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BRIEF CLINICAL COMMUNICATION

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Retrospective evaluation of the seasonality of canine tetanus in England (2006–2017): 49 dogs

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Abstract

Objective: To evaluate the seasonality of canine tetanus in England.

Methods: Medical records of a single referral hospital in England were reviewed. Dogs diagnosed with localized or generalized tetanus between January 2006 and June 2017 were studied.

Results: Forty-nine cases were included. The prevalence of tetanus in England was significantly higher in the winter when compared with the summer ($P = 0.002$) and autumn ($P = 0.024$), with the highest number of cases recorded in February.

Conclusions: The prevalence of canine tetanus in England was significantly higher in winter months, especially in February.

KEYWORDS
canine tetanus, *Clostridium tetani*, seasons

1 | INTRODUCTION

Canine tetanus is an uncommon neuromuscular disease caused by neurotoxins of *Clostridium tetani*. Several studies in human literature reported seasonal variation in tetanus prevalence.[1–5] Although there are no data regarding seasonality of canine tetanus, anecdotal evidence suggests that the prevalence of tetanus in dogs may be higher during certain periods of the year. Knowledge of seasonal variation in occurrence of canine tetanus may direct further research toward understanding environmental exposure factors and animal characteristics contributing to contraction of the disease. This, in turn, could increase awareness of this rare disease among veterinary professionals and dog owners and the development of disease prevention strategies targeting populations at risk. This study aimed to determine if there is a seasonal variation in the prevalence of canine tetanus. It was hypothesized that a seasonal variation in occurrence of canine tetanus exists in England.

2 | MATERIALS AND METHODS

Medical records of a single small animal teaching referral hospital in England were reviewed. Data from canine tetanus cases presenting to the hospital between January 2006 and June 2017 were evaluated retrospectively. Dogs diagnosed with tetanus by either a Diplomate in Emergency and Critical Care, Neurology, or Internal Medicine were included in the study. The diagnosis was made based on history, presentation, and progression of clinical signs. Dogs with characteristic local or generalized signs such as wrinkled forehead, erect ears, retracted lips, stiff gait, and generalized increase in muscle tone were included. Dogs with evidence of another neuromuscular disease were excluded. For the purpose of this study, it was assumed that the dogs were diagnosed on the day of presentation to the hospital. The month and season of the presentation were recorded, with seasons of the year being defined as winter (December–February), spring (March–May), summer (June–August), and fall (September–November).

Age, breed, sex, weight, and date of presentation were recorded. Depending on weight on admission, dogs were categorized as small (<10 kg), medium (10–25 kg), or large (>25 kg). Data regarding monthly caseload distribution in the hospital were recorded, and the correlation between the caseload and the monthly distribution of tetanus cases was assessed. Information regarding monthly average rainfall and temperatures in England for each month between January 2006 and June 2017 was obtained from a government database.[a]

Ethical approval for this study was granted by the Social Science Research Ethical Review Board at the Royal Veterinary College (reference URN SR2017-1392).

2.1 | Statistical analysis

Data were assessed for normality using the Shapiro–Wilk test. A Kruskal–Wallis test was used to evaluate statistically significant differences in numbers of tetanus cases presenting to the hospital between each month of the year, as well as between 4 seasons of the year. A Dunn–Bonferroni post hoc test was conducted to test pairwise comparisons. A *P*-value of <0.05 was considered statistically significant. A Spearman's correlation test was used to assess relationship between the monthly prevalence of canine tetanus and monthly hospital caseload, average monthly precipitation, and average monthly temperatures in the studied region. Standard statistical software was used to generate statistical calculations.[b,c]

3 | RESULTS

Forty-nine cases of canine tetanus were identified and included in the analysis. The most commonly reported breeds included crossbreeds ($n = 13$), Labrador Retriever ($n = 10$), Border Collie ($n = 4$), Boxer ($n = 3$), Pointer ($n = 3$), Doberman Pinscher ($n = 2$), English Cocker Spaniel ($n = 2$), and Golden Retriever ($n = 2$). Data regarding weight were available for 33 of 49 dogs, of which 13 were large, 17 were medium, and 3 were small. There were 8 intact females, 14 neutered females, 15 intact males, and 12 neutered males. The age of the dogs ranged from 10 months to 9 years (median, 4 y). Available data regarding monthly hospital caseload were limited to the period between August 2006 and June 2017. The prevalence of canine tetanus during this period was documented at 0.038%. Spearman's rank correlation test showed no correlation between the prevalence of canine tetanus and the hospital caseload ($P = 0.47$).

Monthly and seasonal canine tetanus prevalence is displayed in Figures 1 and 2, respectively.

There was a statistically significant difference in the monthly prevalence in canine tetanus presentation ($P = 0.048$), with the highest number of cases seen in February ($n = 11$) and no cases recorded in August. There was also a statistically significant difference in case distribution between seasons of the year ($P = 0.003$). A significant difference in seasonal case distribution was noted between winter and summer ($P = 0.002$) and between winter and fall ($P = 0.024$). There was no correlation between the prevalence of tetanus and monthly rainfall in England. There was, however, a weak negative correlation between the prevalence of tetanus and the average monthly temperatures in England ($r_S = -0.30$, $n = 138$, $P < 0.001$; Figure 3).

4 | DISCUSSION

This retrospective case series aimed to assess whether there was a seasonal prevalence of canine tetanus. The prevalence of canine tetanus in England was found to be significantly higher in winter months when compared with summer and fall, with the highest number of cases recorded in February. The tetanus population evaluated in this study was similar to that described in previous retrospective studies consisting of predominantly medium and large breeds and a younger population of dogs.[6–8]

The seasonality of tetanus has been reported in people in several studies, although findings are contradictory. In 1 study, the highest prevalence of tetanus among people living in India was in the post-monsoon season (September–December).[1] The authors found that one third of tetanus cases occurred in the transition period between the hot and wet monsoon season and the cool and dry winter season. It was suggested that this was likely related to the occupation of the affected people (farmers and manual laborers), who were more likely to come into contact with the toxin via injuries sustained at work during this period. In Nigeria, higher numbers of adult tetanus have been recorded in the hot and dry season.[2] The authors hypothesized that this was due to reduced activity, increased wearing of shoes, and increased washing away of animal waste that littered the streets in wet weather. A higher prevalence of human tetanus in warmer months has also been noted in Italy, Canada, and Japan and has been associated, by some authors, with greater outdoor activity and increased exposure to soil.[3–5]

Given these differing findings in the human data and lack of definitive reasoning for the seasonal variations seen, it is unclear why a seasonal prevalence in canine tetanus was noted in England. As there was not a similar variation in hospital caseload over the same months, the variation in prevalence is thought to be a true finding. The correlation between tetanus caseload and lower temperatures suggests that cooler weather conditions may lead to increased canine exposure to *C. tetani* spores. One possible explanation is that mild winter weather conditions support bacterial growth and survival. A combination of environmental factors, such as temperature and humidity, may stimulate favorable anaerobic conditions or production of nutrients

[a] Met Office. Met Office Integrated Data Archive System (MIDAS). NCAS British Atmospheric Data Centre. England monthly mean temperature and England monthly rainfall. [Internet] 2018. Available at: https://www.metoffice.gov.uk/climate/uk/summaries/datasets#yearOrdered. Accessed April 22, 2018.
[b] SPSS, version 24, SPSS, Inc., Chicago, IL.
[c] Microsoft Office Home and Student 2013. Microsoft Excel (version 15). Microsoft Corporation, Redmond, WA.

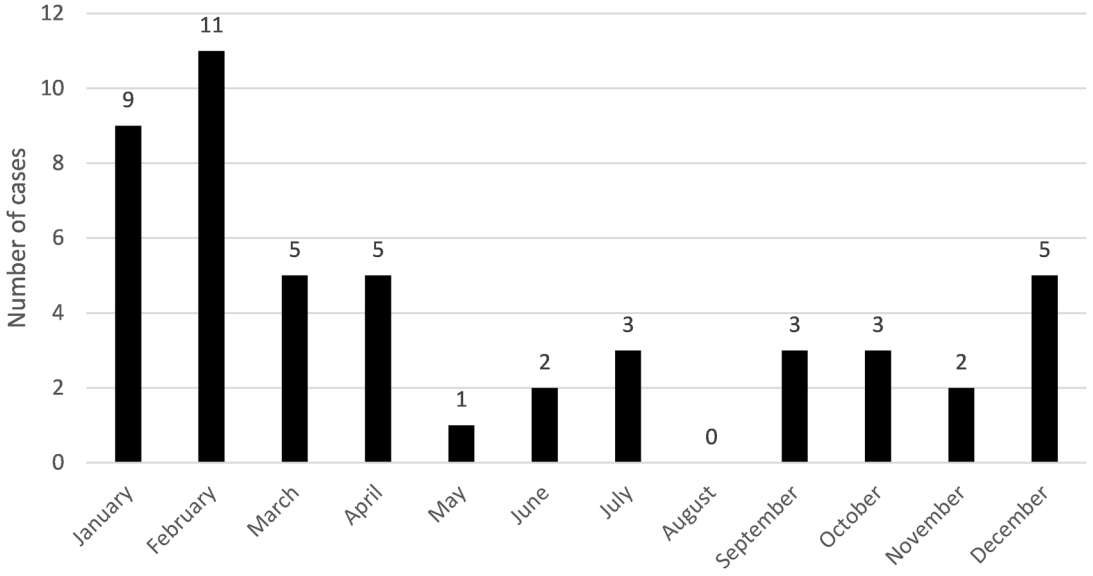

FIGURE 1 Monthly prevalence of canine tetanus in England

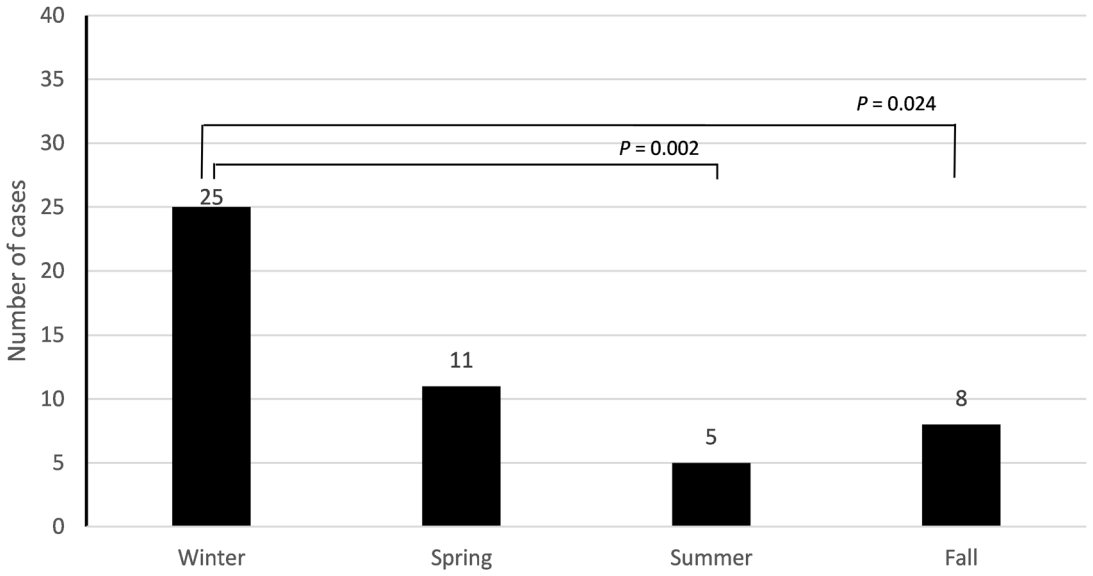

FIGURE 2 Seasonal prevalence of canine tetanus in England

promoting spore germination.[1] Dogs walked in England during winter months are often exposed to wet and muddy conditions, less pronounced in warmer seasons, which may predispose to increased contamination of wounds with soil-containing spores. Further studies aiming to elucidate the effect of environmental factors on the proliferation of *C. tetani*, spore germination, and exposure of dogs to the spores would be worthwhile.

This study has several limitations. First, a sample size calculation was not performed prior to commencement of this study as a convenience study period was chosen instead. Therefore, it is possible that underpowering could have led to finding a difference where one did not exist (type I error), though this is generally thought to be less common than type II error. Second, lack of significant correlation between the prevalence of tetanus and monthly rainfall in England may be due to a low number of cases included in the study. Additionally, the effect of activity level, working status, and environmental exposure (urban vs. rural) of the dogs on the prevalence of tetanus could not be assessed due to the retrospective nature of the study. Moreover, because only a referral population was investigated, the true occurrence of canine tetanus in investigated regions may be higher as many affected dogs may have not been referred. This, in turn, could influence the results of investigations on the seasonality of the disease. Furthermore, in the current study, the date of diagnosis was used to evaluate the seasonality. This date, however, may not represent the date of initial signs of

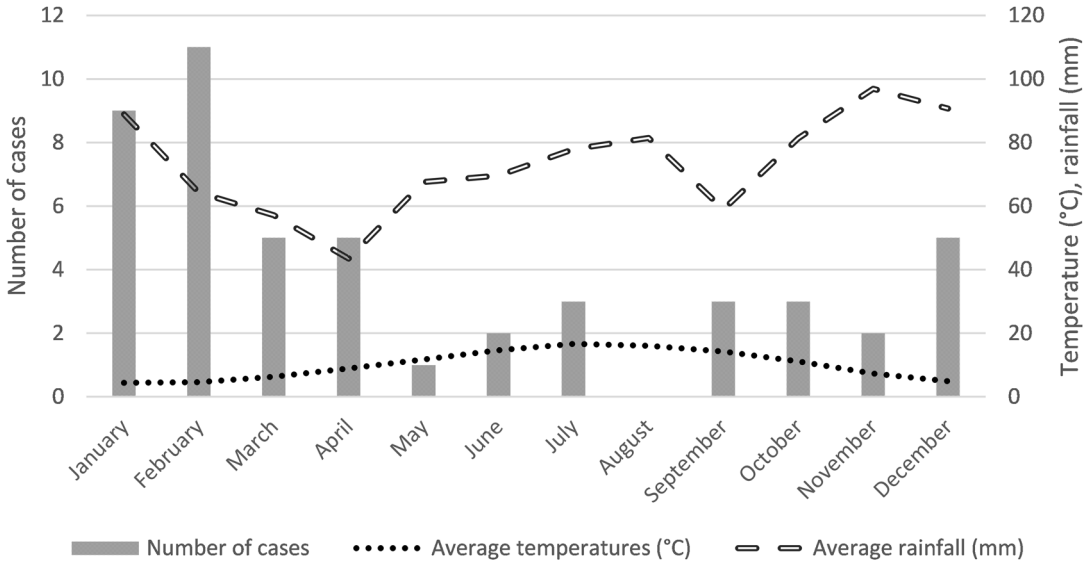

FIGURE 3 Monthly tetanus occurrence, average monthly temperatures (°C), and rainfall (mm) in England

the disease, the identification of which would rely on owners and primary care practitioners. Finally, the date of diagnosis does not reflect the date of exposure to spores, as *C. tetani* has a variable incubation period of 3 days to 3 weeks. Therefore, although the seasonal prevalence of canine tetanus appeared to peak in the winter months, it is likely that the actual onset of the disease process was up to a month earlier.

The prevalence of canine tetanus in England was significantly higher in winter months, especially in February. Further studies could investigate the effect of different climates, other environmental factors, and activity levels of exposed dogs on the prevalence of canine tetanus.

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CONFLICT OF INTEREST

Dr Burkitt-Creedon is an editor for the Journal but did not participate in the peer review process other than as an author. The authors declare no other conflict of interest.

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