Investigating herds with lameness problems.

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Introduction

Many dairy herds have unusual or exceptionally serious lameness problems. The paper describes a systematic way to approach and evaluate such problems based on published observations of risk factors for specific disease problems and the author's experience. It is important to define an etiologic diagnosis since preventive or corrective measures will depend on the cause of the herd problem. Compound etiologies and complex risk factor interactions are the norm in this sometimes frustrating endeavor.

Data and definition of the problem.

The characteristics reported by the owner or herd manager may be adequate to generally describe the process occurring in the herd. More often, examination of several cows with what is considered the primary problem will be required to define the nature of the lesions and establish an etiologic diagnosis. The nomenclature for lameness lesions and causes varies widely. Many times all lameness cases are called footrot or abscesses regardless of the true nature of the lesions responsible.

The magnitude of the problem is important when formulating a plan. Data from health records or hoof trimmer score sheets should be consulted. It is desirable to examine data covering a significant historical period if such data is available. Since some problems are linked to seasonal changes in climate, feeding, or management, 24 months of data would be most useful. Many times the only data available are an impression or the recollections of the owner or manager. This type of data, however sincerely held, is most difficult to assess. Further, the response to any corrective actions proposed will be measured against current data.

Recommended data include the cow ID, date of treatment or trimming, lesion or diagnosis, and treatment administered. Usually there are two sources of data. The individual cow records kept by the dairyman of treatments by him or the veterinarian and the records of the hoof trimmer. The quality and thoroughness of this data are quite variable. Providing data recording sheets for trimmers and herdsmen in the form of a checklist for common lesions can create a useful database if they are not already using a system that allows later analysis. In one problem herd without individual cow records where treatments were done by the herdsman, I was able to estimate the magnitude of the problem month by month by checking invoices for hoof blocks purchased during the preceding year. For computerized records, such as Dairy Comp 305, the dated events TRIM or LAME if followed by comments regarding diagnosis or treatment can be readily analyzed.

If data are not available, then examination of the entire herd or a proportional sample of each of the groups within the herd should be done. Depending on the nature of the problem, it may require scoring locomotion, posture, or the presence of specific lesions only revealed after restraint of the cow in a chute or on a tilt-table and cleaning the digits or paring of the soles. Scoring cows at the walk is easy to perform. I prefer a four-point scale, using no subdivisions, with 1 for perfectly sound, 2 for slight gait abnormalities, 3 for limping cows, and 4 for cows unwilling to bear weight on a limb. Posture abnormalities were described by Toussaint Raven[21] and a scoring system was first proposed by Dutch workers in 1996. The degree of rotation of the rear hooves outward is a reflection of the cow's attempt to avoid pressure on the lateral claw. The Dutch system gives a score of 1 to less than 15 degrees, 2 for 15 to 30 degrees, and 3 for

greater than 30 degrees. For scoring heel horn erosion or digital dermatitis it may be possible to assess these in the milking parlor with a flashlight. These examinations of the herd aim to answer the questions of who demographically is affected (stage of lactation, parity, housing group), what proportion of the herd is affected, and what lesions or diseases are most prominent.

It may be useful to create a photographic record of the lesions or of other important features of the environment. With the fall in price of digital cameras this may be the most economical means of recording observations. Digital images also allow communication of observations to others for evaluation or comment.

Classification of herd problem by etiology.

Major herd problems will fall into one of several main categories: infectious digital disease, laminitis/coriosis, and overworn/trauma. Specific risk factors for the problem identified as primary in the herd should be examined. Conclusions about the relative importance of each risk factor and the appropriate corrective or prophylactic measures comprise the main effort in correcting the herd problem.

Infectious Diseases

Footrot

Control programs should be capable of maintaining the incidence of cases requiring individual animal treatments below 2% of cows at risk per year. Incidence rates in excess of this mean interdigital skin injury beyond the simple maceration due to the constant exposure to moisture in freestall environments or an ineffective control effort. This may be from small stones in inorganic bedding or walking through stony laneways or mudholes outside. There may be additional risk due to interdigital fibromas from chronic interdigital dermatitis which can lead to secondary injury of the interdigital skin by trauma. There may be abnormally high infection pressure due to slurry or mud coating of the extremities.

Control measures usually require a combination of hygiene and prophylaxis. Hygiene may be accomplished by more frequent manure removal from freestall barns or redesigning laneways to avoid trauma and reservoirs of infection. Prophylaxis is usually with footbaths containing copper or zinc sulfate.

Interdigital Dermatitis

Control programs should be capable of limiting individual animal treatments for lameness due to heel cracks or heel horn erosion below 5 % of the cows at risk per year. Infection is generally chronic with the lesions resulting in lameness developing over weeks to months. Hypertrophy of interdigital skin, skin of the heel bulb, and perhaps of the caudal axial sole of the hoof in response to this chronic irritation result in the lesions producing lameness. Since interdigital dermatitis is so common, its effects are often superimposed on those of any of the other causes of lameness in the digit. Moist conditions and inadequate footbathing are the most important risk factors for interdigital dermatitis that progresses to lameness. Abnormal claw shape due to heel and sole hypertrophy are prevented by frequent maintenance claw trimming.

Papillomatous Digital Dermatitis

Control programs should result in less than 10 % of the cows at risk requiring individual

treatment per year. Infective manure slurry is the primary risk factor for new cases in an already infected herd. As with the other infectious diseases, the nature of the cow environment will have a dominant influence on the magnitude of the problem and the potential control points.

Investigation of Lameness Problems due to Infection

Management of manure removal from the cow environment is paramount for controlling the exposure risk to infective agents. All the important disease causing bacteria seem capable of surviving in moist manure or slurry for adequate time to infect the next in-contact cow. Slotted floors might be superior in this regard but have cost and comfort concerns that make the widespread adoption of this option unlikely in dairies in the United States. Most barns have solid concrete floors and have manure removed by tractor scraper, automatic scrapers, or water flush. There is no data on the relative success of each of these systems in preventing new cases of infectious lameness. If the same ideal of clean and dry that is appropriate for teat skin is applied to digital skin, then automatic alley scrapers would be best in some circumstances and water flush in others. Tractor scraping may be the least desirable option. Given that some exposure will occur, then prophylactic footbathing is the most economical technique for control. Design and management of footbaths are important for their success in controlling infectious digital diseases. Adequate depth and length to immerse the digits to the dewclaws is important. Management of the contents of the bath requires oversight. Baths heavily contaminated with manure will be ineffective. The number of cow passages before this occurs will vary from herd to herd and over time within a herd. When the incidence of infectious lameness cases exceeds a trigger point the management of the bath or the environment should be changed.

Laminitis/Coriosis

The 2 most important risk factors are ruminal acidosis and standing time, particularly on concrete. Systemic inflammatory diseases such as toxic metritis or mastitis may play a role in some cases of laminitis but the author believes that their role is minimal in the general population. Acceptable incidence rates for lameness cases due to laminitis/coriosis are probably about 10% of the herd per year. Typically the incidence is much higher and represents the main challenge in managing herd digital health.

Nutrition/feeding management

Most historical concern for the prevention of laminitis has been focused on the nutritional management of cattle to minimize the occurrence ruminal acidosis. Ruminal acidosis is probably a necessary but not sufficient condition for the development of the most commonly observed lesions of subacute ruminal acidosis, sole and white line hemorrhages, white line abscesses, and sole ulceration. Environmental conditions and cow behavior appear to modify the final expression of the insult caused to the laminae and corium of the claws caused by ruminal acidosis. Subacute ruminal acidosis likely occurs in most dairy cattle in North America at some time during lactation.[7] Despite this likely common occurrence, lameness is more variable although quite severe in some herds. Experimental data is available on the ruminal effects of high concentrate diets. On the other hand, there is very little data on the consequences within the claws of diet manipulations.[10,13,18] These 3 reports describe the incidence of laminitis lesions in small groups of cattle in experimental herds with diet treatments that were either high or low levels of concentrate feeding relative to forage. In each study there were

more cases of lameness in the higher concentrate feeding groups. The groups fed low to moderate levels of concentrate were affected with some lesions of laminitis despite attempts to minimize the occurrence of ruminal acidosis. The author is not aware of any published experimental studies on the influence of environmental conditions on the occurrence of laminitis lesions with or without diet manipulations.

If laminitis/coriosis is the primary cause of lameness in a problem herd, both nutritional and environmental factors should be investigated. Nutritional factors to consider are diet formulation, feed delivery system including timing of delivery, access to feed, and particle size distribution of the feedstuffs. Diets should be formulated to meet or exceed NRC recommendations for NDF and ADF. At least 75% of the NDF requirement should be provided from forage sources. Understanding the feeding management on the farm including the schedule of daily events is necessary to trouble shoot ruminal acidosis problems. For lactating cows, feed should be available almost continuously but especially at the times when the group is most likely to eat, eg. before and after each milking. For component fed herds, concentrate should be fed as often as required to keep each feeding less than 8 lbs. Most TMR fed herds are given fresh feed once or twice a day. Depending on the feeding system, regular push-up of feed is required to keep the feed within easy reach. Both delivery of feed and push-up are signals to the herd that will stimulate eating. Lactating cows typically consume feed 8 to 14 times in 24 hrs. For herds milked 3X, 6 of these meals are commonly tied to milking. Another meal or 2 commonly occurs between milkings. Stanchioned or tied cows eat in discrete meals and are likewise stimulated to eat by new feed or other activities in the barn. Overcrowding in loose housing can disrupt desirable feed consumption patterns. Least dominant cattle will not have equal access to feed and may return to the stalls or resting area when the majority of the herd finishes eating with the likely consequence of slug feeding for the most timid.

Forage particle size is important for rumen dynamics including the resulting ruminal pH. Larger particles remain in the rumen longer contributing to the floating rumen mat which helps trap small feed particles and tempers their rate of fermentation. Inadequate particle size may occur in silages at harvest from too fine a cut or at delivery from grinding by the feed handling system. Specific guidelines for forage particle size are still empirical. Techniques for measuring particle size usually involve graded sieves such as the Penn State forage particle separator or shaker box. Lots of large particles in the feed as delivered is not a guarantee of adequate particle size in the rumen. Large pieces are potentially sorted by cows so that what they consume is not identical to the ration as delivered. Examining the feed at several stages in the process from harvest to disposal as refusals is sometimes necessary to correctly characterize the composition of consumed feed and identify potential problems.

Bulk milk butterfat concentration is an indicator of mean daily rumen pH. If the butterfat % is low (less than 3.5% for North American Holsteins) there is likely a significant acidosis problem. With low bulk milk butterfat it is likely that the whole herd is affected. However, significant acidosis can be occurring to some cows in the herd every day and this not be reflected in the bulk tank. In addition, the ruminal events during a period of acidosis leading to changes in the vasculature of the digits is still largely unknown. This may mean, and in my opinion does, that important health consequences of ruminal acidosis can occur in an individual cow due to a short term drop in rumen pH without a change in her butterfat output if the mean ruminal pH remains above 5.8. Direct measurement of rumen pH is commonly done to investigate suspected acidosis problems. Samples are obtained by rumen puncture with a 4 to 5 inch needle between the last rib and the thigh muscles at the level of the stifle joint. Fluid

samples of about 2 cc are placed on the sensor of a portable pH meter.[17] Like forage particle size recommendations the guidelines for desirable pH are still empirical but cows below 5.6 are considered at risk for adverse health consequences.

The occurrence of ruminal acidosis can be due to errors at any of the steps in providing the feed supply, whether it is via grazing, component feeding, or total mixed ration. For the majority of herds that the author has worked with TMR feeding is practiced in freestall housing. Problems encountered have included 1) diets formulated with inadequate forage fiber, usually when available forage was of low quality and grain was pushed to make up the energy deficit, 2) silages chopped too fine such as from sealed storage silos 3) overmixing of the TMR resulting in forage grinding in the mixer, 4) lack of timely access to feed eg. empty bunk or infrequent pushup, 5) lack of access due to overcrowding or social interactions.

Environment

The consequences of standing on concrete are considered by many to be very important in the development of lesions of laminitis. Pressure exerted on specific portions of the claw may contribute to the observed vascular derived lesions of either hemorrhage or necrosis. Cattle claws not recently trimmed are commonly shaped in less than desirable forms. When these misshapen claws are supporting a cow on an unyielding surface, the localized pressure can contribute greatly to damage of the underlying germinal epithelium. It is these consequences that have lead to my suggesting that barn floors be surfaced with something other than concrete and that routine trimming can prevent many of the more severe cases of lameness. It is of interest that the installation of rubber by feed alleys, in parlor holding areas, along alleys connecting pens to the milking parlor, and most recently complete alley covering with rubber mats has been increasing. Thus far there is no data on the effects of these changes on lameness but unquantified observations of cow behavior by the author suggest that we are moving in the right direction.

Lameness incidence in bullocks housed on slatted floors, 4.75% of 12010, in winter in Ireland was twice that of bullocks housed in straw yards, 2.43% of 2882, in 1984.[16] Similarly, a cross-sectional survey of Dutch dairy calves between 2.5 and 12 months of age observed more sole hemorrhages in heifers housed on slatted floors than in straw yards.[6] Calves were examined on 117 farms. The prevalence of sole hemorrhage in straw yards was 5% and was 45% on slatted floors. A comparison between 11 herds with chronic laminitis problems and 11 control herds was made during 2 years by Dr. Christer Bergsten in the vicinity of Skara, Sweden.[1] There was a correlation between the stall surface, either concrete or with a rubber mat, and the occurrence or hemorrhages. Fewer sole hemorrhages occurred in stalls fitted with rubber mats. The cows were in tiestalls and bedding use was not found to influence the prevalence of sole hemorrhages although it was described as minimal in all stall types. The only publication suggesting an effect of environment on laminitis in freestall housing compared the problem in 2 herds with the same owner and stall design but managed differently due to the requirements of the manure removal system. The herd with a higher incidence of lameness used less bedding. Both the proportion of animals standing in the alleys and the proportion of animals standing half in the stalls was higher for the herd with more lameness. Increasing the bedding amount for the problem herd resulted in amelioration of the lameness.[5]

Time spent standing either in alleys or half in-half out of stalls has not been quantitatively related to lameness. However, almost everyone agrees that there is a strong correlation between the time cows don't spend lying down and the incidence of lameness. For freestall housed cows

the degree of overcrowding and the specific conditions and dimensions of the stalls are paramount in encouraging optimal stall usage.

Standing time on concrete is heavily influenced by the environmental design of dairy facilities and modified by overcrowding and management activities. Synchronization of behavioral activities again leads a group of cattle to mostly lie down at the same time. Overcrowding of freestall pens prevents some of the subordinate animals from access to a stall. When a stall becomes available it might signal the pen is ready to collectively eat or be milked thus preventing that timid animal from lying at all. Data from long term observations of groups of cattle with known dominance structure showed that a very subordinate animal, usually a heifer, might stay in a stall during some group eating times.[19] Reasons for this are speculative but, regardless, the result is slug feeding for that animal when she does leave the stall. Subordinate animals are also more likely to stand either in the alley with the head placed in a stall or half in a stall. Interpretation of this behavior is that it provides a reduction in the danger posed by more dominant cattle. Housing first lactation animals separate from older cows has resulted in a reduction of the negative effects of these social interactions on the heifers.[12]

Standing in a freestall pen is heavily influenced by the design of the freestall itself. Great attention has justifiably been spent in the last 20 years on improving the design of freestall partitions, beds, and overall dimensions. Cow-comfort has been a popular theme of the last decade with most of the emphasis placed on the stall. This emphasis has in great part been driven by the desire to improve lying time to reduce lameness. The goal of freestall facility design should be to provide a space for every cow. Cows should enter and exit freely including lying and rising without interference and ultimately spend about 14 hours per 24 lying in the stall. Since mechanical loading of the claws contributes very importantly to the development of the serious lesions of laminitis, evidence of underutilization of stalls is a cause for alarm. Cows that have had an unpleasant experience in a stall are more reluctant to use a stall the next time it is appropriate. Those cows that stand half in and half out of stalls are often increasing the load on the rear digits and at an unnatural angle. Maintenance of the bedding in stalls is also critical for use and comfort. Hock lesions are a common complaint of many mattress stall designs due to the lack of adequate bedding at the rear of the stall. Plain concrete or hard rubber mat stalls with bedding appear to be the least desirable for overall comfort and utilization and hock lesions. Forty three heifers were housed in pens with 2 freestall designs through late pregnancy and early lactation.[10] One stall type was the Dutch comfort with side openings and outfitted with rubber mats. The other was Newton Rigg that prevented side lunging and had no rubber mat over the concrete base. Lying time was increased and standing half in stalls was reduced in the Dutch comfort stalls. There were more sole hemorrhages and 6 cases of acute lameness in the Newton Rigg stalls versus 1 lame heifer in the Dutch comfort stalls.

Time management

For freestall housed herds the forced standing time imposed by management activities may contribute to laminitis problems. The milking parlor should be sized to limit holding period time to 3 hours in 24 regardless of milking frequency. Other management activities such as bedding stalls or veterinary work should be organized to minimize the intrusion on potential lying time.

Summary for Laminitis

Environmental circumstances for dairy cattle appear to have 2 possible avenues of

influence on the development of laminitis. First are those environmental conditions that influence feeding behavior. Second are those conditions that predispose to excessive standing time, and standing on concrete in particular. Both feeding and lying behavior are prone to the tendency of synchronization of activities within a group of cows. Observations on the behavior of cattle have shown that regardless of feed access, either 100% can eat at once or 50% at once, most eating will occur in temporal clusters.[15] When feed access is limited the subordinate cattle will have less time available to eat and be slug feeding more often. Besides overcrowding the feeding space, heat stress probably influences feeding behavior the most adversely with regard to laminitis. These 2 factors comprise the major influences of environment on feeding behavior with ultimate consequences mediated via ruminal acidosis on the development of laminitis.

In many herds in North America laminitis has a pronounced seasonal occurrence. Late summer through early fall is the peak of cases of white line abscess and sole ulcers. I believe that there are 2 primary causes that both are environmental in nature. First, cows experiencing heat stress will redistribute their meals to eat predominately in the morning. This slug feeding increases the incidence of ruminal acidosis. Second, and of unknown importance relative to the increase in low rumen pH, is the increase in standing time. Cows stand huddled around waterers. They stand in the stalls, often concentrated where fans move the most air. Sometimes, apparently when stable flies are bothersome, they stand in tight groups at one end of a pen. To avoid fly bites the goal of a cow is to be in the center of a group where the heat stress is likely maximal. Maybe they stand in the stalls because they perceive themselves to be cooler standing than lying down. For whatever constellation of reasons, the slug feeding and excess standing lead to large increases in lame cows. Summer ventilation and strategies to cool cows have the possibility to significantly reduce this seasonal lameness problem.

Investigating the diet and feeding management.

Examination of individual feeds and the complete ration as formulated should be done to insure that minimum NDF requirements are being met. Following that, the forages or TMR might be evaluated for distribution of particle size as with a Penn State forage particle separator.

Times of feed delivery and pushup should be determined. Check the amount of feed refusal or leftover at the next feeding and how it is managed. How much sorting is occurring during the interval between deliveries of fresh feed. Check refusals for particle size distribution as compared with fresh feed.

Examine manure consistency for evidence of scouring. Does the manure seem appropriate for the diet?

Lastly, determine rumen pH directly on samples obtained via ruminocentesis.

Investigating social interactions and time management.

Do housing groups contain more cows than stalls? Concern is greatest for the effects of overcrowding on cows from the pre-fresh period until mid-lactation. Are first lactation cows grouped separately from older cows? How long does each group spend out of their pen each day for milking or other management activities? The goal is less than 3 hours away from the home pen per 24 hours. Do the pens have dead-end alleys where subordinate cows can be trapped by dominant cows? Do management activities in the pens disrupt routines of eating and lying?

Investigating the comfort of the stalls and the construction of alley and pen floors.

Details on stall design are available in the Dairy Freestall Housing Guide from Midwest Plan Service. Examination of the specific dimensions of the stalls and evaluation of the

bedding practices will aid understanding stall usage patterns. If stall usage is an issue and observations are difficult, a time-lapse video recording spanning several days of cow behavior in the barn can be invaluable in understanding what is really happening in the herd. Lying time should exceed 12 hours per 24 on average for each cow. Video observations of freestall cows show that lying should occur within 6 seconds of occupying the stall and rising should take 4 seconds if the stall design is adequately cow friendly.

The best surface for cows to walk on is sod. In the barn, fairly smooth concrete with appropriate grooves to prevent slipping is preferable to roughly grooved or broken concrete. Most grooves formed in uncured concrete have disadvantages for the cow over grooves sawed in cured concrete. Rubber walkways are better yet.

Trauma/Excessive Wear

The rate of hoof growth varies with age or parity, nutritional status, and season.[8] For adult Holstein cattle the average rate of growth is 6 mm/mo. In most environments wear is slightly less than growth leading to slow net growth. When cattle were placed in a new freestall barn during a project measuring growth and wear, the wear rate increased to 10 mm/mo followed a couple of months later by an increase in the growth rate to 10 mm/mo for about 3 months. Thus it appears that hoof growth can respond to the rate of wear. No details were provided about the preparation of the concrete surfaces in the new barn but wear rates remained above typical growth rates for a year. From experimental measurements of hoof wear in a testing device wet concrete is always more abrasive than dry.[4]

Lameness may occur if the hooves are overworn or trimmed too short and rough surfaces must be walked on. A two year study of 14 Irish grazing herds evaluated the farms' systems of roadways and correlated the road characteristics with the incidence of lameness. Roadways with some concrete and grass interspersed, considered to be indicative of poor maintenance, were associated with the most lameness.[9] In some extreme cases, hoof wear will exceed growth and directly expose the corium. This has occurred in new facilities with concrete that is excessively abrasive, in circumstances where cows are forced to walk long distances to pastures, and in at least one herd with sand bedded freestalls. In the last case, corium was exposed at the toe tips in all affected cows. Unusually, cows that had blocks applied also wore the blocks away at the toe first. The parlor holding area was sloped 8% which was believed to be the location where excessive toe wear was occurring although the hooves were overworn in general. This was probably due to the abrasiveness of the sand on the concrete floors. This is an unusual occurrence for sand bedded herds and was probably due to a unique combination of manure removal technique (automatic alley scrapers) and sand particle size. Several sand sources had been tried and it was not possible to determine which particular type was responsible.

Examination of representative cows from the herd should enable a reliable diagnosis of excessive wear or trauma as the cause of a herd problem. Reducing the abrasiveness of new concrete or improving the surfaces of cattle walkways will minimize the future occurrences of lameness due to these environmental insults. Dr. Roger Blowey described an inexpensive, cow-friendly walkway design recently developed in Great Britain.[3] A trench is excavated about 1 meter wide to a depth of about 30 cm. The bottom is filled with crushed stone for drainage, a layer of geotextile placed over the stone, and the remainder filled with shredded tree bark. More bark is added as needed. Newly constructed concrete surfaces can be smoothed by dragging concrete gravity blocks or scraping with the steel blade of a loader bucket. An additional consideration should be to refrain from trimming before putting cows in a new facility in

anticipation of the initial high rates of hoof wear.

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