Tetanus Surveillance Worksheet (Appendix 18) may be used as a guideline for the investigation, with assistance from the state health department. At the direction of the state health department, additional assistance may be obtained from the Meningitis and Vaccine-Preventable Diseases Branch, National Center for Immunization and Respiratory Diseases, CDC (404-639-3158).

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