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TITLE: Assessment of horse owners' ability to recognise equine laminitis: A cross-sectional study of 93 veterinary diagnosed cases in Great Britain

AUTHORS: D. Pollard, C. E. Wylie, K. L. P. Verheyen, J. R. Newton

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1 **Assessment of horse owners' ability to recognise equine laminitis: a cross-sectional**
2 **study of 93 veterinary diagnosed cases in Great Britain**

3

4 **Author names and affiliations:** D. Pollard^{1,3*}, C. E. Wylie², K. L.P. Verheyen³, J. R. Newton¹.

5

6 ¹Epidemiology Department, Centre for Preventive Medicine, Animal Health Trust, Newmarket,
7 Suffolk, UK

8 ²RosSDales Equine Hospital, Exning, Newmarket, UK

9 ³Veterinary Epidemiology, Economics and Public Health Group, Production and Population Health,
10 Royal Veterinary College, North Mymms, Hertfordshire, UK.

11

12 ***Correspondence email:** danica.pollard@ah.org.uk

13

14 **Key Words:** horse, laminitis, epidemiology, clinical signs, cross-sectional; owner-reported

15

16 **Word Count:** 5423

17

18 **Ethical Considerations**

19 This study was granted institutional ethical approval from the Animal Health Trust (AHT01-2014) and
20 the Royal Veterinary College (2014 0105H). Animal use not applicable. Return of a completed
21 questionnaire was taken as informed owner consent.

22

23

24

25 **Authorship**

26 D.P., C.E.W., K.L.P.V. and J.R.N. designed the study. Data collection, analysis and interpretation was
27 conducted by D.P., supervised by C.E.W., K.L.P.V. and J.R.N. All authors contributed to the
28 preparation of the manuscript and approved the final version.

29

30 **Competing Interests**

31 The authors have declared no competing interests. None of the authors of this paper has a financial or
32 personal relationship with other people or organisations that could inappropriately influence or bias
33 the content of the paper.

34

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40

41 **Acknowledgements**

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43 their assistance with this study.

44

45

46

47 **Background:** Use of owner-reported data could further epidemiological knowledge of equine
48 laminitis. However, owner recognition of laminitis has not previously been assessed.

49 **Objectives:** The primary objective was to establish whether cases of owner-suspected laminitis
50 would be confirmed as laminitis by the attending veterinary surgeon. Secondary objectives
51 were to compare owner- and veterinary-reported information from veterinary-confirmed cases
52 of equine laminitis.

53 **Study Design:** Cross-sectional study.

54 **Methods:** Twenty-five British veterinary practices were invited to submit laminitis reporting
55 forms (LRFs) for active laminitis cases attended between January 2014 and October 2015;
56 detailing 27 clinical signs, five underlying conditions and seven risk factors associated with
57 laminitis. Owners were invited to independently complete a modified LRF if reason for the
58 veterinary visit was suspicion of laminitis. Differences between paired veterinary and owner
59 LRFs, and between cases where owners did and did not recognise laminitis, were assessed
60 using McNemar's and Fisher's exact tests, respectively.

61 **Results:** Veterinary LRFs were received for 93 veterinary-diagnosed laminitis cases. All 51
62 owner-suspected cases were confirmed by veterinary diagnosis, with the remaining 42 (45.2%)
63 not recognised as laminitis by owners. Undefined lameness, foot abscesses, colic and stiffness
64 were common reasons for owner-requested- veterinary visits in owner-unrecognised cases.
65 Divergent growth rings (prevalence difference: 27.3%, $P=0.01$) and 'breed type' (prevalence
66 difference: 21.2%, $P=0.04$) were more commonly reported by veterinary surgeons in owner-
67 recognised compared to owner-unrecognised cases. 'Difficulty turning', 'shifting weight' and
68 'body condition' were more frequently reported by veterinary surgeons whilst 'increased hoof
69 temperature' was reported more frequently by owners.

70 **Main limitations:** The limited number of case data restricted statistical inferences regarding
71 the secondary objectives.

72 **Conclusions:** All owner-suspected laminitis cases were confirmed upon veterinary
73 examination, showing validity for the inclusion of owner-reported cases in future
74 epidemiological studies. However, failure of laminitis recognition by owners highlights further
75 need for evidence-based education to ensure early disease detection.

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91 **Introduction**

92 Equine laminitis is a complex, multifactorial disease for which further epidemiological investigations
93 have been identified as key to reducing its welfare impact [1; 2]. However, systematic reviews of studies
94 addressing the frequency of, and risk factors for, equine laminitis identified a paucity of high-standard
95 studies from which to extrapolate data to the general horse population [3; 4]. The most recent
96 epidemiological investigation in Great Britain utilised a cohort with nested case-control study design,
97 based within veterinary practices, such that cases were identified on the basis of a veterinary diagnosis
98 of equine laminitis [5; 6]. Whilst data from first-opinion veterinary practices has also been used
99 successfully to collect prospective data for other diseases [7-11], it is recognised that this may
100 underestimate the true incidence of disease [12; 13]. This may be particularly true for equine laminitis
101 due to the chronic and recurrent nature of the disease which potentially leads to owner recognition and
102 treatment without veterinary intervention. As horse owners are likely to be the first to witness deviations
103 from normality in their animal's health, disease estimates including data derived directly from owners,
104 in conjunction with veterinary diagnoses, may prove to be more accurate and representative of the
105 burden of laminitis to the horse-owning population. Before owner-reported information can be used to
106 further epidemiological knowledge, it is important to confirm the validity of what horse owners report
107 as laminitis in their animals is consistent with a veterinary diagnosis of the disease. Thus it is necessary
108 to establish to what extent owners are able to recognise laminitis, and the basis on which they do so.

109

110 The aim of this study was to collect preliminary evidence on the potential usefulness and validity of
111 including owner-reported laminitis data, alongside veterinary diagnoses, in future epidemiological
112 studies. The primary objective was to establish whether what horse owners suspected to be laminitis in
113 their animals was confirmed as laminitis by their veterinary surgeon. Such owner-suspected cases of
114 laminitis would be most representative of cases which might contribute to further epidemiological
115 studies as owner-reported, but not necessarily veterinary-diagnosed, cases of laminitis. It was therefore
116 important to determine the confidence with which these cases could be considered to be 'true' cases of
117 laminitis, based on comparison with concurrent veterinary assessment. It was anticipated that some
118 laminitis cases would not be recognised as such by owners but would be diagnosed when attended by a

119 veterinary surgeon. As the collected data allowed the opportunity, the secondary objectives were to
120 compare: (i) veterinary-reported information between owner-recognised and owner-unrecognised
121 cases, giving insight into factors that made cases more or less likely to be recognised by owners, and
122 (ii) paired veterinary- and owner-reported information in owner-recognised cases only, exploring
123 veterinary and owner assessment of clinical signs and factors perceived to be important in assisting a
124 veterinary surgeon to diagnose active laminitis and an owner to recognise it.

125

126 **Material and methods**

127 *Study design and sample size*

128 A cross-sectional study was conducted using a convenience sample of veterinary practitioners in order
129 to assess the accuracy of owner-suspected laminitis against veterinary-diagnosis of the disease in horses
130 and ponies (hereafter referred to as ‘horses’). Information was collected regarding the presence of pre-
131 defined clinical signs, underlying conditions and risk factors which may have contributed to laminitis
132 being suspected by the owner and/or diagnosed by the veterinary surgeon. Data were collected between
133 January 2014 and October 2015.

134

135 A sample size estimation (EpiTools^a) was conducted to address the primary objective of establishing
136 whether owner-suspected active laminitis cases were subsequently confirmed as laminitis by the
137 attending veterinary surgeon. It was assumed that the majority of owner-suspected laminitis cases would
138 be veterinary-confirmed (98%). In order to detect this proportion with 4% precision and 95%
139 confidence, observations from 48 horses were required.

140

141 *Practice selection*

142 Twenty-eight veterinary practices that contributed to a previous laminitis study [5] were invited to
143 participate in the current study. Ten of these (35.7%) agreed to assist with the study, with a further 15
144 practices recruited following a public announcement.

145

146 *Data collection tools*

147 A ‘laminitis reporting form’ (LRF) previously used to collect data on clinically apparent veterinary-
148 diagnosed active cases of laminitis in British horses [5] was modified for use in this study, resulting in
149 a veterinary LRF (Supplementary Information Item 1). The veterinary LRF was further modified for
150 owner use by using lay person terminology and the addition of explanatory images, resulting in a
151 corresponding owner LRF (Supplementary Information Item 2). The veterinary and owner LRFs
152 specifically collated information regarding:

153

154 1. Identifying information

155 The forms were distributed with pre-set practice ID numbers, allowing identification upon return.
156 Respondents were further asked to record the name of the horse, owner, consulting veterinary surgeon
157 and date of veterinary consultation.

158

159 2. Clinical signs

160 Tick-box responses were collected for 27 common clinical signs associated with both acute- and
161 chronic-phase laminitis. Clinical signs were based on lameness, stance, feet affected and characteristics
162 of the most severely affected foot/feet [5]. Responses were recorded as present, absent or not assessed.

163

164 3. Underlying conditions

165 Tick-box responses were collected regarding evaluations (yes, no or don’t know) of five clinical features
166 indicative of an underlying condition, which may assist in differentiating between endocrinopathic,
167 systemic inflammatory response syndrome and contralateral limb-related laminitis cases. Respondents
168 were asked to state whether the horse currently, or in the past week, had any of the following:
169 suspected/confirmed pituitary *pars intermedia* dysfunction (PPID)/ Cushing’s Disease or equine
170 metabolic syndrome (EMS), gastrointestinal disease (e.g. colic/diarrhoea), retained placenta/metritis
171 and severe unilateral weight bearing/contralateral limb overloading.

172

173 4. Risk factors

174 Tick-box responses were collected regarding the evaluations (yes, no or don't know) of seven horse-
175 and management-level risk factors perceived to be associated with laminitis. Respondents were asked
176 if these factors helped with suspicion/enhanced confidence in diagnosis of laminitis: horse breed type,
177 age, body condition score (BCS) (overweight/underweight), a previous history of laminitis, quality of
178 available grazing/pasture, accidental carbohydrate/concentrate overload and season/weather conditions.

179

180 5. Additional information

181 Veterinary LRF: The veterinary surgeon was asked to provide additional information including the
182 horse's age and breed, their opinion as to whether the horse was underweight, neither overweight nor
183 underweight (adequate) or overweight/obese, whether the owner suspected their horse had laminitis and
184 whether this agreed with the final diagnosis. Free text was used to record the owner's reason for seeking
185 veterinary attention if laminitis was not suspected or to record a different diagnosis if the owner
186 suspected laminitis but the veterinary surgeon diagnosed another condition.

187

188 Owner LRF: Owners were asked to indicate if they had prior direct experience with laminitis, in order
189 to indirectly gauge their likely knowledge of the disease. They had a choice of four pre-specified tick
190 box responses relating to experience with the same horse having laminitis, with another horse they
191 owned, another circumstance, or no prior experience with laminitis. Any additional information of
192 relevance was invited as free-text.

193

194 Owners and veterinary surgeons were asked to report information independently from each other, based
195 on the owner's reason for requesting the veterinary visit (whether laminitis was suspected or not):

196

197 1) If the owner suspected laminitis, they were asked to complete an owner LRF prior to and
198 independent of the veterinary surgeon examining the horse. Post-examination and diagnosis,
199 the veterinary surgeon completed the veterinary LRF, indicating the final diagnosis, even if this
200 was not laminitis.

201

202 2) If the owner identified a clinical problem necessitating veterinary intervention but did not
203 suspect laminitis, yet a laminitis diagnosis was made by the veterinary surgeon, only a
204 veterinary LRF was submitted.

205

206 *Case definition*

207 Cases were defined as veterinary-diagnosed, clinically apparent active laminitis in horses and ponies
208 attended by the participating veterinary practices [5; 6]. Active cases of laminitis, both acute and
209 chronic, and of any suspected origin were included in the study. Multiple episodes of laminitis in a
210 single individual were not included although information as to whether the animal had previously had
211 laminitis was collected. Recruited practices were asked to complete and submit LRFs for 10 to 15
212 prospective cases of owner-suspected and/or veterinary-confirmed laminitis cases attended.

213

214 *Data analysis*

215 Initial data processing and descriptive statistics were conducted using Microsoft Excel^b (v.2010).
216 Subsequent statistical analyses were performed in STATA^c (IC v.13.1). Statistical significance was set
217 at a P-value of <0.05; however, marginally significant results of potential clinical relevance were also
218 presented. P-values were not adjusted for multiple comparisons [14] to decrease the likelihood of type
219 II errors (not detecting a difference that does exist) in particular, in light of the relatively small sample
220 sizes to achieve the (opportunistic) secondary objectives. Proportions are presented with corresponding
221 95% confidence intervals (CI).

222

223 i) Equine demographics: Descriptive statistics were used to describe the distribution of horse
224 breeds, age and veterinary opinion as to whether the horse was underweight, in adequate body
225 condition or overweight/obese.

226

227 ii) Owner recognition of laminitis: The proportion of owner-suspected cases of laminitis that
228 were also veterinary-diagnosed and the proportion of these owners that had direct prior
229 experience of laminitis were determined. Additionally, the proportion of veterinary-diagnosed

230 cases of laminitis that were not initially recognised as such by owners was determined, along
231 with the reasons that veterinary attention was sought.

232

233 iii) Comparison of veterinary-reported data between owner-recognised and owner-
234 unrecognised cases: Differences in prevalence of clinical signs, underlying conditions and risk
235 factors between veterinary LRFs where the owners did and did not recognise laminitis were
236 compared using Fisher's exact test.

237

238 iv) Comparison between veterinary- and owner-reported data in owner-recognised cases:
239 Differences in the prevalence of clinical signs, underlying conditions and risk factors recorded
240 by pairs of veterinary surgeons and owners evaluating the same owner-recognised laminitis
241 cases were compared using the McNemar's exact conditional test without continuity correction.

242

243 **Results**

244 Twenty-five veterinary practices were recruited (22 located in England and 3 in Scotland). The range
245 of LRFs returned was 0-26 per practice (median 4), with at least one submitted from 15 of the practices
246 (60.0%). A total of 137 LRFs were returned, reflecting 93 cases of veterinary-diagnosed laminitis.

247

248

249 *i) Equine demographics*

250 The study population represented a range of breeds and their crosses (Figure 1), with Welsh breeds and
251 crosses most frequently reported in this sample (32.2%; CI 22.8-41.8%). Age and body condition
252 assessments by veterinary surgeons were available for 92 animals. The horses had a median age of 15
253 years (range 3-26 years) and 62.0% (n=57, CI 52.0-71.9%) were considered to be overweight/obese by
254 the veterinary surgeons, 35.9% (n=33, CI 26.1-45.7%) were considered to be of adequate weight and
255 2.2% (n=2, CI 0.0-5.2%) underweight.

256

257 *ii) Owner recognition of laminitis*

258 Of the 93 cases of veterinary-diagnosed active laminitis, 54.8% (n=51, CI 44.7-65.0%) had been
259 suspected as having laminitis by their owners (Figure 2). All 51 of these owner-suspected cases of
260 laminitis were confirmed by a veterinary surgeon, i.e. no ‘false positive’ cases of owner-suspected
261 laminitis were reported and all owner-suspected cases were therefore classed as ‘owner-recognised’.
262 Seven owner LRFs were not returned, resulting in 44 completed owner LRFs with corresponding paired
263 veterinary LRFs. The majority of owners who completed a LRF (n=34; 77.3%, CI 64.9-89.7%) reported
264 having direct experience with laminitis prior to this active episode; more than half with the same animal
265 (n=19; 55.9%, CI 39.2-72.6%). The 45.2% (n=42, CI 35.0-55.3%) of owners who did not suspect
266 laminitis, in horses with a subsequent veterinary diagnosis of laminitis, either did not know what the
267 problem was or suspected another condition. Owner-suspected conditions reported in these cases were
268 lameness in one or more feet (either undefined [n=14], thought to be foot abscesses [n=5], bruised sole
269 [n=1] or navicular disease [n=1]) (n=21; 50.0%, CI 34.9-65.1%), colic (n=6; 14.3%, CI 3.7-24.9%) and
270 musculoskeletal stiffness (n=4, 9.5%, CI 0.6-18.4%). Three owners (7.1%, CI 0.0-14.9%) reported three
271 other conditions (retained placenta, sunburned heels and swollen sheath) and eight (19.1%, CI 7.2-
272 30.9%) either did not know or did not report what the problem was.

273

274

275

276 *iii) Comparison of veterinary-reported data between owner-recognised and owner-*
277 *unrecognised cases*

278 Two incomplete veterinary LRFs were excluded along with their paired owner LRFs, resulting in 133
279 useable forms available for analysis (Figure 2). These comprised 42 owner LRFs and 91 veterinary
280 LRFs, of which 49 were from cases recognised by owners and 42 were from laminitis cases that were
281 not recognised by owners.

282

283 The only significant difference in prevalence of veterinary-reported clinical signs (n=27) between cases
284 where owners recognised laminitis and those where owners did not recognise laminitis was the presence
285 of divergent growth rings (prevalence difference: +27.3%, P=0.01) (Table 1). Divergent growth rings

286 were more commonly reported by veterinary surgeons in cases where owners recognised laminitis
287 (54.2%, CI 40.1-68.2%) compared to cases where owners did not recognise laminitis (26.8%, CI 13.3-
288 40.4%). There were no significant differences in veterinary-reported prevalence of the five underlying
289 conditions between owner-recognised and owner-unrecognised cases.

290

291 From the seven listed risk factors for laminitis, only the veterinary-reported breed type of the animal
292 was significantly different between owner-recognised and owner-unrecognised cases (prevalence
293 difference: +21.2%; P=0.04). The animal's breed type was more commonly reported as a risk factor
294 that assisted with final laminitis diagnosis by veterinary surgeons attending owner-recognised laminitis
295 cases (n=38; 77.6%, CI 65.9-89.2%) compared to veterinary surgeons attending laminitis cases not
296 recognised by owners (n=22; 56.4%, CI 40.8-72.0%) (Table 1). There was a significant difference in
297 breed distribution between owner-recognised and owner-unrecognised cases (P=0.001) with pony
298 breeds generally being more prevalent than horse breeds in owner-recognised cases of laminitis. A table
299 of breed distributions is provided in Supplementary Information Item 3.

300

301 *iv) Comparison between veterinary- and owner-reported data in owner-recognised cases*

302 Paired veterinary and owner LRFs were available for 42 out of 51 cases of owner-recognised laminitis
303 (Figure 2).

304

305 Four of the 27 clinical signs evaluated were reported differentially by veterinary surgeons and owners.
306 'Difficulty turning' (P=0.02) and 'shifting of weight from leg to leg' (P=0.04) were more frequently
307 reported by veterinary surgeons while 'increased hoof temperature' (P=0.04) and 'recumbency'
308 (P=0.06) were reported more frequently by owners (Table 2).

309

310 Suspected or confirmed EMS was more frequently reported by veterinary surgeons compared to owners
311 (P=0.06) and veterinary surgeons more frequently considered BCS useful for laminitis diagnosis than
312 owners (P=0.04) (Table 2).

313

314 **Discussion**

315 This is the first study to provide epidemiological data regarding owner-recognition of active laminitis
316 in Great Britain, to evaluate differences between veterinary data from owner-recognised and
317 unrecognised cases and to consider differences in data reported by veterinary surgeons and owners in
318 owner-recognised cases.

319

320 The data presented provides evidence to confirm that what horse owners suspected as laminitis in their
321 horses, in a very high proportion of cases (>98% *a priori*) was confirmed as laminitis by their veterinary
322 surgeons. This suggests that owner-reported laminitis cases could reliably contribute to epidemiological
323 studies of this disease. The inclusion of these cases would be of particular value in instances where
324 owners recognise laminitis but may not necessarily seek veterinary intervention. In this study, nearly
325 80% of owners that suspected laminitis, which was also subsequently diagnosed by a veterinary
326 surgeon, had previous direct experience with the disease; over half of them with the same animal. A
327 previous study found that the decision for horse owners to consult a veterinary surgeon regarding
328 occurrence of colic relied mainly on the owner's knowledge and previous experience with the disease,
329 as well as their interpretation of the severity of associated clinical signs [15]. Theoretically, an owner
330 that has had previous experience with a disease would be more aware of the clinical signs but may also
331 be less likely to consult a veterinary surgeon, especially if clinical signs are not perceived to be severe
332 or the horse recovers due to management interventions based on either the owner's previous experience
333 or following telephone advice from their veterinary surgeon. The owner's previous direct experience
334 with the disease could also be used as a secondary validity indicator when collecting owner-reported
335 data, in the absence of veterinary diagnosis. Inclusion of non-veterinary attended owner-reported
336 laminitis cases would therefore be a useful addition to data on veterinary-diagnosed cases when
337 gathering epidemiological information about the disease, creating a better-informed picture of the true
338 disease burden and welfare implications of horses which undergo multiple recurrent episodes during
339 their lifetime and whilst with the same owner. Additionally, by using a combination of both veterinary-
340 and owner-reported data, the potential over-representation of recurrent laminitis cases recognised and
341 reported by owners may be balanced by the veterinary-reporting of incident cases.

342

343 Owners were unable to recognise laminitis in approximately half of the veterinary-diagnosed cases;
344 indicating that further targeted owner education is required to raise awareness of common clinical signs
345 associated with laminitis, and to encourage rapid and evidence-based decision-making to seek
346 veterinary advice. This is especially important if owners have not had previous direct experience with
347 the disease or their horse's prior clinical history is unknown. While less knowledgeable owners may be
348 more likely to seek veterinary advice if a change in their animal's well-being is observed, and would
349 ultimately contribute to veterinary-reported cases, earlier and more accurate recognition of the disease
350 will lead to better outcomes for the horse. Laminitis diagnosis is complicated by the absence of
351 recognised clinical signs pathognomonic of the disease [5]. Appearance of (initial) acute unilateral limb
352 lameness, along with heat, an increased digital pulse and sensitivity to hoof-testers are clinical signs
353 typical of a foot abscess that are also common to many laminitis cases and as such laminitis should
354 always be ruled out in these instances [16]. Encouraging owners to monitor all four feet continuously
355 in such cases could improve earlier laminitis recognition. Similarly, failure to recognise laminitis can
356 lead to actions which could unintentionally place the horse in danger of further damage. In a case in
357 this study where the horse was thought to have colic, the owner had been walking the horse in-hand
358 throughout the night prior to veterinary diagnosis. Recent decision tree-analysis of clinical data
359 comparing clinical signs of veterinary-diagnosed laminitic cases with non-laminitic but lame controls
360 has shown promise as a tool for evaluating clinical signs to differentially diagnose laminitis [17].
361 Providing owners with a list of potential clinical signs to be aware of, including questions relating to
362 management and clinical history of their animals, could encourage more rapid and pro-active decision-
363 making.

364

365 The presence of divergent growth rings on the hoof capsule as reported by veterinary surgeons was
366 almost 30% more prevalent in owner-recognised compared to owner-unrecognised cases. Thus either
367 owners recognised laminitis because the horse had had it previously while under their care (observed
368 in approximately 56% of owner-recognised cases), or the presence of divergent growth rings was being
369 used as a distinct indicator of laminitis pathology. Divergent growth rings are a visual consequence of

370 internal insult to the lamellar layer and signify that the foot had in the past undergone chronic-phase
371 changes in the suspensory apparatus of the distal phalanx; however, their presence alone does not
372 necessarily mean that the horse is undergoing an active, acute phase of the disease [18]. There is
373 continual regeneration and growth of the tubular hoof wall at the coronary band, where insult to the
374 lamellae, and the appearance of the divergent growth rings, would originate. The downward migration
375 of the keratinocytes from the coronary band to the ground surface can take up to eight months, replacing
376 hoof wall lost due to motion or regular foot trimming [19]. Thus the location of the divergent growth
377 rings on the hoof wall in relation to the coronary band, while indicating historic insult, would likely not
378 be a direct result of the present active acute-phase episode. The presence of divergent growth rings is
379 much less prevalent than clinical signs that are perhaps less publicised; being reported by veterinary
380 surgeons in 41.6% of laminitis cases in the present study and 23.7% of cases in a prior study [5]
381 compared with ‘difficulty turning’ which was reported in more than 75% of laminitis cases in both
382 studies. Recent research suggests that commonly cited clinical signs such as the classic ‘laminitis
383 stance’ and divergent growth rings, which were found in less than half of the active laminitis cases
384 diagnosed, are not useful laminitis discriminators [17]. Ensuring this is clarified in educational material
385 and communications with owners, as well as raising the profile of other more subtle clinical signs should
386 help reduce the proportion of cases not recognised by owners.

387

388 Veterinary surgeons attending owner-recognised cases reported breed type as a risk factor that assisted
389 in their final diagnosis more frequently than veterinary surgeons that attended owner-unrecognised
390 cases. This was reflected in a difference in breed distribution between owner-recognised and
391 unrecognised cases (Supplementary Information Item 3). Horse breeds and their crosses, with the
392 exception of Irish draught horses, were more prevalent in the owner-unrecognised laminitis cases
393 compared to pony breeds and their crosses. This suggests that while both veterinary surgeons and
394 owners may rely on breed type to assist in laminitis diagnosis or recognition, perception of laminitis
395 risk based on breed may be resulting in owners not considering laminitis as a possibility in horse breeds,
396 contributing to misrecognition of the disease. Although certain breeds are perceived to be at an
397 increased risk of laminitis, there is currently little evidence to support a true breed-linked association

398 with laminitis [4]. In fact, Wylie et al. [6] found that a horse's height, rather than breed, was a more
399 discriminating risk factor for laminitis with smaller animals being at a greater risk of having laminitis
400 than taller animals, and that this was along a significant biological gradient. This indicates that breed
401 alone may not be the most valid laminitis discriminator. In the present study breed type may be a proxy
402 for size, however, height data were not collected.

403

404 Overall, veterinary surgeon and owner paired laminitis data showed broad consistency when reporting
405 the presence or absence of clinical signs, underlying conditions and risk factors associated with
406 laminitis. Statistically significant and marginally significant difference between discordant pair
407 proportions was found for only four clinical signs, one underlying condition and one risk factor;
408 signifying a difference between veterinary- and owner-reporting. Veterinary surgeons reported a higher
409 proportion of animals as having 'difficulty turning' and 'shifting weight from leg to leg' compared with
410 owners, who more frequently reported the horse having 'increased hoof temperature' and being
411 'recumbent'. Difficulty turning was previously reported in over 90% of veterinary-diagnosed cases and
412 while shifting weight was reported less frequently (55.2%), both clinical signs were among five
413 lameness investigation and stance features considered most useful in laminitis diagnosis [17]. The
414 difference in reporting between veterinary surgeons and owners could be influenced by disease
415 progression in the time interval between an owner noticing the clinical signs and the veterinary surgeon
416 examining the horse. Additionally, a clinical lameness investigation by a veterinary surgeon is more
417 systematic and thorough than an owner assessment of lameness. Shifting weight and difficulty turning
418 may be lesser-known clinical signs amongst owners or could signal the progression of the disease
419 between owner assessment and veterinary clinical examination. The larger proportion of time owners
420 spend with the animal compared with veterinary surgeons may also play a role; recumbency may be
421 reported more by owners as they are able to observe their animals for a longer period of time.

422

423 Fewer owners reported that their horse had suspected or confirmed EMS compared with veterinary
424 surgeons, although a similar trend was not observed for suspected or confirmed PPID. Owners may be
425 more aware of PPID and its association with laminitis due to a combination of visually-apparent clinical

426 signs that mark progression of the disease in older animals and the annual PPID-testing campaign run
427 in Britain over the last few years. The clinical consensus statement for EMS is the presence of three
428 characteristics: obesity (whether general or regional), insulin resistance (IR) and history of laminitis
429 [20]. However, the existing difficulty in defining clinical cases (for example, IR and laminitis in the
430 absence of obesity) and the varying terminology used (IR, hyperinsulinaemia, insulin dysregulation),
431 may contribute to potential confusion amongst owners. Since hyperinsulinaemia/IR is considered
432 instrumental in the development of endocrinopathic laminitis [21; 22] perhaps it is this feature of EMS
433 that should be more clearly translated to owners alongside encouragement of insulin testing.

434

435 While not all obese animals will be insulin resistant, obesity is considered a risk factor for EMS and
436 thus laminitis [23]. It was therefore surprising to note that fewer owners in this study population, which
437 included a high proportion of owners with prior laminitis experience, reported using BCS as a risk factor
438 to help with laminitis recognition compared to veterinary surgeons. While owners may be aware that
439 obesity and a high BCS are associated with an increased laminitis risk, their perception of obesity may
440 be skewed. A previous study has shown that 50% of owners underestimated their horse's BCS compared
441 with an experienced researcher [24]. This indicates that when collecting owner-reported condition and
442 weight estimates, apart from providing owners with clear instructions on how to conduct hands-on
443 condition scoring, a more objective method of weight estimation should be used concurrently.

444

445 Sample size requirements were satisfied to achieve the primary objective of demonstrating a very high
446 proportion of owner-suspected laminitis cases being confirmed upon veterinary examination, and
447 thereby supports use of owner-reported data in research studies. However, we caution that the limited
448 extent of data does restrict statistical inferences regarding the secondary objectives. The data from the
449 secondary objectives are therefore presented in their raw format, including proportions and
450 corresponding CIs, allowing readers to evaluate the potential effect of small numbers on the presented
451 significance levels.

452

453 **Conclusion**

454 Although derived from a relatively small convenience sample, due to the very high proportion of owner-
455 suspected cases of laminitis which were subsequently also veterinary-confirmed, the findings from this
456 study indicate that cases based on owner-recognition of laminitis would be a valid and useful metric
457 alongside veterinary-reported data. These owner-reported laminitis cases would be of particular benefit
458 to future epidemiological studies that seek to identify laminitis risk factors or where laminitis diagnosis
459 is considered an inclusion criterion. Using a combination of veterinary- and owner-reported data would
460 also increase accuracy of current veterinary-reported disease estimates. However, owner-reporting
461 alone, in the absence of veterinary diagnosis, would underestimate actual disease frequency and does
462 raise concerns about the number of cases that are neither owner-recognised nor veterinary-attended.
463 These findings also emphasise that owner education about laminitis and its associated risk factors,
464 which should have a strong evidence base, is vital to encourage earlier and more accurate detection of
465 the disease. Additionally, raising awareness of clinical signs that have been shown to be the best
466 discriminators for laminitis, rather than those commonly perceived to be present in affected animals,
467 will promote swift treatment and provide animals with the best chance of recovery. Owner education
468 could further be targeted to owners lacking previous direct experience of the disease and those owning
469 breeds not perceived to be at risk.

470

471 **Manufacturer's addresses**

472 ^aSergeant, ESG, 2016. Epitools epidemiological calculators. AusVet Animal Health Services and
473 Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease.

474 <http://epitools.ausvet.com.au>.

475 ^bMicrosoft Corporation, Redmond, Washington, USA.

476 ^cStataCorp LP, Texas, USA.

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480 **Tables**

481 Table 1

482 The prevalence, difference in prevalence and Fisher's exact P-value for the presence of
483 veterinary-reported clinical signs, underlying conditions and risk factors in cases of
484 veterinary-diagnosed laminitis in a cross-sectional study in Great Britain, ordered by
485 difference in prevalence.

| Clinical sign | Prevalence among owner-recognised cases | 95% CI (%) | Owner-unrecognised cases | 95% CI (%) | Difference in prevalence (%) | P-value |
|---|---|------------|--------------------------|------------|------------------------------|-------------|
| Lame at trot | 19/20 (95.0%) | 85.4-100.0 | 6/9 (66.7%) | 35.9-97.5 | +28.3 | 0.08 |
| Divergent growth rings | 26/48 (54.2%) | 40.1-68.3 | 11/41 (26.8%) | 13.3-40.4 | +27.3 | 0.01 |
| Front feet placed in front of body | 27/49 (55.1%) | 41.2-69.0 | 16/42 (38.1%) | 23.4-52.8 | +17.0 | 0.14 |
| Short, stiff gait at trot | 18/19 (94.7%) | 84.7-100.0 | 9/11 (81.8%) | 59.0-100.0 | +12.9 | 0.54 |
| Hind feet placed underneath body | 15/49 (30.6%) | 17.7-43.5 | 8/41 (19.5%) | 7.4-31.6 | +11.1 | 0.33 |
| Stretched white line | 11/43 (25.6%) | 12.5-38.6 | 6/38 (15.8%) | 4.2-27.4 | +9.8 | 0.41 |
| Shifting weight from leg to leg | 30/49 (61.2%) | 47.6-74.9 | 22/42 (52.4%) | 37.3-67.5 | +8.8 | 0.41 |
| Short, stiff gait at walk | 45/47 (95.7%) | 90.0-100.0 | 34/39 (87.2%) | 76.7-97.7 | +8.6 | 0.24 |
| Increased hoof temperature | 17/47 (36.2%) | 22.4-49.9 | 12/41 (29.3%) | 15.3-43.2 | +6.9 | 0.51 |
| Change in dorsal hoof wall angle | 14/48 (29.2%) | 16.3-42.0 | 9/40 (22.5%) | 9.6-35.4 | +6.7 | 0.63 |
| Difficulty turning | 44/47 (93.6%) | 86.6-100.0 | 35/39 (89.7%) | 80.2-99.3 | +3.9 | 0.70 |
| Recumbent | 5/47 (10.6%) | 1.8-19.5 | 3/39 (7.7%) | 0.0-16.1 | +2.9 | 0.72 |
| Coronary band swelling | 0/47 (0.0%) | 0.0 | 0/39 (0.0%) | 0.0 | 0.0 | * |
| Prolapsed sole | 0/49 (0.0%) | 0.0 | 0/42 (0.0%) | 0.0 | 0.0 | * |
| Coronary band depression | 2/47 (4.3%) | 0.0-10.0 | 2/41 (4.9%) | 0.0-11.5 | -0.6 | 1.00 |
| Increased digital pulse | 42/49 (85.7%) | 75.9-95.5 | 37/42 (88.1%) | 78.3-97.9 | -2.4 | 0.77 |
| Hoof wall separation | 0/48 (0.0%) | 0.0 | 1/42 (2.4%) | 0.0-7.0 | -2.4 | 0.47 |
| Lame at walk | 40/47 (85.1%) | 74.9-95.3 | 37/41 (90.2%) | 81.2-99.3 | -5.1 | 0.53 |
| Reluctance to walk | 36/49 (73.5%) | 61.1-85.8 | 33/41 (80.5%) | 68.4-92.6 | -7 | 0.47 |
| Flattened sole | 16/47 (34.0%) | 20.5-47.6 | 16/39 (41.0%) | 25.6-56.5 | -7 | 0.65 |
| Crescent shaped bruising dorsal to frog | 0/48 (0.0%) | 0.0 | 3/40 (7.5%) | 0.0-15.7 | -7.5 | 0.09 |
| Convex sole | 2/47 (4.3%) | 0.0-10.0 | 5/39 (12.8%) | 2.3-23.3 | -8.6 | 0.24 |
| Leg trembling | 5/48 (10.4%) | 1.8-19.1 | 8/41 (19.5%) | 7.4-31.6 | -9.1 | 0.25 |
| Hoof wall pain | 3/46 (6.5%) | 0.0-13.7 | 6/37 (16.2%) | 4.3-28.1 | -9.7 | 0.18 |
| Reluctance for foot to be lifted | 23/49 (46.9%) | 33.0-60.9 | 24/42 (57.1%) | 42.2-72.1 | -10.2 | 0.40 |
| Refusal to move unless forced | 13/48 (27.1%) | 14.5-39.7 | 19/41 (46.3%) | 31.1-61.6 | -19.3 | 0.08 |
| Hoof sole pain | 17/46 (37.0%) | 23.0-50.9 | 22/39 (56.4%) | 40.8-72.0 | -19.5 | 0.08 |
| Underlying condition | | | | | | |
| Unilateral weight-bearing | 0/45 (0.0%) | 0.0 | 0/41 (0.0%) | 0.0 | 0.0 | * |
| Suspected/confirmed EMS | 27/44 (61.4%) | 47.0-75.8 | 23/37 (62.2%) | 46.5-77.8 | -0.8 | 1.00 |
| Gastrointestinal disease | 0/45 (0.0%) | 0.0 | 1/41 (2.4%) | 0.0-7.2 | -2.4 | 0.48 |

| | | | | | | |
|----------------------------------|---------------|-----------|---------------|-----------|-------|-------------|
| Retained placenta/metritis | 0/45 (0.0%) | 0.0 | 1/41 (2.4%) | 0.0-7.2 | -2.4 | 0.48 |
| Suspected/confirmed PPID | 23/44 (52.3%) | 37.5-67.0 | 20/36 (55.6%) | 39.3-71.8 | -3.3 | 0.82 |
| Risk factor | | | | | | |
| Breed type | 38/49 (77.6%) | 65.9-89.2 | 22/39 (56.4%) | 40.8-72.0 | +21.2 | 0.04 |
| Previous laminitis history | 25/48 (52.1%) | 38.0-66.2 | 11/35 (31.4%) | 16.0-46.8 | +20.7 | 0.08 |
| Grazing quality | 29/45 (64.4%) | 50.5-78.4 | 24/41 (58.5%) | 43.5-73.6 | +5.9 | 0.66 |
| Body condition score | 34/48 (70.8%) | 58.0-83.7 | 27/41 (65.9%) | 51.3-80.4 | +4.9 | 0.65 |
| Season/weather conditions | 32/48 (66.7%) | 53.3-80.0 | 25/40 (62.5%) | 47.5-77.5 | +4.2 | 0.82 |
| Accidental carbohydrate overload | 2/48 (4.2%) | 0.0-9.8 | 2/39 (5.1%) | 0.0-12.1 | -0.9 | 1.00 |
| Age | 21/45 (46.7%) | 32.1-61.2 | 19/39 (48.7%) | 33.0-64.4 | -2.0 | 1.00 |

486 * not calculable as zero in multiple cells

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499 Table 2

500 The number of paired veterinary and owner laminitis reporting forms detailing veterinary-

501 and owner-reported presence of clinical signs, underlying conditions and risk factors of

502 laminitis and the McNemar's exact conditional P-value for the difference in the proportion of

503 discordant pairs in a cross-sectional study in Great Britain, ordered by ascending P-value.

| Clinical sign | LRF pairs (n) | +/+ | -/+ | +/- | -/- | P-value |
|---|---------------|-----|-----|-----|-----|-------------|
| Difficulty turning | 38 | 29 | 0 | 7 | 2 | 0.02 |
| Increased hoof temperature | 39 | 11 | 12 | 3 | 13 | 0.04 |
| Shifting weight from leg to leg | 39 | 16 | 1 | 8 | 14 | 0.04 |
| Recumbent | 35 | 4 | 5 | 0 | 26 | 0.06 |
| Flattened sole | 34 | 3 | 2 | 8 | 21 | 0.11 |
| Reluctance for foot to be lifted | 37 | 16 | 8 | 2 | 11 | 0.11 |
| Stretched white line | 29 | 3 | 0 | 4 | 22 | 0.13 |
| Lame at walk | 37 | 25 | 1 | 6 | 5 | 0.13 |
| Short, stiff gait at trot | 12 | 9 | 0 | 3 | 0 | 0.25 |
| Hoof sole pain | 27 | 4 | 0 | 3 | 20 | 0.25 |
| Short, stiff gait at walk | 38 | 32 | 1 | 4 | 1 | 0.38 |
| Change in dorsal hoof wall angle | 38 | 6 | 2 | 5 | 25 | 0.45 |
| Front feet placed in front of body | 38 | 9 | 6 | 10 | 13 | 0.45 |
| Reluctance to walk | 41 | 20 | 6 | 10 | 5 | 0.46 |
| Refusal to move unless forced | 37 | 7 | 6 | 3 | 21 | 0.51 |
| Divergent growth rings | 40 | 13 | 3 | 6 | 18 | 0.51 |
| Coronary band depression | 36 | 0 | 1 | 1 | 34 | 1.00 |
| Coronary band swelling | 36 | 0 | 1 | 0 | 35 | 1.00 |
| Convex sole | 34 | 1 | 0 | 1 | 32 | 1.00 |
| Crescent shaped bruising dorsal to frog | 34 | 0 | 1 | 0 | 33 | 1.00 |
| Hoof wall pain | 32 | 1 | 3 | 3 | 25 | 1.00 |
| Hind feet placed underneath body | 37 | 6 | 4 | 4 | 23 | 1.00 |
| Increased digital pulse | 34 | 26 | 3 | 4 | 1 | 1.00 |
| Leg trembling | 36 | 2 | 1 | 1 | 32 | 1.00 |
| Lame at trot | 14 | 13 | 0 | 1 | 0 | 1.00 |
| Hoof wall separation | 37 | 0 | 0 | 0 | 37 | * |
| Prolapsed sole | 40 | 0 | 0 | 0 | 40 | * |
| Underlying condition | | | | | | |
| Suspected/confirmed EMS | 29 | 6 | 3 | 11 | 9 | 0.06 |
| Unilateral weight-bearing | 38 | 0 | 4 | 0 | 34 | 0.13 |
| Suspected/confirmed PPID | 30 | 10 | 2 | 6 | 12 | 0.29 |
| Gastrointestinal disease | 38 | 0 | 1 | 0 | 37 | 1.00 |
| Retained placenta/metritis | 38 | 0 | 0 | 0 | 38 | * |
| Risk factor | | | | | | |
| Body condition score | 39 | 21 | 2 | 10 | 6 | 0.04 |
| Age | 33 | 8 | 4 | 9 | 12 | 0.27 |
| Breed type | 40 | 22 | 4 | 9 | 5 | 0.27 |
| Grazing quality | 35 | 17 | 2 | 6 | 10 | 0.29 |
| Season/weather conditions | 40 | 23 | 6 | 3 | 8 | 0.51 |
| Previous laminitis history | 41 | 19 | 1 | 1 | 20 | 1.00 |
| Accidental carbohydrate overload | 39 | 0 | 3 | 2 | 34 | 1.00 |

504 * not calculable as zero in multiple cells, ++ reported present by both veterinary surgeon and owner, +/-
505 veterinary surgeon reported absent while owner reported present, +/- veterinary surgeon reported present while
506 owner reported absent, -- reported as absent by both veterinary surgeon and owner.

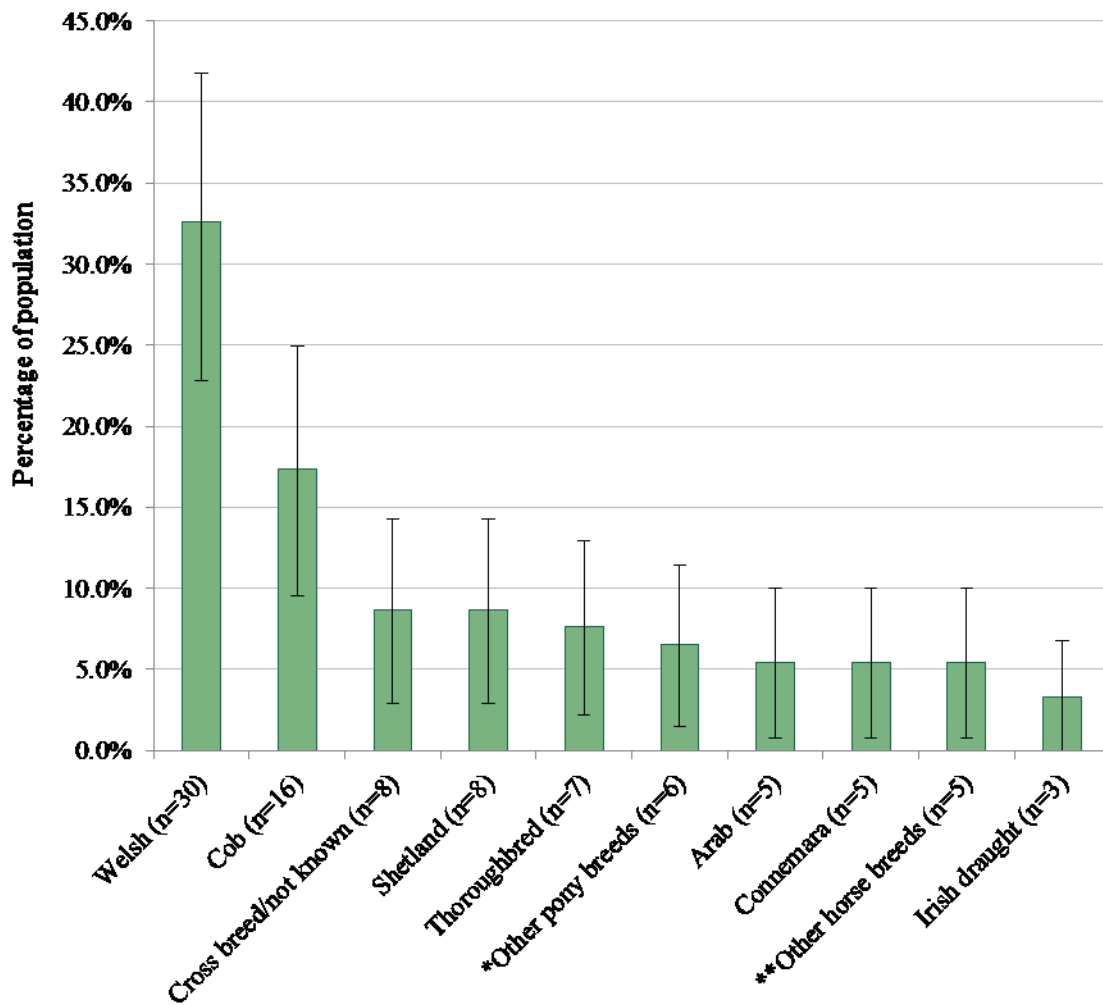
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511 **Figures**

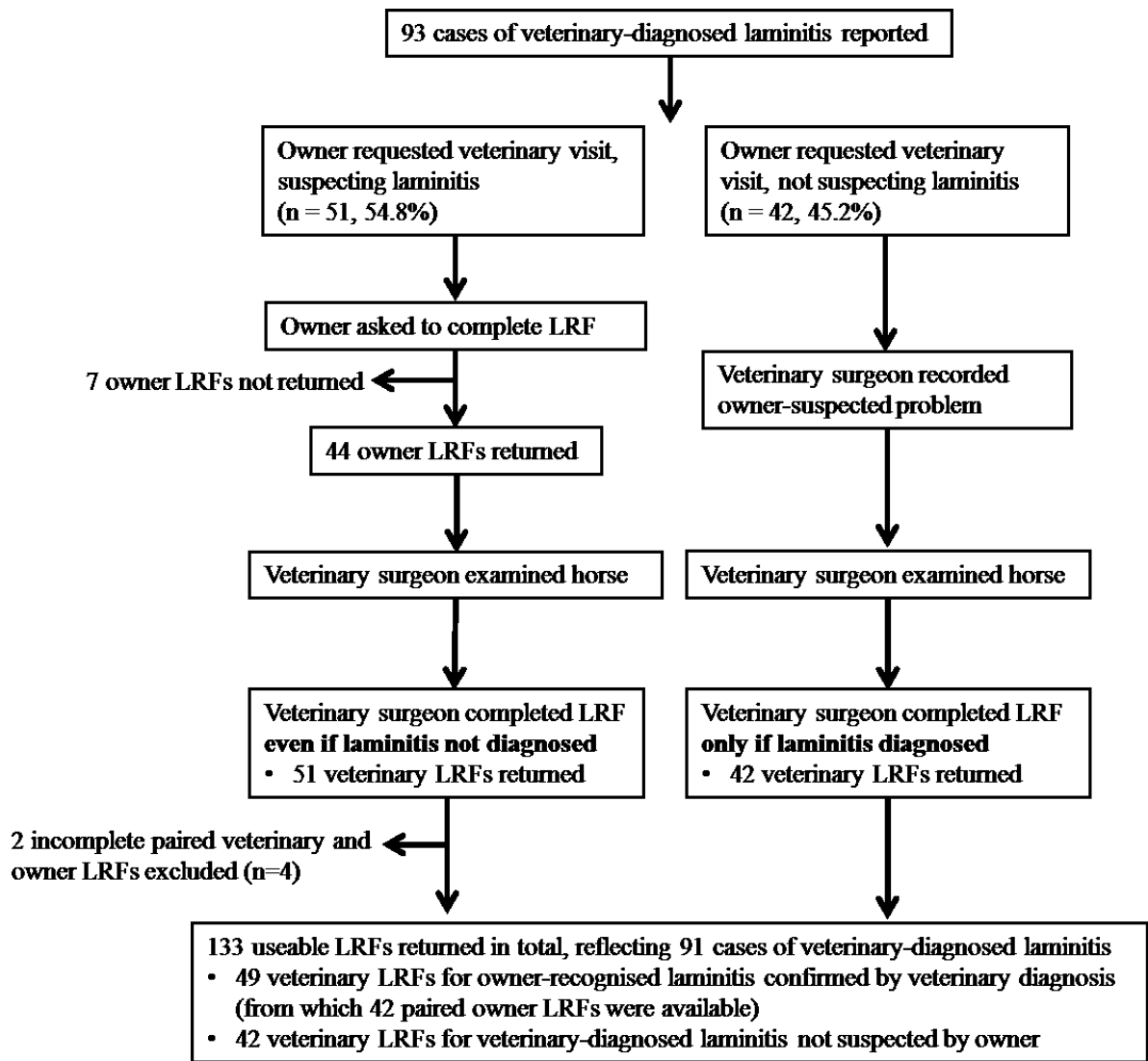


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513 Figure 1: Breed distribution (including breed crosses) of horses and ponies with veterinary-
 514 diagnosed active laminitis (n=93) reported by attending veterinary surgeons from a
 515 convenience sample of veterinary practices in Great Britain between January 2014 and October
 516 2015, presented in descending order of frequency. Error bars represent 95% confidence
 517 intervals. *Includes Dales, Dartmoor, Highland and New Forest ponies, **Includes Hanoverian,
 518 Quarter horses and heavy breeds.

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522 Figure 2: Flow diagram to illustrate the grouping of data received from both veterinary
 523 surgeons and owners in a cross-sectional study of laminitis in Great Britain between January
 524 2014 and October 2015.

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530 **Supplementary information**

531 Item 1: Veterinary laminitis reporting form used to collect data on active laminitis episodes in
532 a cross-sectional study of laminitis in Great Britain between January 2014 and October 2015.

Practice ID

Vet Laminitis Reporting Form

Thank you very much for contacting me and expressing your interest in helping with the pilot study. I greatly appreciate your contributions and your time.

I require your help in testing the Laminitis Reporting Forms (LRFs) and for validating owner-reported information regarding clinical signs and diagnosis of laminitis. The LRF is a short 4 page checklist of common clinical signs and features of laminitis which comes in two versions – one for the vet (blue) and one for the owner (yellow).

Please have the LRFs readily available when you attend initial consultations and return the completed forms via the reply paid envelopes provided.

❖ Scenario 1 – "Owner suspects laminitis"
If the owner suspects laminitis, ask if they are willing to complete the owner LRF regarding the clinical signs that led them to suspect laminitis. **It is important that the owner completes the LRF without your input.** Post-diagnosis, you would complete the vet LRF and post both forms back to me. **Please complete the LRF even if laminitis is not the diagnosis.**

❖ Scenario 2 – "Owner unaware but laminitis diagnosed"
If the owner does not suspect laminitis, but you confirm a diagnosis of laminitis, then only you would complete the vet LRF (no need for owner LRF) and post this back to me.

We would ask that you submit between 10-15 cases of suspected/confirmed laminitis per practice, starting from the date that you receive the information, although more than 15 cases would of course be welcome.

If you have any questions, please don't hesitate to contact me on 01638 751000 (Ext 1506) or danica.pollard@aht.org.uk

Many thanks and kind regards,
Dee Pollard

*Please complete the form if your client has consented to participate in the pilot study and in **case of suspected/confirmed laminitis – even if laminitis is not your final diagnosis.** Please complete all **FOUR pages** of this form*

1. Did the owner initially suspect laminitis to be the cause of the reported illness/lameness?

Yes
If yes, please make sure the owner completes the owner LRF indicating clinical signs which led them to suspect laminitis, without your input.

No
If no, what did the owner suspect the problem may have been? Please indicate below. The owner would not have to complete the owner LRF.

.....

2. Owner surname:

3. Name of horse/pony:

Page 1 of 4

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4. Age of horse/pony: years

5. Breed of horse/pony:

6. In your opinion, is the horse/pony:

- Underweight Neither overweight nor underweight (adequate) Overweight/obese

7. Consulting vet initials:

8. Date of veterinary consultation: / /

*Below is a list of common clinical signs associated with laminitis. Please provide details of the **clinical signs observed in this instance, even if laminitis was not the diagnosis.***

| | | | | |
|-----|--|--------------------------|--------------------------|--|
| 9. | Lameness <i>(please tick one option per line)</i> | YES | NO | NOT ASSESSED |
| | Recumbent (lying down) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Refusal to move unless forced | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Reluctance to walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Lame at walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Lame at trot | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Short, stiff gait at walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Short, stiff gait at trot | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Difficulty turning | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. | Stance <i>(please tick one option per line)</i> | YES | NO | NOT ASSESSED |
| | Shifting weight from leg to leg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Leg trembling | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Front feet placed in front of body | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Hind feet placed underneath body | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Reluctance for foot to be lifted | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. | Feet affected <i>(please tick all feet that apply)</i> | YES | NO | Please indicate which of these were most severely affected |
| | Right foreleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Left foreleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Right hindleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | Left hindleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

12. Clinical signs of the most severely affected foot/feet (please tick one option per line)

| | YES | NO | NOT ASSESSED |
|--|--------------------------|--------------------------|--------------------------|
| Strong/bounding pulse at the back of fetlock | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Hoof or coronet band unusually warm to the touch | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Painful sole, especially in front of frog | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| General pain at the front of the hoof wall | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Painful swelling at the coronary band | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Painful depression at the coronary band | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible growth rings on the hoof wall (narrow at the toe and wider at the heel) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Change in the angle of the hoof wall | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible separation of the hoof wall at the coronary band | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Change in sole shape - becoming flat as opposed to concave (dished) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Change in sole shape - becoming convex (bulging outwards) as opposed to concave (dished) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| White line abnormally stretched and wide | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible bruising in front of frog e.g. half-moon/crescent bruise | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Protrusion of the pedal bone through the bottom of the hoof (prolapsed sole) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

13. Please indicate if the horse/pony has, or in the past 7 days had, each of these clinical features and, irrespective of their presence/absence, rate their importance in formulating your final diagnosis. (please tick a choice/(s) for each line)

| Horse/pony has, or in the past 7 days had: | YES | NO | DON'T KNOW | How IMPORTANT was the applicable feature to your clinical diagnosis? |
|---|--|--------------------------|--------------------------|--|
| Pituitary <i>Pars Intermedia</i> Dysfunction (PPID)/Cushing's | <input type="checkbox"/> confirmed <input type="checkbox"/> suspected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |
| Equine Metabolic Syndrome (EMS) | <input type="checkbox"/> confirmed <input type="checkbox"/> suspected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |
| Gastrointestinal disease (e.g. colic/diarrhoea) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |
| Retained placenta or metritis | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |
| Severe unilateral lameness of contralateral limb | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |

Please don't forget to turn over and complete the last page.

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| Horse/pony has, or in the past 7 days had: | YES | NO | DON'T KNOW | How IMPORTANT was the applicable feature to your clinical diagnosis? |
|---|--------------------------|--------------------------|--------------------------|--|
| Radiographic changes in the hoof | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |
| Were there any other clinical features that helped form your final diagnosis? <i>(please specify)</i> | | | | <input type="checkbox"/> Very <input type="checkbox"/> Moderately <input type="checkbox"/> Not |
| | | | | |
| | | | | |

14. Did you diagnose laminitis in this animal?

Yes No, the diagnosis was

14.1. If yes, did any of these additional factors enhance the confidence of your laminitis diagnosis? *(please tick one option per line)*

| | YES | NO | DON'T KNOW |
|--|--------------------------|--------------------------|--------------------------|
| Breed type | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Age | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Body condition score (overweight/underweight) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Previous history of laminitis | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Quality of grazing or pasture available | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Accidental carbohydrate/concentrates overload | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Season/Weather conditions | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Did any other additional factors enhance your laminitis diagnosis? <i>(please specify)</i> | | | |
| | | | |

15. Any other comments relevant to this consultation?

.....
.....


Once complete please return form to:

Danica Pollard, Animal Health Trust, CPM, Lanwades Park, Kentford, Newmarket, CB8 7UU.
Phone: 01638 751000 Ext 1506 Email: danica.pollard@aht.org.uk



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548 Item 2: Owner laminitis reporting form used to collect data on active laminitis episodes in a
 549 cross-sectional study of laminitis in Great Britain between January 2014 and October 2015.


Practice ID

Owner Laminitis Reporting Form

Thank you for volunteering your information for this study. Please complete the form in the event that you suspect your horse/pony has laminitis, **before the vet examines them**. It may feel unusual to complete this form without your vet's assistance – we are interested in the reason you called the vet out, not in what the veterinary diagnosis is! You are welcome to keep the CARE about laminitis information flyer. Please complete all **FOUR pages** of this form.

By completing this form I agree to the use of the collected data for research purposes. I understand that my details will remain confidential and will not be shared with third parties. I also give consent for my veterinary practice to be contacted directly with regards to my animal's health records.

1. Owner name:

2. Owner surname:

3. Name of horse/pony:

4. Name of consulting veterinarian:

5. Date of veterinary consultation: / /

*Please think about the reasons you called your vet for a visit today and indicate the **presence or absence** of these **clinical signs/characteristics**.*

6. Lameness
(please tick one option per line)

| | YES | NO | NOT ASSESSED |
|-------------------------------|--------------------------|--------------------------|--------------------------|
| Recumbent (lying down) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Refusal to move unless forced | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Reluctance to walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Lame at walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Lame at trot | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Short, stiff gait at walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Short, stiff gait at trot | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Difficulty turning | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

7. Stance
(please tick one option per line)

| | YES | NO | NOT ASSESSED |
|------------------------------------|--------------------------|--------------------------|--------------------------|
| Shifting weight from leg to leg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Leg trembling | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Front feet placed in front of body | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Hind feet placed underneath body | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Reluctance for foot to be lifted | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |





8. Feet affected
(please tick all feet that apply)

| | YES | NO | Please indicate which of these were most severely affected |
|---------------|--------------------------|--------------------------|--|
| Right foreleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Left foreleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Right hindleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Left hindleg | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Page 1 of 4

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| 9. Characteristics (clinical signs) of the most severely affected foot/feet (please tick one option per line) | | YES | NO | NOT ASSESSED |
|--|---|--------------------------|--------------------------|--------------------------|
| Strong/bounding pulse at the back of fetlock |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Hoof or coronet band unusually warm to the touch |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Painful sole, especially in front of frog |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| General pain at the front of the hoof wall |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Painful swelling at the coronary band |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Painful depression at the coronary band |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible growth rings on the hoof wall (narrow at the toe and wider at the heel) |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Change in the angle of the hoof wall |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible separation of the hoof wall at the coronary band |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| *Image courtesy of Dr L. Wells-Smith | | | | |
| Change in sole shape - becoming flat (red line) as opposed to concave/dished (blue line) |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Change in sole shape - becoming convex/bulging outwards (red line) as opposed to concave/dished (blue line) |  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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| Characteristics (clinical signs) of the <u>most severely affected foot/feet</u> <i>(please tick one option per line)</i> | YES | NO | NOT ASSESSED |
|---|--------------------------|--------------------------|--------------------------|
| White line abnormally stretched and wide  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Visible bruising in front of frog e.g. half-moon/crescent bruise  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Protrusion of the pedal bone through the bottom of the hoof (prolapsed sole)  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

*Image courtesy of Dr S. N. Collins

10. Have you had direct experience with laminitis before? *(please tick all that apply)*

- Yes, this horse/pony has had laminitis before
- Yes, with another horse/pony I currently own or owned
- Yes, other *(please specify)*
- No

11. Please indicate if your horse/pony has, or in the past 7 days had, each of these conditions and, irrespective of their presence/absence, rate their importance in making you suspect your horse/pony had laminitis. *(please tick a choice/(s) for each line)*

| Horse/pony has, or in the past 7 days had: | YES | NO | DON'T KNOW | How IMPORTANT was the applicable condition to your laminitis suspicion? | | |
|--|--|--------------------------|--------------------------|--|-------------------------------------|------------------------------|
| Pituitary <i>Pars Intermedia</i> Dysfunction (PPID)/Cushing's | <input type="checkbox"/> confirmed <input type="checkbox"/> suspected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very | <input type="checkbox"/> Moderately | <input type="checkbox"/> Not |
| Equine Metabolic Syndrome (EMS) | <input type="checkbox"/> confirmed <input type="checkbox"/> suspected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very | <input type="checkbox"/> Moderately | <input type="checkbox"/> Not |
| Gastrointestinal disease (e.g. colic/diarrhoea) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very | <input type="checkbox"/> Moderately | <input type="checkbox"/> Not |
| Retained placenta or metritis | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very | <input type="checkbox"/> Moderately | <input type="checkbox"/> Not |
| Severe lameness/injury in leg opposite to the one with suspected laminitis | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> Very | <input type="checkbox"/> Moderately | <input type="checkbox"/> Not |

Please don't forget to turn over and complete the last page.

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Practice ID

12. Have any of these additional factors helped you suspect your horse/pony has laminitis?
(please tick one option per line)

| | YES | NO | DON'T KNOW |
|--|--------------------------|--------------------------|--------------------------|
| Breed type | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Age | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Body condition score (overweight/underweight) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Previous history of laminitis | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Quality of grazing or pasture available | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Accidental carbohydrate/concentrates overload | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Season/Weather conditions | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Did any other additional factors help you suspect laminitis? <i>(please specify)</i> | | | |
| | | | |

13. Any other comments relevant to this suspected laminitic episode?

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Once complete please return form to:

Danica Pollard, Animal Health Trust, CPM, Lanwades Park, Kentford, Newmarket, CB8 7UU.
Phone: 01638 751000 (Ext: 1506) Email: danica.pollard@aht.org.uk



565 Item 3: Frequency and difference in breed distribution of veterinary-diagnosed active laminitis
 566 cases between owner-recognised and owner-unrecognised cases in a cross-sectional study of
 567 laminitis in Great Britain between January 2014 and October 2015 ($\chi^2(9)=28.32$, $P=0.001$).

| Breed (including breed crosses) | Frequency of laminitis cases recognised by owner | | Difference in breed distribution |
|---------------------------------|--|------------|----------------------------------|
| | Yes (%) | No (%) | (%) |
| Welsh | 19 (38.8%) | 11 (26.2%) | +12.6% |
| Cob | 7 (14.3%) | 9 (21.4%) | -7.1% |
| Cross breed/not known | 3 (6.1%) | 4 (9.5%) | -3.4% |
| Shetland | 7 (14.3%) | 1 (2.4%) | +11.9% |
| Thoroughbred | 0 (0.0%) | 7 (16.7%) | -16.7% |
| Connemara | 5 (10.2%) | 0 (0.0%) | +10.2% |
| Arab | 1 (2.0%) | 3 (7.1%) | -5.1% |
| Irish draught | 3 (6.1%) | 0 (0.0%) | +6.1% |
| Other pony breeds* | 4 (8.2%) | 2 (4.8%) | +3.4% |
| Other horse breeds** | 0 (0.0%) | 5 (11.9%) | -11.9% |

568 *Including Dales, Dartmoor, Highland and New Forest ponies and their crosses, **Including Hanoverian, Quarter
 569 horses, heavy breeds and their crosses

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