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Tetanus Surveillance -- United States, 1991-1994

Hector S. Izurieta, M.D., M.P.H.(1),(2) Roland W. Sutter, M.D., M.P.H., T.M.(1) Peter M. Strebel, M.D., M.P.H.(1) Barbara Bardenheier, M.P.H.(1) D. Rebecca Prevots, Ph.D., M.P.H.(1) Melinda Wharton, M.D., M.P.H.(1) Stephen C. Hadler, M.D.(1) (1) Epidemiology and Surveillance Division National Immunization Program (2) Division of Viral and Rickettsial Diseases National Center for Infectious Diseases Abstract

Problem/Condition: Despite the widespread availability of a safe and effective vaccine against tetanus, 201 cases of the disease were reported during 1991-1994. Of patients with known illness outcome, the case-fatality rate was 25%.

Reporting Period Covered: 1991-1994. **Description of System:** Physician-diagnosed cases of tetanus are reported to local and state health departments, the latter of which reports these cases on a weekly basis to CDC's National Notifiable Disease Surveillance System. Since 1965, state health departments also have submitted supplemental clinical and epidemiologic information to CDC's National Immunization Program.

Results: During 1991-1994, 201 cases of tetanus were reported from 40 states, for an average annual incidence of 0.02 cases per 100,000 population. Of the 188 patients for whom age was known, 101 (54%) were aged greater than or equal to 60 years and 10 (5%) were aged less than 20 years. No cases of neonatal tetanus were reported. Among adults, the risk for tetanus increased with age; the risk for persons aged greater than or equal to 80 years was more than 10 times greater than the risk for persons aged 20-29 years. All deaths occurred among persons aged greater than or equal to 30 years. The case-fatality rate (overall: 25%) increased with age, from 11% in persons aged 30-49 years to 54% in persons aged greater than or equal to 80 years. Only 12% of all patients were reported to have received a primary series of tetanus toxoid before onset of illness. For 77% of patients, tetanus occurred after an acute injury was sustained. Of patients who obtained medical care for their injury, only 43% received tetanus toxoid as part of wound prophylaxis.

Interpretation: The epidemiology of reported tetanus in the United States during 1991-1994 was similar to that during the 1980s. Tetanus continued to be a severe disease primarily of older adults who were unvaccinated or inadequately vaccinated. Most tetanus cases occurred after an acute injury was sustained, emphasizing the need for appropriate wound management.

Actions Taken: In addition to decennial booster doses of tetanus-diphtheria toxoid during adult life, the Advisory Committee on Immunization Practices (ACIP) recommends vaccination visits for adolescents at age 11-12 years and for adults at age 50 years to enable health-care providers to review vaccination histories and administer any needed vaccine. Full implementation of the ACIP recommendations should virtually eliminate the remaining tetanus burden in the United States.

INTRODUCTION

The reported incidence of tetanus has declined substantially since the mid-1940s, when tetanus toxoid (TT) became available for widespread use (1,2). This decline in tetanus incidence followed a) the widespread use of both tetanus toxoid (TT)-containing vaccines formulated as diphtheria and tetanus toxoids and whole-cell pertussis vaccine (DTP) and diphtheria and tetanus toxoids (DT) for infants and children and diphtheria and tetanus toxoid (Td) for adults, b) the use of TT and tetanus immune globulin (TIG) for postexposure prophylaxis in wound treatment, and c) improved wound care and management. Furthermore, the proportion of the U.S. population residing in urban areas has increased during the 1900s (3), resulting in decreased exposure to tetanus spores; this decreased exposure possibly contributed to the decline in tetanus mortality.

Major efforts have been made to increase immunization coverage among children in the United States. All 50 states have passed legislation requiring that children be vaccinated for tetanus before admission to school (4), and greater than 96% of school-aged children have received three or more DTP vaccinations by the time they begin school (1). Vaccination rates historically have been lower for preschool children aged less than 5 years (1,4). Since 1991, initiatives to improve immunization coverage among preschool children have substantially increased immunization levels among 2-year-old children (5). In 1994, 93% of children aged 19-35 months had been vaccinated with three doses of either DTP or pediatric DT (6). Vaccination coverage among elderly persons remains low (7).

CDC conducts surveillance for tetanus to monitor the epidemiology of the disease and to identify persons at greatest risk. This report describes an analysis of reported tetanus cases in the United States for 1991-1994 and evaluates long-term trends of disease incidence since 1947.

METHODS Tetanus Surveillance

Tetanus surveillance relies on the passive reporting of physician-diagnosed cases to local and state health departments. Because a laboratory assay to enable a definitive diagnosis of tetanus is not routinely available, the diagnosis is based on the clinical judgment of the attending physician. Before 1990, the clinical case definition of tetanus was "physician-diagnosed tetanus." In 1990, this definition was revised, for the purposes of public health surveillance, to include illness characterized by an acute onset of hypertonia and/or painful muscular contractions (usually of the muscles of the jaw and neck) and generalized muscle spasms without other apparent medical cause (8).

State health departments report cases of tetanus on a weekly basis to CDC's National Notifiable Disease Surveillance System (NNDSS). CDC publishes the number of cases reported by each state to the NNDSS on a weekly basis and in an annual summary (2). In addition, state health departments report supplemental clinical and epidemiologic information for each case to CDC's National Immunization Program (NIP). This supplemental reporting system, which was initiated in 1965, provides CDC with information concerning the clinical history, presence and nature of any associated risk factors, vaccination status of the patient, wound care, and clinical management for each tetanus case (9). A summary of this additional information is published every 2-3 years (10-13).

Data Analysis

The differences between medians were tested by using the Wilcoxon rank sum test statistic (14). A p-value of less than 0.05 was considered statistically significant.

RESULTS Long-Term Trends

The national tetanus surveillance system documented a decrease in tetanus morbidity from 560 reported cases in 1947 (i.e., the year national reporting of tetanus cases was initiated) to fewer than 50 cases in both 1992 and 1993 ([Figure 1](#)). However, since 1976, the rate of decline of reported tetanus incidence has been slower. The incidence rate for 1991-1994 was similar to that for 1987-1990. The overall case-fatality rate also has declined, from 91% in 1947 to 44% in 1976 and to 24% in 1989-1990. Since 1990, the overall case-fatality rate has remained relatively unchanged (i.e., 25% overall for 1991-1994).

Epidemiology

During 1991-1994, 201 tetanus cases were reported to the NNDSS (i.e., 57 cases in 1991, 45 in 1992, 48 in 1993, and 51 in 1994). The average annual incidence rate for 1991-1994 was 0.02 cases per 100,000 population; this rate represents a 95% decrease from the 0.39 cases per 100,000 population reported for 1947.

At least one case of tetanus was reported by each of 39 states and the District of Columbia during 1991-1994 ([Figure 2](#)), and tetanus cases were reported all 4 years by eight states (California, Florida, Illinois, Michigan, Minnesota, Ohio, Pennsylvania, and Texas). No cases were reported in 11 states; six (55%) of these states are located in the Rocky Mountain and West North Central regions (i.e., regions in which the reported incidence of tetanus was low in previous years {10-13}).

Supplemental information was provided for 192 (96%) of the 201 reported tetanus cases. Of the 189 patients for whom sex

was reported, 99 (52%) were female. Of 188 patients for whom age was reported, 101 (54%) were aged greater than or equal to 60 years, and 10 (5%) were aged less than 20 years ([Figure 3](#)). Six cases occurred in children aged less than 15 years. No cases of neonatal tetanus were reported. The youngest patient was an unvaccinated 6-year-old boy who had sustained a puncture wound in his foot. He had generalized tetanus that required mechanical ventilation; he recovered after a 1-month hospitalization.

A total of 46 deaths occurred among the 185 patients whose illness outcome was known (case-fatality rate: 25%). All tetanus-related deaths occurred among persons aged greater than or equal to 30 years. The case-fatality rate increased with age, from 11% in persons aged 30-49 years to 54% in persons aged greater than or equal to 80 years.

Type of Tetanus

The type of tetanus was reported for 150 cases. Of these cases, 121 (81%) were generalized, 20 (13%) were localized, and nine (6%) were cephalic tetanus.

Previous Vaccination Status

Tetanus vaccination status was known for 89 (46%) of the 192 patients, and age was known for 86 (97%) of these 89 patients. Of the nine patients aged less than 20 years for whom vaccination status was reported, five had received no previous doses of a TT-containing vaccine, three had received four doses, and one had received five doses. Of the 77 patients aged greater than or equal to 20 years for whom this information was reported, 42 (55%) had received no previous doses of TT, 17 (22%) had received a single dose, and 18 (23%) had received at least three doses.

Twenty-three (12%) of the 192 patients were reported to have received at least a primary series (i.e., three or more doses) of TT before onset of illness ([Table 1](#)). Of these patients, 13 were reported to have received the last booster less than or equal to 10 years before onset of illness. For two patients, this information was verified by records obtained from their primary health-care providers. The first patient was a 12-year-old girl who had onset of illness during 1994. She had previously received five doses of DTP, the last of which was received 4 years before onset of illness. She was not hospitalized, and she recovered without sequelae after 6 weeks of home care. The second patient was a 29-year-old man who had a history of amphetamine abuse. He had previously received four doses of a TT-containing vaccine, the last dose of which was received 6 years before onset of illness. He also recovered.

Two cases occurred in persons who did not receive vaccination because of religious objections (i.e., a 12-year-old boy in Montgomery, Georgia, and a 17-year-old boy in Lancaster, Pennsylvania). Both patients had generalized forms of tetanus and required mechanical ventilation.

Type of Injury, Wound Treatment, and Prophylaxis

An acute injury sustained before onset of illness was identified for 148 (77%) of the 192 tetanus cases. Of these cases, 72 (49%) occurred after puncture wounds. The most frequently reported type of puncture wound was sustained by stepping on a nail, which was reported by 23 (16%) of all patients who had sustained an identified acute injury. The other most frequently reported types of acute injury were lacerations (20%) and abrasions (12%). Five patients had been bitten or scratched by animals, including one patient who reported having been scratched in the face by a peacock.

The site of the antecedent acute injury was a lower extremity in 77 (52%) cases, an upper extremity in 50 (34%) cases, and the head or trunk in eight (5%) cases. The injury site was not specified for 13 cases.

The median incubation period was 7 days (range: 0-90 days) for the 138 patients for whom the dates of both the antecedent injury and the onset of illness were specified. The incubation period was less than or equal to 45 days for all but one case, which occurred in a 64-year-old woman who was on long-term immunosuppressive therapy and whose immunization status was unknown. This woman had been bitten on one of her legs by a dog 90 days before onset of illness, and her wound ulcerated. She died after 75 days of treatment. The incubation period for most (101 {73%}) of the 138 tetanus cases ranged from 4 to 14 days; this period was less than or equal to 3 days for 21 (15%) cases and greater than 14 days for 16 (12%) cases.

The environment in which the antecedent injury occurred was reported for 117 patients. Of these patients, 57 (49%) were injured while indoors; 36 (31%), while performing outdoor farming or gardening activities; and 23 (20%), while engaged in

other outdoor activities. One (1%) patient had sustained motor-vehicle-related injuries.

Information regarding medical care was reported for 135 patients who became ill with tetanus after sustaining an acute wound; of these patients, 51 (38%) had obtained medical care for the injury. TT was administered as prophylaxis to 22 patients (i.e., 43% of those who obtained medical care), 15 (68%) of whom received toxoid within 4 days after the injury. In accordance with the recommendations of the Advisory Committee on Immunization Practices (ACIP) for the use of adult formulation Td and TIG in wound management ([Table 2](#)) (32), 22 (92%) of the 24 patients who had obtained medical care for an acute injury but were not administered Td should have received the toxoid. Information regarding administration of toxoid was unavailable for the remaining five patients.

Thirteen patients who had acute wounds severe enough to have received prophylactic wound debridement were candidates for both Td and TIG ([Table 2](#)); five of these patients were administered Td in the course of wound management, and three were administered TIG.

Twenty-three cases unrelated to acute injury were associated with either diabetes (seven patients, five of whom were insulin-dependent) or chronic wounds (e.g., skin ulcers, abscesses, or gangrene) (21 patients). Five patients were reported as having both diabetes and a chronic wound. The only risk factor associated with tetanus for one patient was a history of parenteral drug abuse.

Surgery performed 3-21 days before onset of illness was reported for seven patients; for six of these patients, it was the only reported risk factor for tetanus (the other patient had concomitant insulin-dependent diabetes mellitus). For these cases, the median interval between surgery and onset of illness was 7 days (range: 2-13 days). None of these patients were known to have received TT during the 10 years preceding the surgery. One patient had surgery performed on the leg; three patients, the hips and sacral area; and three patients, the abdomen (i.e., by laparotomy). The mean age of patients who had undergone surgery was 51 years (range: 21-77 years). One patient, an unimmunized 63-year-old woman who had had toe surgery, died as a result of tetanus. Information regarding acute injury, chronic wound, or other preexisting medical conditions was unavailable for 14 patients.

Clinical Features and Treatment

Information concerning therapeutic use of TIG was available for 168 patients; of these patients, 163 (97%) reported having received TIG. The exact dosage of TIG was specified for 115 (71%) of the 163 patients; the median dosage used therapeutically was 3,000 IU (range: 250-10,000 IU). The time interval between onset of illness and TIG administration was known for 146 of the patients who received TIG; TIG was administered to 42 (29%) of these patients less than 24 hours after onset of illness and to 52 (36%) patients from 1 to 4 days after onset. Information concerning illness outcome was reported for 157 patients who received TIG; 35 (22%) of these patients died. Two (40%) of the five patients who did not receive TIG died. This difference was not statistically significant (relative risk {RR}=0.56; 95% confidence interval {CI}=0.18 less than RR less than 1.7). Initial (Wilcoxon rank sum test: $p=0.67$) or total (Wilcoxon rank sum test: $p=0.46$) dosage of TIG did not differ significantly between patients who died and those who recovered.

The length of hospitalization was reported for 131 patients; the median duration was 15 days (range: 0-92 days). Information regarding the use of assisted ventilation was available for 151 patients; of these patients, 101 (67%) required ventilation. Information concerning both the outcome and the use of assisted ventilation was available for 145 patients; of these, 29 (30%) of the 98 patients who required ventilation died, compared with two (4%) of the 47 who did not require ventilation.

The direct costs of medical care were assessed for the 10 cases reported by Texas during 1991; the median cost was \$65,651 (range: \$12,099-\$154,200) (J. Pelosi, Texas Department of Health, personal communication). The cost of hospitalization, including physicians' fees, for the two tetanus cases reported by Kansas during 1993 was \$145,329 and \$151,492 (15).

DISCUSSION

The epidemiology of reported tetanus in the United States during 1991-1994 was similar to that during the 1980s (10-13). Tetanus continued to be a severe disease primarily of older adults who were unvaccinated or inadequately vaccinated. Data obtained from a national population-based serologic survey (16) indicate that the prevalence of immunity to tetanus in the United States is lower in older age groups, from greater than 80% among persons aged 6-39 years to 28% among persons

aged greater than or equal to 70 years. Previous serologic studies also have indicated that older adults lack protective levels of tetanus antibodies (17-19) and that elderly persons who reside in rural areas are more likely to be unimmunized than elderly persons in urban areas (20).

Tetanus is preventable through both vaccination and appropriate wound prophylaxis. Vaccination with a primary series of three doses of TT-containing vaccine and booster doses of Td every 10 years is highly effective in preventing tetanus (21). During 1991-1994, only 26% of patients with known vaccination history had completed a primary series of TT before onset of tetanus, and in only two cases was vaccination against tetanus in the 10 years preceding onset of tetanus verified.

Tetanus remains a clinical diagnosis because confirmatory laboratory tests are not available for routine use. Isolation of the organism from wounds is neither sensitive nor specific, because a) anaerobic cultures of tissues or aspirates usually are not positive and b) the organism might be grown from wounds in the absence of clinical signs and symptoms of disease (22-24).

The number of tetanus cases derived from passive reporting by physicians to local and state health departments underestimates the true incidence of tetanus in the United States. Completeness of reporting for tetanus mortality has been estimated at 40%, while completeness of reporting for tetanus morbidity may be even lower (25). Although tetanus reporting is incomplete, an analysis of tetanus mortality reporting suggests that the reported tetanus cases are representative of all tetanus cases (25).

As noted previously (10-13), most (77%) tetanus cases occurred after an acute injury was sustained; stepping on a nail was the most frequent cause of these injuries. Acute-wound-associated tetanus can be prevented by appropriate wound management, including active and/or passive immunization. Only 38% of patients for whom this information was available had obtained medical care for the acute injury; according to current ACIP recommendations ([Table 2](#)), 43% of these patients should have received prophylaxis but did not. Approximately half the antecedent injuries occurred indoors, emphasizing the need to consider such injuries as being risk factors for tetanus. The median incubation period between the antecedent injury and onset of tetanus was 7 days; in all but one case, this time period was less than 45 days. More than 80% of cases were diagnosed as generalized tetanus.

No cases of neonatal tetanus were reported during this 4-year period. Only one case of neonatal tetanus, which occurred during 1989 in an infant born to an unvaccinated mother, was reported during 1984-1994 (10-13). Although almost all tetanus cases in the United States occur in adults, most reported cases of tetanus worldwide occur as neonatal tetanus (26-28). Neonatal tetanus can be prevented through maternal vaccination and hygienic delivery practices, and the World Health Organization has targeted neonatal tetanus for elimination (27,28).

When immunization programs are in place, the age distribution of patients usually reflects the remaining susceptibility to the infection in the population (29). During 1991-1994, two tetanus cases occurred in persons aged 12 and 17 years who were members of communities that object to vaccination. Persons who object to vaccination because of religious or philosophical beliefs may disproportionately contribute to the remaining tetanus burden in the United States (30).

During 1991-1994, more than half the total number of reported cases occurred in persons aged greater than or equal to 60 years. In January 1994, the National Vaccine Advisory Committee concluded that vaccine-preventable diseases among adults in the United States were a continuing cause of morbidity and mortality, particularly among older persons (31). Adult immunization levels may be markedly increased by reducing missed opportunities to vaccinate adults during health-care visits (32). During 1991-1994, recent surgery was the only known injury for seven (4%) patients; TT had not been administered preoperatively to these patients, although none had a history of vaccination during the preceding 10 years. Because persons of all ages are exposed to tetanus, maintaining protection against tetanus (and diphtheria) after the primary series can be achieved by routinely scheduling booster doses of Td at decade ages (e.g., at 30, 40, and 50 years of age) (7).

ACIP recommended recently that persons be routinely scheduled for a vaccination visit at age 11-12 years and age 50 years (33). Such visits enable health-care providers to a) review the patient's vaccination status, b) administer Td as indicated, and c) determine whether a patient needs other vaccinations, such as influenza and pneumococcal vaccinations (34,35). Full implementation of these recommendations and compliance with the decennial Td booster policy should virtually eliminate the remaining tetanus burden in the United States.

Acknowledgments

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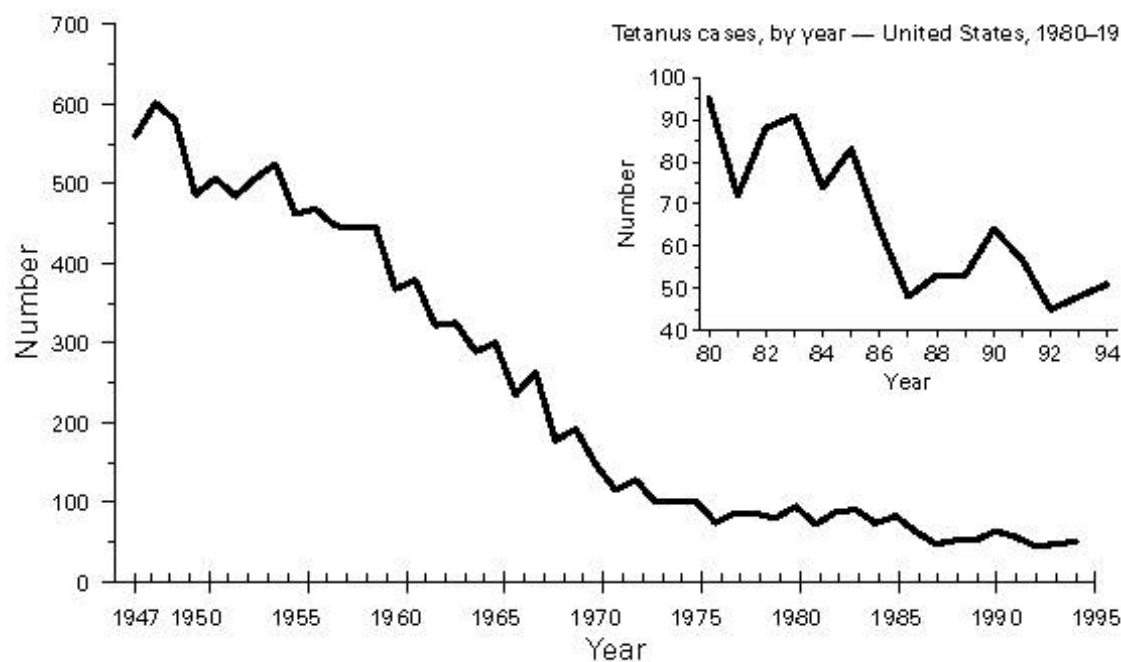
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Figure_1

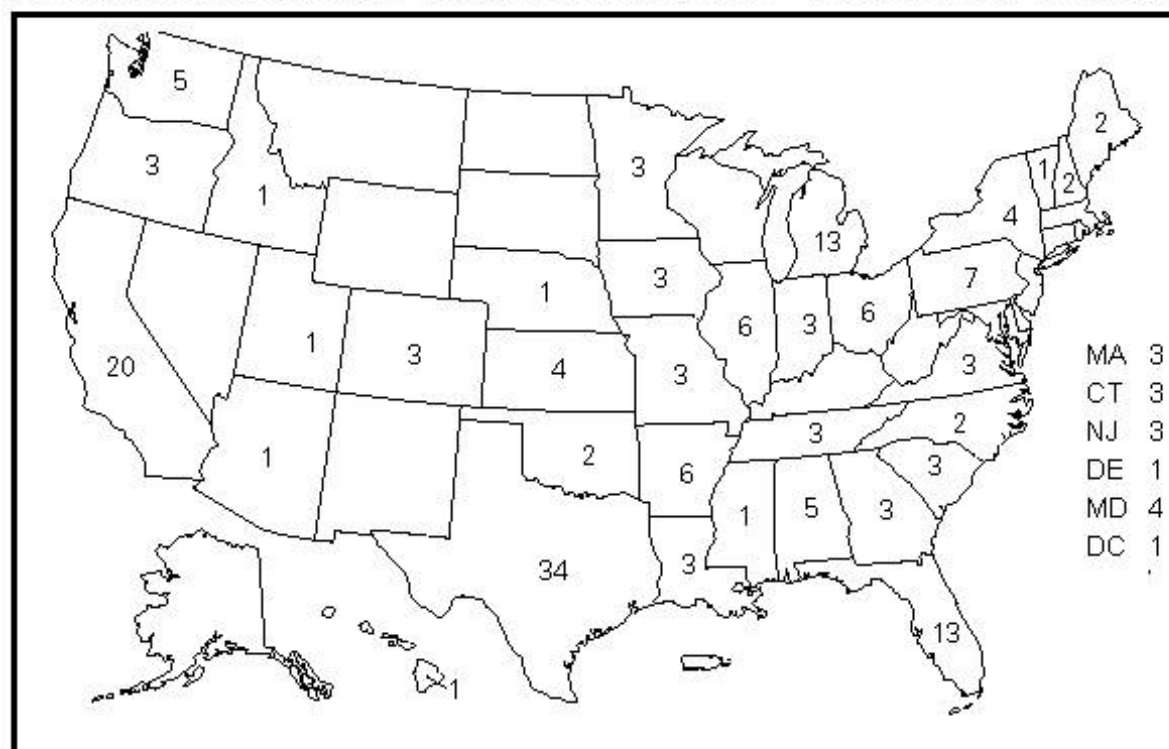
FIGURE 1. Reported number of tetanus cases, by year — United States, 1947-1994



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Figure_2

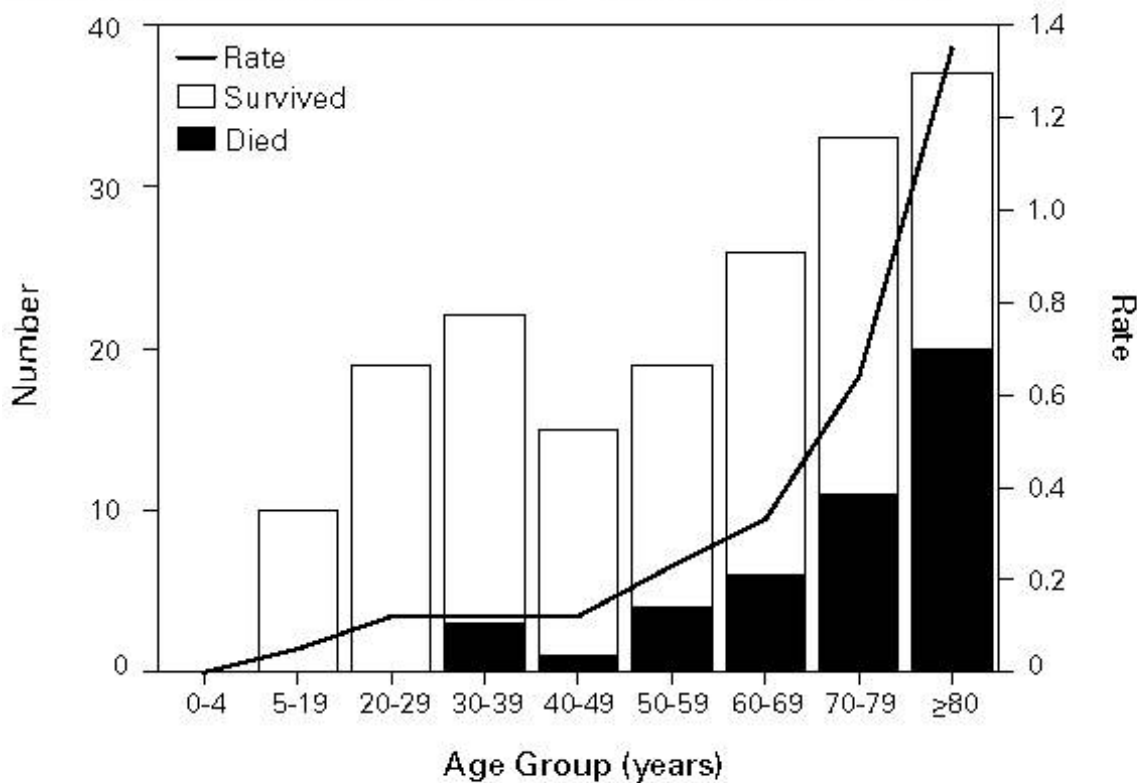
FIGURE 2. Reported number of tetanus cases, by state — United States,* 1991-1994



*Cases were reported from 39 states and the District of Columbia.

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Figure_3

FIGURE 3. Reported number of tetanus cases, average annual incidence rates,* and survival status of patients, by age group — United States, 1991-1994

*Per 100,000 population.

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TABLE 1. Tetanus toxoid vaccination status of persons with reported tetanus -- United States, 1991-1994

Vaccination status	No.	(%)
0 doses	49	(25.5)
1 dose	17	(8.9)
2 doses	0	(0.0)
3 doses	5	(2.6)
>=4 doses	18	(9.4)
Unknown	103	(53.6)
Total	192	(100.0)

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TABLE 2. Summarized recommendations for the use of tetanus prophylaxis in routine wound management -- Advisory Committee on Immunization Practices (ACIP), 1991 (7)

History of adsorbed tetanus toxoid	Clean, minor wounds		All other wounds *		No ++	No
	Td +	TIG &	Td	TIG		
Unknown or <3 doses	Yes	No	Yes	Yes	>=3 doses @	No **

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

+ For children aged <7 years; the diphtheria and tetanus toxoids and pertussis vaccine (DTP) or pediatric diphtheria and tetanus toxoids (DT), if pertussis vaccine is contraindicated-is preferred to tetanus toxoid (TT) alone. For persons aged ≥7 years, the tetanus and diphtheria toxoids (Td) for adults is preferred to TT alone. TIG=tetanus immune globulin.

& If only three doses of fluid toxoid have been received, a fourth dose of toxoid -- preferably an adsorbed toxoid -- should be administered.

** Yes, if >10 years have elapsed since last dose.

++ Yes, if >5 years have elapsed since last dose. (More frequent boosters are not needed and can accentuate side effects.)

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