Development of a Lameness Control Programme for Dairy Cattle

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SUMMARY

The objective of this subtask was to produce a lameness control programme (LCP) for dairy herds across the EU, and investigate the factors likely to limit the use and success of such a programme. The LCP we suggest has been developed from one drawn up for dairy heifers in the UK, based upon principles of HACCP (Hazard Analysis and Critical Control Points) (Bell et al., 2003). The risk assessment and control measures used by Bell et al. were expanded to include the whole herd. Assessments for tied cows were required. These included both risk assessment and assessment of lameness, for which a new method had to be developed. Recent work from the EU Lamecow project and other sub-projects within Welfare Quality was reviewed, to ensure that the latest information was incorporated in the control strategies. Experiences gained during a concurrent University of Bristol project on controlling lameness in dairy herds were drawn upon. The LCP comprises sections on diagnosis, risk assessment, action planning and monitoring.

A questionnaire was carried out in four EU countries to investigate the likely uptake of the type of LCP proposed. Responses from the questionnaire were taken into consideration as the structure of the LCP was finalised. Relevant literature and experiences from similar herd health projects have been referred to in considering the likely limiting factors for the use and success of the LCP.

The uptake of the programme is likely to be affected by:

- Country
- Farmer perception of the existing capability for lameness control within the farm
- Farmer perception of the current success in controlling the lameness problem in relation to acceptable limits
- Farmer priority for lameness control among other herd health issues
- The cost involved
- The time perceived to be required for following the programme

Barriers to uptake include:

- Perceived lack of associated benefit
- Time pressure
- Opposition to perceived “interference from outside”

The success of the programme could be limited by:

- Failure of farmers to apply appropriate management controls arising from the risk assessment.
- Failure of farmers to persevere with management changes if reductions in lameness are slow to become apparent.
- Incomplete current understanding of the interactions between different risk factors for lameness on which the programme is based

The final deliverables are:

- a web-based tool designed to provide information on lameness control and guide farmers and advisors in a structured approach to carrying out a lameness investigation and implementing control measures, accessible through the Welfare Quality website.
- a paper document explaining the structured approach to lameness control and providing copies of the main support materials.
1. INTRODUCTION

The requirements for this subtask were:

1. to develop a lameness control programme (LCP) for dairy herds which could be applied across the EU.
2. to indicate the factors which might limit the use and success of such a programme.

Lameness in dairy cattle is known to be multifactorial, and to arise as a result of a variety of different lesions. Therefore a simple “five point plan” such as that introduced in the UK for the control of mastitis in the 1960’s (Wilson and Kingwill, 1975) is less easy to formulate. Logue and Bergsten (2006) suggested a “five point plan” for lameness control, but the five points are very broad, namely:

1. Identify, treat and record all lame cases immediately using these records to target the most appropriate risk factors including those below.
2. Ensure good claw shape and health by regular foot trimming (including recording of lesions).
3. Reduce environmental challenge to the foot by attention to detail.
4. Ensure well balanced food with adequate access to this for every cow.
5. Select for sires whose daughters have a proven record of good foot health.

Due to the variety of lesions and risk factors involved, the details of a control plan will vary between farms. Inevitably, the allowance for variation introduces complexity. To prevent users becoming overwhelmed and abandoning the process in its early stages, we aimed to include the facility to concentrate on the control of a particular lesion, or to begin the investigation at a general level.

The approach taken was to base the LCP on one developed for dairy heifers in the UK using principles of HACCP (Hazard Analysis and Critical Control Points) (Bell et al., 2003). This needed to be expanded to cover the whole herd, incorporate the findings of other subprojects, and make it applicable to the range of dairy systems across the EU. Figure 1.1 illustrates the steps in the overall process of the LCP.
From literature and expert opinion, Bell et al. (2003) identified a series of risk factors and control points for each of the four most commonly reported lesions – sole ulcer, white line disease, digital dermatitis and foul in the foot. These are illustrated in Figures 1.2 – 1.5.

These four were the most common lesions reported in the UK in the LAMECOW study. In the Netherlands, in addition to these four, interdigital dermatitis and heel erosion were among the most common (Amory personal communication). For the sake of simplicity, and because heel erosion and interdigital dermatitis are lesions which often occur without causing lameness, it was decided to concentrate on the four lesions mentioned above. In fact, many of the control measures suggested will also help with control of heel erosion and interdigital dermatitis.
**Figure 1.2 Sole ulcer disease process and control points**

**MAIN EFFECTS**
- Prolonged standing
- Hard or rough surfaces
- External trauma

**POSSIBLE EFFECTS**
- Damage to soft tissues of foot
- Sole bruising and overgrowth
- Poor quality claw horn

**TRANSITION MANAGEMENT**
- Hormonal effects at calving

**ULCERATION**
- Prolonged exposure to slurry

Control points are shown in circles and colour coded to match corresponding control strategies.

**Figure 1.3 White line disease process and control points**

**MAIN EFFECTS**
- Shear forces when turning
- Loose hard sharp stones

**POSSIBLE EFFECTS**
- Weakened white line horn
- Nutritional effects – possibly effects of acidosis?

**TRANSITION MANAGEMENT**
- Optimize claw horn quality with diet

**ULCERATION**
- Prolonged exposure to slurry

Control points are shown in circles and colour coded to match corresponding control strategies.
Figure 1.4 Digital dermatitis disease process and control points

Control points are shown in circles and colour coded to match corresponding control strategies.

Figure 1.5 Foul in the foot disease process and control points

Control points are shown in circles and colour coded to match corresponding control strategies.
Analysis of data collected on 60 farms confirmed that the risk factors identified were related to prevalence of the particular lesions (Bell, 2006).

The technical information on lameness control measures was evidence based wherever possible. Due to the lack of evidence on the relative importance of different risk factors at the early stages of development of the programme, expert opinion was initially used as the basis for ranking control measures in order of importance. However, any recent evidence that has become available through experiments or epidemiological studies has been reviewed (Section 2) and incorporated.

Across the EU a wide range of dairy systems is found. It was necessary to ensure that the programme would be applicable to all these. Since UK dairy systems are diverse, the original programme covered the majority of situations, with the exception of cows kept tied in individual stalls. Methods commonly used for assessment of the extent of lameness by established “gait scoring” or “locomotion scoring” methods cannot be used in herds where cows are continuously tied. Although such housing systems are likely to be phased out, there is a need to assess cows in them while they exist, and therefore a method was developed for doing this, which is described in section 3.

The final design of the LCP and a summary of the approach are described in section 4. The materials required for the LCP are available in a separate document and through electronic links.

Information on factors limiting the use and success of a LCP was drawn from sociological and marketing theory, the results of a specifically designed questionnaire and reports of experiences with structured intervention exercises for lameness and other herd health issues. This is presented in section 5.

2. REVIEW OF RECENT RESEARCH FINDINGS

2.1 EU Lamecow project

The Lamecow project has provided relevant information on:
- The gait of cows on different floor surfaces
- Risk factors for lameness in dairy systems in the UK and the Netherlands

2.1.1 The influence of floor surface on gait

Since the nature of the underfoot surface affects the degree to which cows “track up” (reach forward with the hind foot to the place left by the front foot), tracking up was not included in the assessment method recommended for quantifying the prevalence of lameness in the LCP.

The work of Telezhenko (2007) concluded that soft (rubber covered) flooring provides good comfort for cows when walking, but lack of wear results in claw overgrowth, if the whole area is rubber covered. Rubber flooring resulted in maintenance of sole concavity, with weight bearing on the wall, which is lost on very abrasive floors. However, if net growth is too excessive, access to an area providing a moderate amount of abrasion and/or additional claw trimming might be needed to maintain good claw shape.

2.1.2 Risk factors for lameness in dairy systems in the UK and the Netherlands
An epidemiological study of 19 cubicle housed herds in the Netherlands (Amory et al., 2006) showed an association between a higher percentage of lame cows and the following management factors:

- Presence of a hoof trimming crate on the farm
- Footbathing
- Lack of supplementary vitamins and minerals for milking cows
- Feeding maize silage to heifers

The first two factors may be a result of farmers’ response to recognising a lameness problem. In controlled experiments, foot trimming and foot bathing have been shown to reduce lameness, so the relationship is not necessarily causative, although if inappropriately used these practices may become risk factors. The association reported was not considered to give sufficient reason for ceasing to recommend these practices as control measures, but the programme stresses that the procedures should be carried out appropriately and effectively, and provides some guidelines.

Experimental evidence for the degree of influence of nutrition on lameness is mixed. In view of this fact, the likely associations between alternative forages and herd size, and the widespread use of maize silage, we do not feel that a specific suggestion to avoid maize silage is appropriate at this stage, but checking correct nutritional balance is included in the risk assessment.

The following recommendations for reducing risk of lameness in the UK arising from a study on 49 farms (Barker et al., 2007) have been adopted in the control programme, since the evidence fits with other findings, and there is a logical explanation:

- In cubicles, preferentially use bedding other than the combination of sawdust on rubber mats or mattresses, to avoid hock damage and encourage lying down.
- Whatever the type of bedding, make sure it is deep enough to make the bed comfortable.
- Avoid use of automatic scrapers in cubicle houses. If they have to be used, try not to run them when the passageways are crowded. Also check the height of the slurry wave and the places where slurry is left at the end of the run to see if these are causing cows’ feet to be immersed in slurry above the dewclaws.
- Avoid excessive walking of cows on concrete tracks or roadways, to avoid excessive wear (perhaps surprisingly, there was more SU, WL and DD where cows walked on concrete tracks, roads or no tracks, than on stone or dirt tracks).
- Passageways should preferably be at least 3m wide
- Avoid housing pregnant heifers with the milking herd
- If routine foot trimming is carried out make sure that
  1. Hygiene between cows is excellent to prevent the spread of DD
  2. Lame cows do not have to wait for the foot trimmer

The following were also shown by Barker et al. (2007) to be associated with poor locomotion, but advice to avoid these has not been included due to lack of practicality or conflict with previous findings:

- Kerb heights greater than 15 cm
- Housing dry cows in straw yards followed by housed in cubicles after calving
2.2 Relevant work within Welfare Quality

2.2.1 Subproject 3.4.1 On-farm risk factors for lameness in dairy cattle
The results from subproject 3.4.1 show clearly that restrictions to lying and cow comfort in cubicles are associated with higher prevalence of lameness (Dippel et al., 2007), and add further evidence that encouraging cows to lie down is central to the reduction of lameness. Specifically, deeper bedding in cubicles was associated with less lameness. Also, there was an interaction between the cow:cubicle ratio and the time taken for cows to lie down. When there were fewer cubicles per cow, and cows took longer to lie down, lameness prevalence was higher. This suggests that a limited number of restrictive cubicles is a particularly high risk situation.

Other relationships were indicated but with weaker statistical support, and less obvious interpretation, so it is felt that these should not be used as the basis for recommendations at this stage. Three parameters relating to metabolism (higher milk urea: protein ratio and higher kg conc fed/l, and lower fat:protein ratio) were related to higher lameness. The fat:protein relationship was contrary to the underlying hypothesis but there were breed and system differences, so the result is not easy to interpret.

Rather unexpectedly, more time on pasture was associated with higher lameness. Perhaps this was because farmers with problems saw this as a control measure and left their cows out longer, or because weather conditions were not optimal when cows were at grass.

An investigation into risk factors for hock lesions in cubicle systems within 3.4.1 (Brenninkmeyer et al., 2007) showed that aspects of the lying surface had the strongest relationship with hock lesions, but aspects of cubicle divisions were also influential. Risk factors were: absence of a kerb, a hard surface at the rear of the cubicle, short cubicles, and less space below the cubicle side partitions. The effect of the kerb is explained as being linked to the depth of bedding, with a kerb permitting a deeper bed. In contrast, Mowbray et al. (2003) and Fulwider et al. (2007) found the presence of a kerb increased the size and prevalence of hock lesions respectively. The detrimental effect is thought to occur in situations where the cubicle bed is too short, although statistically in the model of Brenninkmeyer et al. (2007) an interaction between bed length and presence of a kerb did not survive the testing process.

The general advice emerging would be to ensure that beds are soft and cubicles are long enough for the size of cow, to avoid pressure, impact and abrasion to the hocks.

The LCP incorporates the above with a section in the risk assessment devoted to assessing cubicle comfort in detail.

2.2.2 Subproject 3.4.3 Controlled experiment on cattle lameness
From subproject 3.4.3 there is evidence that walking on concrete slats causes abnormal forces on cows’ feet and abnormal locomotion, and is not to be recommended. Walking on rubber surfaces resulted in development of a weight bearing hoof wall due to net growth, while slatted concrete caused rapid growth overgrown hooves, with weight bearing by the sole. This suggests that different claw trimming regimes may be needed in conjunction with
different floor types. However, beyond warning against the use of concrete slats, no clear recommendations on the relative suitability of grooved concrete, solid rubber and rubber covered slats have emerged (van der Tol et al., 2006).

The main recommendations arising from recent work are summarised in Table 2.1 below:

| Table 2.1 Recommendations for lameness control arising from recent EU studies |
|-----------------------------|-------------------------------------------------|
| Recommendations              | Study                                                                 |
| Provide deep bedding         | 3.4.1 Dippel et al.(lameness), Brenninkmeyer et al; (Hock lesions), Lamecow, (Barker et al.) |
| If cubicle design restricts lying down and cannot be improved, increase the number of cubicles per cow | 3.4.1 Dippel et al |
| If the number of cubicles is limited, remove any obstructions to lying down | 3.4.1 Dippel et al |
| In cubicles, ensure the soft surfaced area is long enough for cows to lie on | 3.4.1 Brenninkmeyer et al; (Hock lesions) |
| Concrete slats are the least suitable floor surface from the point of view of maintaining good claw shape and weight bearing. Rubber flooring improves cow comfort and foot shape (weightbearing area) but results in increased net growth. The trimming regime required is likely to depend on floor type. | Lamecow (Telezhenko) 3.4.3 (van der Tol et al.) |
| Avoid use of automatic scrapers in cubicle houses if possible If used, avoid times when alleys are full of cows. Ensure that scrapers do not increase the contact between feet and slurry by causing deep waves or leaving deep deposits where cows can walk | Lamecow (Barker et al.) |

2.3 Other relevant recent work
A recent paper on risk factors for lameness at the herd and animal level on Czech farms by Dembele et al.(2006) reported slippery floors as a herd level risk factor, and overgrown claws as a cow level risk factor.

2.4 Successful interventions
The only intervention study with obvious success so far reported is that by Brinkman et al.(2006) on organic farms, where a reduction in lameness prevalence of 14% was achieved over a period of one year, and 17% over 2 years, on intervention farms, compared with control farms where the equivalent reductions were 4% and 5% respectively. The suggested interventions were identified as a result of weakpoint analysis of the initial situation. There was intensive contact with the farmers, involving them in lameness scoring and discussion on farm visits made at three monthly intervals. Progress was achieved in controlling lameness on organic farms without the use of footbathing, by implementing regular claw trimming by a professional, and improving the lying surface (softness, cleanliness, dimensions of
cubicles), the hygiene of the environment, and the detection and treatment of digital dermatitis (March et al., 2007). Table 2.2 summarises the most frequently made interventions.

| Table 2.2  Beneficial interventions for lameness control. (March et al., 2007) |
|------------------------------------------|---------------------------------|
| Successful interventions | Outcome | |
| Regular professional claw trimming | Reduced lameness   | |
| Improvements to lying surface (softness, cleanliness, cubicle dimensions) | Reduced lameness | |
| Reduced slipperiness of floors | Reduced lameness | |
| Improved floor hygiene – achieved by more frequent cleaning – even of slatted floors | Reduced lameness | |
| Regular cleaning of feet in the parlour | Improved digital dermatitis detection and treatment | |

3. DEVELOPMENT OF A METHOD FOR ASSESSMENT OF LAMENESS IN TIED COWS

3.1 Introduction

Since an assessment of the prevalence of lameness in a herd is needed for monitoring progress in a LCP, a method for assessment of lameness in tied cows was required. Housing for tied cows may not have suitable space to carry out gait scoring, and even if there is space, if the cows are not accustomed to being free, scoring their movement is very difficult. Behavioural indicators of limb pain which do not necessarily involve locomotion, such as weight shifting between limbs, limb guarding, abnormal weight distribution, pointing and rotating limbs, are described in horses and used in clinical diagnosis of equine lameness and have recently been reviewed by Ashley et al. (2005). However, there is little published information on the use of such indicators in cattle. This section reports the development of a system for the assessment of lameness in cows kept in tie-stalls, (referred to as “stall lameness score“ or SLS), and its validation by comparison with locomotion scoring.

3.2 Methods

A veterinary surgeon with particular experience of husbandry, claw trimming and treatment of tied cows (Observer A) identified a list of indicators which he associated with cows presenting foot lesions (Table 4.1). These were discussed with colleagues experienced in assessment of lameness by locomotion scoring. An assessment procedure was then formalised, as follows:

1. Any cows lying down are encouraged to rise and left for a short period before being assessed.

2. The stance of the cow standing undisturbed in the stall is assessed, and presence of any of the indicators in Table 1 noted.
3. The cow is moved to left and right in the stall (by the assessor moving from side to side behind the animal, applying hand pressure to the hind quarters if necessary), and any reluctance to bear weight on a particular foot noted.

4. The position resumed after movement is observed and any indicators noted.

5. If two or more indicators have been recorded, the cow is scored as lame

Using this protocol, a test of inter-observer agreement for the SLS was carried out by Observer A and a second observer (B), who was already experienced in gait scoring. Four farms with a total of 99 cows were visited. The observers visited each farm together, and scored the cows independently in the stalls, without consultation. The cows were released one by one and both observers independently scored their gait according to the system of Winckler and Willen (2001). The data collected was also used to investigate relationships between individual indicators observed in the stall (and combinations of these), and the gait of the cow when released, thus testing the validity of the new method. The prevalence of lameness detected by the same observer using the two different methods was also analysed.

<table>
<thead>
<tr>
<th>Table 3.1. Indicators of lameness in tied cows listed by an expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent “stepping” (shifting weight from one foot to another)</td>
</tr>
<tr>
<td>Rotation of feet from the line parallel to the midline of the body</td>
</tr>
<tr>
<td>Standing on the edge of a step</td>
</tr>
<tr>
<td>Resting a foot (one foot more than another)</td>
</tr>
<tr>
<td>Uneven weight bearing between feet when moving from side to side</td>
</tr>
<tr>
<td>More than one indicator may be demonstrated by an individual cow</td>
</tr>
</tbody>
</table>

Intra-observer repeatability for the stall lameness score (SLS) was tested in a separate exercise, by one observer who scored a total of 46 cows, on two farms, on two occasions, between six and 12 hours apart.

**Statistical analysis**

The percentage agreement for SLS between observers and within observer (for one observer only) was calculated. Sensitivity and specificity of SLS as a predictor of lameness were calculated for each observer. The locomotion scores given by Observer B were used as the Gold Standard to define the cows as lame or not lame. The prevalence of lameness detected by each observer in each herd by SLS and LS was calculated. The differences between these prevalences were expressed as percentages of the prevalence according to LS. The effects of farm and observer on this difference were analysed by ANOVA. The Chi-squared test was used to investigate whether there was a difference in the occurrence of the individual indicators used in the SLS, between cows scored lame or not lame while walking.
3.3 Results

Within observer repeatability for stall lameness score
Repeatability for one observer on two separate occasions scoring 46 cows as lame or not lame when standing in the stall was 70%.

Between observer reliability for stall lameness score
The percentage agreement between Observers A and B on classification of cows as lame or not lame using SLS was 91%.

Validity – agreement between stall lameness score and locomotion score
Agreement between SLS and gold standard LS on classifying cows as lame or not lame was substantial with 77% agreement for Observer A and 75% agreement for Observer B. When a 5-point LS was used, the discrepancy between SLS and LS was greatest in gait category 3 (mildly lame). Observer B scored only 26% of these cows as lame when standing, while Observer A correctly identified 42% of them as lame. Among locomotion score 4 cows, Observer B detected 76% and Observer A detected 71% as lame when standing.

Sensitivity and specificity of the stall lameness score and effect of locomotion score on sensitivity
The SLS had a relatively low sensitivity for cows that were gait scored as lame (gait score 3, 4 or 5), especially for the observer less experienced in working with tied cows, who detected only 54% of the cows which were lame when walking (Table 5). However, the test had very high specificity (93%) when used by either observer. More severely lame cows were easier to identify in the stall; sensitivity of SLS for detecting locomotion scores 4 and 5 was high, at 80% for the Observer B and 90% for Observer A.

Individual indicators
The Chi-squared test showed that resting a foot, stepping, and reluctance to bear weight all occurred significantly more often in cows which were lame when walking than in those which were not ($P < 0.001$). Standing on the edge of a step was recorded significantly more often in lame cows by observer A only. Rotation of the feet was equally likely to be recorded in cows which were scored lame walking and those which were not.

Effects of assessment method on estimation of lameness prevalence
Both observers gave a lower estimate of lameness prevalence when using the stall lameness score compared with the locomotion score (Table 3.2). The percentage underestimation ranged between 12% and 37% of the prevalence detected by locomotion scoring (mean 28.6%, sd 8.71). Analysis of variance showed that the underestimation was not significantly affected by farm or observer.
Table 3.2 Lameness prevalence detected on four farms by two different methods and two observers

<table>
<thead>
<tr>
<th>Farm</th>
<th>Observer</th>
<th>Prevalence when cows scored standing (%)</th>
<th>Prevalence when cows scored walking (%)</th>
<th>% underestimate when scoring cows standing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>44</td>
<td>69</td>
<td>36</td>
</tr>
<tr>
<td>1</td>
<td>B</td>
<td>41</td>
<td>62</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>22</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>18</td>
<td>28</td>
<td>36</td>
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<td>3</td>
<td>A</td>
<td>22</td>
<td>29</td>
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<td>3</td>
<td>B</td>
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<td>A</td>
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<td>4</td>
<td>B</td>
<td>33</td>
<td>44</td>
<td>25</td>
</tr>
</tbody>
</table>

3.4 Conclusions
The method developed is considered to be feasible and valid for detecting lame cows in tie-stalls, although it will not be as sensitive as locomotion scoring of freely moving animals. Therefore gait scoring remains the preferred option where it is possible, but this method provides an alternative. For situations where reproducibility or specificity is important, we recommend that at least two of the specified indicators should be present to determine that a cow is lame. On the other hand, if it is more important to identify all lame cows, then single indicators, with the exception of rotation, could be used. This small scale study suggests that lameness prevalence is under-estimated by around 30% when using the stall lameness but a larger scale investigation on more farms is needed to investigate this relationship further.

4. THE LAMENESS CONTROL PROGRAMME

4.1 Introduction
Drawing on information from literature review, consultation and experience with other herd health projects, we have developed a structured approach to tackling lameness in dairy herds, which is referred to as a lameness control programme (LCP). The approach is intended to be flexible enough to be applicable to a wide variety of farms and farmers in different countries. Due to the disparate nature and varied causes of lameness problems in dairy herds, even within one country, a simple prescriptive approach is not possible. This programme does not provide prescriptive solutions, but offers a method for discovering the most appropriate solutions for individual farms.

In a similar way to the Mastitis Diagnosis and Control Plan (Green et al., 2007), the approach is based upon diagnosis of the type of problem, which allows a targeted analysis of the risks and selection of the most appropriate control measures. As in the Heifer Lameness Plan of Bell (2006), the principles of Hazard Analysis and Critical Control Points are applied. The work of Bell (2006) reported by Webster (2007) has confirmed relationships between hazards and the prevalence of certain types of lesion and we have based the programme on these relationships. A survey across five EU countries revealed that farmers would wish to use the
LCP in a variety of ways: with and without a computer and with and without an external adviser. However, the majority would expect to enlist the help of an adviser, which in turn is likely to give access to computer resources. We have provided both paper based and computerised versions of the materials required to apply the LCP. These could be used by farmers on their own, but involving a suitably qualified adviser (eg vet, foot trimmer, agricultural adviser) is recommended.

4.2 The steps of the Lameness Control Programme

The steps for using the programme are as follows:

1. **Diagnosis** (of lesions and the scale of the problem)
   Knowledge of the types of lesions causing lameness and the prevalence of lameness are vital for understanding the likely root causes and determining solutions. Diagnosis may be based upon records if these are detailed enough, but may require examination of current lame cows by a vet or foot trimmer.
   To give a baseline level of lameness prevalence, scoring the mobility (or gait or locomotion) of the whole milking herd is advocated.

2. **Risk assessment**
   Following the HACCP principles, the next step is to assess the farm for the risks for the most common types of lesions (identified in the diagnosis step). This is done systematically by completing a structured risk assessment document. A web-based tool has been created which filters and prioritises the risks for different types of lesion and generates relevant control strategies. Even without access to this, completing the structured assessment on paper should still provide direction towards the areas in which control measures should be concentrated. Two levels of complexity of the Risk assessment are available

3. **Action Plan**
   Having carried out the risk assessment, the next step is to prepare an action plan to address the greatest risks. This will be farm specific, and must be practical, therefore input from the farmer is essential at this stage. The management strategies generated by the web-based programme can form a basis for the plan, but individual effort, from people who know the farm, is required here. To achieve commitment and sustained action writing and displaying a formal action plan is strongly encouraged. The website contains technical information which may be helpful in drawing up the details of plans, eg for cubicle design and track construction. General tips on preparing action plans are also included.

4. **Monitoring**
   Once changes have been made it is important to record the incidence and prevalence of lameness so that progress can be monitored. Recommendations for recording and monitoring would be as follows:
Frequency | Recording/monitoring activity
--- | ---
Every time a cow is examined for lameness | Record cow identity, date, foot affected, lesion and treatment given
Every three months: | Summarise lameness records, note most common lesions
 | Score mobility/locomotion of whole milking herd.
 | Note lameness prevalence
Every 12 months | Summarise lameness records
 | Note most common lesions, chronically lame cows, and problem times of year
 | Consider culling chronically lame cows
 | Review risk assessment
 | Amend action plan accordingly

NB More than one year may be needed to see the impact of a LCP, particularly if the main problems are claw horn lesions.

4.3 Materials provided

1. Diagnosis
Lesion identification: Reference sheets illustrating and describing the most common lesions are provided.
Lameness prevalence assessment: A simple method for scoring the “mobility” (or gait or locomotion) of the whole milking herd is described. An alternative method of lameness assessment for tied cows is also provided.

2. Risk Assessment
Guidelines for assessing the risks for lameness on a farm are provided at two levels of detail, at a general level covering 13 general management areas, and a second fully detailed risk assessment with specific questions. To reduce the scale of the task, it is possible to restrict the assessment to the risks relevant to a particular lesion type.

3. Action Plan
The web-based risk assessment will generate suggested management control strategies, based on the risks reported. This can form the basis of an action plan, but the suggestions are necessarily generic, and thought and effort will be needed to convert them to practical action on the farm. Technical information on management relating to lameness is available on the website.
Without access to the web, completing the structured assessment on paper should direct the farmer towards the areas in which control measures are needed. A suggested format for the action plan is given.

4. Monitoring
Forms for recording lameness and instructions for lameness scoring are available in both the paper based and web-based resources.
5. FACTORS WHICH WOULD LIMIT THE USE AND SUCCESS OF THE LAMENESS CONTROL PROGRAMME

5.1 Introduction
Information on factors likely to influence the use and success of the LCP was sought by three routes:
1. Recourse to literature on achieving human behaviour change.
2. Experiences of herd health intervention projects
3. An interview questionnaire to gather the opinions of farmers in five EU countries on the use of a formal LCP.

5.2 Theory of human behaviour change

Uptake, and subsequently, successful implementation, of a LCP would require changes in behaviour by farmers: first, that of taking up a new approach and, in consequence, making alterations to management. Success would depend on maintaining sustained change. The first step required for altering behaviour is awareness of the need for change. The likelihood of action depends on an individual’s perception of the severity of a problem (Rosenstock, 1974). In this case, this means being aware of the lameness levels in the herd and whether or not they are acceptable. Literature shows that farmers often recognise or acknowledge only a small proportion of the lameness recorded by visiting researchers (Wells et al., 1993; Whay, 2002). Nevertheless, Bell (2007) and March et al. (2006) reported that after concerted training, farmers’ detection of lameness converged with that of researchers. Initially, however, raising awareness without causing antagonism or raising farmers’ defensiveness or denial may prove difficult.

From reference to the literature on human behaviour, a model which is appropriate for the situation we face here in trying to instigate change is that described by McKenzie-Mohr and Smith (1999). This framework suggests that there are three main reasons why people fail to change their behaviour:

- They have no knowledge of the alternative practices
- They perceive barriers or difficulties associated with new practices (eg effort, financial cost, practical restrictions)
- They perceive no benefit to changing, or insufficient benefit to compensate for the effort/expense/time required to make the change

In this context, lack of technical information or knowledge of alternative management practices, difficulties perceived with the cost, time, or practicalities of changing, and failure to perceive a benefit associated with making changes may all prevent farmers from deciding enter into the lameness control programme. These same factors may also limit the success of the programme. In addition, sustained behaviour change (required for success) is believed to be more likely in situations where individuals feel “ownership” of the decision to make the change (Vaarst et al., 2006). Aids to sustained change are prompts (reminders), “norms” (examples which show that it is common for others to make the same change), and incentives (McKenzie-Mohr and Smith, 1999). These could be relevant in the context of success of the LCP.
5.3 Experiences from other projects

Experiences of recruitment to a University of Bristol intervention project aiming to reduce lameness on UK dairy farms, (the Healthy Feet Project or HFP) have indicated that the plethora of regulations and assurance schemes have increased UK farmers’ hostility to any outsiders whom they see as imposing more paperwork or requirements to be complied with. This backs up the theory that a person is more likely to change if they instigate the change themself. Only ten percent of farmers contacted took the opportunity to participate in the project, which offered access to a LCP including subsidised visits from a veterinary specialist. Although the access to advice and potential benefits were explained, some farmers’ responses may have been less positive due to their perception that this was a research exercise, rather than a project from which they would benefit. Nevertheless, this experience gives an idea of the range of barriers to farmers becoming involved in activities related to lameness control. Specific reasons for declining participation in the HFP, are shown in Figure 5.1. The most common reason given was lack of time.

Figure 5.1 Farmers' reasons for not participating in a lameness control project

It might be expected that the scale of the lameness problem would influence uptake and indeed, no perceived problem with lameness was among the reasons for declining the opportunity to join the HFP (Figure 5.1). Recruitment to a mastitis control programme showed 75% of participating farmers recognised that they had a problem and were seeking solutions (Leach et al., 2004). However, the case for lameness differs from that for mastitis in two ways: many dairy farmers do not see a direct cost to lameness, unlike the obvious financial somatic cell count penalty, and under-detection of lameness means that farmers are often unaware of the scale of the problem (Wells et al., 1993; Whay, 2002). These facts may cause barriers to uptake.

The cost of the LCP is likely to have an effect on uptake. At the start of the HFP, although participation was free, farmers were asked to contribute to the cost of visits from a lameness specialist, but uptake of this option began only when this cost, already subsidised, was waived completely. The general financial state of the dairy industry will be influential: approximately 25% of farmers who declined entering the HFP in 2006 gave an uncertain future for their enterprise as the reason. The scale of this figure would have been influenced by the fact that these farmers were asked for a three year commitment to the project and the economic situation for UK dairy enterprises was very poor at this time, but it is likely that
farmers need to feel confident in their herd’s future before making a serious commitment to any herd health improvements. Milk buyers or quality assurance bodies could potentially impose the requirement to instigate a LCP, but the degree of enthusiasm for following the programme might be different from that in a situation where the farmer has voluntarily embarked on the programme, and this could affect success.

5.4 Survey to investigate factors which would affect the likely uptake of the control programme in five EU countries

5.4.1 Methods

Within this work package, a survey was carried out to discover the attitudes of farmers to the control of lameness on their farms, and, specifically, their opinion on a LCP of the type shown in Figure 1.1. A questionnaire was written in English and translated into Italian, German and Czech, by animal scientists, who were familiar with any agricultural terms included. The sample population in each country was drawn from farmers who had contact with the research institutions responsible for carrying out the questionnaire (generally through participation in research projects) and members of local farmers’ discussion groups. Forty-six dairy farmers were consulted in five different countries (Austria, Czech Republic, Germany, Italy and UK). These countries were selected because they are involved with the welfare assessment of cattle in WP2.2. Herd sizes for the farms are shown in Table 5.1. A researcher visited each farm and explained the concept of the Lameness Control Programme to the farmer, who was then interviewed using the questionnaire to find information about his or her views on lameness control and whether he/she would be interested in following such a programme. The responses were collated in an Access database and summary statistics were calculated using Excel. The t-test and chi-squared tests were used to compare some parameters for farmers who expressed an interest in the LCP and those who did not. For open questions the main themes of answers were collated.

<table>
<thead>
<tr>
<th>Country</th>
<th>Average no of cows</th>
<th>Min no of cows</th>
<th>Max no of cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>28</td>
<td>10</td>
<td>62</td>
</tr>
<tr>
<td>CZK</td>
<td>292</td>
<td>100</td>
<td>904</td>
</tr>
<tr>
<td>Germany</td>
<td>66</td>
<td>35</td>
<td>93</td>
</tr>
<tr>
<td>Italy</td>
<td>164</td>
<td>71</td>
<td>380</td>
</tr>
<tr>
<td>UK</td>
<td>181</td>
<td>92</td>
<td>450</td>
</tr>
</tbody>
</table>
5.4.2 Results and discussion

There was no difference in herd size or lameness incidence (Table 5.2) between farmers who expressed an interest in the programme and those who did not.

<table>
<thead>
<tr>
<th>Would consider LCP (n= 26)</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd size</td>
<td>120</td>
<td>19</td>
<td>450</td>
<td>14.9</td>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>Lameness incidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would not consider LCP (n= 20)</td>
<td>175</td>
<td>10</td>
<td>904</td>
<td>18.4</td>
<td>3</td>
<td>67</td>
</tr>
</tbody>
</table>

Neither was there any clear pattern of potential use of the LCP related to the farmer’s description of the scale of the lameness problem (Table 5.3). However, 70% of the farmers who ranked lameness as their highest herd health concern said they would consider the LCP, compared with around 50% of those who considered lameness a lower ranked priority.

<table>
<thead>
<tr>
<th>Description of lameness problem</th>
<th>Priority of lameness in health issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major</td>
<td>Priority of lameness in health issues</td>
</tr>
<tr>
<td>Minor</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>2</td>
</tr>
<tr>
<td>Would consider LCP (n= 26)</td>
<td>5</td>
</tr>
<tr>
<td>Would not consider LCP (n= 20)</td>
<td>5</td>
</tr>
</tbody>
</table>

Responses varied between countries. German and Italian farmers appeared more likely to take up the control programme than those in other countries (Figure 5.3). Potential uptake was particularly low in the UK and Czech republic.
60% of farmers with a computer expressed an interest, compared with only 40% of those without a computer. Although this difference was not statistically significant using the chi-test, there were only four farmers in the category with no computer and uptake, which would affect the suitability of the test.

Among the components of the LCP, the most valuable were generally considered to be the structured approach to addressing the lameness problem, and an increased understanding of the causes of problems on the farm.

Farmer opinions on the importance of various attributes of a LCP are summarised in Table 5.4.

Table 5.4. Importance of attributes of a lameness control programme indicated by the number of respondents for each score

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Score</th>
<th>Not at all important</th>
<th>Extremely important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective</td>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Saves more money than it costs</td>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Specific to your farm</td>
<td></td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Plan created by a person or organisation in which you have confidence</td>
<td></td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Help provided by a person in whom you have confidence</td>
<td></td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>A quick easy solution to the lameness problem</td>
<td></td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>A continuing long term programme</td>
<td></td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>
The majority of farmers considered it extremely important that the plan should be effective, cost effective, and provide a quick, easy solution to the lameness problem. A continuing long term programme was less frequently given extreme importance. This pattern of responses is concerning, since lameness due to claw horn lesions is unlikely to be solved quickly due to the chronic nature of damage to the corium, and prolonged effort is needed to see benefits. It will be necessary to educate farmers to this expectation, to prevent them from becoming disillusioned about lameness control.

Farmers who said they would not consider using a lameness control programme were asked for their reasons and gave the following types of answer (Table 5.5):

<table>
<thead>
<tr>
<th>Reason for lack of interest</th>
<th>Number of farmers mentioning, and country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good lameness control/problem solving “comes from inside the farm” not from external advice</td>
<td>5 C, 1 UK</td>
</tr>
<tr>
<td>Already have good control</td>
<td>3 A</td>
</tr>
<tr>
<td></td>
<td>1 UK</td>
</tr>
<tr>
<td>Would take too much time or effort</td>
<td>1 A, 1 UK, 1 G</td>
</tr>
<tr>
<td>Sceptical of benefits</td>
<td>1 UK, 1 I, 1 A</td>
</tr>
<tr>
<td>Would go to vet first</td>
<td>1 UK</td>
</tr>
<tr>
<td>Suspicious as sees programme as prescriptive part of Farm Assurance</td>
<td>1 UK</td>
</tr>
</tbody>
</table>

A – Austria; C – Czech Republic; G – Germany; I - Italy; UK – United Kingdom

The most common reasons given for lack of interest were the belief that the best knowledge and skills for lameness control came from within the farm, and the opinion that lameness was not a major problem, followed by lack of time, and not being convinced of the benefits. These are barriers that will need to be overcome before some farmers can be persuaded to invest more effort in confronting lameness.

The Czech farmers in particular seemed to have little belief in the benefits of advice from outside (Table 5.5), yet two of those who were of the opinion that good husbandry was the key to lameness control described their own lameness problem as “major”. It would be necessary to assure farmers such as these that they could use the LCP themselves. The majority of farmers expected that they would involve an adviser when using the LCP (Table 5.6). Forty-two percent said they would prefer a method which did not require a computer. In fact, all of these farmers intended to involve an adviser, so access to a computer would be likely, even if the farmer did not possess one. However, we felt it would be important to provide a means whereby the LCP could be followed even without computer access.
Table 5.6 Ways in which 26 farmers might approach use of a lameness control programme

<table>
<thead>
<tr>
<th></th>
<th>Number of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone</td>
<td>6</td>
</tr>
<tr>
<td>With vet</td>
<td>11</td>
</tr>
<tr>
<td>With foot trimmer</td>
<td>1</td>
</tr>
<tr>
<td>With vet and foot trimmer</td>
<td>6</td>
</tr>
<tr>
<td>With other adviser</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Alone</th>
<th>With help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper based materials</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Computer based materials</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

Although over one third of the farmers said they would increase their efforts to control lameness if the incidence increased, only one of these gave a low level of lameness as the reason for lack of interest in the LCP itself. It appears the remainder would increase their efforts in a way other than following a structured plan of the type described, although these routes were not explored.

In answer to an open question, important additional requirements of an LCP were:

- Must be feasible on farm, using existing tools
- Must provide something new beyond what is already available
- Needs access to an adviser with quick response to queries
- Must not take up too much time, must be acceptable to staff and not keep them from their practical tasks
- Must not create more paperwork
- Should be compatible with farm assurance schemes

It should be noted that the sample population already had contact with research institutes or discussion groups, and might give an over-optimistic indication of uptake, being the more outward looking farmers. The difficulty of recruitment of UK farmers to the HFP also suggests that interest in the general population is likely to be lower. A more detailed psychological analysis would be needed to identify the personalities of farmers most likely to participate.

5.4.3 Conclusions
Interest in the LCP will vary between countries and it will not appeal to all farmers. The majority of farmers will seek help to use the LCP, but there will be some who will wish to use it alone. Trained advisers who can guide farmers need to be accessible. Both paper based materials and computer resources need to be provided. A structured approach to problem
solving and an increased awareness of the causes of lameness were seen as the most valuable aspects of the programme, and should be incorporated and stressed. Pressures of time and paperwork are barriers to farmers undertaking new tasks and may prevent uptake. Farmers will need to be made aware that the benefits of following the LCP may take time to become apparent.

**Factors which would limit the success of the LCP on farms where it was implemented.**

Experience with implementing a mastitis control programme in the UK was that the reduction in cases of mastitis increased significantly with the percentage of suggestions made by an external adviser which were followed up by the farmer (Green et al., 2007). See Figure 5.2. Therefore the degree of compliance would be expected to influence the success of the LCP greatly.

**Figure 5.2. Percentage change in incidence rate of cows affected by mastitis, in groups of farmers with increasing compliance with a control plan. (Green et al., 2007)**

Reports of success from projects aiming to achieve a reduction in lameness on dairy farms are, to date, very limited. In the course of one year, lameness levels increased on all farms involved in the University of Bristol Heifer Lameness Project (HLP), so that Intervention farms showed no benefit compared with Control Farms. The success of the HLP is believed to have been limited by two main factors:

1) The short timescale of one year
2) The fact that initiation of participation came from vets rather than farmers. This may have limited the farmers’ commitment to action.

The increase in lameness was lower on farms where both the vet and the farmer were described as having a positive attitude to lameness control, so the attitudes of those involved in decision making is likely to have an influence.
The Lamecow project (Barker 2006) also had only one year of intervention and again failed to show significant improvements as a result of the control measures imposed. With the chronic nature of many hoof horn disorders, and the low rate of culling of cows for lameness, a slow response would be expected.

In comparison, a German programme run over two years on organic farms did achieve a reduction in lameness in an intervention group compared with controls, and, in fact, differences between the groups became apparent in the first year. The success has been attributed to frequent contact and good relationships between project staff and farmers (March et al. 2007; 2008).

Bradley et al. (2007) found that sustained contact with the project personnel to encourage and remind farmers to maintain monitoring and management changes was needed to maintain the benefits of initiating the mastitis control programme.

Farmers need to understand that a LCP is designed to benefit them and their cows, and the information delivered at the first point of contact can be highly influential in their perception of the reasons for following a LCP, and their likely commitment to doing so. Initial experiences with the HFP were that those farmers who had been required to participate by their milk buyer felt threatened by an assessment of the level of lameness in their herd made by a third party. Any situation in which farmers perceive there is a possibility of restriction and regulation will meet with resentment. Presenting farmers with an assessment of the level of herd lameness in the form of a summary of the proportion of cows in milk classed as lame could be controversial. Misunderstandings of the results presented can easily arise, and promote antagonism. However, some farmers found a list of cows identified as likely to benefit from treatment helpful, and in this case the assessment of the level of lameness was a good point to begin from.

Through the EU survey, it appeared that some farmers would prefer to follow a LCP alone while others would require the help of an adviser. HFP and MDC plan experiences suggest that farmers often need encouragement and reminders to follow up a programme. Working with farmers in “stable schools”, based on group discussions between farmers in a farm setting, Vaarst et al. (2006) reported that the group’s ownership over a common goal, in combination with the individual goals of each farmer, formed a motivation for improvements on all farms. “The encouraging process of seeing successful development in colleagues’ farms, together with the advice received from the group, formed a basis for a strong common learning process”. This suggests that following a LCP could be more likely to succeed if farmers had contact with others with similar goals. If working alone, they may be more liable to give up before improvements are seen.

Although the LCP is as far as possible evidence based, there are still many gaps in our understanding of lameness, the causes of which are multifactorial. In particular, knowledge of interactions between different risk factors is very limited. Although attempts were made to explore these relationships in WP 3.4.1, the situation is highly complex due to the great variety of management factors which influence foot health in dairy herds. It is therefore recognised that current knowledge is unlikely to be sufficient to solve all lameness problems.
5.6 Overall conclusions on factors limiting the use and success of a LCP

Voluntary use is likely to vary between countries. Use will depend on the farmer’s perception of the need for change, and the competition from other demands on the time available for management and implementation. Uptake is also likely to depend on the costs involved and the perceived cost benefits. No specific descriptors of farms or farmers more or less likely to use the LCP were identified by the survey.

The impression that often farmers are seeking a cheap, quick solution to the lameness problem is rather concerning, particularly for herds where claw horn lesions are the main problem, given the time these take to resolve and the likelihood of sole ulcers to recur (Enevoldsen et al., 1991; Hirst et al., 2002).

Once a farmer decides to follow a LCP, we expect limits to success to be the timescale available for achieving change and the compliance of the farmer with the control measures suggested by the plan, (or his ability to carry out all the action points he himself has listed). These two factors may be in conflict as it appears that more than a year may be needed to see results, yet many farmers have said they want a quick easy solution. Interim indicators other than overall reduction in herd lameness may be needed to maintain the interest and commitment of the farmer. It is likely that compliance, or sustained behaviour change, will be related to the farmer’s own feeling of engagement with and ownership of the plan, but also to the degree of support and encouragement received. Communication with other farmers, for example through discussion groups or focus groups, may be beneficial in maintaining interest and sustaining action.

We should also bear in mind the opinion of some farmers that:

Good lameness control/problem solving “comes from inside the farm not from external advice”, and make it clear that the farmer himself can and should drive the LCP, even if working in conjunction with an adviser. It should not be seen as something imposed from outside. Participation could be imposed, but it may be that success is not guaranteed by participation.

6. CONCLUSIONS

Recent findings from controlled trials and epidemiological studies have identified many of the relationships between risk factors and lesions causing lameness upon which the Lameness Control Programme is based. However there are still limits to our understanding of the causes and control of lameness, in particular the interactions and relative importance of different risk factors. Reduction of lameness on commercial farms has been difficult to achieve in intervention studies. The effectiveness of the suggested LCP has yet to be proven in the field. However, experiences from Germany show that successful interventions can be made, specifically in the areas of professional claw trimming, improvements to lying areas, and foot hygiene. Therefore we consider that, given time and commitment from the farmers, supported by advisers, the LCP we suggest should result in reduction of lameness.

Uptake of the programme is likely to be slow and varied between countries. Limitations of time and money, and lack of perceived need are likely to restrict uptake. Advisers will need
to be trained to guide and support farmers who wish to use the LCP, although some farmers will use it alone. The LCP needs to be accessible to farmers with and without their own computers. Success of the LCP will be affected by farmers’ commitment. Progress in lameness control is likely to be related to the degree of compliance with action points arising through the LCP.

7. REFERENCES


