INTRODUCTION

A recent economic analysis estimated that each clinically lame cow costs the dairy producer approximately $300 (C. L. Guard, Cornell University as quoted in Shearer et al., 2005). Costs associated with lameness include decreased milk production (Warnick et al., 2001; Hernandez et al., 2002b; Juarez et al., 2003), reduced fertility (Sprecher et al., 1997; Hernandez et al., 2002a; Melendez et al., 2002), increased culling risk (Collick et al., 1989; Sprecher et al., 1997; Booth et al., 2004), treatment costs and increased labor requirements. Surveys indicate that incidence of lameness on dairies varies between 4 and 55 cases per 100 cows per year and is dependent upon farm, location and time of year (Clarkson et al., 1996; Whitaker et al., 2000; Booth et al., 2004). Clearly, lameness is a costly disease and reducing its incidence will have a very favorable impact on dairy profitability.

IDENTIFYING LAME COWS

The first step in reducing lameness is to determine its incidence and severity. Compared to evaluating reproductive performance or udder health, determining incidence and severity of lameness is a rather subjective task. Due to the lack of quantitative measurements for assessing lameness, most dairy producers rely on the training, judgment and observation skills of their personnel to determine if cows are lame or experiencing discomfort standing and walking. Thus it is not surprising that research indicates that dairy personnel typically underestimate incidence of lameness. In a British study, 53 dairy producers estimated that only 5.73% of their cows were clinically lame, while independent observers identified 22.11% of the herd as clinically lame (Whay et al., 2002). Similarly, a team of Michigan veterinarians evaluated 13,144 cows on 95 dairy operations (Kopcha et al., 2003). They reported that while dairy producers estimated that only 4.5% of cows were lame, nearly 52% of cows were identified by the veterinarians as mildly to acutely lame. These studies confirm earlier research in which lameness recorded by independent observers was 2.5 times higher than prevalence.
reported by dairy producers (Wells et al., 1993). These studies would suggest that either most dairy personnel are not proficient at detecting moderately and/or clinically lame cows or have accepted a certain degree of lameness as normal cow behavior.

Dairy personnel may not be proficient at detecting lame cows because they have not been exposed to a simple, yet relatively accurate, system of scoring cattle for lameness. Over the years, several researchers have developed scoring systems to assess the degree of lameness in dairy cattle. These systems were based upon observations of the cow’s gait, behavior and weight distribution (Lucey et al., 1986; Manson and Leaver, 1988; Wells et al., 1993). However, it has been difficult for dairy producers to implement these scoring systems as they are complex and obtuse.

Sprecher et al. (1997) developed a locomotion scoring system that appears to be relatively easy for dairy producers to implement. In this system, cows are scored from 1 to 5, based upon observation of the cow standing and walking with special emphasis on the cow’s back posture. Descriptions of locomotion scores in this system are given in Table 1. It should be noted that cows should be scored when they are standing and walking on a flat surface that provides adequate traction. Cows should walk and not run when being scored.

The arched back, without appearance of favoring a limb, has been recognized for some time as an indicator of cows experiencing discomfort in their feet (Morrow, 1966). Cows arch their back to alter weight distribution. O’Callaghan et al. (2002) noted that of the behaviors exhibited by cows with claw lesions, spinal curvature had the highest numerical correlation to the presence of claw lesions.

<table>
<thead>
<tr>
<th>Locomotion Score</th>
<th>Clinical Description</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Normal</td>
<td>Stands and walks normally, all feet placed with purpose</td>
</tr>
<tr>
<td>2</td>
<td>Mildly Lame</td>
<td>Stands with a flat back, but arches when walks; gait is slightly abnormal</td>
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<tr>
<td>3</td>
<td>Moderately Lame</td>
<td>Stand and walks with an arched back; short strides with one or more legs</td>
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<tr>
<td>4</td>
<td>Lame</td>
<td>Arched back standing and walking; one or more limbs favored but at least partially weight bearing</td>
</tr>
<tr>
<td>5</td>
<td>Severely Lame</td>
<td>Arched back; refuses to bear weight on one limb may refuse or have great difficulty moving from lying position</td>
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Through the use of locomotion scoring, dairy producers can assess the incidence and severity of lameness within their herd. While having 5% of cows in the herd score a 4 or 5 may be considered acceptable, there is room for improvement. Incidence of lameness is unacceptable when more than 10% of cows on the dairy score a 4 or 5.
DETERMINING THE CAUSE OF LAMENESS

Cows that score a 2 or higher should be examined by trained personnel, such as a hoof trimmer, to determine the cause of discomfort when cows are standing and walking. In most cases, determining the source of discomfort requires that the feet of the cow be examined as 95% of lesions that cause lameness occur in the feet (Clarkson et al., 1996).

Promptly examining and treating cows that show mild discomfort while standing and walking is important to prevent cows from developing more serious lesions. If not treated promptly, cows that develop toe, sole and heel ulcers, white line lesions and foot rot are prone to developing deep digital sepsis (Bailey et al., 1997; Shearer et al., 2005). In most cases, cows with deep digital sepsis will not improve without surgery, including amputation of the claw or surgical fusion of the distal interphalangeal joint (Bailey et al., 1997).

In order to determine the best course of action to reduce lameness on the dairy, claw lesions must be accurately identified and recorded. There are numerous systems for recording claw lesions. These systems range from simply recording the cow identification and lesions to systems in which an extensive list of information is recorded including cow identification, the leg and zone of claw affected by the lesion, whether or not a block or wrap was applied, treatment and medications administered and schedule for recheck (Shearer et al., 2005).

CORRECTIVE AND PREVENTATIVE ACTION PLANS TO REDUCE INFECTIOUS LESIONS

Once lesions have been recorded, data should be analyzed to determine what lesions are most prevalent and to determine if there is any seasonality or stage of lactation effect. To help with record interpretation and treatment, lesions should be classified as infectious or non-infectious lesions. Infectious lesions include foot rot, digital dermatitis, interdigital dermatitis and, in some cases, heel erosion (Bergsten et al., 1997; Shearer et al., 2005). The primary risk factors associated with increased incidence of infectious lesions include wet conditions, poor foot hygiene and presence of other infected animals in the herd (Berry et al., 2002).

A prerequisite for development of foot rot and digital dermatitis is local injury of the skin either between the claws or in the heel bulb region (Bergsten, 1997; Berry et al., 2002). This can be the result of a traumatic lesion caused by a foreign object or by maceration of skin by water, feces and urine (Bergsten, 1997; Berry et al., 2002). Thus keeping pens, pastures and lots dry, clean and free of foreign objects can substantially reduce incidence of infectious lesions.

In most cases, promptly treating cows afflicted by foot rot with antibiotics, either topically or intramuscularly results in very favorable cure rates (Bergsten, 1997; Shearer et al., 2005). Depending upon the antibiotic used and the means of application, this may represent extra label use. Dairy producers are encouraged to work closely with their veterinarian to de-
termine which antibiotic is most efficacious for treating each claw disorder, the correct dosage of the antibiotic, correct milk and meat withholding time and appropriate means of application.

Footbaths, used correctly, can help prevent infectious lesions (Raven, 1989; Berry et al., 2002; Shearer et al., 2005). Used incorrectly, footbaths can become a fomite for the transmission of infectious lesions. Copper sulfate (5 to 10% solution), formaldehyde (3 to 5 gallons of a 36 to 40% formalin solution per 100 gallons of footbath solution), zinc sulfate (5 to 20% solution) and some commercial products have been reported to help reduce incidence of infectious lesions (Raven, 1987; Socha et al., 2005). The following factors should be considered to maximize effectiveness of footbaths (Socha et al., 2005):

1. Footbath solutions should be of proper strength (see above or manufacturer’s directions)
2. Footbaths should be located where cows frequently pass (e.g., return alleys),
3. Footbaths should be sized so that the cow places all four feet in the solution (generally 8 to 10 feet long, 3 feet wide),
4. Footbath solution should be deep enough to facilitate good contact of the treatment solution with the interdigital skin (4 to 6 inches deep),
5. Feet should be clean when entering the treatment footbath to facilitate contact of the treatment solution with the foot.
6. Producers should consider using a prebath, containing either water or a water soap solution to clean feet prior to the treatment bath and reduce soil load in the treatment bath.
7. Separate the prebath and treatment bath by 6 to 8 feet to minimize the prebath solution diluting the treatment bath solution.
8. Footbath solutions should be routinely changed (typically every 150 to 200 cow passes, more often if cows are dirty).
9. If using formaldehyde in footbaths, discontinue use when temperatures drop below 45°F.

While footbaths are appealing because they appear to require minimal amounts of labor, there are several very serious drawbacks to footbaths. First, use of copper or zinc sulfate in footbaths at the recommended strength, requires disposal of very large amounts of copper and zinc (Socha et al., 2005). While formaldehyde breaks down into carbon dioxide and water upon disposal, the concerns with formaldehyde include that it is a potential carcinogen, eye protection must be worn at all times when handling formaldehyde and it must only be used in well ventilated areas (Shearer et al., 2005; Socha et al., 2005).

There are several commercial footbath products being marketed that, when used as directed, substantially reduce the amount of disposed copper or zinc and are not suspected carcinogens. One drawback of many of these commercial products is that research on efficacy in controlling infectious lesions is limited or nonexistent, depending upon the product (Socha et al., 2005).
CORRECTIVE AND PREVENTATIVE ACTION PLANS TO REDUCE NON-INFECTIONOUS LESIONS

Non-infectious claw lesions include toe, sole and heel ulcers, white line lesions, sole hemorrhages, double soles, thin soles and vertical and horizontal fissures. Similar to infectious lesions, development of non-infectious lesions is multifactorial. For instance, thin soles can result from hoof trimmers removing excessive amount of claw horn. It can also be the result of cattle walking long distances on abrasive surfaces, resulting in horn wear exceeding the rate of horn growth. Factors that can result in increased incidence of non-infectious lesions include:

1. Lack of claw trimming, infrequent claw trimming or improper claw trimming (Raven, 1989; Shearer et al., 2005),
2. More than three hours per day spent standing in the holding area and/or excessive time locked in headlocks (Nordlund et al., 2004),
3. Poorly designed stalls including insufficient cushioning, poor surface traction, low neck rail, short beds, lack of lunge space, obstructions in lunge space, high brisket boards and narrow stalls (Anderson, 2005, Cook, 2005)
4. Insufficient lying time resulting from limited access to stalls due to overstocking, excessive amounts of time away from the pen, poor pen layout and low social ranking (Cook et al., 2004),
5. Nutritional factors including feeding excessive amounts of rumen fermentable carbohydrates, lack of effective fiber, feeding excessive amounts of protein, TMR sorting, inconsistent feeding times and inadequate trace mineral status (Nocek, 1997; Nocek et al., 2000; Cook et al., 2004),
6. Limited access to feed due to overstocking or insufficient feed bunk space (Cook et al., 2004)
7. Postcalving metabolic disorders such as milk fever (Nocek, 2002; Tomlinson et al., 2004),
8. Flooring conducive to excess horn wear such as holding areas with more than 2% slope, pen alleys with more than 1.5% slope, improperly grooved floors, floors with holes, and slatted floors in poor repair (Cook, 2005; Kloosterman, 2005),
9. Heat stress, resulting in lower rumen pH and cows spending more time standing (Cook et al., 2004; Shearer, 2005).
10. Abrupt transition from dry cow to lactating cow, both nutrition and environment (Cook, 2005)

While there are many causes of non-infectious lesions, properly identifying the lesion as well as recording the zone in which the lesion occurs, will help the investigator determine the root cause. For instance, ulcers in the toe (zone 5) occur more commonly in cows with thin soles, while ulcers in the center of the sole (zone 4) are indicative of overgrown soles or excess standing time.
MONITORING EFFECTIVENESS OF CORRECTIVE AND PREVENTATIVE ACTION PLANS

Provided cows are not subjected to new sources of discomfort, effectiveness of a corrective action plan can be monitored using Locomotion Scoring. In most cases, if the corrective action plan is effective, locomotion scores should improve in less than two weeks if cows are primarily afflicted by infectious lesions (Bergsten, 1997).

Improvements in locomotion scores, when cows are afflicted by non-infectious lesions, will not be evident as quickly. Horn on the dorsal walls grows at a rate of 5 to 7 mm per month, and the typical dorsal wall is 75 mm or longer (Shearer et al., 2005). Horn on the sole of the claw is generally 5 to 7 mm or thicker (Shearer et al., 2005). Thus the claw capsule is a composite of horn produced over the last 12 to 15 months. In situations where cows are functionally and correctly trimmed by a competent hoof trimmer, claw lesions may take 4 to 6 weeks or more for horn lesions to heal. In situations where cows are not being treated by a competent trimmer or not treated at all, it may take several months and possibly never for locomotion scores to improve.

CONCLUSIONS

Lameness is a costly disease for dairy producers as it reduces lactation performance and fertility. True reduction in dairy cattle lameness can only be fully achieved when dairy producers implement a program to determine the extent and severity of total herd lameness. As noted in Figure 1, Locomotion Scoring is an excellent tool to accomplish this objective. Cows scoring a 2 or higher should be examined by a competent hoof trimmer and the source of discomfort should be investigated. In most cases, this will require examining the feet, as more than 90% of lesions causing discomfort occur in the feet. All lesions should be recorded with appropriate corrective and preventative treatment based upon whether the pain is caused by infectious or non-infectious lesions. Effectiveness of all treatment measures should be monitored through continual locomotion scoring.

REFERENCES:


Figure 1. Outline of program to reduce lameness on the dairy.


