2009 CATTLE LAMENESS CONFERENCE

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The University of Nottingham

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- Lameness epidemiology and control
- Disease and pain control
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GENERAL INFORMATION

TIMETABLE of EVENTS

09:00	**ARRIVE / REGISTRATION / COFFEE and POSTER DISPLAY**	
09:30	**CHAIRPERSON'S INTRODUCTION:** **Jon Huxley, University of Nottingham**	
09:50	Lameness in dairy cows; piecing together the evidence base and looking forward	**Laura Green** University of Warwick
10.30	Questions and Discussion	
10:45	**COFFEE and POSTERS**	
	Session 2 Chairperson: Nick Bell, University of Bristol **INTRODUCTION TO SESSION 2**	
11:15	Dermatitis – Microbial aetiopathogenesis approaches providing opportunities for treatment	**Stuart Carter** University of Liverpool
11:55	A decade of pain	**Becky Whay** University of Bristol
12:35	Questions and Discussion	
12:50	**LUNCH and POSTERS**	
	Session 3 Chairperson: Brian Pocknee, *The* Dairy Group	
14:00	**INTRODUCTION TO SESSION 3 and VOTING ON POSTERS**	
14:05	A view from the market place	**Chris Brown** ASDA, Leeds
14.45	A clinician's approach	**Chris Watson** Wood Veterinary Group, Gloucester
15.25	Questions and Discussion	
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15:50	**TEA and DEPART**	

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CHAIRPERSON'S INTRODUCTION

On behalf of the organising committee I would like to welcome you to the inaugural ***Cattle Lameness Conference*** and to the University of Nottingham's School of Veterinary Medicine and Science.

Lameness in cattle is an increasingly important issue for the industry; the organising committee firmly believe that it is currently one of the most significant problems affecting the health, welfare and productivity of the national herd. Recent research work from around the UK suggests that between 25 and 30% of dairy cows are identifiably lame on any single day of assessment and that the situation is worse than a decade ago. Those of us with an interest and expertise in the field cannot and should not shy away from this situation. Solving this multi-causal, multi-factorial problem will not be an easy task; nor will there be any quick fix solutions. It is vital that we start to research, devise and implement evidence based controls which deliver cost effective improvements to the industry now.

The absence of a UK forum to share latest research findings and disseminate best practice on this subject was notable in its absence. To address this deficit we have instigated today's conference to gather interested parties in a forum which will facilitate knowledge sharing and discussion. For the inaugural event we have put together a programme of high quality UK speakers with national and international reputations in their fields. They including Prof Laura Green (University of Warwick), Prof Stuart Carter (University of Liverpool), Dr Becky Whay (University of Bristol), Dr Chris Brown (ASDA) and Mr Chris Watson (The Wood Veterinary Group). We are grateful for their time and enthusiasm. Please take the opportunity to question them during the periods we have allocated for questions and during breaks; I am sure they will be happy to discuss their papers with you.

We are hugely indebted to our sponsors for sharing our vision for this inaugural event and their generous financial support. Representatives from all the companies are with us today, I am sure they will be happy to talk to you during the event.

We are grateful to Barbara Hepworth (Division of Animal Health and Welfare, School of Veterinary Medicine and Science) for administrative support and the hard work she has put in to CLC, in addition to her regular role within the School.

Finally we are indebted to you as delegates, without your attendance the conference would not exist. We really hope you enjoy the day and you find it a useful forum. We have deliberately left plenty of time during the day for discussion and networking and we have opted for a buffet lunch to allow delegates to circulate. We would welcome and value your feedback, please tell us what you liked about this inaugural event and what we can improve for the future. Feedback forms are available for this purpose or alternatively please talk directly to any of the committee during or after the event.

Jon Huxley
Cattle Lameness Conference Chairperson, University of Nottingham
On behalf of the CLC Organising Committee

FURTHER INFORMATION

Organised by:

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Conference Secretariat: Barbara Hepworth
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Editor: Brian Pocknee

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PAPERS

Proceedings of the Cattle Lameness Conference (2009) Sutton Bonington, p 1-7
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LAMENESS IN DAIRY COWS; PIECING TOGETHER THE EVIDENCE BASE AND LOOKING FORWARD

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SUMMARY

The findings from the epidemiological studies of the EU Lamecow project run in England on approximately 50 farms are summarised. The key findings were that cows treated with sole ulcer and white line disease had an average reduction in 305-day yield of 570kg and 370kg respectively. There was wide variability in the prevalence and causes of lameness between farms and sole ulcers and poor locomotion were linked to automated systems with hard lying surfaces in cubicles. White line disease and digital dermatitis were not strongly associated with farm resources but there was a suggestion that wet feet together might predispose to these causes of lameness. When farmers were offered suggestions to reduce lameness on their farms they made quick, cheap changes. The evidence for methods for prevention and treatment of lameness are considered. There is little evidence for the true cost of lameness but we know it impacts on yield, culling rates and fertility. It is therefore likely to be quite high, but hidden, because of the chronic and common nature of the disease. When we consider the currently available evidence we now have many studies on risks but very few clinical trials outside the experimental framework. Lame cows are in pain and their welfare is poor. One current change that can be made that would reduce the economic costs and improve cow welfare is prompt treatment of lame cows. Looking to the future we need intervention studies on commercial farms that can be used to estimate the cost effectiveness of changes in farm buildings, floors and management of all cows and lame cows.

EPIDEMIOLOGICAL STUDIES IN THE EU LAMECOW STUDY

From 1999 – 2003 a series of studies on lameness were run on 49 dairy cattle herds in England. In these studies we followed a cohort of cattle on each farm for one year to investigate factors associated with poor locomotion and with lesion specific causes of lameness. Each farm was visited four times over one year and at the visits cows were scored for locomotion using a 3-point scale (1) and the farm management was observed and recorded. We estimated the impact of lesion specific causes of lameness on milk yield and 2-years later we intervened on 22/44 farms to attempt to reduce lameness through changes in management on farms. The key results were that the prevalence and incidence of lameness was highly variable between the farms and the causes of lameness also varied between farms. The most common causes of lameness were sole ulcer, white line disease and digital dermatitis, but there were many other causes of lameness at lower incidence. Factors associated with an average poor locomotion on 44 farms, where cows were housed in cubicles, were dry cows kept in straw yards versus cubicles, pregnant heifers kept with milking cows vs dry cows, cubicle house aisle <3m, kerb height <15cm, a hoof trimmer trimming all cows' feet vs the farmer, feeding corn silage and using automatic scrapers vs manual (2). Use of automatic scrapers was highly correlated with mats and sawdust bases in cubicles. Factors associated with a high treatment rate of sole ulcer were parity 4 or greater, the use of roads or concrete cow tracks between the parlour and grazing, the use of lime on cubicles and housing in cubicles with sparse bedding for 4 months or more. The risks for white line disease were increasing parity and increasing herd size, cows at pasture by day and housed at night and solid grooved concrete floors in yards or alleys. Solid grooved floors were also associated with an increased risk of digital dermatitis and cows 6 or more months after calving had a decreased risk of a first case of digital dermatitis (3). From 30 herds which recorded with national milk records we ascertained that cows that developed sole ulcer and white line disease were more likely to be high yielding cows in the months before they were lame and that milk yield fell up to 4 months before these cattle were treated. The impact of a sole ulcer that was treated was a reduction in yield of 570kg and the impact of a white line lesion that was treated was 370 kg over a 305 day lactation. Cattle that were lame from any cause and treated had an increased milk yield after treatment (4). Farmers that were visited and offered recommendations that were considered likely to reduce the occurrence of lameness on the farm adopted 25% of the recommendations offered. The changes in management that farmers made were quick, cheap changes. The commonest changes were an increase in bedding depth and a change in cow flow around the farm. The results after one year were not conclusive. However, there was a significant improvement in locomotion score overall and a consistent reduction in sole ulcers across these farms[2].

Bringing together the evidence base

The evidence for the economic impact of lameness on milk production (4, 5, 6 & 7), together with the direct effect of lameness on fertility through reduced expression of oestrus because of increased lying times (8) and the cost of culling lame cows is mounting, although we do not have a good economic model that truly reflects the cost of lameness as we do with the Fertex score (9). We now need to consider whether there are strategies to prevent milk loss and to reduce other health effects linked with lameness because these strategies will benefit the health of cattle and increase their longevity (10 & 11) and so increase farm income. The two broad strategies to prevent economic loss from lameness are prevention of lameness and prompt treatment of lame cows.

PREVENTING LAMENESS IN DAIRY COWS

Managing high yielding cattle

Several authors have reported that higher yielding cows in a herd have a greater risk of becoming lame (5, 7 & 12). Can we prevent high yielding cows from becoming lame? High yielding cows have many diseases (13) and the common cause might be that farmers are tending to the needs of the average cows' husbandry rather than the highest producing cows. There is evidence that this would increase disease in these cows: in a study in 1979, Hansen and colleagues (14) demonstrated that when genetically selected high yielding cows are managed as unselected cows they are more vulnerable to many diseases. There is considerable variation between farms in maintaining health in these high yielding cows through management (11) and we can improve management to ensure that all herds are managed to the highest yielding cows. However, it might be that there is an absolute maximum yield above which cows cannot feed and rest for sufficient hours to maintain their health however excellent the farmer's husbandry, as mooted, again by Hansen, some twenty years later (15).

Sole ulcers and tarsal damage

Many authors have reported that sole ulcers and tarsal damage are strongly related to unnecessary standing on hard floors (2, 3 & 16), primarily because lying spaces are insufficient (lack of stalls {17}, wet floors {18} inability to access stalls) or insufficiently comfortable (depth of bedding, type of bedding {19}, size of free stall in relation to size of cow {20}) but also because of queuing for feed, water or to be milked. We therefore have some knowledge to reduce sole ulcers. We do not have precise figures for the percent reduction and so cannot demonstrate that it is cost effective to do so. Amory and co-workers (4) estimated that sole ulcers reduced yield by about 570kg in a 305-day lactation. Can we make changes to cow comfort that would cost less than this per affected cow on the farm? Barker's intervention study suggests that 24 farmers in the UK were able to improve cow comfort and reduce standing time using very cheap measures of additional bedding and reduced queuing times for milking and this reduced sole ulcer rates by an average of 15% in the following year (2).

White line disease and digital dermatitis

Although walking and twisting actions (21) and soft, wet horn 3 & 22) all apparently contribute to the development of white line lesions / lameness there is no evidence from commercial farm intervention studies that this lesion can be prevented, although it seems biologically very sensible that cows should have dry feet to prevent both infectious and non-infectious claw diseases. Digital dermatitis, once on a farm can be controlled but not eradicated. This, together with the fact that there are tens of causes of lameness in cattle (23) and that not all cases of sole ulcer will be prevented by the above managements, indicate that we will need to continue to manage cow's feet and to treat lame cows in a timely way.

TREATING LAMENESS IN DAIRY COWS

Timing of treatment

The reduction in yield before treatment (4 & 5) suggest that lameness is impacting on the well being of cattle for a considerable time (up to four months) before they are treated for lameness. This could be because of reduced feed intake and / or raised metabolic rate with chronic pain and re-allocation of energy away from milk production, suggesting that these cattle are in pain. What is unknown is at what point these cattle could have been detected lame. Several authors have reported that farmers underestimate the prevalence of lameness in their herds (24 & 25) and we know that whilst sheep farmers can recognise lame sheep they make a separate decision on whether a sheep is 'sufficiently lame' to treat (26). We also know that locomotion tends to be poorer in herds that use a routine foot trimmer (3 & 25). A likely explanation for this is that farmers do not treat lame cows but wait for the foot trimmer to visit and treat these cows; thus delaying the time to treatment.

The role of lameness/mobility scoring

Veterinarians and researchers have also used locomotion (motility) scores (e.g. Sprecher *et al.* {27}) to define severities of unsound locomotion. This scoring has a use for benchmarking the patterns of lameness on a farm and for elucidating risks for lameness, or the impact of interventions in research. However, we repeatedly code unsound but mildly lame cattle as clinically not lame (28). By making this distinction we might be encouraging farmers not to treat mildly lame cows. Many of these mildly lame cows have lesions (29 & 30) and mild lameness, particularly over a period of time might affect milk production. In a recent study of 800 sheep on one farm followed for two years in the UK, sheep lame for more than 5 days with a locomotion score of 2 (defined in Kaler *et al.* {31}), or more than 3 days with a locomotion score of 3, were in poorer body condition, produced fewer lambs in the next lambing season and reared lambs more slowly than sheep that were never lame, or lame for less than this length of time (Wassink *et al.*, submitted). Lameness in sheep is mostly caused by bacterial infection (32) that responds rapidly to treatment (Kaler *et al.*, submitted), so sheep lame for any length of time are generally lame because they are untreated. This is different from cattle where recovery from lameness may take up to a month (24), although looking at the change in yield recovery does start within a month of treatment. However, the time to treatment of lame cows can be reduced considerably and we should be urging the industry to check even mildly lame cows as soon as they are seen lame.

Lesions and pain and foot trimming

Ideally, we should inspect all cows, because some non-lame cows have lesions (29) with claw pain (33). Studies on routine claw care through functional trimming to prevent lameness indicate that it is beneficial for cows in tied- stalls (30). In this situation cows are not walking but they are on a hard floor and so claw horn will be hard but might not wear away, or might wear differently than for cattle that walk. Functional trimming can therefore remove excess horn and reshape the foot. Functional trimming has also been reported to be beneficial in clinical trials of cows in cubicles (30) but the evidence is more controversial when routine foot trimming is a factor in analysis of farm levels of lameness (3 & 34) possibly for the reason above, that it is in fact lame cows that are routinely trimmed, not non-lame cows. Another difference between tied stall and free stall cattle is that, in the latter, claw horn is eroded by walking on concrete and functional trimming is far less easy if there is no excess horn present that can be used to reshape the claw. There is a danger that too much horn is removed at trimming and so cows have insufficient wall to bear weight and so walk on the sole horn and also that this might be too thin (35). In this situation cows that are foot trimmed might be at greater risk of white line disease or sole ulcer than cows that are not. We need more research to understand when and how foot trimming can be beneficial to prevent lameness in dairy cows.

CONCLUSIONS

Lameness in dairy cows is one of the most common causes for early culling and one of the most prevalent diseases on dairy farms. Its aetiology is complex and multi-factorial and we will spend many more years resolving challenging issues such as the role of the environment, yield, genetics and nutrition on the disruption of the foot integrity, on the aetiology and pathogenesis of digital dermatitis all in an attempt to reduce lameness. Until these associations are understood more clearly the key factors that we can suggest are to manage the herd to the highest yielders rather than the average. To ensure that all cattle have good cow comfort, dry feet (!), free flowing movements around the farm and pasture, routine foot inspections and prompt treatment. It is difficult to provide the economic evidence for the costs versus benefits for structural changes to reduce lameness (2 & 36) and we desperately need this evidence. However, the current evidence does suggest that many lame cows are untreated, and possibly farmers and veterinarians tolerate this. It is highly likely that rapid treatment will reduce the impact of lameness on a dairy cow’s health and so avoid losses in milk production, reduced fertility and early culling whilst improving her welfare.

ACKNOWLEDGEMENTS

I thank the people who really did the work in the EU Lamecow project in the UK, Drs Zoe Barker and Jonathan Amory and also Jo Wright and all the other partners and collaborator especially Roger Blowey and Christoph Mulling for enthusiasm and drive: we all thank the farmers who participated in this study. The funders of research mentioned here were the EU, DEFRA, EBLEX, HCC, QMS.

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NOTES

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University of Bristol, The Dairy Group and University of Nottingham

DERMATITIS – MICROBIAL AETIOPATHOGENESIS APPROACHES PROVIDING OPPORTUNITIES FOR TREATMENT.

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SUMMARY

Bovine digital dermatitis (BDD) is a severe infectious cause of lameness which has spread through dairy cattle populations worldwide, causing serious welfare and agricultural problems. Treponemes are the main organisms implicated and have previously proven difficult to isolate. We have developed ways to isolate these organisms and study their role in BDD. Fifty five isolates were obtained from 30 BDD lesions, which by 16S rRNA gene and *flaB2* gene analysis and by enzyme activities clustered within the genus *Treponema* as three phylogroups; one of these is now considered as a new species, *Treponema pedis*. Examination (by group-specific PCR) of 51 BDD lesions collected from infected cattle across the UK revealed that the three phylogroups were present together in 74.5% of lesions. Immunohistochemistry and electron microscopy were used to investigate lesional hoof tissues and treponemes were identified copiously in hair follicles and sebaceous glands suggesting a potential route of exit/entry for these pathogens. A microdilution method was adapted to determine the *in vitro* susceptibilities of 19 UK digital dermatitis treponemes to eight antimicrobials and showed the highest susceptibility to penicillin and erythromycin. PCR investigation of bovine tissues and the farm environment has failed to identify any significant infection reservoirs except lesional tissues. We are now undertaking genome sequencing to identify pathogenicity elements and the original source of infection.

INTRODUCTION

Bovine digital dermatitis (BDD) is an ulcerative foot disease found in dairy cattle, initially reported in Italy in 1974 (1) and which has subsequently been identified worldwide. In more recent years, the disease has been identified in sheep (2) where it may be considered an emerging disease (3). The main clinical feature of BDD is lameness resulting from a lesion immediately above the coronet between the heel bulbs (4). BDD results in large welfare and economic problems; hence prevention and treatment of this disease is of great importance (5 & 6). The aetiology of BDD has not yet been completely determined; however, the majority of evidence suggests involvement of spirochetes. Spirochetes have frequently been found in large numbers, deep inside BDD lesions (6, 7, 8, 9 & 10) and molecular methods have further implicated and identified them as belonging to the genus *Treponema* (8 & 11).

The *Treponema* species are very difficult to maintain in culture, although some progress has been made in isolation from BDD lesions. Eight spirochetes were isolated from BDD lesions in the USA, with seven of these isolates forming a distinct phenotypic group (12). A further four USA BDD spirochetes were identified as similar to *Treponema phagedenis* (13). A spirochete isolated from a BDD lesion in the UK was identified as similar to the USA isolates (14), whilst a German BDD spirochete (*Treponema brennaborense)* has been identified as quite different (15). We identified a need for further isolation of BDD treponemes given the small number of isolations and that a previous molecular survey (11) suggested a more diverse treponemal community than the above isolation data suggests. In the present study, we attempted to determine the range of spirochetes present in BDD lesions from a number of farms in the UK. We have isolated and characterised over 60 treponeme strains and compared against other relevant treponemes (16). These organisms have provided an unparalleled biological resource for BDD research. From this beginning, it was then considered important to develop PCR techniques to identify and localise treponeme phylogroups. This would enable us to address the question of the polytreponemal nature of BDD and to identify any the potential reservoirs of infection which could explain the ready spread of the disease between animals and farms. Other questions to be addressed included the nature of the interaction of these organisms with the host, the usage of antimicrobials in vivo and whether whole genome analysis could provide us with information about the origin of the infection and provide targets for therapy.

MATERIALS AND METHODS

Treponeme isolation and cultivation.

Single biopsies were taken from Holstein-Friesian cows with BDD from dairy farms in Merseyside, Cheshire, Shropshire and Gloucestershire. UK. After cleaning the foot surface by brushing and washing with sterile PBS, a 3 mm punch biopsy was taken from the centre of the lesion, washed in sterile phosphate buffered saline (pH 7.4), placed in oral treponeme enrichment broth (OTEB: Anaerobe Systems, Morgan Hill, CA, USA) containing rifampicin and enrofloxacin and transferred to the laboratory. The biopsy was diced in an anaerobic cabinet and the fragments were inoculated into fresh OTEB supplemented with 10% fetal calf serum with antibiotics as above and incubated for 24 hours. Bacteria were then subcultured on fastidious anaerobe agar (FAA) plates supplemented with 5% defibrinated sheep blood for ~2 weeks. Single colonies were inoculated into growth media without antibiotics and subculture repeated if cultures were not deemed pure by phase contrast microscopy and 16S rRNA gene sequencing. Isolates were stored at -80ºC in growth medium containing 10% glycerol.

Gene sequencing and phylogenetic analyses

Treponeme 16S rRNA gene and *flaB2* gene PCR were carried out as described previously (2). Amplified PCR products were sequenced commercially and complete genes assembled using the Staden sequence analysis package. Gene sequences were aligned using CLUSTALW and phylogenetic trees were calculated with the neighbor joining method (bootstrap values based on 1000 iterations). Enzyme profiles for each strain were determined using the APIZYM system.

PCR assays for Treponeme phylogroups

Nested PCR assays were developed which were specific for the three BDD treponeme groups. The initial PCR step used a universal bacterial primer pair encompassing the majority of the 16S rRNA gene. The second/nested PCR step used primers encompassing smaller (300-500bp) regions within the 16S rRNA gene. Primers were identified using a 16S rDNA CLUSTALW alignment of the isolated strains with all known treponeme sequences present in GENBANK. Stringent PCR conditions were identified using a Mastercycler gradient thermocycler. The BDD treponeme specific PCRs were applied to culture and tissue derived DNA samples using 25µl reaction mixes as described above with 1µl PCR product template from the initial reaction. In addition to the group specific PCR assays, a PCR assay was also used which would detect all currently known treponemes. Both BDD lesion tissues and normal foot tissues were tested with these PCR assays.

Production of anti-treponemal antibodies

Antigens were prepared from each of the 3 groups of treponemes by sonication and repeated freeze/thawing. These were then pooled and supplied to a commercial concern for generation of rabbit antisera.

Immunohistochemistry

Paraffin-embedded foot tissues were sectioned by a microtome, deparaffinised with xylene, blocked with 3% hydrogen peroxide and 2% BSA. Each slide was incubated with anti-treponeme antibodies (1:1000 dilutions), washed with PBS three times and then probed with a 1 in 500 solution of goat-anti-rabbit antibody conjugated to peroxidase for 2 hrs. After a second washing step, bound peroxidase was localised with chromogen (diaminobenzedine) for 30 min and then counterstained with H&E prior to light microscopy.

Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was performed by a broth microdilution method. Bacteria counts were determined using a Petroff-Hausser counting chamber under phase contrast microscopy. The microplates were incubated at 36 ºC under anaerobic conditions for the required time for MIC measurement. The antibiotics tested were penicillin G, ampicillin, oxytetracycline, gentamicin, lincomycin, spectinomycin and erythromycin and enrofloxacin. Growth curves were recorded for each of the BDD associated spirochaete groups by measuring the absorbance of the microplate wells at 540nm every day for up to 10 days using a Multiskan microtitre plate reader. The MIC for each antibiotic was taken as the lowest concentration of antibiotic that prevented growth in wells.

RESULTS

Treponeme isolation

To date, 59 spirochete isolates have been obtained from BDD lesions. Two different strains were isolated from single lesion biopsies from two cows.

16S rRNA gene analysis

On phylogenetic tree construction, the isolates separated into three distinct phylogroups. 16S rRNA gene sequence identity shared within each phylogroup was high with individual members of groups 1, 2 and 3 sharing a minimum sequence identity of 100%, 99.9% and 99.7% respectively. Group 3 isolates were closely related to a spirochete isolated in this laboratory from a case of contagious ovine digital dermatitis (CODD) (2) with ~99.8% sequence identity.

flaB2 gene analysis

After phylogenetic tree construction, the isolates could be divided into the same three distinct groups already identified by growth characteristics and 16S rRNA gene analysis.

Enzyme activities

The enzyme profiles for each of the previously categorised three groups were identical within each group and different between groups, in good correlation with the genetic analyses and growth characteristics.

***Treponema pedis* sp. Nov**

The third treponeme phylogroup shared less than 97 % 16S rRNA gene sequence identity with any of the currently recognised *Treponema* species. Phylogenetic reconstruction revealed that the four isolates tested in this phylogroup, separated into a distinct and well-supported phylogroup that diverged from an ancestor of *T. putidum* / *T. denticola* before these two species diverged from one another. The evolutionary distance between the third phylogroup and *T. putidum* or *T. denticola* was akin to that observed between sister species throughout the *Treponema* genus. In agreement with 16S rRNA-based analyses, the third phylogroup were found to be specifically related to, but clearly distinct from *T. denticola* by *flaB2* sequencing. This work has been accepted for publication (17 – In press).

Group-specific PCR survey of biopsied BDD lesions

From the 29 BDD lesions biopsies collected during this current study (2002-2007); groups 1, 2 and 3 treponemes were present in 96.6%, 100% and 72.4% of lesions respectively (Table 1). All BDD lesion samples were positive for the general treponeme PCR.

PCR survey of healthy foot tissues

Healthy (non-BDD) foot tissues were obtained from nine young bullocks, none of which had been reported to have suffered or had any symptoms of BDD. None of the biopsies from the young bullocks tested positive for any of the BDD associated treponeme groups (Table 2). In order to test animals that had been present in the farmyard environment but did not have current BDD lesions, seven non-BDD cows that had been on farms that had endemic BDD were tested for the presence of the BDD treponemes in hoof tissues. For six of the seven samples tested, the PCRs did not reveal BDD treponemes in normal healthy hoof skin (Table 2). The single exception was one sample which tested positive for all three of the treponeme groups. Interestingly, all healthy hoof tissues, including that of the bullocks, tested positive for the general treponeme PCR. This work is now published (18).

Studies in sheep have revealed a similar treponeme distribution in CODD lesions as seen in BDD (19).

Immunohistochemistry of healthy and infected bovine foot tissues

Healthy foot tissues showed no treponemal presence by immunohistochemistry using antisera raised against the BDD treponemes. In comparison, lesional tissues from BDD cases displayed very strong staining with the anti-treponemal antisera. This was apparent particularly in the deep layers of the lesion and, unexpectedly, in the hair follicles and sebaceous glands. This staining pattern was seen in all the cases tested. Differences were seen in the sub-localisation of the treponemes; in the hair follicles, the treponemes appeared to be both intra and extra-cellular, in the surrounding tissues, they were almost entirely extracellular in location. This work is now published (18).

Antimicrobial susceptibility testing

All groups were most susceptible to penicillin and erythromycin whilst not being particularly susceptible to enrofloxacin. However, there were group-specific results; for example, the group 3 isolates appeared to be more susceptible to gentamicin than the other two groups, whilst group 2 isolates were less susceptible to lincomycin than the other two groups (Table 3). This work is now accepted for publication (20 – In press).

CURRENT STUDIES

Reservoirs of treponemal infection in cattle and farm environments

Biopsies and swabs have been taken of many tissues, from both BDD and normal cattle, and from the farm environment, including bedding, straw, faeces, urine, slurry, lying water, insects. These were tested, by PCR for the BDD associated treponemes and the PCR for general treponemes. In no cases were the BDD specific treponemes detected outside of BDD lesions. On the other hand, the general treponeme PCR was positive in the vast majority of samples. We are currently testing other cattle foot lesions (toe necrosis, sole ulcers and white line disease) and will report our findings.

Interactions of treponemes with host cells in the hoof/immune system

The cultured treponemes are being cultured with host keratinocytes and fibroblasts and the effects on host gene expression being assessed by q-PCR. In parallel with this, we are investigating the adhesion (and subsequent penetration) of the treponemes with host cells.

Whole genome sequencing of BDD treponemes

To date, we have whole genome sequences for 2 organisms (different phylogroups) and are analysing these for sequences known to be related to pathogenesis and to bacteriophage infection of treponemes (14). Another 5 isolates are being sequenced (Roche 454 Titanium)

Genetic basis of cattle susceptibility to digital dermatitis

We are determining the SNPs in the cow genome relating to bacterial infections and looking for specific associations with digital dermatitis.

In vivo antimicrobial trial to eliminate BDD from a dairy farm

A selected antimicrobial is being trialled at the Tesco Centre of Dairy Excellence at Liverpool Veterinary Faculty. We expect results in 5-6 months.

DISCUSSION

We now have a much better understanding of the treponemes associated with BDD (and CODD). To date, however, we have not identified an infection reservoir other than foot lesions and this will have an implication for farm management recommendations. The completion of the genome sequencing will be a major resource for data mining to elucidate the pathogenic mechanisms involved in BDD/CODD and provide molecular targets for therapeutic intervention and vaccine development.

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Table 1. PCR detection of treponemes in BDD lesion biopsies (2003-2007)

Sample No.	**Biopsy date**	**Details**	**Type[a]**	**Treponeme isolated**	**Group Specific PCR**			**All Trep PCR**
					1	**2**	**3**	
1	1/12/03	Cheshire, Farm 1, cow 167, left hoof.	Chronic	T167[b] (2)	+	+	+	+
2	1/12/03	Cheshire, Farm 1, cow 167, right hoof.	Acute	IF	+	+	-	+
3	1/12/03	Cheshire, Farm 1, cow 13.	-	IF	+	+	-	+
4	26/1/04	Shropshire, Farm 1, cow 136	-	T136 [b] (2) T136E[C] (1) T136P2[C] (3)	+	+	+	+
5	26/1/04	Shropshire, Farm 1, cow 52	-	T52A [b] (2) T52B [C] (1)	+	+	+	+
6	26/1/04	Shropshire, Farm 1, cow 200	-	T200 (2)[c]	+	+	+	+
7	26/1/04	Shropshire, Farm 1, cow 119	-	T119A [b] (2)	+	+	+	+
8	13/2/04	Merseyside, Farm 1, cow 320	-	T320A [b] (2)	+	+	+	+
9	13/2/04	Merseyside, Farm 1, cow 380	-	T380A [b] (2)	+	+	+	+
10	13/2/04	Merseyside, Farm 1, cow 272	-	T2721A [b] (2)	+	+	+	+
11	13/2/04	Merseyside, Farm 1, cow 355	-	T3552B [b] (3)	+	+	+	+
12	26/4/04	Gloucestershire, Farm 1, cow 819	-	G819CB [b] (3)	+	+	+	+
13	26/4/04	Gloucestershire, Farm 1, cow 317	-	IF	+	+	+	+
14	23/4/04	Gloucestershire, Farm 2, cow187	IDD	G187 [b] (2)	+	+	-	+
15	16/5/04	Gloucestershire, Farm 3, cow 1	-	IF	+	+	+	+
16	16/5/04	Gloucestershire, Farm 3, cow 169	-	G169A [b] (2)	+	+	+	+
17	9/7/04	Merseyside, Farm 1, cow 323	-	T323C [b] (2)	+	+	+	+
18	9/7/04	Merseyside, Farm 1, cow 645	-	T645C3[c](2)	+	+	+	+
19	28/4/05	Merseyside, Farm 2, cow 116		T116B[c] (2)	+	+	+	+
20	2/9/05	Cheshire, Farm 2, cow 100	-	T100A[C] (2)	+	+	+	+
21	2/9/05	Cheshire, Farm 2, cow 122	-	T122A[C] (2)	+	+	-	+
22	1/12/05	Cheshire, Farm 2, cow 5	-	NIA	-	+	-	+
23	15/06/06	Cheshire, Farm 2, cow 67, left hoof	Chronic	NIA	+	+	-	+
24	15/06/06	Cheshire, Farm 2, cow 67, right hoof	Chronic	NIA	+	+	+	+
25	7/11/06	Cheshire, Farm 1, cow 577	-	NIA	+	+	-	+
26	20/11/06	Cheshire, Farm 3, cow 87	Chronic	NIA	+	+	+	+
27	20/11/06	Cheshire, Farm 3, cow 574	Chronic	NIA	+	+	+	+
28	20/11/06	Cheshire, Farm 3, cow 265	Acute	NIA	+	+	-	+
29	11/01/07	Lancashire, Farm 1, cow 1	-	NIA	+	+	+	+

+ = positive PCR reaction; - = negative PCR reaction

Table 2. PCR detection of treponemes in hoof tissues from cows without BDD

Sample No.	***Biopsy date***	***Details***	***Group Specific PCR***			***All Trep PCR***
			1	***2***	***3***	
1-9	15/12/05	Cheshire, Farm 1, single rear foot from 8 young bullocks	-	-	-	+
10	17/01/07	Lancashire, Farm 1, cow 182265	-	-	-	+
11	17/01/07	Lancashire, Farm 1, cow 00645	+	+	+	+
12	17/01/07	Lancashire, Farm 1, cow 600309	-	-	-	+
13	17/01/07	Lancashire, Farm 1, cow 391	-	-	-	+
14	17/01/07	Lancashire, Farm 1, cow 100233	-	-	-	+
15	17/01/07	Lancashire, Farm 1, cow 20560	-	-	-	+
16	17/01/07	Lancashire, Farm 1, cow 111B	-	-	-	+

+ = positive PCR reaction; - = negative PCR reaction

Table 3. Antibiotic sensitivity of BDD associates treponemes.

	Median MIC (mg/L)							
Strain no.[a]	Penicillin	Oxytetracycline	Ampicillin	Lincomycin	Spectinomycin	Erythromycin	Gentamicin	Enrofloxacin
1	0.0469	0.375	0.0938	6	1.5	0.0117	12	24
2	0.0469	0.375	0.0938	6	1.5	0.0059	24	48
3	0.0469	0.375	0.0938	6	1.5	0.0117	3	48
4	0.0469	0.375	0.0938	6	3	0.0059	12	48
5	0.0469	0.375	0.0938	6	1.5	0.0117	6	48
6	0.0469	0.375	0.0938	12	1.5	0.0117	12	48
7	0.0117	0.375	0.0469	24	>12288	0.0469	12	24
8	0.0235	0.375	0.0938	12	6	0.0235	24	24
9	0.0235	0.375	0.0938	12	6	0.0469	12	96
10	0.0117	1.5	0.0938	24	6	0.0469	24	48
11	0.0235	0.1875	0.1875	24	6	0.1875	48	48
12	0.0235	0.75	0.0938	12	3	0.0469	12	24
13	0.0117	0.375	0.0469	12	6	0.0469	24	48
14	0.0235	0.375	0.1875	24	3	0.0469	24	48
15	0.0469	0.75	0.3750	6	12	0.0235	3	96
16	0.0235	0.375	0.3750	0.75	1.5	0.0117	0.75	12
17	0.0469	0.75	0.3750	6	1.5	0.0117	1.5	48
18	0.0235	0.75	0.1875	6	3	0.0117	1.5	24
19	0.0235	0.375	0.1875	6	3	0.0235	1.5	48
MIC_{90}[b]	0.0469	0.75	0.3750	24	12	0.0469	24	96

NOTES

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A DECADE OF PAIN: A LOOK BACK OVER TEN YEARS OF DISCOVERY ABOUT PAIN ASSOCIATED WITH LAMENESS IN CATTLE

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SUMMARY

This paper will consider some aspects of the ethical debate and scientific evidence that contribute towards our now widely held belief that animals do suffer pain. It will look at the effects of pain in cattle and review an effective integrated approach to the management of pain associated with lameness in dairy cattle. Further to this it will consider how the perceptions and attitudes of humans towards pain in animals influence their actions and the likelihood of them taking action to relieve suffering.

INTRODUCTION

The 18th century philosopher Jeremy Bentham said of animals "…the question is not, Can they reason? nor, Can they talk? but, Can they suffer?". This widely used quote from Bentham describes the view that it is not necessary to judge animals' abilities by our own standards, i.e. whether they have speech or sophisticated decision making capacities, but that we should be most concerned about how they feel and whether they themselves are alright. The International Association for the Study of Pain (IASP) definition outlines that; [pain is] "*an unpleasant sensory and emotional experience with actual or potential tissue damage*" (1). It is important to note that this definition recognizes that pain has an emotional as well as physical component; this implies that some level of consciousness is required to fully experience pain in the way that humans do. Interestingly, despite the amount of value put on whether animals can have experiences akin to humans, it is only relatively recently that medical science has recognized that all adult humans experience pain to a similar degree regardless of race, gender and wealth. Even now the debate continues as to the levels of pain experienced by neonates. This uncertainty about whether neonates can experience pain illustrates the problem that we have to overcome when trying to understand whether non-human animals feel pain. It means that a) despite the obvious merit of exercising the precautionary principle it is still not standard practice in all neonatal care units to provide analgesia when dealing with poorly babies, and b) when examining the reason for this uncertainty about human neonates ability to suffer pain much of the problem seems to be that because young children cannot communicate through language there is room for doubt as to their actual pain experiences.

EVIDENCE THAT CATTLE FEEL PAIN

The question of whether animals, in this case cattle, experience pain is clearly not straight forward to answer and a considerable weight of evidence has to be examined and considered before reaching any conclusion. Firstly, for cattle to experience pain the underlying physiological mechanisms of pain, the receptors, nerves and neurochemicals that are activated by noxious stimuli, should be similar to those of humans; which indeed they are. Further to this, the behavioural responses of the cattle to noxious stimuli should closely mirror those of humans; which they do. However, some people have then questioned whether animals [cattle] might experience the sensations of pain without actually suffering (2). This might suggest that cattle have insufficient cognitive ability to allow them to experience pain or to put it another way "they might be too stupid to feel pain". Science continues to increase our knowledge about animal cognition and most who work in the field, while acknowledging that no definitive answers exist, point out that we have no proof that animals do not have subjective experiences; therefore the benefit of the doubt should be afforded to them (3). To convince ourselves that cattle experience pain we might expect them to respond to the administration of analgesics, for example a lame cow should, as indeed it does, bear weight on the affected limb once it has received effective local anesthesia. However, it should also show a change in what might be termed "quality of life": This might take the form of either resting comfortably or alternatively becoming active and performing tasks, such as eating, which it was reluctant to do prior to receiving pain relief. The evidence for this is largely empirical but does exist. It appears when examining the available information that the balance tips towards the likelihood that cattle do suffer pain and so we are ethically obliged to take steps to both prevent and properly manage their pain whenever possible.

EFFECTS OF PAIN & BENEFITS OF PAIN MANAGEMENT

It is important to appreciate that, as well as ranging between unpleasant to down right intolerable for the sufferer, pain also has ancillary effects that cause problems for both the cattle and their carers.

Ancillary effects of pain include:

- Slowing down healing;
- Causing a negative energy balance (at the very least through inappetance);
- Decreases in productivity;
- Impairment of cardiovascular and respiratory function;
- Aggressive behaviours;
- Further associated problems (e.g. postural changes leading to muscle wastage or joint damage).

It is clear that pain in cattle is not only a serious animal welfare concern but that it should also be a cause of considerable management concern. The effective management of pain in cattle can be divided into four phases (4):

1) **Recognition of lameness:** Unless lameness is detected no management action will follow. The earlier lameness is detected the more effective pain management will be. A study described by Whay and colleagues in 2002 (5) found that three out of four cases of lameness in UK dairy cattle were going unreported.
2) **Treatment:** Rapid and effective treatment will often immediately reduce suffering and will decrease the chances of chronic pain developing.
3) **Sympathetic care:** The chances of a full and quick recovery will be greatly increased by providing the cow with an environment in which she can rest comfortably, eat easily without having to compete for feed and where she does not have to walk long distances [especially over rough or difficult walking surfaces]. Again the quicker and more complete the recovery the greater the likelihood of avoiding long-term complications and chronic pain.
4) **Analgesia:** Using drugs to interrupt or modulate the pain experienced by cattle will promote recovery, reduce the risk of prolonged suffering and limit production losses.

Effective pain management requires an integration of these approaches and should not rely on one single element; for example administration of analgesics without effective treatment.

There is research evidence that lame cattle benefit significantly from receiving the aspirin-like Non-Steroidal Anti-Inflammatory Drug (NSAID) ketoprofen when it is given in association with effective lesion treatment (6) and that these combined approaches can also promote recovery of milk yield (7). However, as Weary and co-workers (8) demonstrated in Canada, when a NSAID is given without associated treatment of the cause of lameness an improvement in gait is detected, but to a very minor degree, reinforcing the message that a multilateral approach to pain management is required.

THE INFLUENCE OF HUMAN ATTITUDES TOWARDS CATTLE PAIN

How individuals, veterinary surgeons, farmers and herdspeople respond to pain in the cattle under their care is likely to be influenced by a number of factors. These include their beliefs about whether or not cattle feel pain, their own personal attitudes to and experiences of pain and what they believe they or others around them can do to manage it. In a survey of UK veterinary surgeons, Huxley & Whay (9) found that cattle practitioners varied considerably in their estimates of the levels of pain associated with a range of conditions and procedures. As has been previously reported, in most cases women rated pain higher than men. However, most importantly and regardless of gender, a practitioner's perception of pain severity influenced their likelihood of giving analgesics; those that perceived pain to be more severe were more likely to give pain relief in more cases. In addition, 65% of practitioners surveyed reported a belief that farmers would not be willing to pay for analgesics as a barrier to their use. Interestingly, in a corresponding survey of farmers 53% agreed with the statement "*Veterinary surgeons do not discuss controlling pain in cattle with farmers enough*" (10). While this is clearly not an open mandate for veterinary surgeons to prescribe analgesics for cattle it does suggest that they should not assume that all farmers will be unwilling to pay for them.

CONCLUDING REMARKS

The challenges of pain are that for all individuals it is a private experience. Humans overcome this by using language as well as behaviour to convey how they feel and also about the extent of their suffering. Animals do not have the facility of describing their pain to us which means that, although they cannot be accused of exaggerating, we sometimes take this as leave to assume that they are not hurting. As yet no definitive answer can be given as to whether animals feel pain in a manner and intensity comparable to humans. However, the weight of evidence suggests that they do suffer and that they also benefit greatly from receiving the best treatment that we can offer them.

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A VIEW FROM THE MARKET PLACE

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Animal health and welfare are consistently identified as a major cause of consumer concern associated with livestock agriculture. It is a crucial interest for all in the food supply chain from farmers and animal health professionals through to the processors and retailers or caterers who must be able to provide reassurance on this issue.

In the recent past, the media and specialist interest groups' campaigning has been drawing attention to the husbandry methods of dairy farming. However, these have had limited impact on customer purchasing habits. The challenges cannot be ignored especially when conditions such as lameness are widely prevalent and visually obvious. The sector must strive to meet the expectations from its consumers. This will require clearer understanding on the avoidance and treatment of lameness (as well as many other so called production diseases) but also in guiding the industry to recognise both responsibility and justification as being at the centre of its future.

The presentation will provide a background to what the market place requires, where it has come from and what challenges the dairy and beef cattle industry are likely to face in the future.

NOTES

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CURRENT LAMENESS IN THE DAIRY HERD – A CLINICIAN'S APPROACH

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SUMMARY

The role of the veterinary practitioner in cattle lameness is changing. Not only is this becoming more directed towards the "difficult" lame cow, it also now involves supplying a complete overall initiative to help control lameness. A logical system of investigating lameness is essential to be able to deliver good advice and produce a "management cycle" that will produce results. There is also a need to acquire a better understanding and develop more practical techniques to enable more consistent results with the chronically lame cow. A worrying example of an emerging condition, possibly best described as horn necrosis, needs to be discussed to get more consensus of opinion from veterinarians, lay technicians, and farmers on what is producing this disease and how best to go about treating it.

INTRODUCTION

The last 10 years has seen huge changes in the role of the cattle practitioner in dealing with lameness. Fifteen years ago in our Gloucester practice it would be the norm for a large animal veterinarian to see around 6-8 lame cows a day mostly at the end of the routine fertility visit. Now this is down to 6-8 lame cows a week. The decrease in lame cows seen by the practitioner is mainly associated with the increase in herd size which has seen skills develop in stockpersons to such an extent that they are very capable of dealing with most lame cows on their own. The practitioner has become, on the face of it, a victim of their own success in running foot trimming and treatment courses for these bigger herds – education has been very successful.

The larger herd can also justify hiring in foot care lay technicians on a regular basis, mainly with the aim of developing a system for screening milking cows prior to drying off but obviously there is a lot of treatment and attention given to the lame cow. This may go against the official concept of the lay technician but in a real world it is bound to happen, and to be honest the vast majority of these people have developed good skills when it comes to diagnosis and treatment of lame cows and we cannot criticise them for undertaking this sort of work.

A change to the legislation affecting the handling of cow disposal has had a profound change on the treatment of lame cows. In the past many chronic lame cows were quite legally disposed of through the Over Thirty Month Scheme (OTMS) as being unfit for transport for slaughter. This meant that there was a very easy and economically sound way to get rid of many lame cows. This may have been against the aim of the OTMS but we have in practice to always act in the best economic interests of our clients and using the OTMS was a sound exit route for many of these cows. The loss of the OTMS and now the prospect of actually having to pay for the disposal of fallen stock means that any cow that is not fit for transport is not only a significant loss, with current replacement and cull cow prices being so high, but it has a very significant burden on the farm finances in disposing of them. The practitioner is already becoming more involved with the treatment of the chronically lame cow and we have to develop more adventurous and aggressive ways of dealing with them.

With this background the prospect for the cattle practitioner has changed and we must adapt to new needs. This paper looks at developing 2 key areas for the future:-

- The investigation of lameness problems in the herd
- Using better techniques for the chronically lame cow

INVESTIGATING LAMENESS IN A DAIRY HERD

The practitioner is in an ideal position to bring together skills with lameness recording, recognising types of lameness, how they occur and how they can be prevented. The aim is to put these skills into an "application" that can be used to investigate and improve lameness in cattle.

Any investigation of lameness in a herd needs to go through a series of carefully planned stages to look at relevant aspects of both the cow and its environment. We need to start by looking at the scale of the problem and specifically what types of lesions are involved. The next step usually involves a detailed investigation of the environment – the cubicle and winter housing area or the tracks and gateways if outside grazing. The principles of this approach were laid down with the work of Liverpool University in the late 80s and early 90s. This work has served us well by defining some key parameters of cow housing. However to take this approach further we also need to ask some basic questions from the cow's point of view, to interpret the impact of the housing on the animal? Can we "weight" the various parameters of the housing to see which are more important? The issue is more difficult than it seems, as whatever we do or measure does not necessarily define what the cow thinks about it. We need to observe the cow to understand how it is interacting with its environment and how this could be affecting lameness.

In summary we want the health initiative to: -

- Record the level of lameness
- Record the type of lameness
- Draw up a simple investigation plan
- Recommend and put in place changes
- Monitor the progress

This sort of "closed circle" approach to health initiatives means that we can make progress. If the proposals put in place are not producing the results required then at least we are made aware of this and can go back and review the overall prevention plan. Is the plan being carried out correctly or does it need some changes to be made?

Step 1. Define the problem

We need to be able to assess the lameness level both in terms of how much there is and what type of lesion is occurring. If we were to go out and look for lameness in the herd we would find much higher levels than if we relied on the farm's own records. In most herds lameness records are often non-existent or at best erratic. This means that when we look at lameness records we need to carefully define what they are based on; how the records were obtained, who diagnosed the lameness and who did the recording.

Record the level of lameness
The first step is can we get any lameness records from the farm? If so then we must first take a look at them to assess how complete they are and if the information recorded looks like a reasonable reflection of the type of lesions for that farm. It may be possible to get records from the foot trimmer if one is used.

One way to get round this dilemma of recording lameness is to use lameness scores. The Liverpool team found in the 90's that you can get an accurate picture of the level of lameness in a herd by doing a visual score on as little as two occasions, as long as one of them was during the winter housing period. Madison University (Wisconsin USA) expanded this system to relate the prevalence of lameness seen at locomotion score visits to the actual herd incidence. They found a relatively consistent relationship of three to one i.e. the actual incidence of lameness is about 3 times the prevalence based on an average of herd lameness score visits.

Recording the type of lesion
Recording the type of lesion producing the lameness is again a key feature in determining what is going on in a herd and very necessary before trying to implement improvements. If there are no records then looking at a sample of lame cows, examining the lesions present, and the approach of the farm in treating them will be necessary.

Step 2 – site investigation

The next step is to establish some causal factors we need to carry out a farm investigation and look at key areas that affect lameness.

General Issues
Start the process of investigation by following the typical route taken by a cow as it moves through the various functions of the day. For instance start in the collecting yard and then progress through the milking parlour to the dispersal yard and then the cubicles, loafing area and feed area and back round in a full circle. This should give some structure to the site visit and lend itself to a standard set of questions and scores.

There are a few items that will crop up at each stage of the route such as surface condition. Can the surface be assessed and scored for the following:-

- Slip – feel it with your foot and watch cows moving over this surface. Do the cows ignore their basic one foot following the other routine and go for a wide based stance for safety which may put uneven pressure on the foot and produce lameness lesions? Do the cows actually lose their footing, which although not producing lameness of the foot could indicate poor surface and abnormal posture?
- Physical damage – is the concrete such that it will physically wear the foot or produce damage?
- Hygiene – the amount of slurry present, any standing water, bedding being brought out onto the concrete surface (this may actually be an advantage if it softens the concrete surface?). How often is it scraped, etc?

Collecting yard. The size and capacity are basic measurements that can be assessed very quickly against accepted standards. Does the collecting yard side load or rear load, as the effect of dominance and aggression behaviour in the cows is very significant with side loading collecting yards. Dominant cows pushing in will bully and stress the subordinates in the herd forcing them to have longer standing times and possibly creating more aggression and slipping in the collecting yard. Rear loading yards do not seem to have the same troubles.

What is the exit like from the parlour? Is the turn very tight producing a shearing motion on the foot? Is there a step up or down that could exacerbate this?

Dispersal yards and passageways. Many people think that they are not really necessary except to deliver the cows straight back to the feed or housing area. Do they do any good? The dilemma is that we have convinced ourselves that it is an advantage for a cow to stand for 30 minutes after being milked to allow for teat closure but this may cause more difficulties than we are trying to avoid:-

- Standing times are increased with no access to the bedding or cubicle.
- Slurry build up in this area can be very significant which has implications for the hygiene of both the teat and the foot.

Housing. There are a lot of issues related to the housing, its design, size, and how it is bedded. However there are a few general issues to sort out first such as the type of housing is it a straw yard or cubicles?

If cubicles then:-

- The cubicle passages should be wide enough to prevent slurry becoming too deep and allow the cows to pass without aggression between them. Ideally they should be around 3 metres (10ft) wide and the feed passage 4.6 metres (15ft).
- Is there an advantage in straw bedding coming out into the passage to allow a soft walking surface, especially when there are several cows that stand half-in cubicles?

If straw yard:-

- The overall layout, especially water troughs, bedding, and loafing area must be assessed.

For any housing also look at:-

- Ventilation.
- Stocking rates of the cubicles or loose housing.
- Feed space at the barrier or manger.
- Loafing areas.

Tracks and gateways should be inspected if the cows are out at grazing.

We need a recording sheet such as the one below to fill in some detail whilst walking round. The "size" column indicates stocking rate and area per cow for collecting yards etc., so it can be compared with accepted standards. The hygiene score can be used to assess slurry clearance in each area inspected and the surface score for the quality of the concrete underfoot in each site. The "time" column records the proportion of the day the cows spend in each section of the farm and what they are doing there, e.g. standing, feeding, etc. Asking how long a cow is in each of the areas inspected will give a rough set of values for working out a "time budget".

General Recording sheet

Area	***Detail***	***"Size"***	***Hygiene Score***	***Surface Score***	***Time***
Collecting yard					
Parlour	Width Exits				
Passageways	Width Turning				
Housing	Type Passage width Plan				
Feed fence	Width Type				
Loafing areas					
Tracks @ grass					
Gateways					

Specific Issues
The more specific issues will need a system and recording sheet of their own.

- Assess the cubicle.
- Assess the loose yard.
- Inspect the footbaths and check their construction and siting.
- Cow feeding and nutrition.
- If the cows are at grazing then all aspects of track design and condition should be checked.
- Management of cattle movements within the herd, especially integration of cattle into the herd, is important and should be reviewed:-
  - *Social integration*. What is the policy for social integration? When introducing heifers how are they mixed with the dry cows and what happens to them when they enter the main herd.
  - *Environmental integration*. What is the policy of preconditioning the cows or heifers to life in the main herd? The best option may be to have concrete stimulation, which increases the sole thickness before calving, and then after to use a straw yard to buffer the effects of the calving on the foot to prevent pedal bone "disruption" becoming lameness later in the lactation. Is there cubicle training for the heifers?
  - *Nutritional integration*. What is the policy of introducing the production ration? There are various thoughts about this at present. There may be an advantage in having short dry periods with very few diet changes so the cow does not lose her adaptation to the last lactation diet before she again calves onto the new lactation diet. On the other hand many dairy units are keeping the freshly calved cow on low energy and high fibre diets (e.g. the stale milker ration) until they have adapted to lactation and overcome the disruption of calving.

Conclusions
We can come up with standards and recommendations for all the information gathered on a farm visit but the quandary is what the cow thinks of these ideals we have set. Previous work has highlighted some basic minimums along with what might be the important issues but what does the cow think of these minimums?

Step 3 - Cow Comfort – What are the Cows Telling Us?

Most cows are winter housed in a cubicle environment and we need to concentrate the rest of this examination on the relationship between the cow and the cubicle, as this is where understanding most of the lameness issue now lies.

The difficulty with describing the environment in detail is that it does not tell us how the cow is going to interact with it. We may have what we think is the best design and size for the cow cubicles but are the cows using them? It would be disappointing to find that by using "best knowledge" of cubicle design this has not resulted in the best results in terms of cow comfort, but many parameters of housing design are still not absolutely specific. This means we often cannot "gauge" the importance of any combination of design issues to find which factors are the most important when it comes to cow comfort; we need to look at the cow itself.

Investigating cow behaviour is very much an emerging science but progress is being made and there are some very practical applications we can use in investigating a herd for lameness. Work in the USA and Canada has indicated that we ought to look at:-

- Injuries and damage to the legs. This is a good indicator of how lying in the cubicle physically affects the cow.
- Measuring cow hygiene. How is the way we keep the cow affecting how dirty it is?
- Time spent lying down as a proportion of the day. This is part of what are known as "time budgets" and it allows us to see what areas of the cow's daily routine are limiting and interfering with cow comfort.
- Measuring cow comfort by assessing the actual lying time in the housing.

Measuring Injuries and damage to cows legs
Cubicle design and the way it is managed affects the prevalence of hock lesions in the cows. This can be used as a measure of how the cow is interacting with a cubicle design and bedding material. There are two main types of damage to look for:-

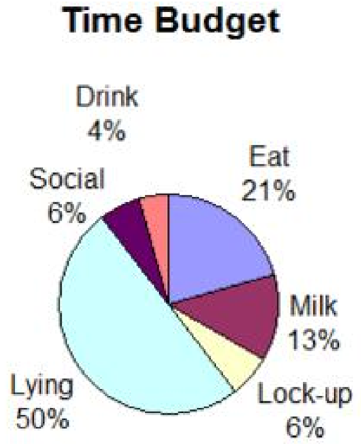
- Lateral or medial hock damage. This involves the tarsal joint, and although it usually starts with simple hair loss it can proceed to skin necrosis or hygroma formation.
- Damage to the point of the hock. This is known as a "Capped Hock" and involves the tip of the hock or tuber calcis.

There may be a problem with the surface bedding material and this can easily produce superficial hock lesions in a lot of cows with the lame cows spending too long lying in the cubicles and developing pressure sores on the upper legs. The cow is telling us that what looks a good idea in theory is not working in practice and we must examine the cubicle surface, its bedding material and the way it is used.

Measuring hygiene score
The amount of manure staining on a cow is a good indicator of the hygiene conditions in which she is housed and managed. Look at the level of muck on the feet, udder and flanks and come up with a simple scoring system that is repeatable and can give a good assessment of farm hygiene. It has been shown that this sort of score is very closely related to lameness, especially skin diseases such as DD. It is also strongly associated with other health performance parameters, such as mastitis.

Time Budgets for Cows
Looking at the cows and how they spend their time in their environment are key steps in understanding the science of cow comfort. The first step in looking at this is to determine a

time budget for the cows; this is a "time and motion" study to find out what are they doing and how long are they doing it?



The key feature is that lying time, which should be a minimum of 50% of the cow's total time budget.

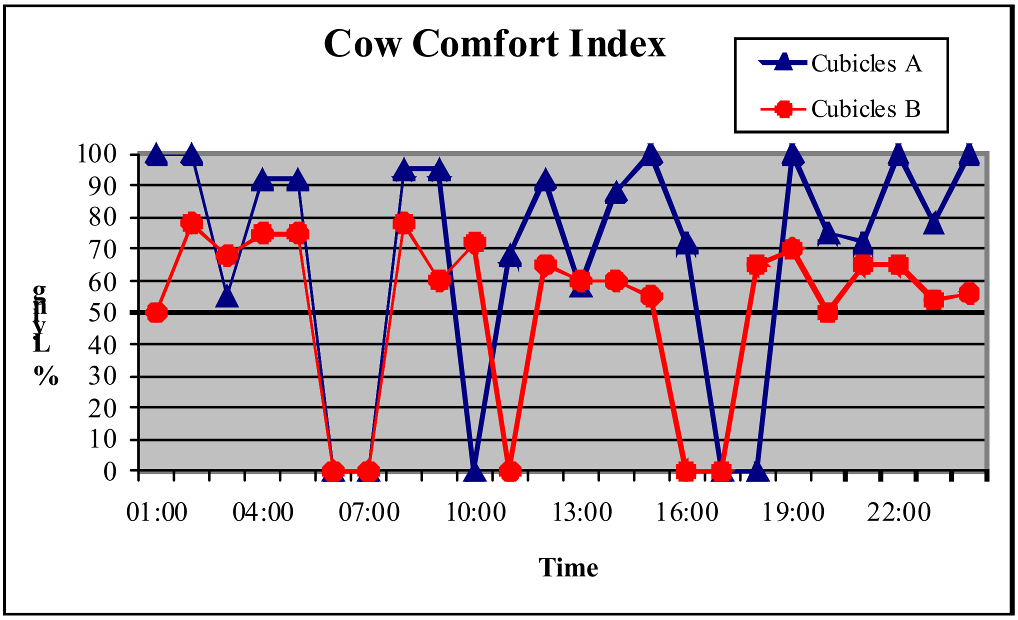
Comfort Measurements
There are more precise ways of defining what the cows are doing in relation to their housing environment that has a more direct relevance to lameness. It is possible with careful observation of cows in the cubicles to put actual figures on comfort.

- Cow Comfort Index (CCI, the number of cows lying in a cubicle divided by the number of cows touching a cubicle surface) gives a numerical expression for the proportion of cows in cubicles that are actually lying down. 85% or more of the cows should be lying in a cubicle two hours before morning milking.
- Proportion Eligible Lying (PEL, the number of cows lying in cubicles divided by number of cows in the pen not eating) shows how many of the cows in the pen that are eligible to lie down in the cubicles (i.e. they are not eating) are doing so. One hour after returning from morning milking 75% or more of the cows should be lying in a cubicle.
- Stall Standing Index (SSI, the number of cows standing with two or four feet in a cubicle divided by number of cows touching a cubicle surface) is the inverse of CCI and shows the proportion of cows in cubicles that are standing, so a lower percentage for SSI is desirable. Figures of 15% or less for SSI at two hours before departure for morning milking is considered good.

These are not very user-friendly terms but they can be defined and measured. Perhaps we ought to simplify this and refer to two straightforward measures: -

1. PEL describes cubicle acceptance by the herd.
2. CCI describes actual cow comfort

Actually getting this information is not that difficult as modern technology means that CCTV (closed circuit television) is often used on modern dairy herds. Even better a web camera can be mounted to observe the cows and by using time-lapse images a very good estimate of these behavioural characteristics can be derived from frames taken every hour. You need to be careful when the behaviour you are trying to measure is relatively short lived, e.g. standing in a cubicle amounts for only about 6% of the cow's day and thus more frequent scanning is needed to be accurate with this measure. However as lying down is a much more prolonged behavioural expression it can be very accurately assessed from hourly snapshots. The following graph shows a typical scan for CCI based on two cubicle designs. The poorer result (lower line) comes from what appear to be the better cubicles, showing again the importance of the cow's point of view.



Summary

Collecting information from the farm will give us the background to enable a lameness situation to be assessed. Then using a well-rehearsed approach to review the farm layout, design, farm management and cow behaviour patterns you can undertake a thorough and constructive investigation of a herd lameness problem.

Finally, achieving true benefits for the cow means carefully looking at the impact of the environment on the animal through its behaviour.

In summary:-

- Investigate herd records or…
- Lameness score the herd – preferably on two occasions at least one of which is in the winter housing period to determine the average lameness prevalence; the lameness incidence is calculated as three times the prevalence recorded.
- Try and get good records of the type of lameness.
- Investigate the herd in a logical fashion.
- Look at simple cow interactions – injuries, hygiene and cow behaviour.
- Formulate a health initiative.
- Monitor compliance and progress.

A logical approach based understanding lameness will enable us to make progress and develop achievable herd initiatives, which **can** deliver results.

TREATING THE CHRONICALLY LAME COW

The 2 main areas of concern are:-

- Septic arthritis arising from other lesions in the foot.
- The disruptive horn damage often produced by chronic foot lesions – especially Digital Dermatitis.

It is essential before starting any treatment of the chronically lame cow to assess the animal ***and*** the farm situation. Welfare of the animal is paramount and all decisions regarding treatment, and even whether to treat, must take this into consideration.

- How much work is the stockperson prepared to put in?
- Can the farm cope with nursing management – is there a straw yard?
- Is the cow going to be able to cope with treatment – is she too old?
- Is there a realistic prospect of the animal returning to production?

Septic arthritis in the dairy cow

Assess the level of joint involvement and make an early decision about treatment which will be ***in order of priority***:-

1. Drainage.
2. Supportive therapy.
3. The use of antibiotics.

Drainage
All procedures involving gaining access to the joint to drain it will require good anaesthesia of the foot. This can only be achieved through an effective regional, local or, in extreme cases, a full anaesthetic technique. The approach to the joint is the problem as the pedal joint is normally fully enclosed within the confines of the hoof itself. This means that prompt radical treatment will have to involve skilled intervention.

The options used in practice are:-

1. “Coring”
The technique involves opening up the original infected tract through to the joint and all other affected structures. This is usually known as “coring” and involves using a foot knife under local or regional anaesthesia to open up a hole big enough to drain affected areas. If the original defect was a solar ulcer then you would use the knife to open up the ulcer and bore deeper toward the retro bulbar area. If there is an abscess in this area the knife will bore in easily and pus will be seen to drain out.

Summary – easy to perform and gives instant drainage. However the core hole heals up too quickly and requires regular maintenance to keep it open and draining. It is inaccurate and not usually very good at draining the joint. It works better when there is an abscess affecting purely the retro bulbar area.

2. Flushing
An incision is made into the joint capsule usually from the lateral or posterior aspect of the coronary band and the original defect line opened up or “cored” to allow drainage as described above. The joint is then flushed by pumping fluid in from the incision wound on the coronary band and out through the original defect.

Summary **–** This is a good way to remove infected material from the joint, but needs maintenance to keep the flushing and drainage hole established. Also it will need to be repeated frequently, which may cause problems for the stockperson as it is not the easiest technique to use without help.

3. Insert a drainage tube

A tube placed through or into the joint has two main benefits; firstly it keeps the drainage holes open because it sits in the drainage tract permanently during treatment. Secondly it allows much easier flushing of the joint and surrounding area.

The drainage tube can be inserted by either using the original defect line and out at the joint line, or by creating a completely new drainage hole transecting the joint. A drain through the original fault line has the advantage of being easy to do but does not allow healing of the original lesion. It may be difficult to get it fully into the joint space as it is more likely to merely touch the back edge of the joint capsule; however, it will not drastically damage the joint. This may seem to be an advantage, but it cannot produce a good drainage line through the joint surfaces and may not flush the joint fully. A new line drilled through the joint allows the original wound to heal but does produce extensive damage to the joint and means that ankylosis will usually be the outcome.

Summary – It is quick and easy to perform giving good access for flushing the joint and is relatively easy to maintain. It may leave a functional joint. There may be problems removing thick clotted material and debris from the joint, however in time these should break down and be flushed out.

4. Full open surgery – Arthrodesis, Arthrotomy

A large incision is made into the joint to fully evacuate the contents and remove all dead and infected material. The procedure requires general anaesthesia to obtain the best results. Arthrotomy implies that the incision is temporary for removal and evacuation while arthrodesis is aiming to produce a fusion of the joint.

Summary – It gives good access to the joint, good removal of infected and necrotic matter and good drainage after. However aftercare is difficult and there may be problems if the tendons are cut gaining access to the joint. Joint function will be completely lost with arthrodesis.

5. Amputation

This is a method for completely draining the area by removing the entire digit with the infected joint and any other all the infected material. It is relatively easy to do under regional anaesthesia; but it may not be very successful for the long-term future of the cow. Some clinical studies indicate that cows with amputated digits are difficult to maintain post operatively and are not retained in the herd for very long. However recent work has shown that the technique for amputating digits can markedly influence the outcome.

Supportive therapy

- Blocking.
- Immobilisation.
- Pain control.

Antibiotics

Antibiotics will only be of supportive use after all the above options have been implemented. The choice is probably not as important as the dose and the period of treatment.

Conclusions

Without enthusiastic involvement of the farm staff and adequate farm facilities to cope with the problem there is little point attempting any treatment of septic arthritis in the adult cow. But with co-operation and a skilled approach to the condition, especially early in the course of disease, the success rate is very good and there is an excellent prospect of the cow returning to normal production.

Chronic horn damage

There are several chronic lesions frequently and perhaps increasingly seen in the bovine foot. Most are found in dairy cows but many beef herds are starting to see the same lesions occurring. These horn lesions are proving extremely difficult to treat and often result in major surgery such as digit amputation, or the eventual culling of the cow. The proposed name for these lesions is horn necrosis.

Suggested definition – chronic extensive damage to horn often originating from a typical foot lesion such as White Line Disease (WLD) but increasingly associated with toe lesions which may or may not originate as toe ulcers. These lesions may be the same as descriptions of toe necrosis described by some workers. Koffler in 1997 described a series of lesions as toe necrosis and indicated that the majority of those treated were due to excessive foot trimming using a grinder.

The basic lesion is that of extensive erosion of the horn with under-running occurring along the laminae junctions. The appearance is:-

- Often very extensive horn loss over the affected area.
- Bulging of the wall horn as it is separated from the underlying laminae.
- Extensive tracking of black lines of necrotic material under the horn.
- Cavitations in the under-run horn.
- Typical foul smell.
- Infection of the underlying corium and osteomyelitis.

The clinical picture seen in practice can be summarised under the following headings:-

1. Extension of a coronary band digital dermatitis lesion down the horn of the wall. Digital Dermatitis (DD) lesions affecting the coronary band are not unusual but in some situations they seem to persist and produce an extensive area of horn loss affecting the horn of the hoof wall directly below the original coronary band lesion. These lesions have many of the characteristics seen in horn necrosis with extensive loss of horn and a severely under-run lesion.

2. Extensive toe necrosis characterised by an erosive lesion affecting the toe which may well start as a toe ulcer but rapidly produces under-run wall horn and an accompanying osteomyelitis. You can often see the vertical laminae under the horn becoming necrotic as the superficial lesion starts to heal after it is exposed and dressed. The amount of damaged and necrotic horn that has to be removed is very extensive and results in a fore-shortened claw on the affected side. Many of these lesions will not heal as the infection rapidly gains access to the bone producing osteomyelitis. Toe ulceration is recognised as a complication of pedal bone movement producing pressure on the sole and although the characteristic site is mid-sole it can occur at the abaxial wall or the toe area. However toe ulceration is rare yet this sort of lesion is becoming very common?

3. Simple lesions such as WLD or even a sole ulcer becoming extended by horn erosion and under-run horn.

4. Toe lesions are often characterised by horn erosion extending up the "medial groove". This is the point where the horn of the wall reflects round inside the interdigital space to form a distinct groove as it meets the horn of the axial sole. This groove can occasionally be affected with septic lesions (e.g. white line disease) but toe necrosis often follows this line to extend away from the sole at the toe and up the axial wall towards the coronary band.

Visually these lesions look as if DD is involved. The liquefaction of the horn and the extensive damage done are reminiscent of very chronic DD lesions seen on some farms. It is unclear why these lesions are becoming more common and what if any treatment can be effectively used to treat them. Some workers feel these lesions are occurring on farms that are not controlling DD well and could indicate the development of chronic DD lesions by lack of proper or prompt treatment. It may be that the level of infection occurring is so high as to continually re-infect these sites despite DD control.

NOTES

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ASSESSMENT OF HOCK LESIONS IN DAIRY CATTLE

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BACKGROUND

Hock lesions are prevalent in housed dairy cattle worldwide. A recent study in the UK found approximately 99% of examined cows to have at least some callused area over a hock (1). Correlations have been established between an increased prevalence of hock lesions and an increased prevalence of lameness. Hock lesions are additionally correlated with injuries to the teats, carpal joints and skin, high somatic cell counts, greater incidences of clinical mastitis, and higher culling and annual death rates.

The range of scoring methods employed in the assessment of hock lesions has resulted in varying estimates of prevalence, and difficulties when comparing the severity of identified lesions. Scores have been attributed to lesions according to one or multiple measures of size or pathology of the lesion, often including a subjective assessment of severity. Often a single score has been assigned per limb or per animal. Alternatively, the most severe lesion per area has been recorded, but with the hock viewed as a whole or subdivided into as many as five individual areas. The method presented here was used in a study which aimed to establish the prevalence and severity of hock lesions in lactating cattle on dairy farms in the East Midlands of the UK.

MATERIALS AND METHODS

A random sample of fifty lactating cows on each of 77 dairy farms in the East Midlands were assessed during a single visit to each farm over the winter housing period of 2007/2008. The lateral and medial aspects of the tarsal joint, and the lateral, medial, and dorsal surfaces of the tuber calcis were examined for lesions. Using a hock map as shown in Figure 1, the size and shape of all lesions at the hock were recorded. Different outline colours were used to identify areas of ruffled or partial hair loss, complete hair loss, and ulceration, as shown in Figure 2. Additionally, the total hair loss and ulceration over each of the left and right hocks, and the degree of swelling at each hock were given a score on a four point scale, based upon scales described by Huxley and Whay (2).

CONCLUSION

Detailed hock score data will allow this condition to be better defined and aid understanding of the potential mechanisms involved in the development of lesions. This will further aid in the provision of practical methods for reducing the prevalence and severity of hock lesions in dairy cattle in the UK.

ACKNOWLEDGEMENTS

We would like to acknowledge Boehringer Ingelheim Vetmedica for their financial support and all of the farmers and veterinary surgeons who participated in the study.

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Figure 1 Hock map used for recording hock lesions in dairy cattle

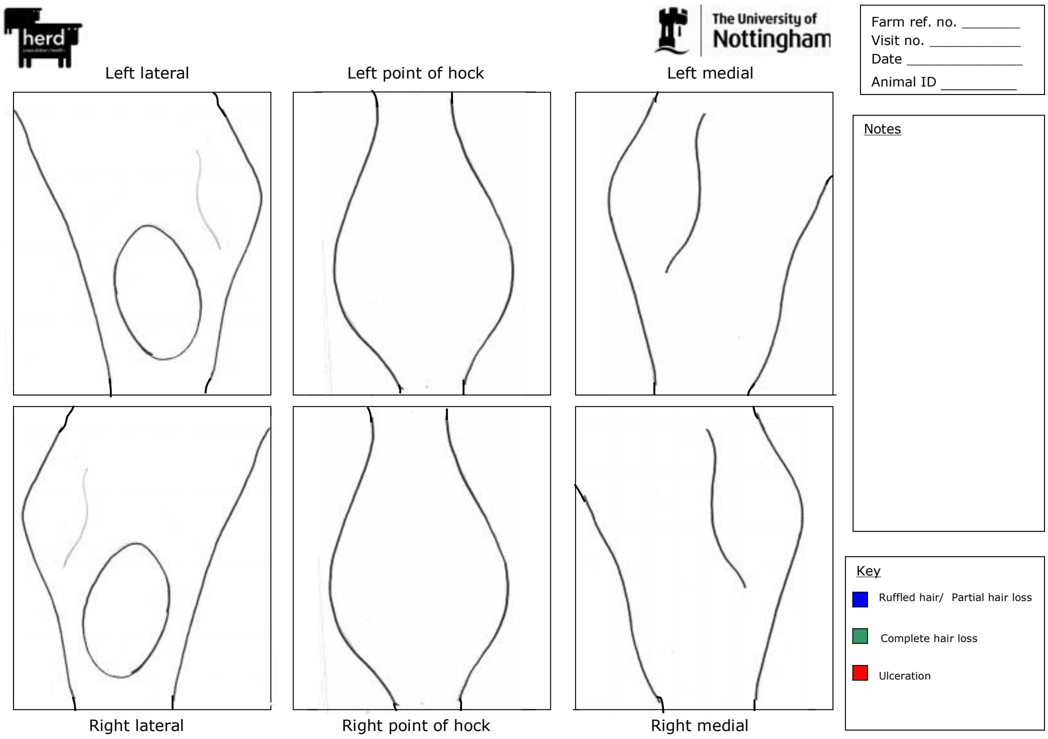
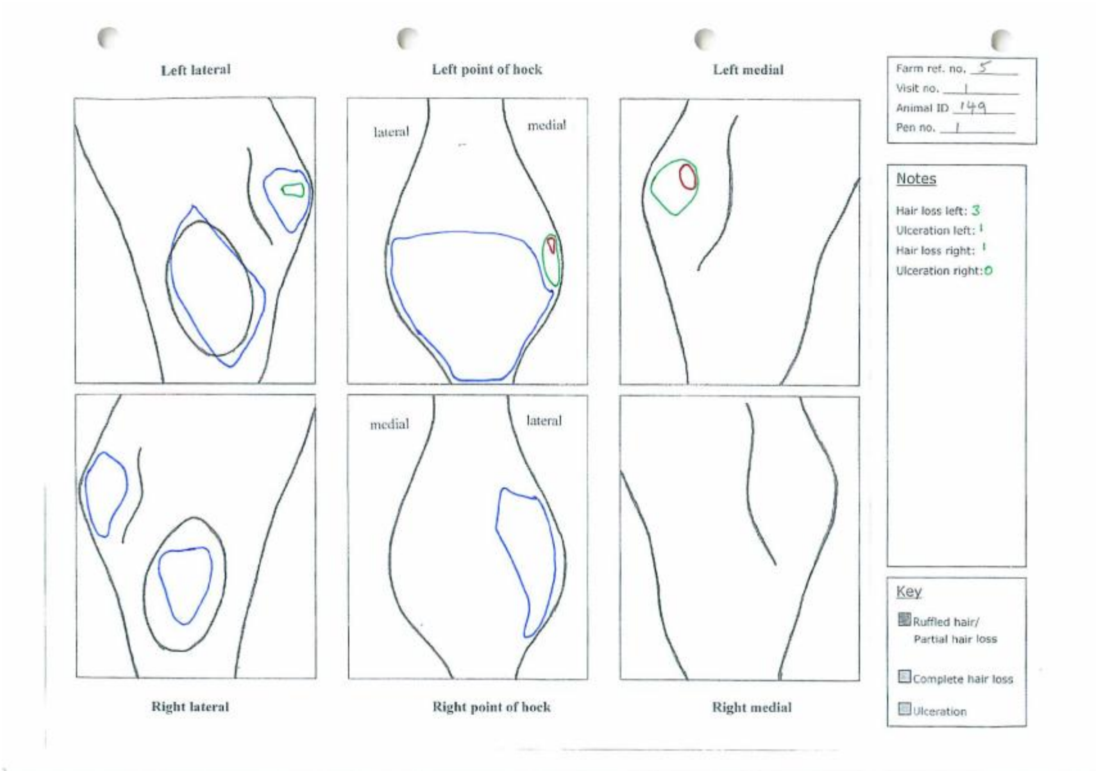


Figure 2 Sample completed hock map



Key and outlines in original hock maps appear in colour, which cannot be reproduced here.

Proceedings of the Cattle Lameness Conference (2009) Sutton Bonington, p 39-40
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PREVALENCE AND INCIDENCE OF LAMENESS ON A COMMERCIAL ZERO-GRAZED DAIRY FARM FROM 2006-2008

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INTRODUCTION

Few studies have been performed on zero-grazed herds and to date there has been limited monthly data available on these farms. Haskell *et al.* (2006) showed the prevalence of lameness in zero-grazed cattle was significantly higher at 39% compared with 15% for cattle which had access to summer grazing in the UK. Whereas a study into the prevalence of lameness on zero-grazed farms in the Netherlands demonstrated a clinical lameness prevalence of 1.2% (Smits *et al.*, 1992).

The estimates of lameness incidence in the UK vary greatly from 32 to 112 cases/100 cows/year with a mean of 70 cases/100 cows/year (Hedges *et al.*, 2001). However many studies used vet treated cases to calculate incidence which is likely to be considerably lower than those levels actually seen on farm. The aim of this experiment was to assess the lameness incidence and prevalence of lameness over the course of a 3 year period in a zero-grazed dairy farm assessed by an independent observer.

MATERIALS AND METHODS

A total of 1171 cows were assessed over the 3 year study period, each cow was observed 11 ±0.31 times. All cows in the milking herd (approx 450) with the exception of cows in the hospital pens and those in straw yard accommodation (through illness or very fresh calved) were locomotion scored monthly using the method of Flower and Weary (2006). Briefly this scoring system is on a scale of 1 to 5 with cows scoring 3 or above classified as lame. The cows are assessed for the presence of an arched back, ease of joint flexation, head movement, gait symmetry and tracking.

The cows were locomotion scored leaving the parlour on concrete and observed walking along an alley before turning right towards the yards. Scoring was carried out by the same observer (NB) every month on the second week. Mean number of days into the month was 8 ±0.86, 11 ±0.72, 10 ±0.59 for 2006, 2007 and 2008 respectively. Any factors which may influence lameness prevalence in any one month were recorded.

Lameness management on the farm involved foot-bathing weekly with copper sulphate and cows were routinely trimmed when dried off. All other hoof trimming events were as required.

A new case of lameness is where a cow scores 3 after a score of 1 or 2 in the previous 30 days.

RESULTS

The monthly prevalence of lameness was calculated as the percentage of cows scoring 3 or above and is shown in Figure 1.

Many of the peaks in the prevalence of lameness could be attributed to the number of cows trimmed, peaks often followed staff shortages (e.g. July 2007 and 2008 and October 2008) stars mark these peaks. The prevalence of lameness reduced slightly between Dec 2007 and March 2008 when Avalia-4 was added to the ration although this effect was not seen after removal from the ration many other factors may have influenced the lameness in the herd.

Figure 1: The prevalence on lameness from 2006-2008 on a 500 cow zero-grazed dairy farm in the south east of England

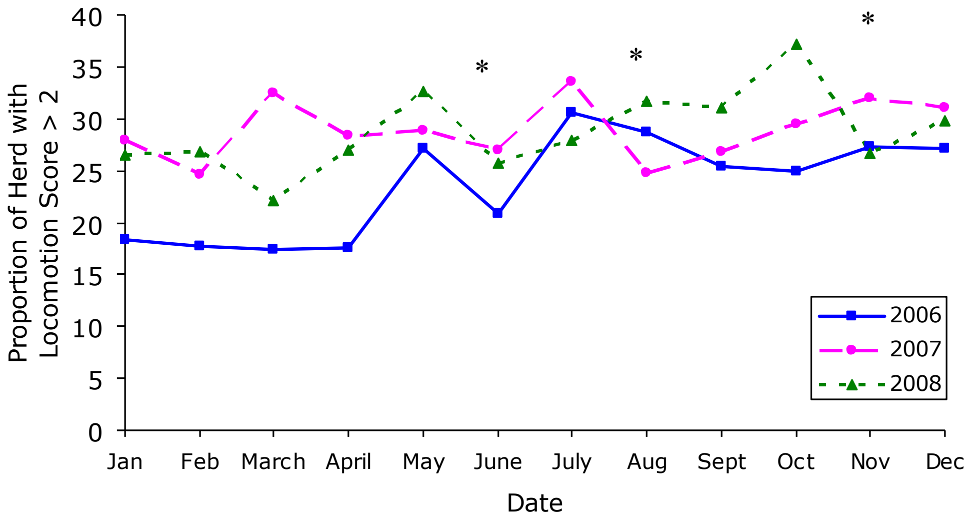

Table 1: Mean prevalence and incidence of lameness per year over the course of the experiment

	2006	**2007**	**2008**
Mean Prevalence	23.6	28.9	28.8
Prevalence Range	17.4 - 30.6	24.7 – 33.5	22.2-37.1
Total Case Incidence of Lameness (Total cases/100 cows/ year)	67	83	85
Cow Incidence (Cows affected/ 100 cows/ year)	42	52	51

The prevalence of lameness was significantly higher in 2007 and 2008 in comparison to 2006 ($p=0.003$) and similar between 2007 and 2008 (Table 1). Incidence of lameness was also lower in 2006 in comparison to 2007 and 2008 and similar between 2007 and 2008.

DISCUSSION AND CONCLUSION

The overall prevalence seen on this farm was lower that that reported by (Haskell *et al.*, 2006) over the course of three years. The importance of regular hoof trimming was seen over the course of this study and these figures may be useful for the benchmarking of high production intensively managed farms.

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Can lameness/mobility scoring be used to identify cows with digital dermatitis?

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INTRODUCTION

Lameness/mobility scoring (LS) is used as a universal outcome measure to grade the degree of pain and discomfort caused by claw lesions in cattle, in order to identify lameness cases in need of treatment. However, it does not identify specific causes. Bovine digital dermatitis (DD) is a painful infectious condition currently considered to be the leading cause of infectious lameness in dairy cattle. However, previous research has suggested that in the majority of cases, DD causes slight to moderate lameness (Somers *et al*., 2004), as opposed to claw horn lesions such as sole ulcers and white line disease that generally lead to obvious lameness (Clarkson *et al*., 1996). Laven & Proven (2000) reported that although 90% of cattle showed a pain response to light pressure on the lesion in the lifted foot, only 27% of these cows were lame. This suggests that lameness/mobility scoring is not a consistent measure of DD.

This study investigated whether lameness/mobility scoring may be used as a tool to identify cows with DD. The system used here has been designed to include relevant locomotive behaviour anticipated for cows with DD. Due to the soreness of the skin and heel bulb affected by lesions, cows that are not lame may walk cautiously with a soft placement of feet, suggesting tenderness.

METHOD

These data were collected as part of a wider study on 87 cows, investigating novel and existing methods of detecting DD in dairy cattle. Cows were examined for DD lesions in the parlour during an afternoon milking on four study farms. The hind feet were cleaned with a pressure hose and inspected using a head torch. For the purpose of validating lesion detection in the parlour, cows were selected for the presence and absence of DD. The next morning, selected cows were separated from the herd and scored while walking across the collecting yard. A 5-point system was used where 0 = sound locomotion (even weight on all four feet, tracking up, and no adduction/abduction), 1 = imperfect locomotion (not tracking up, adduction/abduction but with no obvious limp), 1.5 = tender footed (as Score 1 with cow walking cautiously or slowly with a soft placement of feet suggesting tenderness) 2 = lame (definite limp or pronounced shortening of the stride with arched back) and 3 = severely lame (obvious signs of limb pain and cannot keep up with the healthy herd). Both hind feet were then lifted and examined in a crush, to validate lesion detection in the parlour and identify lesions of the claw horn. Kruskall Wallis and Mann Whitney U Tests were used to test for differences in lameness/mobility score between cows with different lesion types.

RESULTS

Lifting the feet revealed that a significant proportion of cows had disorders of the claw horn/interdigital space (sole ulcers, haemorrhages, interdigital hyperplasia and white line disease) in addition to the DD detected in the parlour. For the purposes of analysis, cows were divided into 4 groups: 13 control cows with no claw or skin lesions, 27 cows with DD only, 14 cows with only sole haemorrhage, and 33 cows with both DD and a claw horn lesion/interdigital disorder. Figure 1 illustrates the difference in LS between control cows and cows with different lesion types ($H_3 = 38.86$, $p < 0.001$).

Cows with any type of lesion had significantly higher LS than control cows (P<0.001). In addition, the LS of cows with DD alone (median 1.5), and cows with both DD and a claw horn/interdigital disorder (median 1.5) was significantly higher than that of cows with sole haemorrhages (median 1.00), (P=0.01 & P=0.001 respectively). However, as illustrated in Figure 1, only 19% of the cows with DD alone had a LS of 2 (lame), while 42% with a claw horn/interdigital disorder were lame. No cows with DD presented as severely lame.

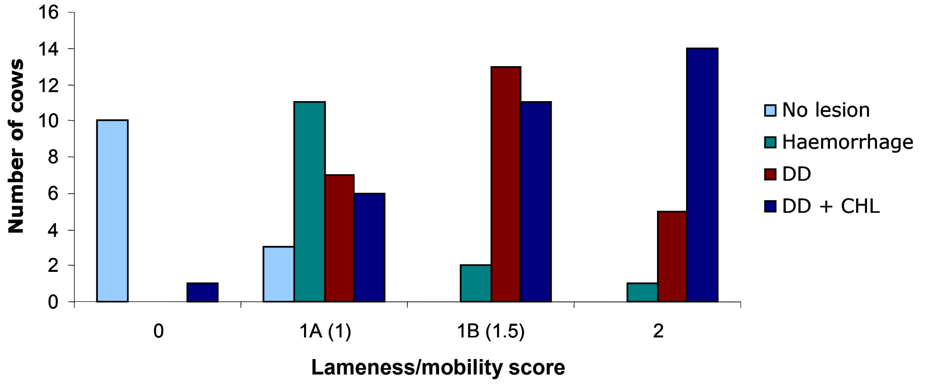

Figure 1. The distribution of lameness/mobility scores for cows with no lesion (controls), cows with sole haemorrhage, cows with digital dermatitis (DD), and cows with both digital dermatitis and a claw horn/interdigital disorder (DD + CHL).

DISCUSSION

This study suggests that cows with DD lesions alone are less likely to show obvious lameness, but rather, a soft placement of feet suggesting tenderness. The majority of cows that were scored as lame had both a disorder of the claw horn/interdigital space and DD. Commonly used lameness/mobility scoring systems may therefore be less appropriate for identifying DD compared to claw horn/interdigital disorders. In order to identify cows with DD, the system used needs to be sensitive enough to incorporate specific behaviour relating to an infectious skin lesion. The mobility of a cow with DD is likely to be affected by the time scoring is carried out, in relation to disease progression within the herd, as well as adopted treatment strategies.

CONCLUSIONS

These results have both welfare and disease management implications for dairy herds that rely on lameness/mobility scoring as a method of detecting individual DD cases for treatment, or taking decisions on herd level strategies for prevention and treatment, since it is likely that the prevalence of DD is underestimated.

ACKNOWLEDGEMENTS

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LAMENESS PREVALENCE AND RISK FACTORS IN ORGANIC AND NON-ORGANIC DAIRY HERDS IN THE UK

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INTRODUCTION AND METHODS

Organic farming is based on the principles that animal health should be maintained through proactive husbandry measures, rather than reactive treatments. The putative welfare benefits of organic farming are often highlighted by organic certifiers or producers and motivate consumers to choose organic products. However, questions have been raised as to the veracity of such claims and very few studies have been undertaken to provide objective evidence that supports or undermines them. Lameness is widely perceived as being one of the most important welfare problems experienced by dairy cows, since it is presumed that many gait abnormalities are caused by, or at least associated with, the experience of pain. This study therefore aimed to compare the prevalence of lameness on organic and non-organic dairy farms in the UK and assess which cow and farm factors influenced lameness levels.

Eighty dairy farms (40 organic, 40 non-organic: matched for location, herd size, housing type and cow genetic merit) across the UK were visited on two occasions (autumn and spring) over a 2.5 year period. These farms were either cubicle or straw-yard housing and herd sizes ranged from 69 to 443. Forty of the farms were visited on a further occasion during the winter housing period. On each visit all milking cows were locomotion scored on a four-point scale and information about farm housing, management and husbandry practices was recorded on-farm. For locomotion scoring, the mean inter-observer reliability between two observers at the end of the training periods was 67.2% when all four lameness score categories were analysed and 90.5% when scores 1 and 2, and 3 and 4 were grouped into two categories of 'sound' and 'lame'. The mean prevalence-adjusted bias-adjusted Kappa (PABAK) coefficient (used to assess inter-observer reliability between three or more observers when the categories were grouped into 'sound' and 'lame') at the end of the training period was 0.88 (range 0.67 to 0.94). Genstat was used for all statistical analyses and due to the better inter-observer reliability all analyses of lameness were based on the sound versus lame categorisation.

RESULTS

For individual farms, lameness prevalence ranged from 1.4% to 48.6% (Table 1) and farmers tended to underestimate their herd lameness prevalence. Overall, lameness prevalence was lower (P=0.012) on organic farms compared to non-organic. For the autumn and spring visits the most significant factor affecting lameness was lactation number, with older cows being more likely to be lame (P<0.001) . Prevalence of lameness was also higher in spring compared to autumn (P=0.005) and when the herd was open versus closed (P=0.004). Herds that kept their cows outside on pasture for longer during the summer also had lower lameness prevalence (P=0.002). Cows housed on cubicles were more likely to be lame compared to those on straw (P=0.011) and higher yielding animals were also more likely to be lame (P=0.013). Finally, farms with an earlier age at first calving had higher lameness prevalence (P=0.004).

Table 1. Lameness prevalence (Mean % lame, range) for different farm types

	Autumn	**Winter**	**Spring**
ALL FARMS	**16.2%** 1.4 – 41.0 *n*=10870	**16.3%** 4.0 – 30.5 *n*=5728	**19.3%** 2.3 – 48.6 *n*=12100
Organic/Straw	**8.3%** 2.9 – 18.0	**9.0%** 4.0 – 13.9	**12.4%** 3.8 – 24.6
Non-organic/Straw	**14.5%** 3.2 – 30.3	**15.3%** 5.2 – 27.9	**17.8%** 4.3 – 34.7
Organic/Cubicles	**16.0%** 1.4 – 41.0	**16.0%** 11.2 – 28.9	**18.0%** 4.4 – 37.9
Non-organic/Cubicles	**19.1%** 3.7 – 38.4	**21.0%** 13.8 – 30.5	**23.1%** 2.3 – 48.6

CONCLUSION

This study supported previous research suggesting that lameness is a serious problem on many UK farms and further emphasises the multi-factorial aetiology of dairy cow lameness. There was some evidence that organic milk production is associated with lower lameness prevalence. Certain factors associated with organic farms, such as slightly delayed breeding and a longer summer grazing period may contribute to this effect. The range of lameness prevalence values for individual farms within a given farm type indicates that progress towards lower lameness levels in the UK herd could be made. For instance, many farms show that it is possible to have a large herd of high yielding cows on cubicles and maintain a reasonably low level of lameness. The challenge for all those associated with the dairy industry is to implement schemes that start to reduce herd lameness, to the benefit of both cow welfare and farm profitability.

We would like to thank all the farmers who participated in the study. This project was funded by the Department for the Environment, Food and Rural Affairs (defra).

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A TEAM APPROACH TO IMPROVE CLAW HEALTH

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Healthy claws are a prerequisite for a good and long lasting life of dairy cows. After infertility and mastitis, claw problems are the third most common reason for involuntary culling of dairy cows. In the early 90's different studies in The Netherlands estimated a prevalence of different hoof lesions, ranging from 5 to 50% for various hoof lesions. Despite increased knowledge, claw health (CH) has been described not to have decreased over the years.

The objective of a study was to investigate the possibility of improving CH at the herd level within a period of 1 year. The improvements should be based on the currently available knowledge and a general consensus within the team of different claw-health advisors (TCHA) on a farm, supervised by an employee of the GD.

The study was conducted in 2007 and was planned to be performed at 21 dairy herds, which were selected on the claw-trimmer's proposal. Evaluations of claw health improvements were based on Claw-Health Scores (CHS); the higher the CHS, the healthier the cows' feet. This score was based on the number of cows with predefined claw disorders as recorded by the claw trimmers and was compared with the number of expected cases corrected for parity, DIM and season of claw trimming. CHS was supposed to be performed at the start of the study, half a year after the start and 1 year after the start of the study, respectively in spring 2007, autumn 2007 and spring 2008. Directly after the first CHS, a meeting between the herdsman and his TCHA (claw trimmer, herd-related veterinarian and feed advisor) was organised to discuss the main claw disorders and the presence of related risk factors. Together a plan to improve claw health in the short and long run was agreed upon with issues ranging from housing, to changes in ration through to direct treatment of lesions by the herdsman.

The statistical evaluation was based on the relative improvement of CHS (ΔCHS= (CHS-Start CHS) / Start CHS).

The mean herd size of the participating herds at the start of the study was 78 dairy cows (range: 37-141), with a mean herd CHS at the start of the project of 66.1 (range: 30-90). Contrary to the initial agreements with the herdsmen, 11 herds were scored three times, 7 herds were scored twice only (at the start and the end of the study) and 3 herds were only scored once (at the start of the study). In 9 of 18 herds with more than 2 scores, the CHS had improved. In 7 herds the score didn't change and in the other 2 herds the CHS worsened during the project. Overall, the mean CHS at the end of the project of 79.1 (range: 40-100), which means an average increase of 21.2%. Disorders that most negatively influenced CHS were an increase of digital dermatitis and white line disorders. A significant difference in ΔCHS was found between herds that were scored twice and three times, respectively 0 and +17 pts. (Wilcoxin rank sum, p=0.02). In herds with 2 scores, the mean period between measurements was 9 months whereas in herds with 3 or more CHS's, the mean interval was 6 months. The level of compliance in relation to implementation of advices was moderate (on average 62% of the suggested changes were executed (20% - 100%)). Reasons for not implementing advice were related to refusal to change routine behaviour (e.g. immediate local treatment of DD-lesions) and to the availability of financial means (e.g. reconstruction of the housing).

As the CHS increased more with 3 scores, we concluded that regular monitoring of the CH motivated the herdsmen to continue necessary changes. This indicated that for improving CH, regular, long lasting and uniform support by advisors is needed. Circumstances that might have had a negative effect on the results per herd were among others, the selection of participating herds, the duration of the project, the moderate attention of dairy farmers and their advisors and the 2007 BTV type 8 infections.

At the start of the project the "selection" of herds was based on the claw trimmers' proposal. These were herdsmen, who were willing to cooperate in the project and not always necessarily experiencing serious CH problems. Some herds already had a CHS≥ 90 at the start of the project and in such herds it was hardly impossible to realize any improvement. On the other hand, the selected dairy farmers were interested in claw health and were motivated to participate and improve management. The BTV type 8 infections in a great part of the country in 2007 may also have had a negative effect on CH, especially on infectious disorders.

The general conclusions of this project were:

1. Improvement of CH can be realized within a one year period and is probably best realized based on advices in which different advisors are involved and agree upon.
2. Despite serious (written) agreements made at the start of the project between farmer and TCHA, the implementation of advices showed a large variation;
3. Based on greater improvements made in herds with ≥3 CHS's compared to others, it was concluded that permanent attention is beneficial for claw health.

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CLAW BACK SOME PROFIT: LIFE AFTER DIGIT AMPUTATION

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Digit disorders account for 90% of lameness cases in dairy cattle, the majority of which are infectious in origin. The hind digits are most frequently involved, with the lateral hind digit affected in up to 85% of cases.

The most common indications for digit amputation are necrotic toe, infected sole ulcer and white line disease. Once infection has entered the digit, either via the sole, wall or interdigital space, unless dealt with quickly, it invariable spreads to surrounding structures. At this stage, once infection has entered the joint, the treatment options are limited: 1) immediate slaughter 2) amputation of the digit 3) digit salvage technique e.g. 'coring'.

With the rise in replacement cost, the end of the Over Thirty Month Scheme (OTMS) and recent introduction of casualty disposal charges, farmers are keener than ever to retain a cow in the herd and avoid the costs associated with culling. As a result digit amputation is becoming an increasingly common treatment option.

STUDY OUTLINE

A retrospective case-control study was undertaken to determine how survival in the herd was affected by digit amputation and therefore assist in decision making when treating lame cows that are potential candidates for digit amputation.

One hundred and thirty one Holstein dairy cows that had undergone digit amputation between 1st January 2000 and 31st December 2007 by vets at Lambert, Leonard & May were included in the study (AMPs). Of the 131 digit amputees, 115 were matched with a 'control' in their herd that was of similar parity, stage of lactation and production level at the time of digit amputation. Forty seven farms were included in total. All cows recruited were followed until 31st December 2008 and their cull date recorded if they left the herd before this date.

RESULTS

The results indicate that amputation had been performed at all stages of lactation from 3 to 540 days calved (at dry off). Amputation was performed on cows between their 1st and 11th lactation, with three performed on in-calf heifers and two performed on maiden heifers. Of digits removed 71% were hind digits with 53% of all digits removed being lateral hind digits.

Kaplan-Meirer survival analysis revealed that the digit amputated had no significant difference on survival at 100 days (p=0.57), 365 days (p=0.07) and over the whole course of the study i.e. long-term (p=0.19).

However, there was a strong trend to suggest that survival post-amputation of a front versus hind digit was greater at 365 days (p=0.08) and also long-term (p=0.08). There was also a trend that cows with a front medial digit amputation survived longer than those with a front lateral digit amputation (p=0.09).

Although not significant, due to the strong trend suggesting differing survival rates between front and hind amputations, these groups were analysed separately in the case-control comparison.

Front Digit Amputations (fAMP)

Survival analysis was conducted on 34 fAMP-Control pairs at 100 days and 365 days post-amputation and over the whole course of the study.

Survival was not significantly different between fAMPs and Controls at 100 days (p=0.64) and 365 days (p=0.64) post-amputation. At 365 days post-amputation 82% of fAMPs and 85% of Controls were still in the herd.

Long term survival in the herd was not significantly different between fAMPs and Controls (p=0.26). The Kaplan-Meier estimate for mean time to failure (i.e. survival time) was 1136.85 days (37.9 months; 95% confidence interval; lower =769.42, upper =1504.28) for fAMPs and 1157.88 days (38.6 months; 95% confidence interval; lower =887.25, upper =1428.50) for Controls. At the end of the study 38% of fAMPs and 53% of Controls were still in the herd.

Hind Digit Amputations (hAMP)

Survival analysis was conducted on 82 hAMP-Control pairs at 100 days and 365 days post-amputation and over the whole course of the study.

Survival at 100 days was not significantly different between hAMPs and Controls with 89% and 95% of cows remaining in the herd respectively (p=0.14). Survival at 365 days was significantly lower in hAMPs (p=0.007) with 56% remaining in the herd compared to 77% of Controls.

Long term survival in the herd was also significantly lower in hAMPs (p=0.001). The Kaplan-Meier estimate for mean time to failure (i.e. survival time) was 830.40 days (27.7 months; 95% confidence interval; lower =600.60, upper =1060.21) for hAMPs and 1246.56 days (41.5 months; 95% confidence interval; lower =941.09, upper =1552.03) for Controls. At the end of the study 29% of hAMPs and 52% of Controls were still in the herd.

In comparison to previous studies, these results show improved survival post-digit amputation with a median survival time following hind digit amputation of 524 days and of 1326 days following amputation of a front digit. One cow that had undergone digit amputation in 2001 was still in the herd and performing well at the end of the study nearly eight years later.

In comparison to Controls, amputation of a front digit did not have a detrimental effect on survival in the herd; however this was a relatively small data set. On the other hand, amputation of a hind digit had a significant impact on survival at 365 days post amputation and also in the longer term. This apparent difference in survival is most likely due to the fact that despite the forelimbs supporting 60% of the cow's bodyweight, it is her hind limbs that provide most of the propulsive force and therefore are more susceptible to lesion development in the remaining digit.

This study shows that digit amputation can provide a successful alternative to slaughter and that cows can be expected to remain in the herd for a considerable period of time. However, further studies are required to explore the links between indication for amputation and survival, to further aid treatment decision of potential amputation candidates.

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THE DYNAMICS OF DAIRY HERD MOBILITY

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INTRODUCTION

Analysis of trends in disease dynamics can be used to monitor population level endemic disease. In dairy practice this is commonly applied to somatic cell count data to provide an indication of whether mastitis control plans are adequate (1). Serial mobility score data lends itself to the same analysis. There is considerable potential to utilise the output for monitoring of lameness control plans and for consumer assurance of welfare.

MATERIALS & METHODS

The Holstein/Friesian study herd has an all year round calving pattern and is located in Staffordshire, UK. Monthly records (National Milk Records, Chippenham, UK) show a rolling average of 172 cows with a mean lactation yield of 7500 litres and a mean calving interval of 388 days. The cows are housed in cubicle sheds and fed a total mixed ration with supplementary cake fed in the parlour according to yield and access to pasture during the grazing season. Milking is carried out twice daily all year round. Lameness prevalence in this herd had been a concern and data were needed to scope the problem.

All milking cows in the study herd were scored for mobility on a monthly basis between August 2008 and January 2009 by a single observer (first author) according to the DairyCo system (2). The scoring took place as cows exited the parlour following an afternoon milking. Cow freeze brands were recorded as identification.

Monthly scores were recoded from a four point scale to a binary scale. Mobility scores two and three (lame) were assigned the value one and mobility scores zero and one (not lame) were assigned the value zero. For cows scored in two consecutive months only, the proportion of cows in each transition state (Table 1) is used to represent the dynamics in the herd. The Net Lameness Index (NLI) is the ratio given by the number of new cases divided by the number of recovered cases.

Table 1. Lameness Transition States

Change in disease state between consecutive months	Classification
0 to 0	Not Lame
1 to 0	Recovered Case
0 to 1	New Case
1 to 1	Chronic

RESULTS AND DISCUSSION

The mobility score data are listed in Table 2 and summarised as the percentage of the herd not lame in each month (DairyCo "Herd Mobility Index"). Table 3 applies the Lameness Transition State Model to those cows present in two consecutive months during the study. Table 4 displays the NLI for each month interval. Where the NLI is greater than one it can be inferred that herd mobility is deteriorating. Conversely where the NLI is less than one herd mobility is improving. An NLI of one implies a steady state where the number of new cases is equal to the number of recovered cases and is the maximum advisable value. In this herd the monthly NLI fluctuates but the rolling mean, over the period of study, is close to one.

Table 2. Number of cows and the proportion not lame ("Herd Mobility Index")

Month	No.	Mobility Score					"Herd Mobility Index"
		0	**1**	**2**	**3**	**Total**	
Aug 08	**1**	9	22	89	26	**146**	**21%**
Sept 08	**2**	1	20	65	34	**120**	**18%**
Oct 08	**3**	1	34	68	26	**129**	**27%**
Nov 08	**4**	2	56	62	23	**143**	**41%**
Dec 08	**5**	0	33	65	34	**132**	**25%**
Jan 09	**6**	2	48	43	37	**130**	**38%**

Table 3. Number of Cows by Lameness Transition State

	Monthly interval				
	Aug-Sept	**Sept-Oct**	**Oct-Nov**	**Nov-Dec**	**Dec-Jan**
Chronics	74	69	61	62	52
New Cases	14	10	15	28	13
Recovered Cases	10	19	27	10	29
Not Lame	9	9	16	19	16
TOTAL	**107**	**107**	**119**	**119**	**110**

Table 4. Net Lameness Index (NLI) by Month Interval and five month rolling mean

Aug-Sept	Sept-Oct	Oct-Nov	Nov-Dec	Dec-Jan	**Mean**
1.40	0.53	0.56	2.80	0.45	**1.15**

Dynamic analysis, such as that applied here may demonstrate trends that are not apparent in the DairyCo "Herd Mobility Index" which describes herd mobility at a single point in time. Combination of measures will improve herd lameness monitoring and appropriate targeting of disease control resources for optimum cost benefit.

Based on an equivalent parameter, successfully used for somatic cell count data (1), the authors would like to propose the measure "Net Lameness Index (NLI)" which can be used to monitor dairy herd mobility over time. There is considerable variation in the monthly NLI demonstrated here. Further data collection and analysis on many dairy herds round the UK is necessary to describe how and why NLI varies between herds and over time so that appropriate targets and intervention levels can be established.

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THE DIAMOND APPROACH TO SUCCESSFUL LAMENESS REDUCTION

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INTRODUCTION

Bovine foot lameness is a symptom of many different disease processes. Each disease has its own aetiology with a peculiar set of risk factors. The prevalence of each lesion type varies from farm to farm, depending on its own particular set of risk factors.

METHOD

Whilst mobility scoring is a useful first step in evaluating a farm's lameness prevalence, a survey of lesion types is required to formulate a lameness reduction plan. Data is graphically represented on axes as shown in the examples ("the lameness diamond").

CONTROL PLAN

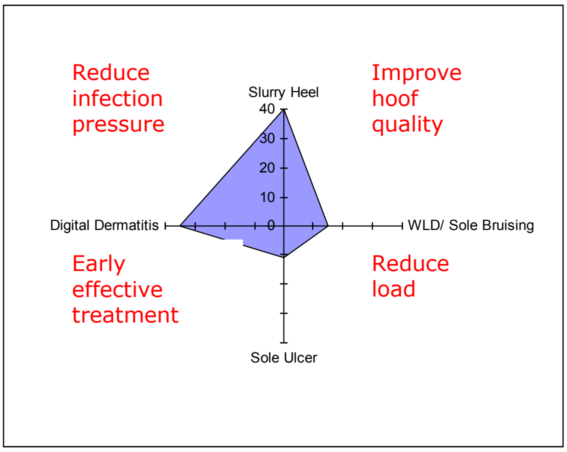
The lameness diamond is used as an aid in identifying the main risk factors contributing to lameness on the farm. Priority can be given to the risk factors associated with the most prevalent lesions.

EXAMPLES

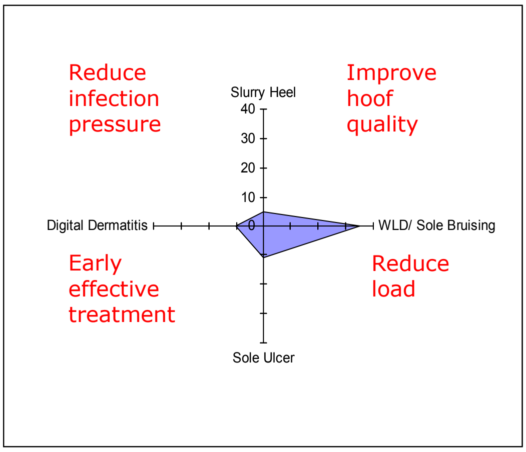
Data from two farms are demonstrated. Both farms have a different pattern of lesion incidence. Farm TK appears to have a controlled infection pressure, but a high incidence of mechanical trauma. Farm BH has a higher infection pressure.

Percentage of Hind Claws Affected with Lesion Types

Farm BH



Farm TK



Farm TK should focus on reducing the load on the foot: areas to consider are walking surfaces, standing times, cow comfort and cow flow. Farm BH should focus on reducing infection pressure by improved hygiene and adopting a good foot bathing regime.

CONCLUSIONS

Simple graphical representation of lesion occurrences can provide a powerful monitoring, investigative and motivational tool for the control of bovine lameness. This allows:

- Identification of most common lesion types so as to institute the most appropriate lameness reduction plan;
- Monitoring of herd trends to highlight the areas of management that are the priority for attention and the areas of strength;
- Motivation of farmers by simple visual demonstration of priority areas.

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MANAGING CATTLE LAMENESS: A NOVEL APPROACH USING SOCIAL MARKETING TECHNIQUES

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Dairy cattle lameness was identified as a high priority welfare issue by the Farm Animal Welfare Council in 1997 and as a consequence government, retailers and industry bodies have been keen to put pressure on farmers to produce "lame free milk". To achieve this, the wealth of research findings and experiential learning about dairy cattle lameness management needs to be implemented by farm owners, managers and herdspersons. There is some evidence that implementation of this knowledge is not taking place effectively on farm. Studies of lameness levels over a 15 year period indicate that lameness prevalences have at best remained constant at around 20 to 22% (Clarkson *et al.* 1996; Whay *et al.* 2003) and at worst have actually increased over time (Huxley *et al.* 2004). Less is known about the rates of lameness-directed management change that take place on UK dairy farms; however studies of lameness control implementation indicate that uptake and action on advice can be limited. This is not surprising as literature from other fields of behaviour change frequently describe how difficult it can be for people to bring about changes in their habits and routines.

It is now widely accepted that, on its own, raising awareness of a problem is not sufficient to bring about behaviour change within the majority of the population. In the context of cattle lameness this means that knowing the prevalence of lameness in a herd of dairy cattle, perhaps through regular locomotion (mobility) scoring, will not in itself trigger the farmer to take preventive action. This is not to diminish the value of regular locomotion scoring as an important management tool but to recognise its limitations in stimulating concerted lameness management activity. There is also considerable evidence that informing dairy farmers about the high economic cost of lameness does not prompt them into implementing lameness reduction strategies. Information about the costs of lameness has been widely disseminated in the farming press for many years but has not been matched with a corresponding fall in lameness prevalence.

There appear to be two main routes by which farmers can be brought to implement lameness management strategies on farm. One is through enforcement; this might be legislation, the use of policy instruments, retailer pressure (backed by consumer pressure) or farm assurance. The second route is that of encouragement; working with farmers to help them make changes to their management practices, largely through recognising that farmers would not keep lame cows through choice and that the majority would like to implement change but do not find the process easy. It is an encouragement route, loosely based around the principles of social marketing, which will be illustrated here.

PROJECT APPROACH

The cattle lameness project described here was set up to develop practical and effective ways of implementing existing knowledge on farm in order to reduce dairy cattle lameness. The project involves 130 intervention farms and 80 control farms recruited from mid to southern England and Wales. Each farm receives a visit from a project team member once a year during which behaviour change is promoted [intervention farms only] and the lameness prevalence of the milking herd recorded.

Social marketing tries to persuade people to do something different, by drawing on advertising and marketing techniques, and uses a range of tools to achieve this. The two key differences between commercial and social marketing are that social marketing is a) directed towards encouraging change that affords a benefit to society (or in our case to animals and their owners) and b) works very specifically to identify and overcome barriers to change. Dairy farmers often work alone on their farms, have limited contact with others and their days involve completing a lot of repetitive, routine tasks. For this reason the social marketing strategy used here includes more individual contact than would normally be expected.

A key feature of the cattle lameness project is that it recognizes that all farms are different, have different problems and that the farmers themselves have unique and valuable existing knowledge of what changes can be implemented on their own farms. There are six "types" of tools being employed in the project; identifying benefits and barriers, facilitating action plans, establishing "norms", encouraging commitment, using prompts and offering incentives. These tools work as a package to encourage dairy farmers to see change as being possible on their own farms, to allow them to plan how change might be implemented, to encourage them to go ahead and try making changes and to sustain successful changes over time. The facilitation element is critical and plays a greater part in this project than in other social marketing exercises, because of the isolated nature of dairy farming. Facilitation is very distinct from giving advice, it is a means of meeting with farmers, discussing the lameness issues they have on farm but ensuring they generate their own solutions which belong to them and that have not been imposed on them from an external source.

PROJECT OUTCOMES

The outcome of the intervention is measured in terms of lameness prevalence on farm. The lameness prevalence on intervention farms is considered in terms of change over time, change in relation to lameness control measures implemented on farm and compared to control farms which are visited once a year for lameness prevalence scoring only. A key indicator of progress is whether implementation of management changes i occurring on farm. Although the project is still ongoing this key indicator has already shown that 62% of farms had made management changes between the first year of implementing the social marketing strategy and the follow-up visit by researchers in the second year.

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FIRST STEP™: A TOOL TO ASSIST IN THE INVESTIGATION AND PREVENTION OF LAMENESS PROBLEMS IN DAIRY HERDS

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INTRODUCTION

While interest and concern in dairy cow lameness has grown in the last decade world-wide, there has been little improvement in the prevalence of lameness despite growing understanding of the role of important risk factors such as management, environment and nutrition. If anything, the situation has become worse.

First Step™ is literally the first step to be taken down the road to healthier non-lame cows. It is the end result of a four year collaboration of Zinpro with the University of Wisconsin-Madison, School of Veterinary Medicine and combines ideas and information from multiple consultants from all around the world.

OBJECTIVE

First Step™ is an attempt to improve the delivery of a functional and effective action plan which will facilitate a reduction in lameness in dairy herds. Lameness is a complex problem with many contributing factors. This complexity leads to confusion and the implementation of ineffective control programs targeted at the wrong issues. It is clear that we have to find a way to educate and motivate the dairy producer to improve their understanding of lameness and assist consultants in identifying the key action areas on any given farm.

COMPONENTS OF THE PROGRAM

It consists of an educational section – referred to as "More Info" combined with a database that stores data collected from the farm and compares it with benchmarks and standards to identify areas that need improvement. Each area has an 'assessor' which summarizes the data and creates a dedicated report unique to the farm. Assessors have been created to cover all of the common management systems for dairy cows worldwide – including freestall, tiestall, straw yard, dirtlot and grazing herds.

Assessors Section

There are 20 assessors in First Step™, each targeted at a key management, housing or nutritional area.

They include:

1. Locomotion – to document the prevalence of lameness and make an assessment of the current cost of lameness on the farm;
2. Lesions – to determine the relative frequency of lesions and focus attention on the main lameness problem on the farm;
3. Hoof-trimming – to determine whether sufficient trimming is being performed and to make sure that it is of an appropriate standard;
4. Transition cow – to make sure that heifers in particular are transitioned gradually into the herd, with the minimum of stress;

5. Time budgets – to estimate the time available for lying down for rest and recuperation;
6. Leg hygiene – to document the risk for infectious hoof disease;
7. Footbaths and sprayers – to assess the design of the bath, the mixing concentrations used and the management of the bath from day to day;
8. Walking surface – to assess flooring for risk of trauma, slipping, wear and concussion;
9. Nutrition and feeding – to identify risk for sub-acute ruminal acidosis, poor feed access and deficiencies in nutrient supply;
10. Dirtlot – to assess the management of the lot;
11. Bedded pack/loose housing – to determine stocking density and bedding management deficiencies;
12. Freestall – to compare existing stall dimensions with targets based on the size of the cow using the stall;
13. Tiestall/stanchion – to compare existing stall dimensions with targets based on the size of the cow using the stall;
14. Freestall ventilation – to minimize heat stress in the building;
15. Heat abatement – to optimize cooling strategies in the barn;
16. Tiestall ventilation and heat abatement - to minimize heat stress in the building;
17. Holding area – to minimize time standing, optimize cooling and reduce stress and trauma;
18. Biosecurity – to minimize the risk for buying in infectious hoof disease and agents that lower immunity;

In addition, for grazing herds there are two dedicated assessors for:

19. Holding yard/milking shed – to optimize parlor throughput and minimize stress;
20. Races/tracks and lanes – to reduce the risk of traumatic sole injury.

The consultant may choose to complete one or a few assessors for a farm, or complete a thorough appraisal using all of the assessors available for any given farming system – this is usually a maximum of 14 assessors.

For each assessor, there is a data capture form that needs to be completed on farm. These data are then loaded into an entry screen. At this time, the user may easily attach pictures (up to six) to the report and write comments on other findings. Once complete, a report may be run. The consultant will need to review these reports, identify the areas of weakness and summarize this information into a short executive summary for the farmer.

Educational Section

Frequently the farmer needs to be educated on the risk factors that are present for lameness in his or her herd. The "More Info" section provides the consultant with an interactive learning module that can be used to help inform and teach.

For each assessor, there is a sortable series of documents containing writing, interactive exercises and video clips to help explain the assessor reports. These pages may be read on screen or printed off and handed to the farm. Each assessor is linked to the appropriate area in the "More Info" section, or it may be accessed directly from the navigation panel.

First Step™ is a complex tool that requires training to master.

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University of Bristol, The Dairy Group and University of Nottingham

A RETROSPECTIVE ANALYSIS OF FIELD DATA TO INVESTIGATE THE PREVALENCE OF FOOT LESIONS IN DAIRY COWS IN SOMERSET AND DORSET 2006-2008

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Lameness, along with mastitis and fertility, is generally agreed to be one of the main causes of serious economic loss to the dairy industry as well as being a serious welfare issue for the cow. The Farm Animal Welfare Council report of 1997 concluded that 'lameness in dairy cattle is at an unacceptably high level' and '….it is essential that action is taken to reduce significantly the prevalence of lameness.'

Actual figures for the incidence and prevalence of lameness are scarce, often quite historical and based on relatively small numbers of farms. A review of the literature indicates that the results have varied from 5-78%. Some of the problems in obtaining this data stem from poor record keeping as well as varying perceptions by farmers (and vets) as to what constitutes a lame cow. In the past these analyses have mostly been assimilated by private veterinary surgeons in practice. This data has, on the whole, been superseded by the growth of paraprofessionals providing a foot trimming service. Possibly a more accurate and relevant approach is to assess the prevalence of lameness by mobility scoring.

In order to pursue epidemiological studies, prioritise areas of research and to find practical ways of improving lameness levels on farm, the prevalence of the various lesions in the feet of cows needs to be appraised. In one review 88% of reported lameness was associated with disorders of the foot. Once again there are very few studies that can provide us with recent data obtained from a large number of cows and farms. The largest and most recent reported in 2007 by Barker collected lesion data from 49 farms (from Cheshire to Devon and including Wales) with an average herd size of 109 cows and relied on farmer recognition of lesions. The predominant lesions were sole ulcer (29.3%), white line disease (22.2%) and digital dermatitis (14.6%).

Synergy Farm Health is a newly established veterinary partnership between the Kingfisher Veterinary Practice in Crewkerne, Somerset and Southfield Veterinary Centre in Dorchester, Dorset. Both practices have for many years employed foot trimmers and have kept records of all the feet trimmed. A decision was made to analyse this data for the last 3 years to provide up to date information on lesion occurrence in the Somerset and Dorset region of the UK.

The period included in the analysis was from January 2006 to December 2008 inclusive and only farms that had trimming sessions in each of six 6 month periods were included. This was in an attempt to reduce bias by farms that may have occasional visits and present large numbers of 'saved up' or problem cows. A separate analysis was also carried out for all farms that had received any foot trimming during 2008.

All trimmers were either holders of the Dutch Foot Trimming Diploma or under going training to achieve this qualification; all have had in house training as well. In order to improve repeatability between trimmers, only well recognised lesions were included i.e. sole ulcer, white line disease, bruising, digital dermatitis and interdigital growth. Cases of lameness treated by the farmer or by a veterinary surgeon were excluded from the analysis. Data was transferred from the recording forms or computerised records onto Excel (Microsoft Windows) and the number of different lesions from all farms calculated for the 6 six month blocks starting in January 2006. In total, over the three year period, 13,413 records from 25 farms met the study criteria and were analysed. The predominant lesion was white line disease with an overall average prevalence of 24.1%, followed by sole ulcer (18.8%), digital dermatitis (9.1%), interdigital growth (7.4%) and bruising (3.6%).

The prevalence of lameness across the three years remained similar except in the case of white line disease which saw the prevalence increase from 21.2% in 2006 to 26.8% in 2008 (an increase of 26.8%).

In 2008, for all cows trimmed at least once on any farm (8703 records on 72 farms), the prevalence of lameness was similar, with white line disease having an overall average prevalence of 27%, followed by sole ulcer (17%), digital dermatitis (17%), interdigital growth (7%) and bruising (4%).

These results indicate the number of the different lesions found as a percentage of the cows trimmed rather than the lesions per cow examined as some cows were found to have more than one lesion. In the majority of cases, however, the lesion considered to be the most significant tended to be recorded. There were also cows with the same lesion reported at different trimming sessions that had not resolved (e.g. sole ulcer, interdigital fibroma) so the figures for some lesions may be slightly higher than the true figure. However, due to the large sample size, we believe that these inaccuracies do not distort the general overall result.

The results of this analysis show a slightly different trend to those reported by Barker. In that study the analysis of 6,172 lesions in cows were for those treated by farmers and only farm records were analysed. In our study, lesions described as sole separation and under run sole were excluded. Corrective trimming of these lesions may have reduced the subsequent levels of sole ulceration by improving claw quality, balance and shape.

It is important to note that levels of infectious lesions (such as digital dermatitis) are likely to be under represented. This study reported levels of digital dermatitis at 9.1% while Barker reported levels at 14.6% and other authors describe levels approaching 40% (N. Bell – personal communication). Many farmers tend to treat these cases of lameness themselves rather than present them to the foot trimmer, and are more likely to present claw lesions, that are more difficult and time consuming to treat, for the attention of foot trimmers. Cows tend to be positively selected for trimming if they are lame and cows with a claw lesion are generally more likely to become chronically lame. It must be emphasised, even with regular foot trimming, that many of these farms may not present sound cows for routine trimming which may further increase the apparent prevalence.

In conclusion this study confirms that whilst many farmers (and veterinary surgeons) spend considerable effort in attempts at controlling digital dermatitis, the claw horn lesions i.e. sole ulceration and white line disease are still common causes of lameness on farm. Despite regular trimming the distribution of lesions has changed little over 3 years. Continued effort needs to be made in controlling these causes of lameness, bearing in mind the known risk factors, as well as more research to increase our understanding of these and other, as yet, unknown risk factors.

This study has also shown the value of large data sets available when two large practices work together and the benefits of a close relationship between the paraprofessionals carrying out much of this work and the health advisors to the farm. Further analysis of this data is intended in the future.

NOTES