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The full details of the published version of the article are as follows:

TITLE: Veterinarians in the UK on the use of non-steroidal anti-inflammatory drugs (NSAIDs) for post-disbudding analgesia of calves

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JOURNAL: *Animal Welfare*

PUBLISHER: Universities Federation for Animal Welfare

PUBLICATION DATE: August 2017

DOI: <https://doi.org/10.7120/09627286.26.3.323>

1 **Study investigating the attitudes and opinions of cattle farmers and veterinarians**
2 **in the United Kingdom on the use of Non-Steroidal Anti-Inflammatory Drugs**
3 **(NSAIDs) for post-disbudding analgesia of calves**

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27 **Abstract**

28 The study examined cattle farmers' and veterinarians' opinions of pain-induced
29 distress associated with disbudding and attitudes towards Non-Steroidal Anti-
30 Inflammatory Drugs (NSAIDs). An emphasis was placed on investigating pain
31 perception, vet-client communication and factors influencing analgesic use. Data was
32 collected from an online questionnaire, links to which were published in professional
33 periodicals, promoted by industry organisations and distributed on private practice
34 mailing lists. A total of 110 veterinarians and 116 farmers that regularly disbud calves
35 completed the questionnaires. Of the respondents, 56% of veterinarians and 14% of
36 farmers routinely use NSAIDs for disbudding. Respondents perceived disbudding to be
37 severely painful without medication and 82% of veterinarians and 43% of farmers
38 perceived post-procedural pain to persist beyond 24 hours. There was a significant
39 difference between female and male veterinarians' pain scores for disbudding without
40 medication. Veterinarians underestimate the influences of welfare and analgesic
41 duration and effectiveness on farmers' decisions and overrated cost impact. The study
42 highlights that improvements in veterinarian-farmer communication regarding calf
43 disbudding analgesia are required; both in terms of refining veterinarians'
44 understanding of farmers' priorities and guiding clients on methods to improve calf
45 welfare.

46

47 **Keywords:** Analgesia; Animal Welfare; Calves; Disbudding; Non-Steroidal Anti-
48 Inflammatory Drugs (NSAIDs)

49 **Introduction**

50 Disbudding and dehorning are routine husbandry practices (Stafford & Mellor
51 2005) used to reduce the likelihood of injury to personnel and other cattle (*Bos taurus*)
52 (Misch *et al* 2007). Horn injuries can cause significant pain and distress, as well as
53 damaging the carcass and hide, resulting in financial penalties (Stewart *et al* 2009).
54 Dehorning involves the amputation of the horn, while disbudding is the destruction of
55 horn germinal tissue in young calves to prevent horn growth. The Department of
56 Environment, Food and Rural Affairs (DEFRA 2003) recommends that calves are
57 disbudded before two months old, ideally as soon as the horn bud is palpable, which
58 varies between breeds (Stafford & Mellor 2005). Under the United Kingdom's (UK)
59 Protection of Animals (Anaesthetics) Act 1954/1964, all methods of disbudding and
60 dehorning require a cornual nerve local anaesthetic (LA) blockade. The only exception
61 being chemical cauterisation in calves less than one week old (DEFRA 2003). Thermal
62 cauterisation with LA blockade is the recommended method for disbudding in the UK.

63 A number of studies have investigated physiological and behavioural indicators
64 of the pain-induced distress associated with disbudding of calves (Allen *et al* 2013;
65 Coetzee *et al* 2012; Earley & Crowe 2002; Gibson *et al* 2007; Graf & Senn 1999;
66 Grondahl-Nielsen *et al* 1999; Heinrich *et al* 2010; McMeekan *et al* 1998; Stewart *et al*
67 2008; Stilwell *et al* 2012; Sutherland *et al* 2002). These studies similarly concluded that
68 disbudding is a painful procedure, which without pain-relief causes pain and suffering.
69 It has been suggested that post-disbudding pain persists for up to 24 hours (Faulkner &
70 Weary 2000) and potentially 44 hours (Heinrich *et al* 2010). It is generally considered
71 that the LA used for disbudding and dehorning are effective at providing nerve
72 blockage for up to two hours (Heinrich *et al* 2009; Stafford & Mellor 2011). However,
73 that can result in a period post procedure where the LA blockage has worn off, with the

74 animal experiencing pain and distress, particularly from the inflammatory response in
75 the wound.

76 Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are routinely used in
77 companion animal (Capner *et al* 1999; Dohoo & Dohoo 1996a, 1996b; Lascelles *et al*
78 1999) and equine practice (Waran *et al* 2010), however their usage is sometimes
79 overlooked in farm animals (Barrett 2004; Whay & Huxley 2005) and they are not
80 routinely used for disbudding or dehorning of cattle in the UK. Non-Steroidal Anti-
81 Inflammatory Drugs are Prescription-only Medicines (POM-V), which farmers require
82 the authorisation of a registered veterinarian for their use (NOAH 2015; RCVS 2015).
83 The use of NSAIDs in combination with LAs have been shown to reduce post-
84 disbudding pain in calves (Faulkner & Weary 2000; Heinrich *et al* 2010; McMeekan *et*
85 *al* 1998; Stewart *et al* 2009; Stilwell *et al* 2012), virtually eliminating the cortisol-stress
86 response when compared to LA alone (Allen *et al* 2013; Heinrich *et al* 2009; Stafford
87 & Mellor 2011; Stafford *et al* 2003). Furthermore, NSAIDs have been shown to
88 increase feed intake (Duffield *et al* 2010; Heinrich *et al* 2010) and growth rates
89 (Faulkner & Weary 2000) in calves post-procedurally. However, despite the large body
90 of scientific evidence on the effectiveness of NSAIDs for reducing the pain and distress
91 associated with disbudding, farmers and veterinarians in the UK do not routinely use
92 them during disbudding. Furthermore, there are currently no legislative requirements
93 for the usage of NSAIDs for disbudding in the UK, it is at the discretion of the
94 farmer/veterinarian carrying out the procedure.

95 Questionnaire-based studies have investigated the opinions of British (Capner
96 *et al* 1999; Lascelles *et al* 1999) and Canadian (Dohoo & Dohoo 1996a, 1996b)
97 veterinarians towards pain and analgesia in companion animals. Similar studies have
98 explored veterinarian and farmer perceptions of pain and analgesia in cattle in relation

99 to various conditions and procedures (Fitzpatrick 2002; Hudson *et al* 2008; Huxley &
100 Whay 2006, 2007; Lorena *et al* 2013; Watts & Clarke 2000; Whay & Huxley 2005),
101 with a number of studies conducted outside of the UK (Gottardo *et al* 2011; Hewson *et*
102 *al* 2007; Hoe & Ruegg 2006; Hokkanen *et al* 2015; Lorena *et al* 2013; Misch *et al* 2007;
103 Norring *et al* 2014; Vasseur *et al* 2010; Wikman *et al* 2013, 2016). However, there is
104 currently a lack of detailed information on the opinions and awareness of UK
105 veterinarians and farmers on the usage of NSAIDs for disbudding and the potential
106 reasons for why they are not more commonly used.

107 The aim of the study was to examine the attitudes and opinions of UK cattle
108 farmers and veterinarians on the pain associated with disbudding, analgesia and the use
109 of NSAIDs for disbudding of calves. With an emphasis on pain perception,
110 demographic factors, vet-client communication, economics and other factors
111 influencing potential NSAID usage.

112

113

114 **Materials and Methods**

115 Two matched online questionnaires were developed with specific questions
116 adapted towards the target populations. The questionnaires were designed to investigate
117 cattle farmers' and veterinarians' opinions on the pain associated with disbudding and
118 the usage of NSAIDs. The study and questionnaires were approved by the Royal
119 Veterinary College Research Ethics Committee.

120

121 ***Questionnaire Design***

122 Some questions were adapted from previous research (Gottardo *et al* 2011;
123 Huxley & Whay 2006, 2007; Whay & Huxley 2005). Questions were primarily closed-
124 ended with appropriate categories, including 'don't know' to avoid selectional bias.
125 Questionnaires examined: participant demographics; education; awareness of cattle
126 pain and analgesia; detailed disbudding practices; and factors influencing NSAID
127 usage. The perception of pain duration and severity experienced by calves during
128 disbudding (with various analgesic protocols) was examined with a numerical scale
129 adapted from previous studies (Fitzpatrick 2002; Hewson *et al* 2007; Huxley & Whay
130 2007; Watts & Clarke 2000; Whay & Huxley 2005). Influences of various factors on
131 NSAID usage (potential side-effects; cost; availability; anti-inflammatory/toxic effects;
132 support; veterinary advice; availability; duration of action; administration; dose;
133 licensing; withdrawal period), were assessed on a Likert scale adapted from Whay and
134 Huxley (2005). Previously in a survey by Huxley and Whay (2007) the majority of
135 participants stated 'less than five pounds' was an acceptable price for NSAIDs.
136 Therefore, in the current survey the cost question focused on the £0 to £5 range.

137

138 ***Survey Distribution and Analysis***

139 The surveys were made available online via SmartSurvey (Smartline
140 International Ltd., Gloucestershire, UK) with access via web links or Quick Response
141 (QR) codes. The study was promoted via newsletters and adverts produced by various
142 organisations (EBLEX, DairyCo, NFU, BCVA, NADIS, Farmers Weekly) and on
143 private practice mailing lists. A prize was offered as an incentive.

144 After collation, data for participants who do not disbud was removed. Prior to
145 analysis, data was categorised and certain responses combined. Pain-scales were treated
146 as categorical variables. In the results, ‘pain perception’ refers to pain scale and post-
147 procedural pain duration responses and ‘analgesia’ refers to NSAIDs and doesn’t
148 consider other drugs such as opioids. Analysis of the standard drugs used for disbudding
149 was made with exclusion of those respondents citing the use of caustic pastes (vets n =
150 2; farmers n = 13), as neural blockade and analgesia are not a requirement for this
151 method.

152

153

154 ***Statistics***

155 Data was analysed using SPSS (Version 22, IBM Corporation, Chicago, IL,
156 USA). Data was rejected where questions were not completed. Categorical variables
157 were analysed for associations with the Chi-squared tests or Fisher’s exact test when
158 appropriate. The Kolmogorov-Smirnov test was used to determine the distribution of
159 continuous data. Continuous data was non-parametrically distributed. Differences
160 between veterinarian and farmer responses for post-procedural pain duration, duration
161 of action and price were analysed with either Mann-Whitney U or Kruskal-Wallis tests.
162 The level of significance for all tests was $P < 0.05$.

163

164

165 **Results**

166 A total of 118 veterinarians and 140 farmers completed the questionnaires, of
167 which 93% (n = 110) and 83% (n = 116) respectively, regularly disbudded calves. Data
168 from those respondents who do not disbud calves were not included in subsequent
169 analysis.

170

171 *Demographics*

172 All veterinary respondents practiced within the UK and 93% (n = 102) were UK
173 graduates. With representatives from seven UK veterinary schools (excluding
174 University of Surrey). Eight (7%) respondents were from overseas veterinary schools.
175 The median year since graduation was 9.5 (year of graduation range 1973 – 2014).
176 There was an even gender distribution of veterinary respondents (50% male; 50%
177 female) (n = 110). The median proportion of time working with cattle was 80%
178 (interquartile range (IQR): 50 – 95%). Seventy respondents (64%) had participated in
179 cattle-related post-graduate training.

180 Farmer respondents were from across the UK. There was an uneven gender
181 distribution of 71 males (61%) and 39 females (34%), six individuals did not answer
182 this question. Ninety-two (79%) respondents had more than 20 years of farming
183 experience (range: < 5 – > 50 years). Most respondents owned farms (64%; n = 74) and
184 cattle were the main enterprise (74%; n = 86). Beef and dairy cattle farmers represented
185 59% (n = 68) and 31% (n = 36) of respondents respectively, with smallholders, breeders
186 and conservation grazers making up the remaining 10%. Median herd size was 150
187 cattle (range: 0 – 1200). Beef farmers had significantly smaller cattle herds (median
188 153, IQR 62 – 200) than dairy producers (median 323, IQR 140 – 478) (P<0.0001).

189

190 ***Disbudding Practices***

191 There was no significant difference between beef and dairy farmers in the
192 reasons or methods used for disbudding calves. Eighty percent (n = 93) of all farmers
193 reported that they disbud to prevent injury, 13% (n = 15) disbud for financial reasons,
194 and 4% (n = 5) for aesthetic purposes. Seven (47%) of those disbudding for financial
195 reasons rated cost as very important, whilst the majority disbudding for safety concerns
196 rated it as less important (n = 27, 29%) ($P = 0.038$).

197 On the farms that disbud the procedure was carried out by: farm personnel 86%
198 (n = 100), veterinarians 11% (n = 13), contractors 2% (n = 2), and students 1% (n = 1).
199 The disbudding methods used by veterinarians included: blow torch and hot iron (52%,
200 n = 57), gas-powered cauteriser (45%, n = 49), mechanical (scoop) disbudding (7%, n
201 = 8), electronic cauterization (5% n = 5) and caustic paste (2%, n = 2), with 6% (n = 7)
202 of these using a combination of methods. Meanwhile, the methods used by farmers
203 included: gas-powered cauterizer (59%, n = 69), blow torch and hot iron (19%, n = 22),
204 electronic cauterization (11%, n = 13), caustic paste (11%, n = 13), mechanical (scoop)
205 disbudding (3%, n = 4), or a combination of methods (4%, n = 5). Fifteen farmer
206 respondents (13%) reported that they were also introducing polled genetics into the
207 herd (10 beef and 5 dairy producers). Twenty four (21%) farmers stated they don't
208 disbud when asked, 71% (n = 17) of these where beef producers (8% dairy, 21% other).
209 Of the farmers that don't disbud, 50% (n = 12) said they breed polled cattle, 17% (n =
210 4) dehorned at a later stage, 8% (n = 2) did not disbud due to ethical/welfare reasons
211 and six choose not to answer the question. Most veterinarians (94%, n = 102) and
212 farmers (93%, n = 108) reported that they disbud calves under eight weeks old. Five
213 veterinarians (5%) and eight farmers (7%) reported that they disbud after eight weeks.

214 There were no significant associations between disbudding age/method with
215 perceptions of pain/analgesic use.

216

217 ***Knowledge of Pain and Analgesia***

218 Veterinarians reported that they gained their knowledge from clinical
219 experience (47%, n = 52) and undergraduate training (21%, n = 23). There was little
220 difference in the sources of knowledge on cattle pain and analgesia between
221 veterinarians that routinely use or don't use NSAIDs for disbudding. The only
222 association found was that veterinarians that routinely use NSAIDS accessed literature-
223 based NSAID information (papers, articles, commercial literature, data sheets, etc)
224 more often than those that don't use NSAIDs ($P = 0.009$). Sixty-seven percent (n = 70)
225 of veterinarians stated that their knowledge of cattle pain and analgesia was adequate,
226 of this 66% routinely used NSAIDs for disbudding. There was a significant association
227 between perceived level of knowledge and the routine use of NSAIDs for disbudding
228 ($P = 0.019$). There were no associations between knowledge/training and veterinary
229 pain perceptions.

230 Seventy-two percent of farmers (n = 84) reported that their knowledge of
231 disbudding analgesia is adequate, there was no significant difference between beef and
232 dairy producers. Farmers reported that they gained their knowledge through tradition
233 (36%, n = 42), training courses (31%, n = 36), veterinarians (27%, n = 31) and media
234 (5%, n = 6). There were no significant associations between information sources and
235 NSAID usage amongst farmers. When asked where farmers would seek advice if they
236 were considering introducing NSAIDs to their disbudding protocol, 94% (n = 109)
237 stated they would approach their veterinarian. Other responses included professional
238 farm management advisors, fellow farmers/meetings and information resources (i.e.

239 internet, articles, leaflets). Almost 20% of farmers stated a combination of these
240 resources but none reported that they would seek advice from drug company
241 representatives.

242

243 ***Perception of the Pain Associated with Disbudding***

244 Veterinary and farmer responders rated the severity of disbudding-induced pain
245 with different analgesic protocols (table 1). Veterinarians and farmers were similar in
246 the ranking of the severity of pain associated with disbudding with the different
247 analgesia protocols. Significantly more female (51%; n = 28) compared to male (26%;
248 n = 14) veterinarians scored disbudding as severely painful (pain severity score 10) (P
249 = 0.029). There was no association between gender, farm type and the scoring of pain
250 severity of disbudding for farmers. There was a significant association between groups
251 (veterinarians/farmers) and the perception of post-disbudding pain duration ($P < 0.001$)
252 (table 2). Eighty-two percent of vets reported that the pain of disbudding lasted >24 hr,
253 compared to 43% of farmers ($P < 0.05$). Twelve percent of farmers reported they didn't
254 know how long post-disbudding pain lasted, compared to 3% of veterinarians ($P <$
255 0.05). There was a significant association between veterinarian use of NSAIDs and
256 perception of post-disbudding pain ($P = 0.02$), with 51% of veterinarians that routinely
257 use NSAIDs reporting that the pain lasted >24 hr, compared to 31% who do not use
258 NSAIDs.

259

260 **TABLE 1**

261 **TABLE 2**

262

263 ***Disbudding Drugs***

264 Drugs used by respondents during disbudding are detailed in table 3. One
265 hundred and six (98%) and 89 (86%) veterinarians and farmers respectively, reported
266 that they routinely use LA when disbudding. In addition, 60 (56%) and 14 (14%)
267 veterinarians and farmers (8 beef and 6 dairy producers) respectively reported that they
268 routinely use NSAIDs when disbudding ($P < 0.001$). Of respondents using NSAIDs,
269 all farmers (100%) and 84% of veterinarians (51%, $n = 48$) reported that the drug used
270 was meloxicam. Veterinarians also reported using flunixin meglumine (7%, $n = 4$) and
271 ketoprofen (2%, $n = 1$). Seventy-nine percent ($n = 87$) of veterinarians identified
272 meloxicam as the UK licensed NSAID for disbudding. Veterinarian's reported having
273 permission to use NSAIDs on a median of 13% of their client's farms (range:0 – 100).

274

275 **TABLE 3**

276

277 There was a significant difference ($P < 0.001$) between responses of farmers
278 and veterinarians in their preference for calves to receive disbudding analgesia. Sixty-
279 one (56%) veterinarians compared to 26 (22%) farmers stated they would prefer if
280 calves received NSAIDs for disbudding, there was no difference between farmer type.
281 While 48% of farmers indicated that they may be interested in the use of NSAIDs.
282 There was a significant association between veterinarian pain scores for disbudding
283 without any pain relief and a preference for clients to use NSAIDs for disbudding ($P =$
284 0.033). Fifty-four veterinarians (49%) reported that NSAIDs should be made
285 compulsory for disbudding. There was a significant association between veterinarian's
286 opinions on compulsory use of NSAIDs and number of years since graduation ($P =$
287 0.015), where newer graduates were more in favour of their use.

288

289 ***Factors affecting the use of NSAIDs for disbudding***

290 Veterinarians were asked to rate the importance of fourteen factors on their
291 decision to use NSAIDs for calf disbudding (Figure 1). The following factors were
292 rated as very important in influencing their decision to use NSAIDs: analgesia and
293 welfare (77%), anti-inflammatory effect (57%), duration of action (63%) and licensing
294 (57%) (modal value). Administration ease (45%), cost (34%) and time to onset (45%)
295 were rated as quite important. Veterinarians routinely using NSAIDs significantly
296 scored analgesia/welfare ($P = 0.015$) and duration of action ($P = 0.019$) as more
297 important, while cost was scored as less important ($P = 0.001$) compared to those who
298 don't use NSAIDs. The majority of veterinarians scoring analgesia/welfare as very
299 important, also perceived pain to persist >24 hr (64%, $n=70$) ($P = 0.016$). Of the 31%
300 of vets that said that pain persist >24 hr but did not use NSAIDs, the factors they
301 reported as very important in influencing their decisions regarding NSAIDs where:
302 analgesia and welfare (75%), duration of action (64%), anti-inflammatory effect (61%)
303 and licensing (58%). Meanwhile, administration ease (50%), time of onset (47%) and
304 cost (36%) were rated as quite important. Twenty three percent ($n=25$) of veterinarians
305 thought that all their farming clients would prefer calves to receive NSAIDs for
306 disbudding. While 71% ($n=78$) reported that some of their clients would.

307

308 **FIGURE 1**

309

310 Similar to the veterinarian ratings, farmers were asked to rate the importance of
311 eleven factors in relation to considering NSAID usage for disbudding calves. In
312 addition, veterinarians were also asked to rate these same factors from the perspective
313 of the farmer (their perceived perspective) (table 4). Fifty-three percent of farmers (58%

314 beef and 42% dairy farmers) rated analgesia and welfare as very important compared
315 to just over a quarter of veterinarians (27%) ($P = 0.001$). Veterinarians significantly
316 underestimated how important farmers rated onset ($P < 0.001$), duration of action ($P <$
317 0.001), side effects ($P < 0.001$), licensing ($P < 0.001$) and product support ($P < 0.001$).
318 Eighty-two farmers (71%) (70% beef and 74% dairy farmers) stated that veterinary
319 recommendation was very or quite important, however this was not significantly
320 different to the veterinarian's perspective of the farmer's concerns. Conversely,
321 veterinarians significantly overestimated the importance of withdrawal periods ($P <$
322 0.001) and ease of administration ($P = 0.001$).

323

324 **TABLE 4**

325

326 Sixty-four percent of veterinarians thought that the most important concern of
327 farmers was cost. However, only 18% of farmers (19% beef and 16% dairy farmers)
328 reported cost as a very important factor when considering NSAID usage; veterinarians
329 significantly overestimated the importance of cost and labour to farmers ($P < 0.001$)
330 (figure 2). Farmers were asked what price per calf they would consider acceptable for
331 NSAIDs for disbudding. Seventy-three percent of farmers (74% beef and 71% dairy
332 farmers) responded that a dose less than £2 per calf would be acceptable (figure 3).
333 When broken down 37%, 36%, 16% and 1% of farmers reported that they thought <
334 £1, £1 – 2, £2 – 5 and > £10 respectively were acceptable costs per dose. Similarly,
335 veterinarians were asked what cost per dose they thought would be acceptable to their
336 clients (farmers). Sixty-six percent said the cost would have to be less than £2 to be
337 acceptable (33% < £1; 34% £1 – 2; 24% £2 – 5). Only 2% of farmers responded that
338 they would be unwilling to pay for NSAIDs, compared to 7% of veterinarians stating

339 that farmers would be unwilling to pay. For veterinarians there was a significant
340 association between the perception of disbudding pain duration lasting > 24 hr and
341 those that stated a higher acceptable price for NSAIDs ($P = 0.034$). Furthermore,
342 veterinarians that routinely used NSAIDs reported that farmers would find £2-5 an
343 acceptable cost per dose of NSAIDs ($P < 0.001$).

344

345 **FIGURE 2**

346 **FIGURE 3**

347

348 *Vet-Client Communications*

349 When asked whether veterinarians discussed cattle analgesia enough, there was
350 a significant difference between the groups with 71% and 45% of veterinarians and
351 farmers respectively stating the subject was not discussed enough ($P < 0.001$). Seventy-
352 eight percent of veterinarians reported that they had discussed the use of NSAIDs with
353 their clients. Overall 29% of farmers said they have had discussions with their vets on
354 the use of NSAID for disbudding. Dairy farmers were more likely to have these
355 discussions with 41% reporting talking to their vets about NSAIDs compared to 25%
356 of beef farmers. Of the farmers that reported they have discussed NSAIDs for
357 disbudding with their veterinarian, 29% routinely used NSAIDs, while 71% did not (P
358 < 0.001). In total 101 farmers said they don't use NSAIDs, of these 72% reported that
359 they have never discussed disbudding analgesia with their veterinarian.

360 Veterinarians that perceived post-disbudding pain to persist > 24 hours were
361 more likely to have discussed the use of NSAIDs with their farming clients ($P = 0.001$).
362 Generally, veterinarians who discussed NSAID usage with their clients spent
363 significantly more time working with cattle, than those who did not ($P = 0.025$). These

364 same veterinarians were more likely to be permitted to use NSAIDs on their clients'
365 farms ($P < 0.001$).

366 **Discussion**

367 This is the first detailed study comparing the attitudes and opinions of UK
368 veterinarians and farmers on the use of NSAIDs for disbudding of calves. There were
369 disparities in responses between veterinarians and farmers on the: influence of
370 veterinarians on analgesia choices; importance of cost; and welfare. However, almost
371 all veterinarians and most farmers favoured NSAID use, with most veterinarians stating
372 that some (71%), if not all of their clients (23%), would prefer calves to receive
373 NSAIDs. Likewise, approximately half of veterinarians think NSAIDs should be made
374 compulsory for disbudding.

375

376 ***Current Practices***

377 The disbudding of calves is a routine husbandry practice, which when practiced
378 without adequate pain relief can result in significant pain and distress. In the study the
379 majority of farmers (86%) and veterinarians (98%) reported that they routinely used
380 LA when disbudding. In addition, 5% and 7% of veterinarians and farmers respectively
381 reported that they were disbudding calves after eight weeks of age. The disbudding of
382 calves without LA and over 8 weeks of age could be considered a breach of the
383 Protection of Animals (Anaesthetics) Act 1954/1964; Veterinary Surgeon Act 1996;
384 Animal Welfare Act 2006; and DEFRA Code of Recommendation for the Welfare of
385 Livestock (Cattle). However, care must be taken with these results as the response was
386 open-ended, so this doesn't necessarily mean that participants are not using LA, even
387 if they have not stated its use. Potentially veterinarians' who did not state LA, instead
388 used general anaesthesia instead for calves older than eight weeks old. Local
389 anaesthesia for disbudding is not routinely used in some overseas countries, although it
390 is widely agreed that the procedure is painful (Gottardo *et al* 2011; Hoe & Ruegg 2006).

391 It is worth noting that several respondents stated use of lidocaine preparations, which
392 are not currently licensed for use in UK food-producing animals (Reg (EC) 37/2010)
393 (Commission).

394 The most commonly used disbudding methods for both groups involved
395 cauterisation of the horn bud and surrounding tissue. This is consistent with the findings
396 of Cozzi *et al* (2015), who reported that cauterization was the most common method in
397 EU Member states. Cauterisation produces third-degree burns, damaging nociceptors
398 and resulting in desensitization (Doherty *et al* 2007). Furthermore, it has been
399 associated with reductions in plasma cortisol concentrations compared to other
400 dehorning methods, suggesting a reduced pain response (Petrie *et al* 1996; Stafford &
401 Mellor 2011). Interestingly 13% of the farmers reported that they were introducing
402 polled genetics into their herds. This was a higher proportion than that reported by
403 King-Eveillard *et al* (2015) (9%) in a survey of farmer attitudes in Italy, Germany and
404 France. The breeding of polled animals would remove the need for disbudding and
405 dehorning. The polled genotype is dominant over the horned, with the gene located on
406 the proximal end of the Bovine chromosome 1 (Brenneman *et al* 1996; Georges *et al*
407 1993). There has been resistance to the induction of polled genetics, based on the
408 concern that selection of the polled allele might result in: lower breeding values for
409 preferred production traits and the potential for high relatedness and inbreeding due to
410 the lower range of available sires and genetic diversity (King-Eveillard *et al* 2015;
411 Windig *et al* 2015). However, as more farmers and breeding companies start to
412 introduce polled genetics, the number of sires with higher genetic merit is increasing,
413 making polled genetics a viable alternative to current practices.

414 Fifty six percent of veterinarians used NSAIDs for disbudding; this was
415 significantly greater than that reported in similar studies by Huxley & Whay (2006)

416 (disbudding 1.7%; dehorning 2.6%) and Misch *et al* (2007) (dehorning 1.5%).
417 Meanwhile, 14% of farmer responders reported that they use NSAIDs, this proportion
418 was higher than previously reported by Gottardo *et al* (2011) (5%) and Vasseur *et al*
419 (2010) (0%) in northeastern Italy and Canada respectively, but was significantly less
420 than Finnish farmers (48%). In addition to regional differences in veterinary and
421 farming practices a possible reason for this apparent increase in usage by both groups
422 may be increased awareness of the benefits of NSAIDs and the recent registering of
423 meloxicam (under brand name of Metacam™ in the UK) for disbudding and dehorning
424 in calves in the EU. Indeed, Huxley & Whay (2006) reported a similar proportion of
425 veterinarians reporting the use of NSAIDs in calves for other procedures and conditions
426 (e.g. sole ulcers, claw amputations, dystocia, caesarean section, etc). Alternatively, the
427 sample could have been biased, as individuals with a greater concern for welfare,
428 analgesia or awareness of the registering of meloxicam may have been more likely to
429 participate in a survey of this type.

430

431 ***Pain, Analgesia and Knowledge***

432 Both veterinarian and farmer respondents agreed that disbudding without
433 medication is severely painful and that this pain can be reduced with the use of LA.
434 This finding is consistent with the existing literature, guidelines and minimum
435 standards. Veterinarian pain-scores were higher and within a narrower range than
436 reported by Huxley & Whay (2006) (median 9 (range: 6-10) versus median 7 (range:
437 2-10) respectively). This difference may be because the current study focuses solely on
438 disbudding, without estimation of pain alongside that of other procedures, meanwhile
439 Huxley & Whay (2006) examined the attitudes relating to a range of procedures and
440 conditions. Meanwhile, the pain score results in the current study were similar to those

441 of Finnish veterinarians & clinical veterinary students as reported by Norring *et al*
442 (2014), who also reported a positive association between disbudding pain scores
443 (without pain relief) with higher human empathy scores.

444 Farmers generally perceived disbudding as less painful with a LA+NSAID
445 compared to LA alone, however veterinarians scored them equally. This is an
446 interesting finding and suggests that research on disbudding and NSAIDs may not be
447 finding its way into cattle practice. To ensure adequate advice is being provided to
448 clients it is important that veterinary surgeons are up to date with recent developments
449 in the profession. An alternative explanation is that as farmers spend more time with
450 their livestock post-procedure than veterinary surgeons, they are more likely to have
451 observed the benefits of LA+NSAIDs for post-operative pain. Whereas due to the
452 financial demands of farm animal veterinary practice, vets seldom have the time to
453 observe calves post procedure prior to leaving to visit other clients.

454 In the study, female veterinarians scored disbudding without medication as
455 significantly more painful than their male counterparts. Meanwhile, there was no such
456 relationship with the farmers. Dohoo & Dohoo (1996a) found similar findings for
457 veterinarians in a study of companion animal practitioner's opinions on post-operative
458 pain and analgesia. However, in studies which also included disbudding, no significant
459 associations were found between gender and opinions on post-operative pain in vets
460 (Hewson *et al* 2007; Huxley & Whay 2006). Years since graduation in the current study
461 had no bearing on veterinarian perception of pain during disbudding, which was similar
462 to findings of Hewson *et al* (2007). However, Huxley and Whay (2006) reported that
463 older graduates assigned higher pain scores to disbudding without pain-relief.
464 Conversely, Dohoo and Dohoo (1996a) found that recent graduates perceived
465 companion animals to experience more post-operative pain compared to more

466 experienced peers. Despite the lack of association between years since graduation and
467 perception of pain of disbudding in the current study, it was found that newer graduates
468 were more likely to agree that NSAIDs should be made compulsory for disbudding.

469 It is important to note, that there has been significant debate about the
470 subjectivity of pain scales. The issue is that pain scales by their nature are subjective,
471 open to interpretation bias and do not take account of the multidimensionality of pain
472 (Krebs *et al* 2007). However, in many situations they are the only available method for
473 the assessment of opinions on painful husbandry practices. Also despite these
474 limitations numerical scoring systems with carefully designed questionnaires are now
475 recognised as sensitive methods for quantifying attitudes in regards to pain, simplifying
476 data for collection and analysis (Hjermstad *et al* 2011, Jensen *et al* 1994, Williamson
477 & Hoggart 2005).

478 It has been previously reported that post-disbudding pain can persist beyond 24
479 hours (Faulkner & Weary 2000, Heinrich *et al* 2010). In the study almost twice the
480 number of veterinarians than farmers stated that post-disbudding pain persists beyond
481 24 hours. This difference in perception may be attributable to veterinarian's training
482 (undergraduate/post-graduation continuing professional development (CPD)),
483 specifically awareness of pain-induced behaviours displayed in calves, or awareness of
484 recent research. Indeed, veterinarians perceiving pain to persist beyond 24 hours stated
485 that analgesia/welfare featured highly in their analgesic choices. In an Italian study,
486 most farmers perceived pain to diminish within 6 hours (Gottardo *et al* 2011), a view
487 shared by a minority in the current study. This could be due to cultural differences or
488 variations in farming systems in other countries compared to the UK. Fifty one percent
489 of veterinarians that reported that post-disbudding pain persists beyond 24 hours were
490 routine NSAID users. The duration of analgesia and its effectiveness was reported as

491 more important to veterinarians who routinely use NSAID than to non-users. This
492 suggests that clinicians' perceptions of animal suffering has an important influence on
493 analgesic choices. However, it is disconcerting that 31% of veterinarians that reported
494 that post-disbudding pain persisted beyond 24 hours did not use NSAIDs. It is unclear
495 from the results the reasons for this seemingly contradictory response. When asked
496 what were the most important factors in influencing their decision on NSAID usage,
497 the results effectively mirrored those of the veterinarians that do use NSAIDs. Potential
498 factors that could have contributed to their decision not to use NSAID may relate to
499 internal and external pressures, such as client wishes, practice policy, perception of
500 importance of cost to the farmer, lack of dissemination of current best practice and even
501 an unwillingness to change practices. These factors were not covered in the survey.

502 Compared to the studies of Lorena *et al* (2013) (16%) and Whay & Huxley
503 (2006) (46%), the current study found that sixty-seven percent of veterinarians
504 considered their knowledge of cattle pain and analgesia to be adequate. This is
505 consistent with the findings of Hewson *et al* (2007) (75%) on attitudes of Brazilian
506 large animal clinicians. The differences between the studies may be due to changes in:
507 (1) awareness of post-operative pain in the past ten years; interestingly there was little
508 change in the reported sources of the information on pain relief by veterinarians in the
509 current study and those of Lorena *et al* (2013) and Whay & Huxley (2005); (2)
510 veterinary school curriculums and teaching filtering through into practice; 62% of
511 veterinary respondents had graduated within the last five years and veterinarians using
512 NSAIDs were more likely to access information on them via literature (papers, articles,
513 commercial literature, data sheets, etc); and (3) due to the recent registration and
514 increased advertising of Metacam™ to cattle veterinarians.

515 Meanwhile, only 16% of farmer respondents felt their knowledge of cattle pain

516 and analgesia to be insufficient. This is in contrast to almost two-thirds of farmers eight
517 years ago (Huxley & Whay 2007). In the current study however, knowledge of
518 analgesia related specifically to disbudding, whilst the Huxley & Whay (2007) study
519 explored more generalised opinions on cattle. Potentially, this indicates that farmers are
520 more aware of analgesia for disbudding of cattle compared to other procedures and
521 conditions (e.g. surgical castration, joint ill, fractures etc). Alternatively, it may suggest
522 that awareness or education on the use of pain-relief for procedures has improved since
523 the previous study. However, this could not be determined from the current study.

524

525 *Veterinary-Farmer Communication*

526 Most farmers reported that they seek advice about analgesia from their
527 veterinarian and indicated that this advice can be highly influential on their decisions.
528 Similarly, veterinary respondents highlighted the importance of vet-client
529 communications. However, 45% of farming respondents reported that veterinarians
530 don't discuss cattle analgesia enough. This is a similar proportion as reported by Huxley
531 & Whay (2007) (53%) in a larger survey of attitudes in relation to use of analgesics in
532 cattle (all procedures). Seventy one percent of veterinarians also reported that
533 disbudding analgesia wasn't discussed enough. In the current study, 71% of farmers
534 have never discussed NSAIDs for disbudding with their veterinarian. Yet 78% of
535 veterinarians said they had discussed NSAIDs with their clients. This disparity suggests
536 a disconnection in vet-client communication on the topic of NSAIDs, suggesting that
537 more work is needed to improve the dialog between vet and client. However, these
538 findings must be interpreted with caution as the surveys were not vet/client matched,
539 regional effects were not tested and sample size of both populations were not large,
540 which could have introduced regional based bias. Veterinarians that had discussed

541 NSAIDs with their clients were more likely to respond that post-disbudding pain
542 persisted beyond 24 hours, these responders also generally spent more of their time
543 working with cattle. This is similar to the findings of Hewson *et al* (2007) for Canadian
544 veterinarians.

545 One discouraging finding in the study was that of the farmers that had discussed
546 NSAIDs for disbudding, only 29% routinely used them, while 71% did not. This
547 suggests that veterinary advice although rated important by farmers in the decision-
548 making processes, does not always help to influence behavioural change. Ajzen (1991)
549 proposed with the theory of planned behaviour that an individual's intention to engage
550 in a behaviour (such as adoption of NSAIDs for disbudding) is influenced by the
551 interaction of attitude towards the behaviour, subjective norms and perceived
552 behavioural control. In the context of analgesia and disbudding the lack of uptake of
553 NSAIDs by farmers could be influenced by attitude to the changes in practice, how
554 these changes will be perceived by others (peers, vets, suppliers, buyers, public etc) and
555 how the farmer perceives the ease or difficulty of the new practice (practicality, skill,
556 perceived barriers) (Godin and Kok 1996). Generally, the more positive the attitude and
557 the subjective norms, combined with greater perceived control the more likely the
558 intention is to perform the behaviour.

559 Both groups had similar concerns about analgesia onset, duration and
560 effectiveness, however veterinarians underestimated the impact that these factors have
561 on farmer decision-making. In addition, veterinarians underestimated the influence of
562 NSAID side effects, licensing and product support on farmers and overestimated the
563 importance of withdrawal periods and administration ease. Suggesting that
564 veterinarians do not always correctly perceive or understand the motivation and
565 concerns of their clients in relation to animal welfare. Veterinarians also overestimated

566 the impact of cost/labour to the farmers, which is similar to the findings of Huxley &
567 Whay (2006) and Kristensen and Enevoldsen (2008). These distorted perceptions of
568 farmer motivations and concerns could potentially affect the type of advice that
569 veterinarian's offered to their clients, which could have impacts on welfare and
570 production. Despite this, the majority (66% veterinarians; 73% farmers) of both groups
571 agreed on an acceptable NSAID price of less than two pounds per calf, which supports
572 the findings of Huxley and Whay (2007). According to a specified list price for
573 meloxicam of £1.97/100kg (Hudson *et al* 2008; Wern Veterinary Surgeons price 2015),
574 NSAIDs would be a viable option for the majority of respondents in the current study.
575 Veterinarians that indicated that the pain associated with disbudding persisted for a
576 longer period were more likely to state that farmers would be willing to pay a higher
577 price for NSAIDs. Similarly, a study by Hewson *et al* (2007) reported an association
578 between the unwillingness to pay for analgesia with lower pain scoring. Veterinarians,
579 who indicated they don't use NSAID, generally rated cost importance higher and stated
580 lower acceptable prices (less than one pound) compared to NSAID users. These
581 findings highlight the importance of improving vet-client communication around the
582 subject. As it suggests that some veterinarians may not be adequately discussing with
583 their clients NSAIDs options due to preconceived notions of farmer perceptions and
584 priorities. It is an essential part of veterinary medicine that all realistic analgesic options
585 are communicated with clients to allow them to make informed decisions for the care
586 of their livestock.

587

588

589 **Implications for animal welfare and conclusions**

590 In conclusion, this study highlights an inadequacy in vet-client communications

591 in conveying the practicalities and potential benefits of using NSAIDs. Importantly
592 veterinarians underestimate the influences of welfare, and analgesic duration and
593 effectiveness on farmers' decisions and overrated cost impact. This perception could
594 have a negative effect on veterinary recommendation and should be addressed.

595

596

597 **Acknowledgements**

598 The authors are grateful for the assistance of the following who kindly provided
599 copies of their previous surveys: J Huxley & B Whay; T Duffield; I Dohoo; and F
600 Gottardo. In addition, the authors would also like to thank those individuals and
601 organisations who helped to promote the questionnaires; T Fullick (NFU); C Lloyd
602 (EBLEX); J Gibbons (DairyCo); NADIS; BCVA; BVA; Farmer's Weekly; and the
603 respondents who took the time to complete the questionnaires. SYN Hambleton was
604 supported by a Universities Federation for Animal Welfare (UFAW) Student
605 Scholarship.

606

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