

Chapter 16: Tetanus

Amanda E. Faulkner, MPH; Tejpratap S. P. Tiwari, MD

I. Disease Description

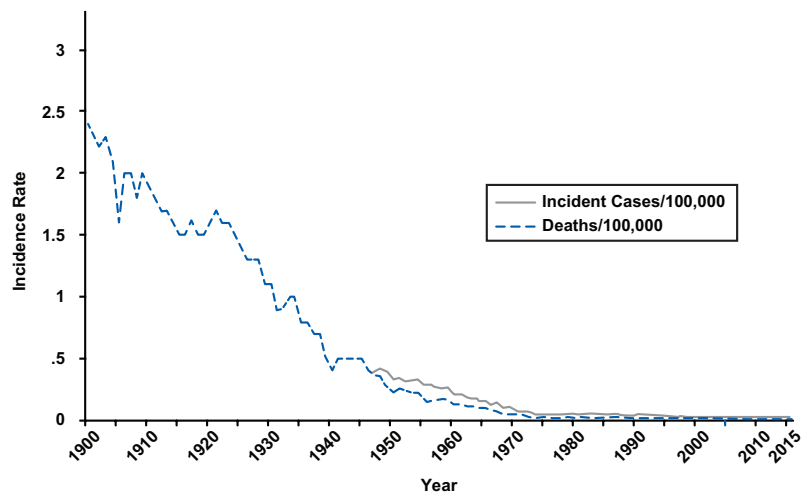
Tetanus is an acute, potentially fatal disease that is characterized by generalized increased rigidity and convulsive spasms of skeletal muscles. Tetanus is caused by the spore-forming bacterium *Clostridium tetani*. Spores of *C. tetani* (the dormant form of the organism) are found in soil contaminated with animal and human excreta. The spores enter the body through breaks in the skin, and germinate under anaerobic 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 binds to gangliosides at the neuromuscular junction and proceeds along the neuron to the ventral horns of the spinal cord or motor horns of the cranial nerves in 2–14 days. The toxin can also be absorbed into the blood stream and lymphatics. Once the toxin reaches the nervous system, where it causes painful and often violent muscular contractions. The muscle stiffness usually initially involves the jaw (lockjaw) and neck, and later becomes generalized. Tetanus is a noncommunicable disease—it is not transmitted from 1 person to another.

II. Background

In the United States, 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). 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 and postexposure use of tetanus immune globulin (TIG), either for prophylaxis in wound management or for 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.¹

In 2015, a total of 29 tetanus cases and 2 deaths were reported through the National Notifiable Diseases Surveillance System (NNDSS).² The effectiveness of tetanus toxoid-containing vaccines is very high, although not 100%.^{3–5} Vaccination status was known for 49 (25%) of 197 tetanus cases reported from 2009 through 2015.² In only 10 (20%) was receipt of 3 or more doses of tetanus toxoid reported. The remaining patients were either unvaccinated or had received fewer than 3 doses of tetanus toxoid. Wherever effective immunization programs are in place, the incidence of tetanus declines and the age distribution of case-patients shifts to reflect underimmunization.¹

Figure 1. Mortality and incidence rates of tetanus reported in the United States, 1900–2015



*Incidence rate is calculated as cases per 100,000 population.



From 2009 through 2015, a total of 197 cases and 16 deaths from tetanus were reported in the United States. Forty-nine (25%) cases were in persons 65 years of age or older, 124 (63%) were in persons 20 through 64 years of age, and 24 (12%) were in persons younger than 20 years, including 2 cases of neonatal tetanus (Figure 2). All tetanus-related deaths occurred among patients >55 years of age.²

During each of these years, coverage among infants and children with at least 3 doses of DTP/DTaP/diphtheria and tetanus toxoids (DT) was

94% or higher.^{6,7} Rates of coverage with booster doses of tetanus toxoid-containing vaccine decrease with increasing age. In a 2014 survey, 62.6% of adults 19 through 49 years of age reported receiving a dose of tetanus toxoid-containing vaccine within the preceding 10 years, compared with 57.7% of adults 65 years of age or older.⁸ 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 while 20% of adolescents 12 to 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.⁹

Diabetes, a history of immunosuppression, and intravenous drug use may be risk factors for tetanus.^{10,11} From 2009 through 2015, persons with diabetes accounted for 13% of all reported tetanus cases, and 25% of all tetanus deaths. Intravenous drug users accounted for 6% of cases from 2009 through 2015;² a cluster of cases was noted in California earlier in the 1990s.¹¹

Despite the availability of highly effective tetanus toxoid-containing vaccines, tetanus continues to have a substantial health impact in the world. In 2015, the World Health Organization (WHO) estimated that 34,019 newborns died from neonatal tetanus, a 96% reduction from the late 1980s.⁸ Neonatal tetanus elimination was defined in 1993 as fewer than 1 case of neonatal tetanus for every 1,000 live births per year in each administrative district of a given country.¹² WHO and its partners (the United Nations Children's Fund and the United Nations Population Fund) are committed to eliminating maternal and neonatal tetanus. As of December 2016, 18 countries have not eliminated maternal and neonatal tetanus.¹³

III. Importance of Rapid Case Identification

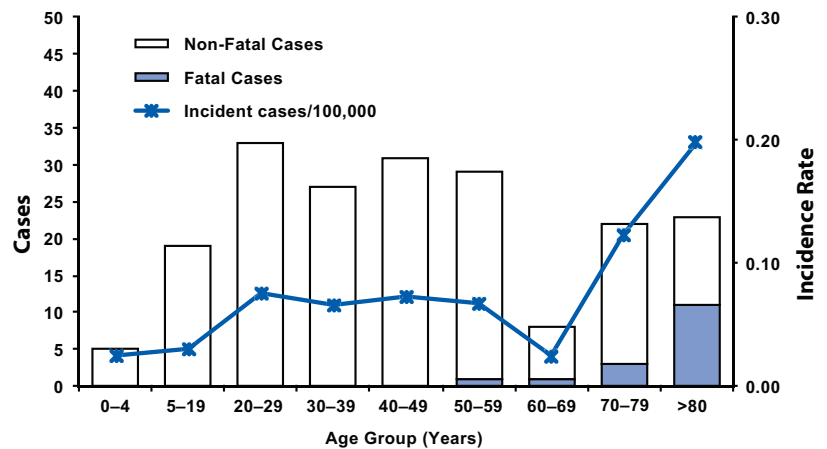
Prompt clinical recognition of tetanus is important because hospitalization and treatment are usually required. Prompt administration of tetanus toxoid and TIG may decrease the severity of the disease. Because tetanus is an uncommon disease, consultation on clinical management may be useful.

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 national incidence and current epidemiologic trends. 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, 1900–2015.



*Incidence rate is calculated as cases per 100,000 population.

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 individual protection. *Healthy People 2020* emphasizes the importance of achieving and maintaining high levels of tetanus-containing vaccine coverage in the United States and calls for continued efforts to ensure effective tetanus vaccination coverage, with particular emphasis on children and adolescents.¹⁴

VI. Case Definition

The following case definition for tetanus was approved by the Council of State and Territorial Epidemiologists (CSTE) and published in 2009.¹⁵

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 and Case Notification

Case reporting within a jurisdiction

Each state and territory has regulations or laws governing the reporting of diseases and conditions of public health importance.¹⁶ 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. Detailed information on reportable conditions in each state is available through the CSTE¹⁷ Tetanus is a reportable disease in all states and territories of the United States. The *Tetanus Surveillance Worksheet* is included as Appendix 18, to serve as a guide for data collection during investigation of reported cases.

Case notification to CDC

Notifications for probable and suspect cases of tetanus should be sent to CDC using event code 10210 in the NNDSS.¹⁸

A provisional notification 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, or NEDSS investigation screens (see Appendix 18). The *Tetanus Surveillance Worksheet* is included as Appendix 18, to serve as a guide for data collection during case investigations and case notifications to CDC. Reporting should not be delayed because of incomplete information. Data can be updated electronically as more information becomes available. The state in which the patient resides at the time of diagnosis should submit the case notification to CDC.

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, immunosuppression)
 - 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)
 - Number of doses of tetanus toxoid-containing vaccine received prior to infection
 - 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, 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) 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 6 weeks through 6 years of age who do not have contraindications.¹⁹ DTaP is the preferred vaccine for all doses in the vaccination series (including completion of the series for children who have received 1 or more doses of whole-cell DTP). Primary vaccination with the DTaP series consists of a 3-dose series, administered at ages 2, 4, and 6 months, with a minimum interval of 4 weeks between each of the first 3 doses. The fourth (first booster) dose is recommended at 15 through 18 months of age to maintain adequate immunity during preschool years. The fifth (second booster) dose is recommended for children 4 through 6 years of age to confer continued protection against disease during the early years of schooling. Adolescents and adults with a history of incomplete or unknown tetanus vaccination should receive a series of 3 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.^{20,21}

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 through 18 years if they have not previously received Tdap.²⁰ A single dose of Tdap is also recommended for adults 19 years of age or older who have not previously received Tdap, to replace the next Td. Adults should receive Td at least every 10 years thereafter.²¹ The appropriate use of tetanus toxoid-containing vaccine and TIG in wound management (Table 1) is also important for the prevention of tetanus.^{19–21}

Table 1. Guide to tetanus prophylaxis in routine wound management

History of adsorbed tetanus toxoid-containing vaccines (doses)	Clean, minor wound		All other wounds*	
	DTaP, Tdap or Td†	TIG	DTaP, Tdap or Td†	TIG‡
Unknown or <3	Yes	No	Yes	Yes
≥ 3	No§	No	No¶	No

Abbreviations: DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine; Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis; Td = tetanus and diphtheria toxoids; TIG = tetanus immune globulin

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

† DTaP is recommended for children <7 years of age. Tdap is preferred to Td for persons 11 years of age and older who have not previously received Tdap. Persons 7 years of age and older who are not fully immunized against pertussis, tetanus, or diphtheria should receive 1 dose of Tdap for wound management and as part of the catch-up series.

‡ Individuals with HIV infection or severe immunodeficiency who have contaminated wounds should also receive TIG, regardless of their history of tetanus immunizations.

§ Yes, if >10 years since the last tetanus toxoid-containing vaccine dose.

¶ Yes, if >5 years since the last tetanus toxoid-containing vaccine dose.

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 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.²¹ 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 report 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%.²²

Streamlining reporting using electronic methods

Although many surveillance systems still rely on paper and pencil for data collection, use of data from sources such as electronic medical records, electronic case reporting,^{23–29} and clinical laboratory information systems (LIMS) can significantly improve reporting speed, enhance data quality, and reduce workload.

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.

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