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Tetanus in England and Wales, 1984–2000

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SUMMARY

A review of national tetanus surveillance in England and Wales during 1984–2000 was undertaken to evaluate the surveillance system and national vaccination policy. Hospital Episode Statistics for tetanus in England for fiscal years 1989/90–1995/6 were also examined to estimate under-reporting. A total of 175 cases of tetanus were reported, giving an annual incidence of 0·20 per million, the lowest levels ever recorded. The highest incidence was in those aged over 64 years (0·66 per million) with no significant sex difference. Twenty (11%) cases were reported in people who were eligible for routine childhood vaccination. Outdoor injuries were the commonest reported exposure risk. Tetanus case under-reporting was estimated as 54–64%. We conclude that GPs should ensure that all their patients are fully vaccinated, targeting those born before 1961. High childhood tetanus vaccination coverage remains a priority. As the disease becomes rarer, enhanced tetanus case surveillance is essential for tetanus immunization policy evaluation.

INTRODUCTION

In England and Wales, national childhood tetanus immunization was introduced from 1961 [1] and since 1990, vaccination coverage at 2 years of age has exceeded 90% (Fig. 1). Since 1930, most tetanus cases have occurred in older people, mainly women, who had never been vaccinated [2–4]. For some time, opportunistic vaccination to capture unvaccinated individuals has been recommended in addition to giving vaccine as part of post-exposure prophylaxis following a tetanus-prone injury [2, 3, 5]. This study evaluates national policy against the epidemiology of tetanus during 1984–2000 and identifies areas requiring further improvement.

METHODS

Routine tetanus surveillance data from 1 January 1984 to 31 December 2000 was obtained from several sources: notifications and death registrations to the Office for National Statistics, and laboratory and clinical reports to the Public Health Laboratory Service Communicable Disease Surveillance Centre. All reported cases were followed up through the notifying or reporting clinician for additional information on risk exposure, clinical and immunization history and to confirm the notified diagnosis. Since 1985, a standard questionnaire has been used.

The Office for National Statistics provided the estimated annual number of hospital discharges and deaths from the Hospital In-Patient Enquiry (HIPE), a 10% sample of hospital discharges and deaths, for the period 1958–81. For fiscal years 1989/90–1995/6, anonymized Hospital Episode Statistics [6] were obtained for all hospital admissions in England for all ages coded for tetanus, neonatal tetanus and obstetric tetanus up to sixth diagnostic code per episode. International Classification of Diseases (ICD) 9 and ICD 10 codes were used (ICD 9 codes '037', '634–638' with fourth digit '.0', '639', '670', '771.3'

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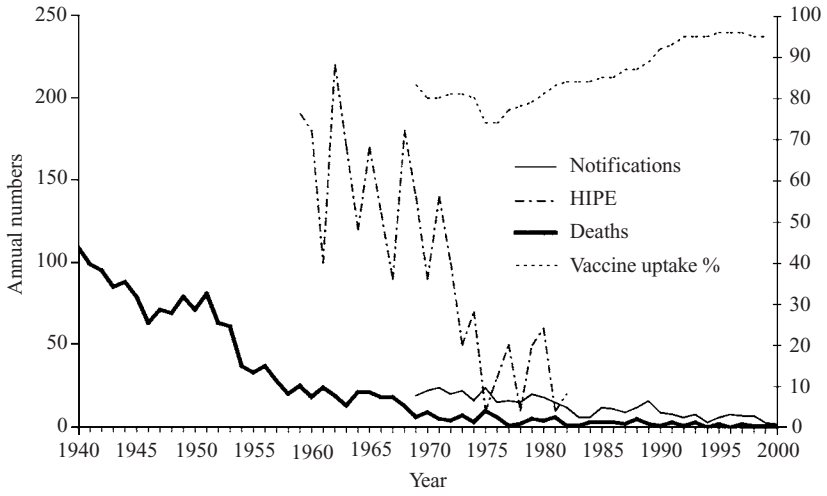

Fig. 1. Tetanus Notifications, Deaths and Vaccine Uptake Rates England and Wales, 1940–2000. Source: Notifications & deaths: Notifications of Infectious Diseases, Death data, Office for National Statistics, 2000 data provisional. HIPE: Hospital In-Patient Enquiry, Department of Health Statistics Division. From 1982 HIPE data applies to England only and is not available after 1984. Vaccine uptake: percentage of children completing vaccination by second birthday (England only after 1986), COVER/Korner Programme.

for 1989/90–1994/5 and ICD 10 codes 'A33X-A35X' for 1995/6).

Multiple hospital episodes for one 'admission' were counted as a single case episode and the lengths of stay combined. Hospital episodes were further analysed by code, health authority, sex and age to detect and exclude probable miscodes for general, neonatal and obstetric tetanus. Additional codes, where given, were analysed to assess the possible extent of miscoding from other conditions such as hypocalcaemic tetani.

Analysis

Age and sex specific incidence rates were calculated using population mid-year estimates for 1992 (population data supplied by the Office for National Statistics). Severity of disease was compared using ordered logistic regression adjusting for age, sex and vaccination status.

RESULTS

National Surveillance Data, 1984–2000

During 1984–2000, 175 cases of tetanus were reported in England and Wales; 134 (77%) cases were notified, 34 (19%) cases were registered deaths due to tetanus (19 of these were also notified) and 26 (15%) cases were reported via clinical or laboratory reporting only. The number of cases reported annually ranged from 2 to 20 cases with a falling trend over the 17-year period (Fig. 1). The average annual incidence of reported tetanus was 0·20 per million population (annual range 0·04–0·39). The country and regional annual averages ranged from 0·06 to 0·33 per million population with the highest incidence in the South West of England (Table 1).

Table 1. *Average annual incidence of tetanus by country and region, 1984–2000*

Cases by country and NHS region	Number of cases	Average annual incidence/10^6 population
England and Wales	175	0·20
England	172	0·21
Wales	3	0·06
Eastern	20	0·23
London	28	0·24
Northern and Yorkshire	26	0·24
North West	9	0·08
South East	40	0·28
South West	27	0·33
Trent	14	0·16
West Midlands	8	0·09

Source: Reports to national tetanus surveillance PHLS CDSC. Population data ONS mid-year estimates, 1992.

Those over 64 years of age had the highest annual incidence of tetanus (0·66 per million) (Table 2). There was no significant difference ($P = 0·34$) in the incidence of tetanus by sex when adjusted for age group (Table 2). No cases of neonatal tetanus or tetanus in children

Table 2. *Average annual incidence of tetanus by age and sex in England and Wales, 1984–2000*

	Males		Females		Persons	
Age groups (years)	No.	/10^6	No.	/10^6	No.	/10^6
0–4	—	—	—	—	—	—
5–14	3	0·05	1	0·02	4	0·04
15–24	6	0·10	6	0·10	12	0·10
25–44	12	0·09	16	0·13	28	0·11
45–64	18	0·19	19	0·20	37	0·19
65+	32	0·57	59	0·71	91	0·66
Not known	3	—	—	—	3	—
All	74	0·17	101	0·23	175	0·20

Source: Reports to national tetanus surveillance PHLS CDSC.

under 5 years of age were reported. Twenty (11%) cases were reported in individuals who were born after childhood immunization was introduced in 1961.

Follow-up information was available in 141/175 cases (81%). The source of reports, age and sex breakdown was similar for cases with additional follow-up information to those without such follow-up, except for 3 of the 4 notified cases in the 5–14 year age group for which there was no further information to confirm these notifications as tetanus despite follow-up.

Cases with additional information provided ($n = 141$)

Immunization status

Information on tetanus immunization status at the time of injury was completed in 91/141 (65%) cases (Table 3). Only 34 of these cases had a reported history of any previous tetanus immunizations; 15 received a primary course (10 as adults) and 19 a single dose of tetanus toxoid. Fourteen cases were born after 1961 when infant tetanus immunization was introduced. Information on immunization status was available in 8 of these cases; 5 had received a primary course of tetanus immunization, 2 were reported as having received 1 dose, and 1 had never been immunized. Of the 91 cases with a vaccination history, only 1 individual, who had a mild clinical infection, had received the recommended 5 tetanus vaccinations. Using the clinical severity grading, a greater proportion of unvaccinated individuals had severe tetanus although the trend was not statistically significant (Table 4).

History of risk exposure and injury

Most cases had a history of recent injury sustained in the garden or home ($n = 81$), on roads or other outdoor settings ($n = 14$) or at work ($n = 13$) (Table 3). These were usually injuries from rose thorns, garden canes, nails, falls or road traffic accidents with potential soil contamination. The injuries sustained whilst at work were all reported as having occurred in outdoor settings: 6 on farms, 3 in outdoor engineering work (1 sustained whilst working abroad), 3 in manual occupations (building trade, window cleaning, market work) and 1 in working with small animals. Only 6 of these 13 work-related cases were reported as having received any previous tetanus vaccination.

Twenty-one patients developed tetanus after other reported injuries or potential risk factors for exposure. Six of them had leg ulcers with peripheral vascular disease or gangrenous feet, 4 cases occurred following dog bites or cat scratches, 2 intravenous drug users had multiple skin lesions at needle puncture sites, 2 had a recent termination of pregnancy where the 'injury' site was considered to be the womb, 2 occurred following assault injuries, 2 occurred post-operatively (after cholecystectomy and hip replacement), 1 had multiple abrasions of unknown cause, 1 a splinter of unknown origin and 1 occurred after being injured playing football. Only 2 of these 21 cases were known to have completed a primary course and an additional 3 had received a single dose of tetanus toxoid in the past.

In 80/141 cases (57%), the dates of injury and onset of tetanus were given. Nearly half of these cases occurred within 1 week of injury and 95% within 4 weeks.

In 91/141 (65%) cases, information on post-exposure prophylaxis before onset of tetanus was available. Forty-eight cases had received either tetanus toxoid (28) or anti-tetanus immunoglobulin (9) or both (11) and 47 cases had received neither. Other treatments given included antibiotics, debridement of the

Table 3. *Severity of disease, immunization status and type of injury in tetanus cases with follow-up information, 1984–2000* (n = 141)

	Number of cases	%*
Immunization status at time of injury		
Primary immunization only	5	5
Primary immunization with boosters	10	11
Previous single dose of tetanus	19	21
No previous tetanus vaccination	57	63
Vaccination history not known or not reported	50	
Type of injury/exposure		
Garden/home	81	61
Road	14	10
At work	13	10
Other†	21	16
No signs or history of injury	4	3
Not known	8	
Post-exposure therapy		
Antibiotics	41	29
Debridement	30	21
Tetanus toxoid	39	28
AT Immunoglobulin	20	14
Other treatment	14	10
Any treatment	66	47
Severity of disease (see box)		
Grade 1	19	15
Grade 2	18	143
Grade 3	90	71
Not known	14	
Outcome at time of follow-up		
Died	42	32
Recovered	72	54
Partial recovery, still ill and in-patient	19	14
Not known	8	
Total	141	

* Excludes not knowns.
† See text.
Source: Reports to national tetanus surveillance PHLS CDSC.

injury site and other treatments such as cleaning and suturing of wounds (Table 3).

Severity of disease

Ninety cases had severe clinical disease at grade 3 (Box 1, Table 3), 18 cases had moderate disease and 19 cases had mild disease. Using ordered logistic regression to analyse age, sex, previous vaccination, there was a statistically significant increase in severity of disease with increasing age ($P = 0{\cdot}027$). Illness was also more severe in those with a history of no previous tetanus vaccination ($P = 0{\cdot}068$) although this was not significant at the 5% level.

Death was recorded as an outcome in 42 (29%) cases. 72 (51%) fully recovered and 19 (13%) only partially recovered or were still ill at the time of reporting. More than a quarter (12/42) of those known from the surveillance questionnaire to have died were not coded as deaths due to tetanus by ONS as they did not appear in the data extract of all death certificates with any mention of tetanus as a contributory cause of death. Amongst cases where the final outcome and severity of disease was known (124/141), the case-fatality rate (CFR) increased with increasing severity of illness; 11% (2/18), 11% (2/18) and 39% (34/88) for grade 1, 2 and 3 disease respectively. Where duration of illness and final outcome were known (92/141), the median duration of illness to recovery was 25 days and over 80% recovered within 6 weeks. The median duration of illness to death was 20 days with 46% of deaths occurring in the first 14 days of illness.

Hospital Episode Statistics

From 1 April 1989 to 31 March 1996, 253 hospital episodes, involving 205 patients, were coded for tetanus. For fiscal years 1989/90 to 1994/5, an average of 25 cases (annual range 18–36) were coded with a hospital episode that included tetanus. In 1995/6, when coding changed from ICD 9 to ICD 10, 58 cases were given a tetanus code. Coding in 1995/6 data showed 31 codes for neonatal tetanus in adults and 2 district health authorities accounted for 39 of the 58 cases coded. Given the coding change that year and associated high proportion of miscoding, 1995/6 codes were excluded from further analysis leaving 147 cases for the remaining 6-year period. Although additional codes examined may have indicated possible miscoding as tetanus in a number of other cases, they were not excluded from further analysis.

Seventy-three (50%) of the 147 patients were aged 45 years or less and 74 (50%) were admitted for 1 week or less (27% for 2 days or less). Only 15 (10%) patients were coded as having died in hospital. Comparing Hospital Episode Statistics data and tetanus surveillance data for the same time period, Hospital Episode Statistics data recorded fewer deaths, shorter lengths of stay, and more episodes in those aged less than 65 years. During the same 6 year time period, 68 cases were reported in England through the national surveillance scheme and 43 (63%) matched on age and sex with the Hospital Episode Statistics data.

Table 4. *Severity of disease and immunization status in tetanus cases with follow-up information 1984–2000* (n = 90)

	Severity (deaths)		
Vaccine history	Grade 1 Mild	Grade 2 Moderate	Grade 3 Severe/very severe
Unvaccinated	6	8 (1)	39 (13)
Primary only	1	1	2 (1)
Booster only	5	4 (1)	10 (4)
Primary and booster	3 (1)	1	6 (1)
Not known	4 (1)	4	33 (15)
Total	19 (2)	18 (2)	90 (34)

Box 1. *Grading of severity of tetanus*

Grade	1 Mild	2 Moderate	3a Severe	3b Very severe
Trismus	+/++	++	+++	+++
General spasticity	+	++	+++	+++
Dysphagia	−/+	+	+++	+++
Respiratory difficulties	−	+	+++	+++
Spasms	−	+	+++	+++
Autonomic dysfunction	−			++

Assessing under-reporting

Using Hospital Episode Statistics data for 1989–95, 79 additional cases were recorded as admissions for tetanus, an estimated level of under-reporting to national surveillance of 54%.

Using case-fatality rates of 10% from clinical studies of tetanus and assuming that the high CFR observed reflects under-reporting of milder cases, an estimate of 64% under-reporting was obtained. The 54% under-reporting figure derived from Hospital Episode Statistics gave a total estimate of 270 cases between 1984 and 2000, compared to an estimate of 311 cases using the under-estimate of 64% derived from the clinical case series CFR.

DISCUSSION

In England and Wales, cases and deaths from tetanus continue to occur, with the CFR remaining unchanged. As herd immunity plays no part in tetanus control, high vaccination coverage in the childhood vaccination programme, opportunistic vaccination and post-exposure prophylaxis [5] need to be maintained to ensure high levels of immunity in the whole population.

Trends and clinical data

Since the 1950s, reported cases and deaths from tetanus fell in England and Wales (Fig. 1) (2–4) and this trend continued over the past 17 years (Fig. 2). Cases continue to occur in older age groups and, for the first time since reporting began tetanus incidence rates for men and women did not differ significantly. In the past, the lower rates in older men were attributed to vaccination during national service [2, 3] but our data suggest that this effect may have decreased. Several factors may have contributed to the decreased relative risk amongst women: increased opportunistic vaccination of elderly women in the past two decades, more tetanus prone injuries in men, or reluctance to seek post-exposure prophylaxis by men. As the number of cases is small, however, any change in the epidemiology must be interpreted with caution.

The CFR from tetanus has remained high (29%) and similar to previous reviews carried out several years ago [2, 3]. Severe disease significantly impacts on

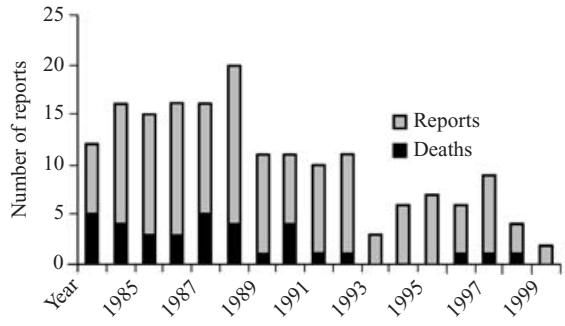

Fig. 2. Tetanus in England and Wales 1984–2000 – Deaths certified as tetanus and total reports to national surveillance from all sources. Source: PHLS CDSC national surveillance data for tetanus, deaths ONS.

health care resources with many patients requiring treatment on intensive care units for several weeks. The cost was estimated in 1996 in Australia at £35 000 for treating one patient with tetanus [7].

Under-reporting, under-ascertainment and misclassification

Tetanus is under-notified and passive clinical and laboratory reports increased the completeness of case ascertainment. There is evidence that, as tetanus is now rare in England and Wales, the diagnosis could be missed or delayed particularly in mild cases [10]. We attempted to estimate under-reporting using hospital admissions data, which has also been used to assess under-reporting of other vaccine preventable notifiable diseases such as poliomyelitis and meningococcal meningitis (M. Ramsay, personal communication) and pertussis [11]. For common conditions, Hospital Episode Statistics data can provide useful information on trends for hospitalized cases and can be used to estimate the burden of disease and the economic impact on health services [12, 13]. The completeness of these data for tetanus should be high, as nearly all diagnosed cases would be admitted to hospital. However, inaccuracies due to miscoding of more common conditions to a rare condition may represent a relatively greater proportion of episodes with that code. Incorrect coding to tetanus may occur where the disease name resembles a more common condition, such as tetanic conditions secondary to metabolic disorders. Although there were some additional codes that may have led us to question the diagnosis of tetanus, without further information it would be difficult to exclude these from the analysis. In 1995/6, the change to ICD 10 from ICD 9 led to a twofold increase in the number of cases coded as tetanus and most were obvious miscodes in relation to the age or sex of cases (for neonatal and obstetric tetanus). The introduction of ICD 10 coding has also led to an increase in miscoding for other rare communicable diseases (M. Ramsay, personal communication). This miscoding affects specificity rather than sensitivity.

Hospital Episode Statistics data for 1989–95 suggest that the level of under-reporting to national surveillance is around 54%, comparable to estimates obtained previously using hospital data [4]. However, these data are poorly validated so this may be an overestimate of under-reporting. Data on deaths are considered to be more complete and have also been used to estimate under-reporting [2, 3]. Earlier estimates by Edmondson and Flowers compared the CFR obtained from surveillance in England and Wales to those of published regional case-series [14] to estimate the 'true' number of cases occurring. Applying their CFR of 10% to the deaths ascertained in our enhanced surveillance gives under-reporting of the order of 64%, compatible with that obtained using HES. Problems with this approach, which may account for the higher estimate of under-reporting, include the potential differences in case-mix at regional specialist centres and the possibility that, during the regional study, optimal management of cases occurred leading to a low CFR. Further investigation is required to validate these estimates of under-reporting, for example by examining the notes of a sample of cases coded as tetanus in HES and of notified cases not identified in HES.

Follow-up of notified cases also identified potential errors. Clinical surveillance with confirmation of diagnosis might improve case-ascertainment as has been established for rare paediatric [8] and neurological disease [9].

Vaccine policy

In many cases, vaccination histories were difficult to obtain. It is known that both individual recall and medical records do not always yield accurate information [7], and this is particularly so for the elderly. Despite this, most cases were completely unvaccinated and only one individual had completed a full course of at least five vaccinations. Department of Health data show that 29 000 reinforcing doses of tetanus vaccine were given to persons aged 16 or over in 1998/9 [15]. As all people born before 1961 have had no opportunity for routine vaccination it is unlikely that a high proportion of the potentially susceptible older

population is receiving tetanus vaccine. Health professionals should make use of all contact by this age group with health services to ask about tetanus immunization status and ensure that unimmunized or partially immunized persons complete a course. National immunization policy currently recommends opportunistic immunization. Can we do more? Opportunistic immunization in the elderly could be linked to the national recommendations to immunize all those aged 65 and over against influenza [17]. Tetanus-low dose diphtheria vaccine should be used, as significant proportions of persons over 40 years old are also susceptible to diphtheria [5]. Five doses of tetanus vaccine give adequate immunity and routine 10-yearly boosters are no longer recommended [5].

Simple injuries in the home, garden and street environment, with potential for contamination with soil, remain the most common risk injuries for tetanus. Tetanus was reported after injuries during sporting activities, after animal scratches and bites, post-operatively, and complicating leg ulcers and intravenous drug use. All the occupational injuries reported were sustained outdoors by outdoor workers and yet very few had been previously immunized.

These reports have highlighted many different scenarios where immunization status could be checked and vaccination offered [2, 3, 17]. Employers and occupational health services need to ensure that their workers are up to date on relevant vaccinations [5]. Many outdoor occupations have no occupational health service and use seasonal and casual labour, leaving the responsibility with GPs to ensure that such labourers are fully vaccinated. Primary care trusts, immunization co-ordinators and public health professionals, as part of local immunization policy, need to ensure that the public and health care professionals are aware of existing messages on opportunistic vaccination and appropriate wound toilet and post exposure prophylaxis [5]. Although our study had some information on management of the injury when presenting to health care, it would be useful for emergency departments and primary care to consider this as an area for audit against standard guidance [5].

Enhanced tetanus surveillance continues to highlight the risks of tetanus, particularly in the elderly, and should be continued. The PHLS is considering carrying out an evaluation of under-reporting to the surveillance system. In future, in order to inform policy, active clinical surveillance may be required to improve case ascertainment and completeness of follow-up.

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