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Naming and recognition of six foot lesions of sheep using written and pictorial information: a study of 809 English sheep farmers

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Abstract

In 2004, 3000 questionnaires were sent to a random sample of English sheep farmers from a list kept by the English Beef and Lamb Executive (EBLEX) to investigate whether farmers could correctly name six common foot lesions in sheep from a characteristic picture and a written description. The lesions were interdigital dermatitis (ID), footrot (FR), contagious ovine digital dermatitis (CODD), shelly hoof, foot abscess and toe granuloma. In addition, farmers were asked to report the total percent of lame sheep in their flock in 2004 and the percent of this lameness attributable to each of the six lesions listed above. The overall response percentage was 44 with a usable response of 32%.

Fifty nine farmers out of 262 (23%) who answered all six questions named all six lesions correctly. This was greater than expected by chance. The same questionnaire of six lesions was presented at a meeting of specialist sheep advisors, primarily veterinarians, 37/47 (79%) responders named all six lesions correctly.

From the six lesions listed above, the percent correctly named by farmers was approximately 83%, 85%, 36%, 28%, 65% and 43% and the percent incorrectly attributed to another lesion was 5%, 47%, 10%, 13%, 35% and 7% respectively. The most commonly used incorrect name was FR, with farmers tending to name any hoof horn lesion as FR. A comparison of the distribution of sheep lame by a lesion correctly named compared with the same lesion incorrectly named as FR suggested that farmers recognised lesions but did not name them correctly; the distribution of lameness fitted the pattern for the correctly named lesion rather than the pattern of lameness attributed to FR. The results were validated with farm visits and a repeatability study of the questionnaire.

The mean farmer-estimated prevalence for all lameness was 10.4%; with 6.9%, 3.7%, 2.4%, 1.9%, 0.9% and 0.8% of the sheep lame with ID, FR, CODD, shelly hoof, foot abscess and toe granuloma respectively from respondents who correctly named these lesions. Whilst ID
and FR were the most prevalent causes of lameness in most flocks it is possible that in up to
17% flocks the primary cause of lameness was a different lesion.

**Keywords:** foot lesions; sheep; repeatability; validity; lameness; footrot

### 1. Introduction

Lameness in sheep has been identified by sheep farmers in GB as their highest cause of concern for poor health in the flock (Goddard et al., 2006). There is no evidence that the incidence or prevalence of lameness in sheep in GB has decreased in the last 30 years despite recommendations for its control. In 1994, the estimated prevalence was 8% (Grogono-Thomas and Johnston, 1997) and in 2000 it was 10% (Wassink et al., 2003, 2004). The most common infectious causes of lameness in sheep are interdigital dermatitis (ID) and footrot (FR) (Grogono-Thomas and Johnston, 1997) and more recently concern has been raised over the newly emerging infectious disease, contagious ovine digital dermatitis (CODD) (Wassink et al., 2003). In addition to these infectious causes of lameness, there are non-infectious causes which include white line degeneration (shelly hoof), foot abscess and toe granuloma. These are generally considered to be of low prevalence (Grogono-Thomas and Johnston, 1997; Winter, 2004 a and b), but there has been no study to be sure of this (details of the clinical presentation of these lesions is presented in Winter 2004a).

Recent research indicates that new approaches to managing FR and ID might be more effective for control of these diseases than previous recommendations (Wassink et al., 2003, 2005; Green et al., 2007). However, another reason for the failure to reduce lameness in sheep may be that farmers incorrectly diagnose the cause of lameness and therefore manage lameness incorrectly. Most recent epidemiological studies in GB that have quantified lameness in sheep and its causes (Grogono-Thomas and Johnston, 1997; Wassink et al., 2003; Hosie, 2003) have used farmer opinion of the cause and prevalence of lameness in
their flock and are, consequently, based on the untested premise that farmers can recognise
and name the foot lesions associated with lameness and that they can identify lame sheep.
The former assumption is tested in this paper.
Self administered questionnaires are a valuable research tool to collect data. They are
generally more rapid to complete than telephone or personal interviews (Kelsey et al., 1996).
In data collected via questionnaires the response to each question should be valid and
repeatable (Sargeant and Martin, 1998). Although questionnaire data are widely used, there
are only a few studies in veterinary epidemiology that discuss validity; only 11 articles out
of 120 (9.2%) using questionnaire data that were published in peer reviewed journals
between 1984 and 1988 stated the questionnaire validity (Vaillancourt et al., 1991).
This paper presents the results from a study of farmer and sheep-expert naming of six foot
lesions of sheep in 2004 with validation. The prevalence of lameness and lesion specific
causes attributed to this lameness is presented.

2. Materials and Methods
2.1. Development and implementation of the questionnaire
2.1.1. Study population
Win Episcope 2.0 was used to estimate the sample size. Sample size was calculated
assuming 50% of flocks affected with each lesion, based on the 34% to 77% of flocks
affected as estimated by Grogono-Thomas and Johnston (1997), with a precision of 2.5%
and a confidence interval of 95% (Cannon and Roe, 1982). This sample size was then
adjusted for an expected response rate of 50%, since the source list was known to contain
redundancy.
A stratified random sample of sheep farms was selected from a list belonging to the English
Beef and Lamb Executive (EBLEX) sorted by region and by flock size within each region.
Sheep farms in England were grouped into five regions, south west (Cornwall, Devon, Somerset, Dorset, Wiltshire and Gloucestershire), south east (Norfolk, Suffolk, Hertfordshire, Berkshire, London, Surrey, Kent, E. Sussex, W. Sussex and Essex), central (Cheshire, Peterborough, Cambridgeshire, Lincolnshire, Nottinghamshire, Northamptonshire, Warwickshire, Bedfordshire, Buckinghamshire, Oxfordshire, Worcestershire, Leicestershire, Staffordshire, Shropshire and Herefordshire), north west (Greater Manchester, Cumbria and Lancashire) and north east (Northumberland, Durham and Yorkshire). Approximately 6% of the target population was surveyed.

2.1.2. Questionnaire

A questionnaire containing a characteristic picture and description (e.g. Figure 1) of six lesions associated with lameness (ID, FR, CODD, shelly hoof, foot abscess and toe granuloma) together with questions on flock size, location and prevalence of lameness was developed. The questionnaire was pilot tested on 15 farmers and the final version developed from these farmers comments and responses to questions.

The questionnaire, covering letter and a return stamped addressed envelope were sent out on March 14, 2005 to 591, 414, 989, 331 and 675 farmers in each of the regions listed above respectively. A reminder postcard was sent to all non respondents on April 14, 2005. A second reminder, which included a copy of the questionnaire and return stamped addressed envelope, was sent to the remaining non-respondents on May 14, 2005. Acknowledgement postcards were sent to all those who responded to the survey.

2.2. Farmer naming and prevalence of six lesions

2.2.1. Definitions/calculations

All answers = the number of farmers who responded to a question.

Correct name of lesion = the percent of farmers who named the lesion correctly out of all those who answered the question.
Incorrect name = the percent of farmers who incorrectly named a lesion out of all those who answered the question.

Most frequently used name for a misnamed lesion = the name most attributed incorrectly to a lesion e.g. the most frequent incorrect name attributed to shelly hoof was FR.

The distribution of proportion of lameness attributed to shelly hoof (correctly named by the farmer) by flock was plotted. This was compared with the distribution incorrectly named as FR and the distribution correctly named as FR. This was repeated for ID, CODD, foot abscess and toe granuloma.

Prevalence of a lesion = percent of sheep lame with a lesion in flocks where the farmer named the lesion correctly.

The most prevalent lesion on a farm = the picture of the lesion with the highest percent of lameness in the flock according to the farmer, irrespective of the farmer’s name for the lesion.

Where ID or FR were correctly named and were the most prevalent lesion in the flock, the farmer’s ability to correctly name other lesions was estimated (43 farms were omitted from both lesion categories because they had both ID and FR equally prevalent on farm).

2.3. Validity and repeatability of questionnaire

The location and size of the selected and participating farms were compared with the DEFRA agricultural survey 2004. (http://www.DEFRA.gov.uk/esg/work_htm/publications/cs/census/analyses/for_2004/pdf/fd/tot_sheep.pdf).

Non-response bias was assessed by comparing the geographical distribution and average flock size of respondents and non-respondents.

2.3.1. Farm visits and examination of live sheep
Four farmers from each category of zero to all six lesions correctly named from the postal study (28 in total) were visited in May and June 2006. Visits were arranged by telephone and were based on farmer availability and proximity to the university. Farmers were sent a letter containing the date and time of the visit, farmers were asked to gather any lame sheep they had in preparation for the visit. The objectives of the visit were to repeat the written lesion recognition questionnaire (repeatability) and to investigate whether farmers named the lesions on lame sheep as they had in the questionnaire (validity). On the farm, the farmer’s and the researcher’s (first author) name for the foot lesions observed were recorded independently. The researcher used codes for lesions to ensure that farmers did not learn the identity of the lesions while the observations were made. After the recordings were complete the farmer was asked to repeat the self administered questionnaire (the same person who filled in the first questionnaire filled in the second one). Finally, the six lesions were then discussed with the farmer. Each farmer was asked to rank the picture quality and written descriptions in the self administered questionnaire using a scale of good, average or poor.

2.3.2. Questionnaire repeatability

In addition to questionnaires administered on farms, 50 questionnaires were sent by post to farmers selected randomly from respondents to the first survey, ensuring that all levels of lesion recognition were represented, to test repeatability. For repeatability we calculated:

Percent exact agreement = percent of farmers who gave the same name to a lesion on both occasions. In addition, kappa statistics and the number of correct answers for the six lesions between the farm visits and the postal questionnaire were calculated. Kappa was interpreted according to Landis and Koch (1977).

2.4. Recognition of lesions by attendees at the Sheep Veterinary Society meeting

The self administered questionnaire was distributed at the Sheep Veterinary Society meeting Cambridge, England in April, 2006. The delegates were asked to complete the questionnaire.
In addition, they were asked their profession and whether they personally had a care of a flock of sheep.

2.5. Data analysis

Comparisons between proportions were made with a $\chi^2$ test, two means with modified t-test (unequal variances) and more than two means with Kruskal–Wallis test (Petrie and Watson, 2000) with significance at $p \leq 0.01$.

3. Results

3.1. Number of replies to the postal questionnaire

A total of 1313 (44%) questionnaires were returned. The regional response percent was 43.0%, 42.8%, 41.4%, 47.3% and 45.3% for the central, north east, north west, south east and south west respectively. Out of the 1313 questionnaires returned, 809 (62%) were usable for the analysis which gave a usable response percent of 32% (Table 1). Three hundred and ten (38%) farmers out of 809 agreed to participate in any further study on lameness in sheep.

3.2. Flock attributes

The mean flock size was 318 sheep with a median of 220 (interquartile range 90 - 450). The altitude of the farms ranged from 60m to 244m above sea level. A total of 394/792 (50%) farmers had pedigree flocks producing replacement ewes and terminal sires while 746 (94%) produced meat and store lambs and 20 (2%) were hobby farmers or produced wool. Ninety seven percent of 809 farmers reported that they had lame sheep in their flock in 2004; the mean within flock prevalence of lameness was approximately 10.4%. This did not vary by region ($H = 7.8$, $p>0.01$) or flock size ($H = 0.99$, $p>0.01$).

3.3. Naming of lesions

The percent of lesions correctly named ranged from 28% (shelly hoof) to 85% (FR) (Table 2). Twenty three percent (59) of 262 farmers who answered all six questions named all six
lesions correctly. The probability of getting all six correct by chance was $0.2 \times 10^{-4}$. The percent of farmers who identified any 5, 4, 3, 2 or 1 lesion correctly was 28%, 47%, 71%, 93% and 98% respectively. The names used by farmers for the incorrectly named lesions ranged from 5% (ID) to 47% (FR) (i.e. 47% farmers incorrectly named other lesions as FR) (Table 2).

3.4. Comparison of the distribution of flock lameness for ID, CODD, shelly hoof and foot abscess misnamed as FR

Interdigital dermatitis, CODD, shelly hoof and foot abscess were most frequently misnamed as FR. When the distribution of flock lameness attributable to ID, CODD, shelly hoof and foot abscess correctly named and incorrectly named as FR were compared, there was no significant difference ($p>0.01$) between the distributions of lameness (ID ($\chi^2 = 9.19$, df = 4), CODD ($\chi^2 = 1.6$, df = 3), shelly hoof ($\chi^2 = 12.9$, df = 4) and foot abscess ($\chi^2 = 6.8$, df = 3)). However, there was a significant difference between the distribution of the lesions incorrectly named as FR and the distribution of FR when correctly named ($\chi^2 = 78.77$ df = 4, $\chi^2 = 11.5$ df = 3, $\chi^2 = 15.7$ df = 4, $\chi^2 = 21.5$ df = 3 with $p<0.01$ respectively) (Figure 2). This suggests that farmers recognised the description and photograph but misnamed the lesion.

For toe granuloma the most frequent incorrect name was foot abscess. There was no indication that farmers recognised this lesion. Interestingly, approximately 12% (51/428) of farmers who reported the presence of toe granuloma named it as ‘other’ and most of them specified ‘other’ as ‘strawberry footrot’ (another cause of lameness in sheep, Winter 2004a).

Anecdotally, we now know that many farmers refer to toe granuloma (small spheres of proud flesh) as strawberries.

3.5. Prevalence of lameness and foot lesions in sheep in 2004
A total of 264,076 sheep were in this survey. Out of these, 27,468 (10.4%) sheep were estimated to be lame in 2004. The most prevalent causes of lameness were ID and then FR (Table 2).

3.6. Association between lesion naming and the most prevalent lesion

A total of 421/514 (82%) and 160/189 (85%) farmers named ID and FR correctly where they had stated this as their most prevalent lesion. A total of 7% (2/29), 13% (11/83), 38% (20/53) and 57% (12/21) farmers correctly named toe granuloma, shelly hoof, CODD and foot abscess where the farmer stated that these were the most prevalent lesion in the flock. Therefore there were 17% (141/809) farmers who reported lesions other than ID and FR as their most prevalent lesion on the farm but did not name them correctly and there were 6% (2459/43340) sheep in these flocks with these lesions.

The 421 farmers, who correctly named ID, and where it was the most prevalent cause of lameness, were more likely to name all other lesions correctly than farmers who stated that FR was most prevalent and had correctly named FR. In the flocks where FR dominated (117), farmers had a tendency to also name other horn damage as FR (Table 3).

3.7. Validity

There was no significant difference in geographical distribution ($\chi^2 = 3.85$, df = 4, p>0.01) or average flock size ($t = 1.96$, p>0.01) between respondents and non respondents. The geographical location of the selected farms ($\chi^2 = 122.0$, df = 4, p<0.01) and participating farms in the survey ($\chi^2 = 43.4$, df = 4, p<0.01) was significantly different from that listed in the DEFRA census for 2004. Similarly, the distribution of flock size of selected and participating farms in the survey was also significantly different from the DEFRA census for 2004 ($\chi^2 = 420$, df = 5, p<0.01), ($\chi^2 = 319.11$, df = 5, p <0.01) respectively (Table 4).

3.7.1. Farm visits
At the 28 farm visits a total of 193 lame sheep were examined, this included 158 ewes, 4 rams and 31 lambs. Approximately 30% of the lame sheep were affected on more than one limb. A total of 278/772 (36%) feet were clinically abnormal. There were 22, 12, 4, 5, 2 and 3 flocks with sheep with ID, FR, CODD, shelly hoof, foot abscess and toe granuloma respectively on the day of the visit. Farmers generally gave the same name to the lesions present on farm as they did in the postal questionnaire (Table 2). A total of 86% (CODD) to 100% (toe granuloma) farmers rated pictures and descriptions of lesions as good (Table 2).

3.8. Repeatability

3.8.1. Farm visits

The same farmer who had completed the postal questionnaire completed it again on farm (self administered). The percent exact agreement for lesion naming ranged from 71% (foot abscess) to 88% (ID, FR and toe granuloma) and the kappa coefficients of agreement between farmer ratings showed substantial agreement ranging from 0.64 (ID) to 0.82 (toe granuloma) (Table 2). Eight farmers gave one more correct answer to the repeatability questionnaire than to the postal questionnaire.

3.8.2. Repeatability questionnaires sent by post

Thirty questionnaires (60%) out of 50 were returned. The percent exact agreement for lesion naming ranged from 49% (foot abscess) to 79% (FR and ID) and the kappa coefficient of agreement between farmer responses varied from fair to substantial ranging from 0.35 (foot abscess) to 0.65 (FR). Out of 30 farmers, 11 (37%) had the same number of correct answers in both questionnaires. Of those farmers who had a different number correct between the questionnaires, 12 gave one or more extra correct answers and 7 gave fewer correct answers.

3.9. Recognition of lesions by sheep specialists

Fifty delegates completed the questionnaire; 40 were veterinarians, 7 other specialists and 3 did not state their profession. Seventeen had care of a flock of sheep. The percent of
correctly named lesions ranged from 86% (shelly hoof) to 98% (FR) (Table 2). A total of 37 out of 47 (79%) respondents named all 6 lesions correctly.

4. Discussion

The results from the study support the emphasis on education and research to minimize lameness caused by ID and FR. However, the key finding from this study is that many farmers could not correctly name all six lesions presented but probably could recognise them. In contrast to the farmer naming of lesions, most sheep specialists were able to name the six lesions correctly. This suggests that these specialists could be a useful source of knowledge to farmers if we can improve knowledge transfer. Photographs (considered good by farmers in this study) may assist with this transfer of knowledge, together with an emphasis on the need to name lesions correctly (to ensure useful dialogue) and then finally an understanding of how lesions occur and may be treated and prevented (to the best of our current knowledge).

In this study, FR was the most commonly used incorrect name for other lesions. The practical and important result of this is that lame sheep and flocks of sheep may be mis-managed, assuming this sample of flocks is generalisable, and that our interpretation of the results that farmers can recognise but not name the lesions is correct. Approximately 17% of farmers stated lesions other than FR or ID were the most prevalent lesions on their farm but did not name them correctly. Given that the majority of misnaming appears to be just that, recognition of the lesion but an attribution of an incorrect name, it is of concern that 17% of flocks (2459 lame sheep and their 40881 non-lame flock mates) might be managed incorrectly. In addition, 6% (45/809) of farmers who did correctly name lesions other than ID or FR as their most prevalent cause of lameness may not receive useful advice.
The most randomly named lesion was toe granuloma. The development of granulation tissue occurs in response to damage to the sensitive dermis, often through trimming horn into sensitive tissue but possibly also in response to footrot disease. In GB, we have emphasised that it is poor practice to trim hoof horn into the dermis for many years (Grogono-Thomas and Johnston 1997; Winter, 2004 a and b) and that an iatrogenic result might be the development of toe granuloma, but this message is apparently unclear to farmers since toe granulomas are still occurring on at least 66% of farms, and possibly many more given the random misnaming of this lesion.

A key assumption from this study was that farmers can recognise lame sheep and that the estimates of farms affected and within flock prevalence are valid. Our results are similar to those presented by Grogono-Thomas and Johnston (1997) and by Wassink et al. (2003) but, of course, all rely on farmer recognition of lameness. Farmer recognition of lameness is currently being investigated, but for the purposes of this paper we assume that these estimates are reasonable. The improvement from this paper is that flock prevalence and proportional contribution of each lesion to lameness is estimated and only from among farmers who named the six lesions correctly.

ID was present in 96% of flocks in this study, more than the 51% and 88% as reported by Grogono-Thomas and Johnston (1997) and Wassink et al. (2003) respectively and FR was present in 90% of flocks. This was again higher than the 77% and 86% as reported by Grogono-Thomas and Johnston (1997) and Wassink et al. (2003) respectively. ID and FR were the most prevalent causes of lameness within flocks which is similar to the results reported by Grogono-Thomas and Johnston (1997).

Not all foot lesions were present on each farm at the farm visits (Table 2), as might be anticipated from our postal questionnaire results, but of those present, farmer recognition was generally similar to that in the postal questionnaire, indicating that the pictures were a
valid technique where use of lame sheep was not possible. A useful finding was that there
were generally several farm workers on each farm and so it was possible to ensure that the
repeatability study was done with the same respondent; repeatability was moderate to high.
The repeatability by post was a comparatively lower; this may be because a different person
completed the second questionnaire. Repeatability would be lower if within respondent pairs
there was a higher or lower level of knowledge about the lesions.
For good precision and representation of sheep farmers in England, we selected farmers with
a representative range of flock sizes from each region. Stratified random sampling within the
strata should have minimised selection bias. However, the distribution of flocks selected was
different with respect to overall distribution of flocks in England from the DEFRA
agricultural survey, 2004 and the average flock size was apparently larger than the DEFRA
estimated flock size. In this survey there was an under representation of very small flocks
(<50) and larger flocks (>1000). We do not know why there was this difference.
The information in this study was obtained by post which is one of the most frequently used
modes to collect data in veterinary epidemiology (Vaillancourt et al., 1991). Although they
are less expensive to conduct than telephone and in-person interviews, postal questionnaires
are prone to number of errors (O'Toole et al., 1986) and their potential major disadvantage is
a low response percent. Even though two reminders were used we had a response percent of
44 rather than the 50% anticipated, and a useable response percent of 32%. However, this
was over 800 farmers, a number that it was not feasible to visit. The response percent in the
current study was high compared with the 20% in the 1993 study (Grogono-Thomas and
Johnston, 1997) which followed a similar random sampling strategy but did not use
reminders. However, the response percent in this study was moderate compared with the
64% by Wassink et al. (2003) which used a non random sample with two reminders and
targeted farmers from the survey of 1993 who had said they were interested in participating
in further research. Interestingly, this response percent was similar to the 60% in our repeatability study using compliant farmers. Considering the fact that sheep farmers are going out of farming and the address list was known to contain redundancy the response percent for this study was reasonable. Although there were no significant differences between respondents and non-respondents with respect to geographical location and flock size; one cannot rule out non-response bias for other reasons, e.g., farmers who responded might have been more concerned about lameness in their flock than non-respondents.

5. Conclusion

This study indicates that there is a gap in knowledge between sheep advisors and sheep farmers in the naming of six common foot lesions in sheep. Some 20% of farmers named all six lesions correctly but the majority recognised only ID and FR while approximately 80% of advisors recognised all the lesions. FR was the name most commonly attributed to other hoof horn lesions. This is of concern for further education programmes and highlights that one of the first stages of a programme to reduce lameness in sheep is to ensure all parties use consistent lesion naming. Only then will education on prevention and treatment for each lesion be possible.

6. Acknowledgements

Jasmeet Kaler is supported by an MLC studentship. Thank you to EBLEX for provision of the address list, to farmers for participating in the study, to Dr. R. Grogono-Thomas for three lesion pictures used in the survey, to Sam Mason for advice with database management and all those in E and E who helped send out the questionnaires and supported the farm visits.
7. References


Table 1: Pattern of the 1313 responses from the survey to 3000 English sheep farmers in 2004.

<table>
<thead>
<tr>
<th>Types of responses</th>
<th>Number</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usable</td>
<td>809</td>
<td>61.6</td>
</tr>
<tr>
<td>No sheep in 2004</td>
<td>443</td>
<td>33.7</td>
</tr>
<tr>
<td>Unknown address</td>
<td>42</td>
<td>3.2</td>
</tr>
<tr>
<td>Non- participation</td>
<td>19</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>1313</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 2. The number and percent of farmers and specialists who named lesions correctly and percent of farms and sheep affected by lesion with validity and repeatability results from 809 English sheep farmers in 2004. * A = interdigital dermatitis, B = Footrot etc.

<table>
<thead>
<tr>
<th>Correct Name</th>
<th>A*</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Interdigital dermatitis</td>
<td>595 (83%)</td>
<td>18 (3%)</td>
<td>11 (3%)</td>
<td>1 (&lt;1%)</td>
<td>10 (2%)</td>
<td>1 (&lt;1%)</td>
</tr>
<tr>
<td>B. Footrot</td>
<td>96 (13%)</td>
<td>531 (85%)</td>
<td>129 (30%)</td>
<td>253 (53%)</td>
<td>65 (14%)</td>
<td>57 (11%)</td>
</tr>
<tr>
<td>C. Contagious ovine digital dermatitis</td>
<td>5 (&lt;1%)</td>
<td>13 (2%)</td>
<td>154 (36%)</td>
<td>8 (2%)</td>
<td>44 (10%)</td>
<td>11 (2%)</td>
</tr>
<tr>
<td>D. Shelly hoof</td>
<td>2 (&lt;1%)</td>
<td>21 (3%)</td>
<td>48 (11%)</td>
<td>135 (28%)</td>
<td>27 (6%)</td>
<td>5 (1%)</td>
</tr>
<tr>
<td>E. Foot abscess</td>
<td>3 (&lt;1%)</td>
<td>37 (6%)</td>
<td>83 (19%)</td>
<td>40 (8%)</td>
<td>293 (65%)</td>
<td>154 (30%)</td>
</tr>
<tr>
<td>F. Toe granuloma</td>
<td>-</td>
<td>2 (&lt;1%)</td>
<td>6 (1%)</td>
<td>35 (7%)</td>
<td>9 (2%)</td>
<td>223 (43%)</td>
</tr>
<tr>
<td>G. Other</td>
<td>20 (3%)</td>
<td>1 (&lt;1%)</td>
<td>3 (&lt;1%)</td>
<td>6 (1%)</td>
<td>6 (1%)</td>
<td>65 (13%)</td>
</tr>
<tr>
<td>Percent sheep specialists who named lesion correctly</td>
<td>96%</td>
<td>98%</td>
<td>94%</td>
<td>86%</td>
<td>90%</td>
<td>96%</td>
</tr>
<tr>
<td>Percent farmers with misnamed lesion names</td>
<td>5%</td>
<td>47%</td>
<td>10%</td>
<td>13%</td>
<td>35%</td>
<td>7%</td>
</tr>
<tr>
<td>Repeatability at farm visits (n=28)</td>
<td>88%</td>
<td>88%</td>
<td>83%</td>
<td>83%</td>
<td>71%</td>
<td>88%</td>
</tr>
<tr>
<td>Percent exact agreement</td>
<td>0.64</td>
<td>0.72</td>
<td>0.79</td>
<td>0.71</td>
<td>0.70</td>
<td>0.82</td>
</tr>
<tr>
<td>Repeatability at farm visits: Kappa (95% C.I.)</td>
<td>(0.31 – 0.96)</td>
<td>(0.41 - 1)</td>
<td>(0.60 - 0.97)</td>
<td>(0.49 - 0.94)</td>
<td>(0.46 - 0.91)</td>
<td>(0.63 - 1)</td>
</tr>
<tr>
<td>Repeatability by post (n= 30)</td>
<td>79%</td>
<td>79%</td>
<td>52%</td>
<td>67%</td>
<td>49%</td>
<td>55%</td>
</tr>
<tr>
<td>Percent exact agreement</td>
<td>0.50</td>
<td>0.65</td>
<td>0.36</td>
<td>0.48</td>
<td>0.35</td>
<td>0.46</td>
</tr>
<tr>
<td>Repeatability by post: Kappa (95% C.I.)</td>
<td>(0.21 - 0.78)</td>
<td>(0.41 - 0.88)</td>
<td>(0.14 - 0.59)</td>
<td>(0.25 - 0.71)</td>
<td>(0.11 - 0.59)</td>
<td>(0.23 - 0.69)</td>
</tr>
<tr>
<td>Number of farmers with identical responses for sheep and questionnaire</td>
<td>16 (n=22)</td>
<td>12 (n=16)</td>
<td>4 (n=4)</td>
<td>4 (n=5)</td>
<td>1 (n=2)</td>
<td>4 (n=3)</td>
</tr>
<tr>
<td>Farmers rating of pictures and description as ‘good’</td>
<td>89%</td>
<td>96%</td>
<td>86%</td>
<td>93%</td>
<td>96%</td>
<td>100%</td>
</tr>
<tr>
<td>Percent flocks affected (on farms with correct name for each lesion)</td>
<td>96%</td>
<td>90%</td>
<td>72%</td>
<td>59%</td>
<td>66%</td>
<td></td>
</tr>
<tr>
<td>Percent lame sheep (on farms with correct name for each lesion)</td>
<td>6.9%</td>
<td>3.7%</td>
<td>2.4%</td>
<td>1.9%</td>
<td>0.9%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Percent flocks with lesion (on farms with all 6 lesions correctly named, n = 59)</td>
<td>92%</td>
<td>92%</td>
<td>25%</td>
<td>56%</td>
<td>49%</td>
<td>51%</td>
</tr>
<tr>
<td>Percent sheep lame (on farms with all 6 lesions correctly named, n = 59)</td>
<td>7.0%</td>
<td>3.9%</td>
<td>0.9%</td>
<td>0.9%</td>
<td>0.7%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>
Table 3. Farmers naming of other lesions where FR or ID was most the prevalent lesion and was correctly named in English sheep flocks in 2004. * A = interdigital dermatitis, B = Footrot etc.

<table>
<thead>
<tr>
<th>Correct Name</th>
<th>Most prevalent lesion</th>
<th>A*</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>No answer</th>
<th>Other name given by farmer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Interdigital Dermatitis(ID)</td>
<td>FR</td>
<td>70 (60%)</td>
<td>19 (16%)</td>
<td>1 (1%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23 (20%)</td>
<td>4 (3%)</td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>378</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B. Footrot (FR)</td>
<td>FR</td>
<td>-</td>
<td>117</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>7 (2%)</td>
<td>273 (72%)</td>
<td>8 (2%)</td>
<td>15 (4%)</td>
<td>14 (4%)</td>
<td>2 (&lt;1%)</td>
<td>58 (15%)</td>
<td>1 (&lt;1%)</td>
</tr>
<tr>
<td>C. Contagious ovine digital dermatitis</td>
<td>FR</td>
<td>3 (3%)</td>
<td>24 (21%)</td>
<td>16 (14%)</td>
<td>3 (3%)</td>
<td>19 (16%)</td>
<td>2 (2%)</td>
<td>50 (43%)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>1 (&lt;1%)</td>
<td>54 (14%)</td>
<td>97 (26%)</td>
<td>29 (8%)</td>
<td>38 (10%)</td>
<td>4 (1%)</td>
<td>155 (41%)</td>
<td>-</td>
</tr>
<tr>
<td>D. Shelly hoof</td>
<td>FR</td>
<td>-</td>
<td>35 (30%)</td>
<td>1 (1%)</td>
<td>19 (16%)</td>
<td>5 (4%)</td>
<td>5 (4%)</td>
<td>51 (44%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>-</td>
<td>131 (35%)</td>
<td>3 (&lt;1%)</td>
<td>83 (22%)</td>
<td>21 (6%)</td>
<td>16 (4%)</td>
<td>120 (32%)</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>E. Foot abscess</td>
<td>FR</td>
<td>3 (3%)</td>
<td>14 (12%)</td>
<td>5 (4%)</td>
<td>3 (3%)</td>
<td>36 (31%)</td>
<td>2 (2%)</td>
<td>53 (45%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>1 (&lt;1%)</td>
<td>27 (7%)</td>
<td>32 (9%)</td>
<td>15 (4%)</td>
<td>167 (44%)</td>
<td>3 (&lt;1%)</td>
<td>130 (34%)</td>
<td>3 (&lt;1%)</td>
</tr>
<tr>
<td>F. Toe granuloma</td>
<td>FR</td>
<td>3 (3%)</td>
<td>24 (21%)</td>
<td>8 (7%)</td>
<td>-</td>
<td>1 (1%)</td>
<td>24 (21%)</td>
<td>48 (41%)</td>
<td>9 (8%)</td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>4 (1%)</td>
<td>67 (18%)</td>
<td>19 (5%)</td>
<td>-</td>
<td>2 (&lt;1%)</td>
<td>142 (36%)</td>
<td>103 (27%)</td>
<td>41 (11%)</td>
</tr>
</tbody>
</table>
Table 4. Number and percent of sheep holdings by flock size listed by DEFRA and those in the study of 809 English sheep farmers in 2004.

<table>
<thead>
<tr>
<th>Flock size</th>
<th>DEFRA survey 2004</th>
<th>Percent of all flocks</th>
<th>Study survey 2004</th>
<th>Percent of all study flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 -&lt;50</td>
<td>18548</td>
<td>38.1</td>
<td>91</td>
<td>11.7</td>
</tr>
<tr>
<td>50-&lt;100</td>
<td>5553</td>
<td>11.4</td>
<td>107</td>
<td>13.7</td>
</tr>
<tr>
<td>100-&lt;200</td>
<td>6300</td>
<td>12.9</td>
<td>147</td>
<td>18.9</td>
</tr>
<tr>
<td>200-&lt;500</td>
<td>8666</td>
<td>17.8</td>
<td>255</td>
<td>32.7</td>
</tr>
<tr>
<td>500-&lt;1000</td>
<td>5355</td>
<td>11.0</td>
<td>145</td>
<td>18.6</td>
</tr>
<tr>
<td>1000+</td>
<td>4317</td>
<td>8.9</td>
<td>34</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Figure 1. An example of a question to investigate farmer / expert ability to Name foot lesions in sheep

<table>
<thead>
<tr>
<th>What you might see when you look at the foot</th>
<th>Photograph</th>
<th>What do you call this lesion</th>
<th>Did you see this lesion in your flock in 2004?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Strawberry-like growth at the toe</td>
<td><img src="image" alt="Photograph" /></td>
<td>☐ FR</td>
<td>☐ No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ ID</td>
<td>☐ Don’t know</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Shelly hoof</td>
<td>☐ Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Foot abscess</td>
<td>What percentage of lame sheep had this lesion?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ CODD*</td>
<td>_____%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Toe granuloma</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Other___________</td>
<td></td>
</tr>
</tbody>
</table>

*Contagious ovine digital dermatitis

(See [www.warwick.ac.uk/go/e2/farmers/sheeplameness](http://www.warwick.ac.uk/go/e2/farmers/sheeplameness) for all six lesions and their correct name).
Figure 2. Comparison of distribution of proportion of flock lameness attributed to a) interdigital dermatitis, b) contagious ovine digital dermatitis, c) shelly hoof and d) foot abscess by farmers who correctly named the lesion and those who misnamed these lesions as footrot compared with the distribution attributed to correctly named footrot, with 95% C.I.

a) ID  b) CODD
c) Shelly hoof

Black bars $n=92$, White bars, $n=207$, Grey bars $n=446$

<table>
<thead>
<tr>
<th>% flock lameness</th>
<th>% farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 10%</td>
<td>60%</td>
</tr>
<tr>
<td>11-20%</td>
<td>50%</td>
</tr>
<tr>
<td>21-40%</td>
<td>40%</td>
</tr>
<tr>
<td>41-60%</td>
<td>30%</td>
</tr>
<tr>
<td>61-100%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Black bars - lesion correctly named, White bars- lesion misnamed as footrot, Grey bars- footrot correctly named

d) Foot abscess

Black bars $n=165$, White bars, $n=39$, Grey bars $n=445$

<table>
<thead>
<tr>
<th>% flock lameness</th>
<th>% farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 5%</td>
<td>60%</td>
</tr>
<tr>
<td>6-10%</td>
<td>50%</td>
</tr>
<tr>
<td>11-20%</td>
<td>40%</td>
</tr>
<tr>
<td>21-100%</td>
<td>30%</td>
</tr>
</tbody>
</table>