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### Tetanus Surveillance — United States, 1998–2000



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## Tetanus Surveillance — United States, 1998–2000

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### Abstract

**Problem/Condition:** Tetanus is a severe and often fatal infection. The incidence of reported cases in the United States has declined steadily since introduction of tetanus toxoid vaccines in the 1940s.

**Reporting Period:** This report covers surveillance data for 1998–2000.

**Description of System:** Physician-diagnosed cases of tetanus were reported to CDC's National Notifiable Disease Surveillance System. Supplemental clinical and epidemiologic information were provided by states.

**Results and Interpretation:** During 1998–2000, an average of 43 cases of tetanus was reported annually; the average annual incidence was 0.16 cases/million population. The highest average annual incidence of reported tetanus was among persons aged  $\geq 60$  years (0.35 cases/million population), persons of Hispanic ethnicity (0.37 cases/million population), and older adults known to have diabetes (0.70 cases/million population). Fifteen percent of the cases were among injection-drug users. The case-fatality ratio was 18% among 113 patients with known outcome; 75% of the deaths were among patients aged  $\geq 60$  years. No deaths occurred among those who were up-to-date with tetanus toxoid vaccination. Seventy-three percent of 129 cases with known injury information available reported an acute injury; of these, only 37% sought medical care for the acute injury, and only 63% of those eligible received tetanus toxoid for wound prophylaxis.

**Interpretation:** The majority of tetanus cases occurred among persons inadequately vaccinated or with unknown vaccination history who sustained an acute injury. Adults aged  $\geq 60$  years were at highest risk for tetanus and tetanus-related death.

**Public Health Actions:** Tetanus is preventable through routine vaccination (i.e., primary series and decennial boosters) and appropriate management. A shortage of tetanus and diphtheria toxoids vaccine that began during 2000 ended in 2002. Efforts by health-care providers are warranted to vaccinate persons with delayed or incomplete vaccination, with emphasis on older persons and persons with high-risk conditions.

### Introduction

Since the 1940s, the incidence rates of reported cases of tetanus and tetanus-related deaths have decreased steadily (1). The decrease has been attributed primarily to universal vaccination with tetanus toxoid (i.e., diphtheria and tetanus toxoids and whole-cell pertussis vaccine-pediatric [DTP], diphtheria and tetanus toxoids and acellular pertussis vaccine-pediatric [DTaP], pediatric diphtheria and tetanus toxoids [DT], and adult tetanus and diphtheria toxoids [Td]). However, improved wound management and childbirth practices have also contributed to the decrease in reported cases and deaths from tetanus (2–4).

All 50 states have legal requirements that children receive at least a primary series (i.e., 3 doses) of tetanus toxoid before entering school (5). In 2000, results of the National Immunization Survey indicated that 94% of children aged 19–35 months had received 3 doses of tetanus toxoid (6). In contrast to the high vaccination rates among young children, the 1998 National Health Interview Survey indicated that only 40% of adults aged  $\geq 65$  years had received a booster dose of tetanus toxoid during the previous 10 years (7) as recommended by the Advisory Committee on Immunization Practices (ACIP) (8). Moreover, only 31% of adults aged  $>70$  years whose serum was tested during 1988–1994 for the Third National Health and Nutrition Examination Survey had protective titers of antibody to tetanus toxin (9,10).

National surveillance for tetanus is conducted to monitor the trends in disease and the effectiveness of the vaccination program. This report is an analysis of the epidemiology of tetanus in the United States during 1998–2000.

## Methods

### Tetanus Surveillance

National tetanus surveillance is a passive system that relies on physicians to report cases of tetanus to state and local health departments. Because no laboratory test provides definitive diagnosis of tetanus, the diagnosis of tetanus is based on the clinical judgment of the attending physician. In 1990, the Council of State and Territorial Epidemiologists and CDC adopted a clinical case definition for public health surveillance of tetanus, which is the acute onset of hypertonia and/or painful muscular contractions (usually of the jaw and neck muscles) and generalized muscle spasms without other apparent medical cause (as reported by a health professional) (11).

State and local health departments report cases of tetanus weekly to the National Notifiable Diseases Surveillance System (NNDSS). The reports are transmitted to CDC through the National Electronic Telecommunications System for Surveillance (NETSS) and contain supplemental clinical and epidemiologic information for each case. Supplemental information includes the clinical history; presence and nature of any associated risk factors; the patient's vaccination status, wound care, and clinical management; and outcome for each case of tetanus. CDC contacted state and local health departments for additional unreported tetanus cases and included 13 cases in this surveillance summary not initially reported to NNDSS.

### Data Analysis

For the calculation of rates of reported tetanus cases per million population by demographic variables, the denominator population used was the mid-year resident population estimates during 1998–2000 (12). For the calculation of rates of tetanus cases per million persons known to have diabetes by age group, the denominator population represented a weighted estimate of persons known to have diabetes obtained from the 1998–2000 National Health Interview Survey (13–15).

## Results

### Long-Term Trends in Morbidity and Mortality

The average annual number of tetanus cases during 1998–2000 was 43 — 45 cases in 1998, 42 in 1999, and 43 in 2000. The lowest average annual number of cases for a

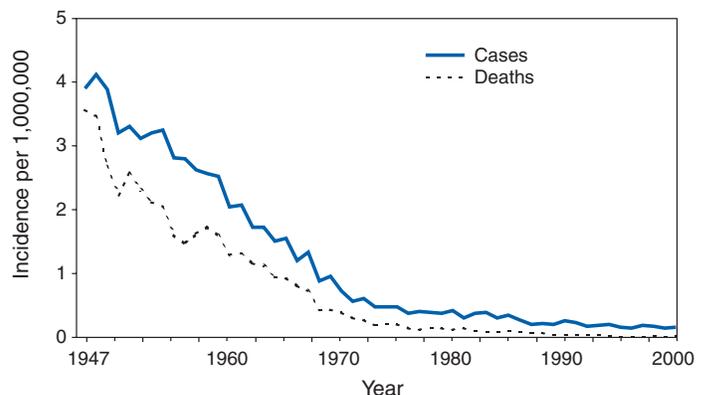
3-year period in the United States since tetanus became reportable in 1947 was 41 cases per year during 1995–1997 (1). The average annual incidence rate during 1998–2000 was 0.16 cases per million population, approximately the same as the average annual rate during 1995–1997 (0.15 cases per million population). The incidence rate during 1998–2000 was a 96% decrease from 3.9 cases per million population reported in 1947 (Figure 1). The case-fatality ratio during 1998–2000 was 18% (20 deaths) for 113 patients with known outcome; the case-fatality ratio was 11% during 1995–1997 (1). The case-fatality ratio during 1998–2000 was 5 times lower than the case-fatality ratio reported in 1947 (91%).

### Epidemiology

During 1998–2000,  $\geq 1$  case of tetanus was reported by 31 states (Figure 2). Six states reported tetanus cases in each of the 3 years (California, Florida, Michigan, Pennsylvania, Texas, and Wisconsin). Nineteen states and the District of Columbia reported no cases of tetanus. Eight states with no reported cases were in the Rocky Mountain and West North Central regions, where the incidence of reported tetanus has historically been low (1,16–20), and no cases of tetanus were reported from New England (Figure 2).

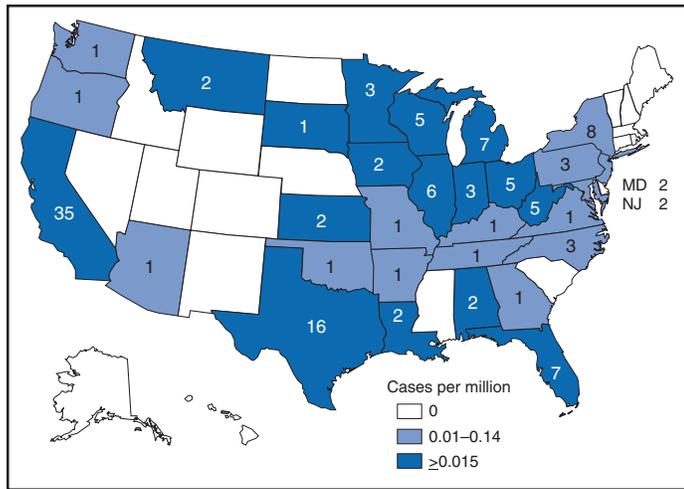
Age and sex were reported for all 130 cases; race was reported for 111 (85%) and ethnicity for 123 (95%) of 130 cases. Twelve (9%) of the cases were aged <20 years (including one neonate); 71 (55%) were aged 20–59 years; and 47 (36%) were aged  $\geq 60$  years (Figure 3). The average annual incidence of tetanus during 1998–2000 was 0.05 cases per million population among persons aged <20 years, 0.16 cases per million population among adults aged 20–59 years, and 0.35 cases per million population among adults aged  $\geq 60$  years.

**FIGURE 1. Tetanus morbidity and mortality rates, by year — United States, 1947–2000**



**Source:** Data from the National Notifiable Disease Surveillance System, CDC, Atlanta, GA.

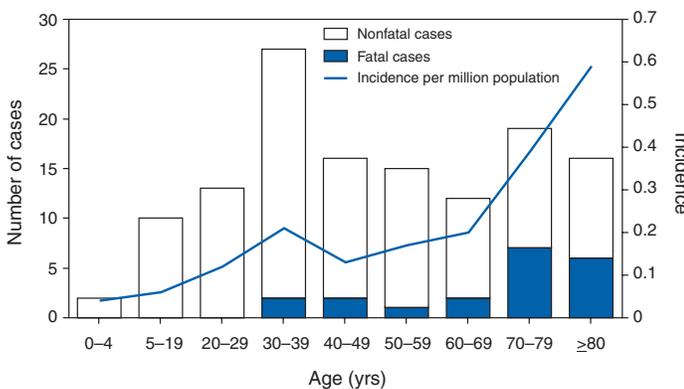
**FIGURE 2. Number of tetanus cases reported and average annual incidence rates, by state — United States, 1998–2000**



*"The important thing is not to stop questioning."*

Albert Einstein

**FIGURE 3. Number of tetanus cases reported, average annual incidence rates, and survival status of patients, by age group — United States, 1998–2000**



Seventy-eight cases (60%) were male. The differences in incidence rates between males and females varied by age group. For persons aged <20 years, the incidence of tetanus among males (0.08 cases per million population) was 2.7 times the incidence among females (0.03 cases per million population). For persons aged 20–59 years, the incidence of tetanus among males (0.23 cases per million population) was 2.9 times the incidence among females (0.08 cases per million population). For persons aged ≥60 years, the incidence of tetanus was 0.31 cases per million population among males, lower than the incidence of 0.39 cases per million population among females.

The incidence of tetanus among non-Hispanic whites was 0.13 cases per million population (78 cases); among non-Hispanic blacks, 0.12 cases per million population (12 cases); among Asian/Pacific Islanders, 0.10 cases per million population (three cases); and among Native American/Alaska Natives, 0.16 cases per million population (one case). The

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incidence of reported tetanus among persons with Hispanic ethnicity was 0.38 cases per million population (36 cases) during 1998–2000, compared with 0.27 cases per million during 1995–1997 (1).

The 20 reported deaths occurred among patients aged 33–88 years. Seventy-five percent (15/20) of the patients who died were aged  $\geq 60$  years. The case-fatality ratio among patients with known outcome aged  $\geq 60$  years was 40% (15/38), compared with 8% (5/63) among patients with known outcome aged 20–59 years.

## Tetanus Toxoid Vaccination

During 1998–2000, the number of doses of tetanus toxoid previously received was reported for 38% (50/130) of patients, compared with 47% (58/124) during 1995–1997 (1). Eight of 50 patients (16%) with known vaccination history (6% of all cases) during 1998–2000 had received  $\geq 3$  doses of tetanus toxoid with the last dose  $< 10$  years before the onset of tetanus (Table 1). All eight patients had nonwork-related acute injuries; six did not seek medical care before the onset of tetanus, and three were aged  $< 20$  years.

Twenty patients were reported to have received at least a primary series of tetanus toxoid; 18 had an outcome reported. Of these 18 patients, one (6%) death occurred; the death was in an injection-drug user (IDU) whose last dose of tetanus toxoid was 11 years before the onset of tetanus. A total of 110 patients reported  $< 3$  doses of tetanus toxoid or had an unknown vaccination history; 95 of these patients had an outcome reported. Nineteen deaths (20%) occurred among these 95 patients.

## Type of Injury, Wound Treatment, and Prophylaxis

Among 129 patients with information provided on the condition leading to tetanus, acute trauma was reported for 73%

(94/129) of patients; no acute injury (i.e., patients with abscesses, ulcers, or gangrene) was reported for 26% (34/129); and one case (1%, 1/129) was reported in a neonate (Table 2). A puncture wound was the most frequent type of acute trauma (50%), followed by lacerations (33%) and abrasions (9%). Puncture wounds included stepping on a nail (15 cases), splinter (five cases), injury from barbed wire (five cases), a tattoo (one case), and a spider bite (one case).\* The acute injury was located on the lower extremity in 48 (51%) patients, the upper extremity in 34 (36%) patients, the head or trunk in nine (10%) patients, and not specified in three patients. The environment in which the acute injury occurred was reported for 83 (88%) patients. Thirty-seven (45%) patients were injured at home or indoors; 26 (31%) were injured while farming or gardening; 19 (23%) were injured while engaging in other outdoor activities; and one (1%) was injured in an automobile accident.

Ninety (96%) of the 94 patients with an acute injury had information reported regarding medical care for the injury. Of these 90 patients, 33 (37%) sought care for the acute injury. Tetanus toxoid prophylaxis for wound management was administered to 20 patients (19 of whom were eligible according to ACIP recommendations [21]); no tetanus toxoid was administered to 12 patients (11 of whom were eligible); and information was not available for one patient. Therefore, 63% (19/30) of eligible patients who sought care received tetanus toxoid prophylaxis.

## Clinical Features and Treatment

The median interval between the acute injury reported to have led to tetanus and the onset of tetanus was 7 days (range: 0–112 days) for the 89 nonneonatal patients with a known

\* Other puncture wounds included injuries from a screwdriver, awl, rake, pencil, rose bush, and lawnmower.

**TABLE 1. Tetanus toxoid vaccination history, time since last dose, and deaths among 130 reported cases of tetanus — United States, 1998–2000**

Vaccination history	No.	(%)	Time since last dose*			Case fatality ratio†	
			<10 years	$\geq 10$ years	Unknown	No. deaths/No. cases (%)	
0 doses	20§	(15.4)	—	—	—	1/16	(6)
1 dose	10	(7.7)	2	8	0	0/9	(0)
2 doses	0	(0.0)	0	0	0	0/0	(0)
3 doses	2	(1.5)	2	0	0	0/2	(0)
$\geq 4$ doses	18	(13.9)	6	8	4	1/16	(6)¶
Unknown	80**	(61.5)	6	17	57	18/70	(28)
<b>Total</b>	<b>130</b>	<b>(100.0)</b>	<b>16</b>	<b>33</b>	<b>61</b>	<b>20/113</b>	<b>(18)</b>

\* Number of cases.

† The outcome was known for 113 of 130 cases.

§ Includes one neonatal case.

¶ Death occurred in an injection-drug user aged 55 years; 11 years since last dose.

\*\* Includes cases with unknown total number of doses who could recall when the last dose of vaccine was received.

**TABLE 2. Condition before the onset of tetanus, by acute injury status and number of cases with a history of injection-drug use (IDU) and diabetes, among 130 reported tetanus cases — United States 1998–2000**

Condition before tetanus	Tetanus among diabetics	Tetanus among IDUs	Other*	All tetanus cases
<b>Acute injury</b>				
Puncture	7	1	39	47
Laceration	2	0	29	31
Abrasion	0	0	8	8
Crush	1	0	2	3
Avulsion	0	0	1	1
Compound fracture	0	0	1	1
Gunshot	0	0	1	1
Unknown	1	0	1	2
<b>Total</b>	<b>11</b>	<b>1</b>	<b>82</b>	<b>94</b>
<b>No acute injury</b>				
Abscess	0	7	0	7
Ulcer	2	2	3	7
Gangrene	2	0	0	2
Cellulitis	0	1	0	1
Gingivitis	0	0	3	3
Other infection(s)	0	1	1	2
No infection†	1	7	4	12
<b>Total</b>	<b>5</b>	<b>18</b>	<b>11</b>	<b>34</b>
<b>Neonate</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>
<b>Unknown injury history</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>
<b>TOTAL</b>	<b>16</b>	<b>19</b>	<b>95</b>	<b>130</b>

\* Tetanus cases that did not occur among diabetics or injection-drug users.

† Patients without a reported injury.

date of injury. The time between the injury and the onset of symptoms was  $\leq 30$  days for 84 (94%) of the patients. Eleven (12%) patients reported an injury  $\leq 2$  days before the onset of tetanus.

The type of tetanus was reported for 115 patients; 93 (81%) had generalized, 20 (17%) had localized, and two (2%) had cephalic tetanus. Generalized tetanus was the most common type reported among all age groups. The vaccination history was known for 40 (43%) patients with generalized tetanus and seven (35%) patients with localized tetanus. Thirteen (14%) patients with generalized tetanus and five (25%) patients with localized tetanus had received  $\geq 3$  doses of tetanus toxoid.

Tetanus immune globulin (TIG) was reported to have been given for treatment of tetanus in 125 patients. Time between reported onset of tetanus and administration of TIG for 121 (97%) patients with information was  $< 24$  hours after onset for 32 patients, 1–4 days after onset for 59 patients, and  $> 4$  days after onset for 30 patients.

Information regarding hospitalization was reported for 119 (92%) of 130 cases. Of the 115 (97%) hospitalized patients, the median length of hospitalization was 19 days (range: 1–123 days). Of the 95 patients with information available on

whether or not mechanical ventilation was used, 52 (55%) received mechanical ventilation. Sixteen (31%) of those who required mechanical ventilation died; four (9%) of those who were not mechanically ventilated died.

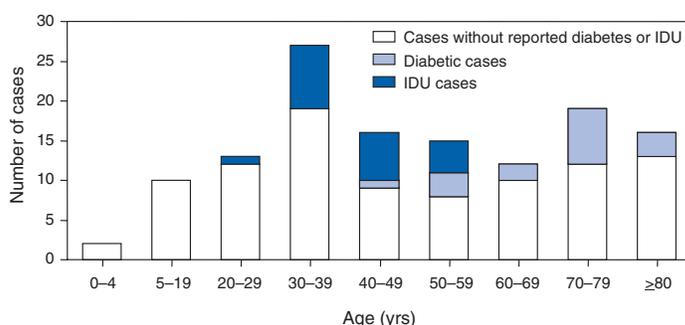
## Neonatal Tetanus

One neonate, delivered in a hospital, developed generalized tetanus on the ninth day of life. The infant had an infected umbilical cord that had been treated with bentonite clay for cord care at home. TIG therapy was administered within 24 hours of the onset of tetanus, and the baby recovered after 19 days of hospitalization. The baby's U.S.-born mother had a philosophic objection to vaccination and had received no tetanus toxoid (22).

## Tetanus Among Diabetics and IDUs

Diabetic patients constituted 12% (16/130) of the 130 reported cases of tetanus during 1998–2000 (Figure 4), compared with 2% of cases during 1995–1997 (1). The median age of the diabetic patients during 1998–2000 was 72 years (range: 42–84 years). The average annual incidence rate of tetanus among persons known to have diabetes was 0.26 cases per million population (four cases) for adults aged 20–59 years and 0.70 cases per million population (12 cases) for adults aged  $\geq 60$  years. Eleven (69%) of the diabetic patients were male; seven (44%) were from Texas; and four (25%) were Hispanic. The vaccination history was reported for two (13%) patients. One patient had received a primary series at an unknown time before the onset of tetanus, and the other patient had received a single lifetime dose of tetanus toxoid 4 years before the onset of tetanus. Eleven of the 16 patients with diabetes had an acute injury; four had gangrene or ulcer; and one had no wound reported. Only two patients, both with a puncture wound, sought medical attention before the

**FIGURE 4. Number of tetanus cases reported among persons with diabetes or injection-drug use (IDU), by age group — United States, 1998–2000**



onset of tetanus. Five (31%) of the 16 patients with diabetes died.

IDUs accounted for 15% (19/130) of the tetanus cases (Figure 4). The median age of these patients was 41 years (range: 27–57 years); eight patients (42%) were aged 30–39 years. Fifteen (79%) of the patients were male; 16 (84%) were from California; and 14 (74%) were Hispanic. Of the 19 cases among IDUs reported from all states, 14 (74%) used heroin; 10 (53%) reported injecting black tar heroin, a low-grade resinous form of heroin (23). The vaccination history was reported for five (26%) patients. Of these patients, three had received a primary series and a booster dose, with the last dose of tetanus toxoid received either  $\geq 10$  years before the onset of tetanus or at an unknown time before the onset of tetanus; one patient had received a single lifetime dose of tetanus toxoid 9 years before the onset of tetanus, and one patient had not been vaccinated. Only one patient among the 19 IDUs reported an acute injury. Four (21%) of the 19 IDUs died.

## Discussion

Tetanus is an uncommon but severe disease that occurs primarily among persons who are unvaccinated or inadequately

vaccinated. The average annual incidence of tetanus during 1998–2000 was 25% lower than that reported in the late 1980s and 96% lower than that reported in 1947. The age distribution of reported tetanus cases among adults shifted during the late 1990s, primarily because of an overall decrease in the number of cases among older adults, without a substantial reduction in cases among young and middle-aged adults. Persons aged  $\geq 60$  years accounted for 36% of cases during 1995–2000, compared with 52%–61% of cases during 1982–1994 (1,16–20).

During 1998–2000, the highest rates of tetanus and tetanus-related deaths were among adults aged  $\geq 60$  years. The immune response to tetanus toxoid can be less robust with increasing age, particularly among adults with chronic conditions (24,25). A national population-based seroprevalence survey during 1988–1994 indicated that 69% of adults aged  $\geq 70$  years lacked protective levels of tetanus antibody, compared with 9% of children aged 6–11 years (10). Certain older adults probably missed booster vaccinations, and others might not have received a primary series of tetanus toxoid.

IDUs comprised 15%–18% of the tetanus cases during 1995–2000, compared with 2.1%–4.5% during 1982–1994 (1,16–20). During this period, the majority of the tetanus cases among IDUs was reported among young and middle-



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aged adults and accounted for 27% of tetanus patients aged 20–59 years (1). Injection-drug use has been associated with an increased risk of tetanus (26–28). The majority of IDUs among the tetanus patients during 1998–2000 had no history of an acute injury, and a high proportion of patients reported injection of black-tar heroin. Contaminated drugs, adulterants (e.g., sugar, quinine, rat poison, laxative, and other illegal drugs), unsanitary injection equipment and practices, and altered immunity might contribute to an increased risk of tetanus among IDUs (23,26,28,29). Moreover, the high incidence of tetanus among Hispanics during 1998–2000 is partly attributable to the cases among IDUs, many of whom were Hispanic.

Vaccination history was known for <60% of tetanus patients reported from 1982–2000. During 1998–2000, only 6% of all tetanus patients were known to have been up-to-date with tetanus toxoid vaccination. No deaths occurred among these vaccinated patients. This finding is consistent with previous reports that illness is less severe among patients who have a history of receiving at least a primary series of tetanus toxoid compared with tetanus among inadequately vaccinated or unvaccinated patients (2).

Tetanus among children is uncommon in the United States. However, 13 nonneonatal cases occurred among patients aged <15 years during 1992–2000. Of these, 85% (11/13) were among children whose parents objected to vaccination (30). Before 1998, the two most recent cases of neonatal tetanus reported in the United States occurred among infants born in 1989 and in 1995 to immigrant mothers with incomplete tetanus toxoid vaccination (31,32). The mother of the neonate with tetanus in 1998 was born in the United States but had not received tetanus toxoid because of philosophical objection to vaccination (22). Protection of neonates against tetanus depends on passive transfer of maternal antibody from vaccinated mothers. Spores of *Clostridium tetani* are ubiquitous, and tetanus usually results after contamination of the umbilical cord (2).

Tetanus contracted after mild injuries or abrasions has previously been recognized and can result when patients do not seek medical attention or receive appropriate wound management (1,18–20,33). Among patients with acute injuries and known medical care history reported from 1998–2000, only 37% sought medical attention for the acute injury; of those who did seek medical attention, only 63% of those eligible received tetanus toxoid as wound prophylaxis. Many of the injuries were probably perceived as mild and occurred in persons inadequately vaccinated.

Surveillance for tetanus has some limitations. Because no confirmatory laboratory test exists, the diagnosis is made on clinical grounds and with the exclusion of other possible causes

of illness. Anaerobic cultures of tissues or aspirates yield *C. tetani* among only a minority of tetanus patients (34,35). CDC relies on passive reporting of cases by physicians to state and local health departments, and no recent evaluation of the completeness of tetanus case reporting to CDC has been performed. However, the completeness of reporting of tetanus deaths was evaluated in the 1980s (36). At that time, an estimated 40% of deaths were reported to CDC, and other data indicated that the completeness of reporting of tetanus morbidity might have been even lower. Surveillance for tetanus has remained essentially unchanged, and the national surveillance system continues to be valuable for identifying and following trends in tetanus disease.

For approximately 50 years, the recommendation that persons receive a primary 3-dose series of tetanus toxoid-containing vaccine and a booster dose every 10 years has proven to be effective in preventing tetanus or modifying its severity (2). The majority of the tetanus cases during 1998–2000 occurred among persons who were not appropriately vaccinated against tetanus or who had an unknown vaccination history. Disease-reduction goals for the United States include elimination of tetanus among persons aged <35 years by the year 2010 (37). Although a shortage of tetanus and diphtheria toxoids vaccine in the United States began in the last quarter of 2000, sufficient supplies of vaccine have been available to resume routine vaccination since 2002 (38). Health-care providers should evaluate their patients' tetanus vaccination status at each encounter and vaccinate as needed, which is critical among those patients in high-risk groups (e.g., older persons, diabetics, IDUs, persons with Hispanic ethnicity, pregnant women, persons with philosophical objections to vaccines, and persons who might not have received a primary series [e.g., immigrants]).

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