Frequency of *Corynebacterium pseudotuberculosis* infection in horses across the United States during a 10-year period

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Objective—To quantify the number of horses with *Corynebacterium pseudotuberculosis* infection identified in the United States from January 2003 through December 2012.

Design—Cross-sectional study.

Sample—State veterinary diagnostic laboratory records of 2,237 *C pseudotuberculosis* culture-positive samples from horses.

Procedures—44 state veterinary diagnostic laboratories throughout the United States were invited by mail to participate in the study. Data requested included the number of *C pseudotuberculosis* culture-positive samples from horses identified per year, geographic location from which the *C pseudotuberculosis* culture-positive sample was submitted, month and year of sample submission, breed and age of horses, and category of clinical manifestation (ie, internal infection, external infection, or ulcerative lymphangitis).

Results—Of the 44 invited laboratories, 15 agreed to participate and provided data on affected horses from 23 states. The proportion of *C pseudotuberculosis* culture-positive samples submitted during 2011 through 2012 (1,213/2,237 [54%]) was significantly greater than that for the period from 2003 through 2010 (1,024/2,237 [46%]). *Corynebacterium pseudotuberculosis* was recovered from horses in states where the disease has not been previously recognized as endemic. Affected horses were identified year-round. The greatest proportion of *C pseudotuberculosis* culture-positive samples was identified during November, December, and January (789/2,237 [35%]). No significant association between the clinical form of disease and age or breed of horse was observed.

Conclusions and Clinical Relevance—The occurrence of *C pseudotuberculosis* infection in horses increased during the 10-year period, and affected horses were identified throughout the United States. Further studies to determine changes in annual incidence and to identify potential changing climatic conditions or vector populations associated with disease transmission are warranted to help control the occurrence and spread of *C pseudotuberculosis* infection in horses. (*J Am Vet Med Assoc* 2014;245:309–314)

Corynebacterium pseudotuberculosis is a gram-positive, facultative, intracellular, pleomorphic bacterium with a worldwide distribution.[1] Infection caused by *C pseudotuberculosis* in horses assumes many forms; the most common clinical expression is characterized by external abscesses in the pectoral or ventral abdominal area, internal abscess formation, or infection of the limbs, which is also termed ulcerative lymphangitis.[2–4] Although the exact mode of infection is unproven, it is hypothesized that the bacteria gain access through abrasions in the animal's skin[2] and that insects such as horn flies (*Haematobia irritans*), stable flies (*Stomoxys calcitrans*), and houseflies (*Musca domestica*) play a role as mechanical vectors of the organism.[5]

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Deep intramuscular abscesses caused by *C pseudotuberculosis* were first reported in 1915 in San Mateo County, Calif.[6] Since then, disease associated with this organism has been frequently reported in the western United States and, in 1979, was considered to have the potential to cause major economic issues for the horse industry in Texas.[7] In 2002 and 2003, there were reports[3,8] of unprecedented outbreaks in states where the disease previously had been rarely encountered, such as Kentucky, Wyoming, Utah, and Colorado. In 2005 and 2007, outbreaks were again reported in Oregon and Idaho.[9] In 2012, > 60 cases were reported from the northwestern panhandle region of Florida, indicating that disease should no longer be considered to be restricted to the western United States.[10]

Factors that may be contributing to this increase in the number of cases include environmental and climatic conditions facilitating infection, such as changing insect populations, or a variety of conditions that may promote persistent survival of the organism in the soil.[3,4,11,12] Increased herd susceptibility in regions where the disease is not endemic may also contribute to increased numbers of observed cases.

The purpose of the study reported here was to examine the occurrence of *C pseudotuberculosis* infection throughout the United States during a 10-year period on the basis of culture-positive samples at state veterinary diagnostic laboratories throughout the country. It was hypothesized that an increasing number of clinical cases would be found both in the western United States, where the disease is considered endemic, and also across the country in states where the disease had not previously been reported. The objective of this study was to document changes in the temporal and geographic distribution of this disease.

Materials and Methods

Data collection—Forty-four state veterinary diagnostic laboratories across the United States were invited by mail to participate in the study. These laboratories were chosen from the directory of the American Association of Veterinary Laboratory Diagnosticians. Data requested from records of horses with *C pseudotuberculosis* culture-positive samples included the following: month and year of sample submission; horse age, breed, and state of residence; and category of clinical manifestation (ie, internal infection, external infection, or ulcerative lymphangitis).

Statistical analysis—Data were summarized as median and range values for continuous data and proportions for categorical data. Graphic representations were also used for descriptive purposes. For comparison purposes, state specific prevalence rates were calculated on the basis of equine population estimates obtained from the 2007 Agriculture Census complied by the USDA, National Agriculture Statistic Service.[a] Continuous data were compared by use of the Wilcoxon rank sum and Kruskal-Wallis tests. Categorical data were analyzed with the χ^2 and Fisher exact tests. Logistic regression modeling was used to analyze the association between a binary categorical variable for the study period (2003 through 2010 vs 2011 through 2012) and categorical variables for states. Associations from logistic regression were summarized as the OR and 95% confidence interval, estimated on the basis of maximum likelihood methods. Post hoc testing of comparisons of ORs was performed according to the method of the Šidák correction. Values of $P < 0.05$ were considered significant. All data analyses were performed with statistical software.[b]

Results

Of the 44 invited laboratories, 15 (34%) agreed to participate in the study. From January 2003 through December 2012, there were 2,237 *C pseudotuberculosis* culture-positive samples from horses in 23 states reported by the 15 diagnostic laboratories participating in the project. The 15 participating laboratories included the following: California Animal Health and Food Safety Laboratory, Colorado State University Veterinary Diagnostic Laboratory, Iowa State University Veterinary Diagnostic Laboratory, Kanas State Veterinary Diagnostic Laboratory, Kentucky Livestock Disease Diagnostic Center, Montana Veterinary Diagnostic Laboratory, Nebraska Veterinary Diagnostic Center, Oregon State University Veterinary Diagnostic Laboratory, Pennsylvania Veterinary Laboratory, New Bolton Center Veterinary Diagnostic Laboratory, South Dakota State University Diagnostic Laboratory, Texas Veterinary Medical Diagnostic Laboratory (College Station), Wisconsin Veterinary Diagnostic Laboratory, Wyoming State Veterinary

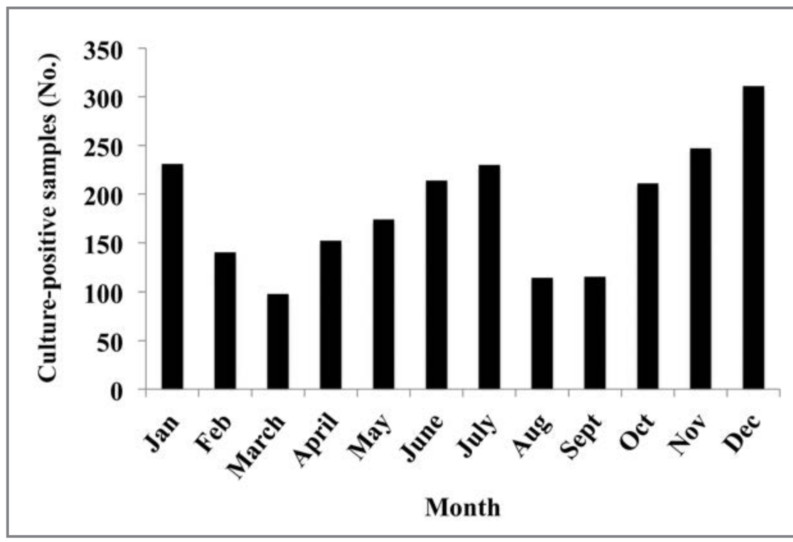

Figure 1—Bar graph showing the distribution of 2,237 *Corynebacterium pseudotuberculosis* culture-positive samples at state diagnostic laboratories by month from 2003 through 2012. The difference in distribution per month of observed from expected (186/2,237 [8.3%] if there was a uniform distribution throughout the year) was significant ($P < 0.001$).

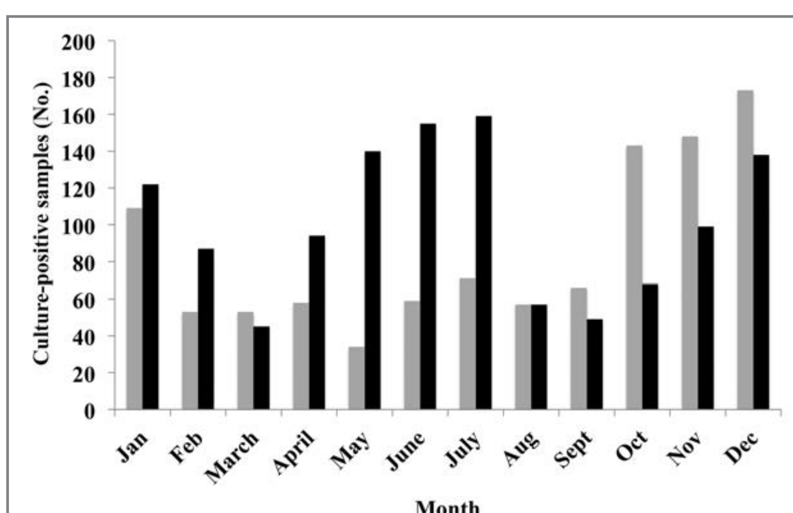

Figure 2—Bar graph of *C pseudotuberculosis* culture-positive samples at state diagnostic laboratories by month, stratified by category of years: 2003 through 2010 (gray bars) versus 2011 through 2012 (black bars). Most infections appeared to occur in the late fall and early winter, except in 2011 through 2012, when the months of May, June, and July appear overrepresented. The difference in distribution between periods was significant ($P < 0.001$).

Laboratory, and Breathitt Veterinary Center Diagnostic Laboratory (Hopkinsville, Ky).

Two of the 15 diagnostic laboratories that agreed to participate did not have any cases to report (both laboratories in Pennsylvania). The annual number of *C pseudotuberculosis* culture-positive samples increased over time. An increase in the proportion of *C pseudotuberculosis* culture-positive samples was found during 2011 and 2012 (594/2,237 [26.6%] and 619/2,237 [27.7%], respectively) relative to 2003 through 2010 (range, 79/2,237 [3.5%] to 217/2,237 [9.7%]).

In most years, peak number of cases occurred during the fall and early winter months **(Figure 1)**. Combining all years, the distribution differed significantly among months. The months of November, December, and January accounted for 35% (789/2,237) of cases (whereas only 25% would have been expected with a uniform distribution of cases by month), and the months of June and July accounted for 20% (444/2,237) of cases (whereas only 17% would have been expected).

It appeared that the seasonal pattern might have differed for the periods from 2011 through 2012 **(Figure 2)**. A dichotomous variable was created in 2003 through 2010 versus 2011 through 2012. The proportion of cases was significantly ($P < 0.001$) greater for the years 2011 through 2012 relative to the years 2003 through 2010. The months of October, November, December, and January seemed to be overrepresented during the years 2003 through 2010. Although this basic pattern seemed to hold for 2011 through 2012, the months of May, June, and July appeared to be overrepresented in 2011 through 2012 relative to 2003 through 2010.

Although 23 states contributed a total of 2,237 cases **(Table 1)**, only 4 states had > 100 cases: Texas (1,559 [70%]), Colorado (211 [9%]), Oregon (104 [5%]), and California (103 [5%]); the other 19 states contributed 260 (12%) cases. To account for variations among states in the number of resident horses, the number of cases from a state was divided by the National Animal Statistics Service census data from 2007 for that state.[a] Although the proportion of cases was highest for horses in Texas, Colorado, and Oregon, horses from the states of Louisiana, New Mexico, and Montana had prevalences similar to California. Of interest, Louisiana and New Mexico are adjacent to Texas, and Montana is close to both Colorado and Oregon.

The distribution of the number of cases varied among years. Case numbers per year in California varied from 6 to 18, with peak numbers occurring in 2008 (n = 17) and 2009 (18). In Colorado, the number of cases per year varied from 6 to 55, with peak numbers occurring in 2003 (n = 42) and 2009 (55). In Oregon, the number of cases per year ranged from 1 to 42, with peak numbers occurring in 2004 (n = 18), 2008 (42), and 2009 (14). In the other states, cases varied from 10 to 47/y, with the highest numbers occurring in 2005 (n = 35), 2008 (36), 2011 (35), and 2012 (47). Texas contributed the majority of cases, ranging from 19 to 540/y. Most cases from Texas (1,078/1,559 [69%]) occurred during 2011 (n = 540) and 2012 (538). The distribution of cases was compared among 5 states (California, Colorado, Oregon, Texas, and other states) by category of years (2003 through 2010 vs 2011 through 2012). The distribution of cases by state differed significantly ($P < 0.001$), presumably attributable to a much larger proportion of cases in 2011 through 2012 for Texas (1,078/1,559 [69%]) than for California (15/103 [15%]), Colorado (30/211 [14%]), Oregon (8/103 [8%]), or other states (81/261 [31%]; **Table 2**). The proportion of cases in 2011 through 2012 from the "Other states" category appeared to be higher than that of California, Colorado, and Oregon. Other states that had increased proportions of cases during the latter 2 years of the study period (2011 through 2012 relative to 2003 through 2010) included Louisiana (38/40 [95%]), Arkansas (5/7), Wyoming (4/8), Kentucky (20/51 [39%]), Oklahoma (2/7), and New Mexico (6/26 [23%]). It is worth noting that, except Kentucky and Wyoming, these states all share borders with Texas.

The clinical form of the disease was reported for all but 1 horse (2,236/2,237). Clinical disease forms were

Table 1—Distribution of *Corynebacterium pseudotuberculosis* culture-positive samples (cases) at state diagnostic laboratories from 2003 to 2012 based on the 2007 National Animal Statistics Service (NASS) census data,[a] with results presented as number of cases/10,000 population.

State	No. (%) of cases	2007 NASS census data	Cases/10,000 population
Arizona	2 (< 1)	68,745	0.29
Arkansas	7 (< 1)	78,968	0.89
California	103 (5)	180,723	5.70
Colorado	211 (9)	119,040	17.73
Idaho	7 (< 1)	74,029	0.95
Kansas	4 (< 1)	89,898	0.44
Kentucky	51 (2)	175,503	2.91
Louisiana	40 (2)	60,520	6.61
Michigan	1 (< 1)	101,138	0.10
Montana	59 (3)	105,243	5.61
Nebraska	17 (1)	65,623	2.59
New Mexico	26 (1)	53,616	4.85
North Carolina	1 (< 1)	78,277	0.13
Oklahoma	7 (< 1)	165,555	0.42
Oregon	104 (5)	89,420	11.63
South Carolina	2 (< 1)	43,283	0.46
South Dakota	10 (< 1)	70,255	1.42
Texas	1,559 (70)	438,827	35.53
Utah	13 (1)	59,783	2.17
Vermont	1 (< 1)	13,285	0.75
Washington	3 (< 1)	89,739	0.33
Wisconsin	1 (< 1)	120,044	0.08
Wyoming	8 (< 1)	80,476	0.99
Total	**2,237 (100)**	**2,422,090**	9.24

Table 2—Distribution of *C pseudotuberculosis* culture-positive samples (cases) at state diagnostic laboratories categorized by years 2003 through 2010 versus 2011 through 2012.

State	No. (%) of cases		OR	95% CI	*P* value
	2003–2010	2011–2012			
California	88 (85)	15 (15)	1.0[a]	Referent	Referent
Colorado	181 (86)	30 (14)	1.0[a]	0.5–1.9	0.935
Oregon	95 (92)	8 (8)	0.5[a]	0.2–1.2	0.122
Texas	481 (31)	1,078 (69)	13.1[b]	7.5–23.0	< 0.001
Other states	179 (69)	82 (31)	2.7[c]	1.5–4.9	0.001

The observed distribution varied significantly from that expected of equal proportions for a given period among states (χ^2; $P < 0.001$). The ORs were derived by logistic regression.

[a–c]Odds ratios with different superscript letters are significantly ($P < 0.05$) different.

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Table 3—Distribution of *C pseudotuberculosis* culture-positive samples (cases) at state diagnostic laboratories by clinical form of the disease and categorized by years 2003 through 2010 versus 2011 through 2012.

Clinical form	No. (%) of cases 2003–2010	No. (%) of cases 2011–2012	OR	95% CI	*P* value
External abscess	988 (46)	1,175 (54)	1[a]	Referent	Referent
Internal abscess	31 (63)	18 (37)	0.5[b]	0.3–0.9	0.017
Ulcerative lymphangitis	4 (17)	20 (83)	4.2[c]	1.4–12.3	0.009

The observed distribution varied significantly from that expected of equal proportions for a given period among clinical forms (χ^2; $P = 0.002$).

See Table 2 for remainder of key.

recorded as external abscess formation (2,163/2,236 [97%]), internal abscess formation (49/2,236 [2%]), or ulcerative lymphangitis (24/2,236 [1%]). Because of the small number of clinical forms other than external abscesses, the association of clinical form with year was examined only as the dichotomous categorical variable of 2003 through 2010 versus 2011 through 2012 (**Table 3**). A significant ($P = 0.002$) difference was found in the distribution of clinical forms of disease between 2003 through 2010 versus 2011 through 2012. The prevalence of ulcerative lymphangitis cases was much higher during 2011 through 2012, whereas internal abscesses appeared to be less common during this period. The clinical form differed significantly ($P < 0.001$) by geographic region. Proportionally, internal abscesses were more commonly reported from California (24/49 [49%]). Moreover, all but one of the cases of ulcerative lymphangitis (23/24 [96%]) were from Texas.

Age was not reported for 578 horses. Among those for which age was reported (n = 1,658/2,237), there was no significant ($P = 0.246$) difference among clinical forms in the age distribution of affected horses. The median age of horses with external abscesses (n = 1,595) was 10 years (range, 0.1 to 47 years), 9.5 years (range, 1 to 40 years) for horses with internal abscesses (40), and 10 years (range, 0.85 to 30 years) for horses with ulcerative lymphangitis (23) .

Sex and clinical form of the disease were reported for 1,983 horses. A significant ($P = 0.035$) association of sex with clinical form of disease was found. Of 1,914 horse with external abscess, 903 (47%) were females and 1,011 (53%) were males. Of 24 horses with ulcerative lymphangitis, 17 (71%) were females and 7 (29%) were males; significantly ($P = 0.027$) more females than males had ulcerative lymphangitis. Of 45 horses with internal abscess, 27 (60%) were females and 18 (40%) were males; although more females than males had internal abscess, this difference was not significant ($P = 0.092$).

Breed was not reported for 201 horses. For purposes of analysis, breeds were categorized as follows: Quarter Horse-type (Quarter Horse, Appaloosa, Paint Horse, Palomino, and Quarter Horse crossbred; n = 1,466/2,036 horses), Arabian (Arabian or Arabian-crossbred; 155/2,036), Thoroughbred (Thoroughbred or Thoroughbred cross; 125/2,036), warmblood (83/2,036), and other breeds (237/2,036). There was no significant association between breed and incidence of disease.

The clinical form of the disease was significantly ($P = 0.002$) associated with the categorical variable of years (ie, 2003 through 2010 vs 2011 through 2012); this difference appeared to be attributable to a higher prevalence of ulcerative lymphangitis during 2011 through 2012 (Table 3). The distribution of cases by month (irrespective of year) was tabulated by clinical form, and the distribution of months differed significantly ($P = 0.002$) among lesion types. In general, most cases of external and internal abscesses occurred during the late fall and January as well as June and July. In contrast, cases of ulcerative lymphangitis appeared to occur more during March, April, and May (**Table 4**).

Table 4—Distribution of *C pseudotuberculosis* culture-positive samples (cases) at state diagnostic laboratories by month and categorized by clinical form of the disease from 2003 to 2012.

Month	No. (%) of cases External abscess	No. (%) of cases Internal abscess	No. (%) of cases Ulcerative lymphangitis
January	225 (10)	6 (12)	0 (0)
February	134 (6)	4 (8)	2 (8)
March	92 (4)	2 (4)	4 (17)
April	147 (7)	0 (0)	5 (21)
May	162 (8)	6 (12)	6 (25)
June	213 (10)	1 (2)	0 (0)
July	227 (11)	3 (6)	0 (0)
August	108 (5)	6 (12)	0 (0)
September	105 (5)	8 (16)	2 (8)
October	204 (9)	4 (8)	3 (12)
November	240 (11)	4 (8)	2 (8)
December	306 (14)	5 (10)	0 (0)

Discussion

The occurrence of *C pseudotuberculosis* infection in horses varies markedly among years and seasons.[4] One of the main findings of the present study is that the number of cases of *C pseudotuberculosis* infection in horses identified at state veterinary diagnostic laboratories throughout the United States increased during the past 10 years. A marked increase in culture-positive samples was found during the period beginning in early 2011, with a marked increase in cases during 2011 through 2012 relative to prior years. To date, there has not been a proven association between the incidence of clinical infection with *C pseudotuberculosis* and climate. Authors of some reports[12,13] have postulated that an increase in the number of horses with a *C pseudotuberculosis* infection in certain years may be associated with climatic conditions favorable for enhanced breeding, hatching, and survival of various insect vectors suspected of mechanically transmitting the bacterium.

Historically, the highest number of affected horses seen in California occurs during the dry months of the year (late summer and fall).[4,12] These findings were consistent with those of the present study for the years 2003 through 2010. This seasonal influence has been suggested to be related to biting insects such as horn flies (*H irritans*) that contribute to ventral midline dermatitis while feeding on the ventral part of the abdomen.[4] A previous study[5] showed that farms with a high number of diseased horses had a high proportion of insects carrying the organism, including horn flies (*H irritans*), stable flies (*S calcitrans*), and houseflies (*M domestica*). In the study presented here, there appeared to be a significant difference in the seasonal pattern of disease for the years 2011 through 2012, in which the months of May, June, and July appeared to be overrepresented. It is possible that changes in climatic conditions, including drought, could influence vector populations, leading not only to an increased number of diseased horses but also a shift in the seasonality during which the disease is seen. Although findings of the present study are consistent with previous reports of disease caused by *C pseudotuberculosis* being seasonal,[4] it is noteworthy that disease was identified year-round. It has been shown previously that various fly species are potential vectors of *C pseudotuberculosis* for horses; however, these insects themselves are not the reservoir for the bacteria.[5] Soil is the purported reservoir for the bacteria.[14] A previous study[14] showed the equine biovar of *C pseudotuberculosis* was able to survive in a variety of soil types under a wide range of environmental conditions. The addition of feces to soil (as occurs in horse paddocks) enhanced multiplication and survival of the bacteria. This persistence for > 8 months and survival in different soil types and moisture content may be 1 contributing factor that accounts for why the disease is being found in regions where the disease was not previously recognized, after introduction of the organism to the environment.[14]

The median age of affected horses (8 to 10 years from states with the most cases) in the present study was slightly higher than that of previous reports.[2,4] Findings in the present study were in agreement with those of another study,[4] which rarely found disease in foals < 6 months of age. In the present study, only 5 foals between the ages of 1 and 3 months had a *C pseudotuberculosis* infection. The low occurrence of disease in foals < 6 months of age suggests that foals born to mares in endemic areas such as California might be protected by colostral antibodies for the first few months of life.[4] The mean age of horses affected in a previous study[4] from California was 5 years for those with external abscesses and 7 years for those with internal abscesses. Findings from a similar study in California[15] found that younger horses (1 to 2 years old) had higher risk of disease, compared with horses > 5 years old. The difference in ages of affected horses between that study[15] and previous studies[2,4] might be related to the spread of disease into nonendemic areas with less herd immunity.

In the present study, male horses (geldings or sexually intact males), compared with female horses, were more likely to have external abscesses than internal abscesses or ulcerative lymphangitis. Previous studies[4,12] have not revealed a sex predilection for the clinical form of *C pseudotuberculosis* infection in horses; however, in 1 study,[2] mares constituted 70% of the horses with internal abscesses. That study[2] population was comparatively smaller than that of the study reported here. In the present study, 60% of the horses with an internal abscess were female; however, because of the low number of horses with internal abscesses in the study, it is difficult to draw conclusions about the relationship between sex and form of disease. The importance of the association between sex and lesion type (external abscess, internal abscess, and cutaneous lymphangitis) should be interpreted with caution given the high statistical power of this study resulting from the large sample size and the relatively modest magnitude of observed associations.

In the present study, as in previous studies,[4,15] a higher number of external abscesses (2,163/2,236 [97%]) were observed, compared with internal abscess (49/2,236 [2%]) or ulcerative lymphangitis (24/2,236 [1%]). A previous study[4] of 538 horses with *C pseudotuberculosis* infection revealed external abscesses in 92%, internal abscesses in 8%, and ulcerative lymphangitis in 1.5% of horses. In the study reported here, most internal abscesses were found in horses in California. One potential explanation for this observation is the increased familiarity of Californian veterinarians with the internal form of this disease, compared with veterinarians in other states where the disease occurs less commonly. As a result of familiarity with the disease over many decades, practitioners from California may not have been as likely to submit samples from external abscesses for culture. Horses with internal abscesses have previously been reported to be evaluated 1 to 2 months following the peak number of external abscesses.[2] In contrast to these previous findings, samples from internal abscesses in the present study population were fairly evenly distributed throughout the year.

Interestingly, there was a significant difference in the distribution of clinical forms of disease between 2003 through 2010 versus 2011 through 2012, with an increased number of ulcerative lymphangitis cases during 2011 through 2012. All but 1 affected horse with ulcerative lymphangitis were from Texas, a finding that might indicate a different vector population in this region. *Corynebacterium pseudotuberculosis* infection in horses was not confined to a particular season, although peak number of infections occurred during March, April, and May. A previous study[5] showed that insects such as horn flies (*H irritans*), stable flies (*S calcitrans*), and houseflies (*M domestica*) were potential vectors of the disease. It would be interesting to investigate the role of other possible vectors, such as *Culicoides* spp or other insects that feed on limbs of horses in Texas.

Most samples submitted for bacterial culture were those from horses in Texas, California, Oregon, and Colorado, states for which outbreaks of disease have been reported.[3,8,16] The disease has historically appeared to be restricted to arid regions of the western United States, especially the external form of infection.[4] It is interesting to note the detection of disease in other states previously reported to be free of the infection, as confirmed in horses from Louisiana, Michigan, North

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Carolina, South Carolina, South Dakota, Vermont, and Wisconsin. Some plausible reasons to account for this increased disease distribution may be reporting bias, environmental factors such as changing climatic conditions that in turn may influence vector populations, or increased herd susceptibility.[8]

Several limitations of the present study exist, including the inability to determine an estimate of prevalence for disease. The total number of bacterial submissions per year from horses was requested from the laboratories to use as a denominator for the numbers of cases to estimate prevalence, but the laboratories did not provide these data. A study of this nature is susceptible to reporting bias or incomplete reporting; for example, many veterinarians choose not to submit samples of external abscesses for bacterial cultures that appear characteristic for the disease or will not submit samples from multiple affected horses from the same farm. The increased numbers of internal abscesses in horses from California and increased numbers of ulcerative lymphangitis in horses from Texas could be a result of reporting bias in that practitioners may be more prone to obtain bacterial cultures for horses with these less common clinical forms of disease than from a horse with a typical pectoral abscess. Nonetheless, the increased number of horses with ulcerative lymphangitis in Texas seen earlier in the year than with external abscesses warrants further investigation. Another limitation to the present study is the unsuccessful attempt to obtain data from all the state diagnostic laboratories. Disease caused by *C pseudotuberculosis* is not reportable, which makes predictions of prevalence and geographic distribution more difficult.

Although *C pseudotuberculosis* infection in horses has previously been one of the most common and economically important infectious diseases in California,[4,15] data from the present study suggested that this disease is no longer confined to the western United States. Positive cultures results were obtained from samples of horses from all regions of the United States, during all months of the year, and from horses of all ages. Whereas the bacteria is soil-borne and able to survive and persist in a wide range of environmental conditions, veterinarians from all regions should be aware of the various clinical forms, treatments, and control measures for the best management of this disease in horses.

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