Key Considerations for the Implementation of a Hoof Health Program

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Take Home Messages

The implementation of an effective dairy herd hoof health program includes several key requirements:

- initial determination of the nature and magnitude of the lameness issue and the specific lesions or injuries contributing to the issue
- timely identification, treatment and follow-up of new lameness cases to prevent them from becoming chronic
- adoption of management practices intended to improve the hoof trimming program, infection control, transition cow management, and cow comfort.

Breaking up the problem into smaller parts and focusing first on the main issue (infectious vs. non-infectious) will make the task less onerous. A structured, integrated team approach is of great value, but farmer buy-in is essential. Advisors need to be active listeners and understand farmer motivation to be able to develop an actionable and feasible hoof health program.

Introduction

Lameness is the dairy industry's leading and most visible animal welfare concern and is among the top three major health problems, along with mastitis and reproductive problems. In a broad survey of industry stakeholders, lameness was identified as the number one health concern and animal welfare was identified as the top management issue (Kelton, 2018). Economic losses due to lameness have been estimated at US$185–470 per case.

Despite the negative impact of lameness on the cow, farmer and consumer, and a large body of literature on causes and risk factors for lameness, we still find that 15–30% of dairy cows housed in freestall barns in North America are

assessed as mildly to severely lame (Solano et al., 2015; National Dairy Study, 2018). In response to concerns regarding animal well-being and the high prevalence of lameness, in 2015 Dairy Farmers of Canada launched a mandatory on-farm animal care assessment (proAction® Animal Care); in this program every farm is subject to a lameness evaluation by a third party.

The focus of this paper is to provide tools to evaluate a hoof health problem and develop a targeted action plan to reduce it. Specific recommendations are not given as these need to be farm specific; rather, a general overview of a strategic approach to a hoof health problem is presented.

Challenges with Lameness Detection

Lameness detection is based on locomotion or gait scoring. Although locomotion scoring has become an industry standard for identifying and monitoring lameness, it is not sensitive or reliable enough to detect cows with hoof lesions, even if they are painful. Furthermore, locomotion scoring is subject to observer bias and the agreement between observers to classify cows as lame or non-lame is low. It is therefore no surprise that lameness prevalence is typically underestimated, and on average, producers fail to recognize two out of three lame cows. This doesn't necessarily mean that farmers don't perceive lameness as an issue or that they don't monitor their cows, but the reality is that detecting lame cows can be challenging and time consuming. Severely lame cows are obvious and easy to detect, but mildly lame cows, those with a slight limp, are not easily detected but are far more common and costly. Most of our efforts for lameness control and prevention should focus on mildly lame cows because they are the most likely to successfully recover if treated.

Although locomotion scoring is not a perfect tool to detect lame cows, it is currently the best tool we have to find lame cows so they can be treated promptly and appropriately. Locomotion scoring is a key component of a hoof health program and if used routinely (i.e., bi-weekly or monthly) can have a large impact on reducing lameness. Producers that have succeeded in implementing a system for detection of lame cows have a designated, trained person that is either part of the staff or an independent advisor responsible for detection, action and follow-up of lame cows.

Getting to the Root of the Problem

We use locomotion scoring to find lame cows, but we need to know what is making cows lame. Approximately 90% of the causes of lameness involve hoof lesions, although hoof lesions do not necessarily result in lameness. Therefore, we use the hoof lesion data from hoof trimming records to understand the causes of lameness. Lameness resulting from hoof lesions

can broadly be categorized into infectious and non-infectious types. The most common hoof lesion in North American dairy cattle is digital dermatitis (DD), an infectious lesion, affecting 22–49% of cattle (Figure 1a; Solano et al., 2016). Sole ulcer (SU) and white line disease (WLD), which are non-infectious lesions and are commonly known as hoof horn lesions, each affect 5–9% of cows (Figures 1b and 1c; Solano et al., 2016). Because of its high prevalence and incidence, DD has the largest economic impact; however, SU and WLD tend to be more painful and lead to more complications in treatment, recovery and recurrence.

Each type of hoof lesion develops in a different manner and different factors contribute to their development. Several bacterial families are involved in the pathogenesis of DD, with treponemes consistently isolated from the lesions.

Although the pathogenesis of SU and WLD is not fully understood, research evidence is accumulating on the impact of inflammation, physiological and hormonal events around calving, mechanical factors, low body condition score (BCS), and cow comfort related to housing, facilities and overall management. Rumen acidosis, resulting from feeding high concentrate diets, is traditionally believed to be a cause of lameness. However, studies designed to demonstrate this connection have failed to establish a clear cause-and-effect relationship. Regarding nutrition and its association with lameness, there is more scientific evidence on the impact of body condition loss and when and how cows eat (abrupt diet changes, infrequent feeding and push-up, inadequate access to the feedbunk due to overstocking, social interactions or feedbunk design), than what cows eat. Therefore, for a thorough understanding of a herd situation, data on hoof lesions must be complemented with information on management practices (footbathing, feeding, bedding, cleaning, milking, hoof trimming management, etc.) and a comprehensive evaluation of the facilities (type and condition of flooring, stall dimensions, stall base, stocking density, pen layout, etc.) and animals (body injuries, BCS, claw length and conformation, leg cleanliness, etc.).

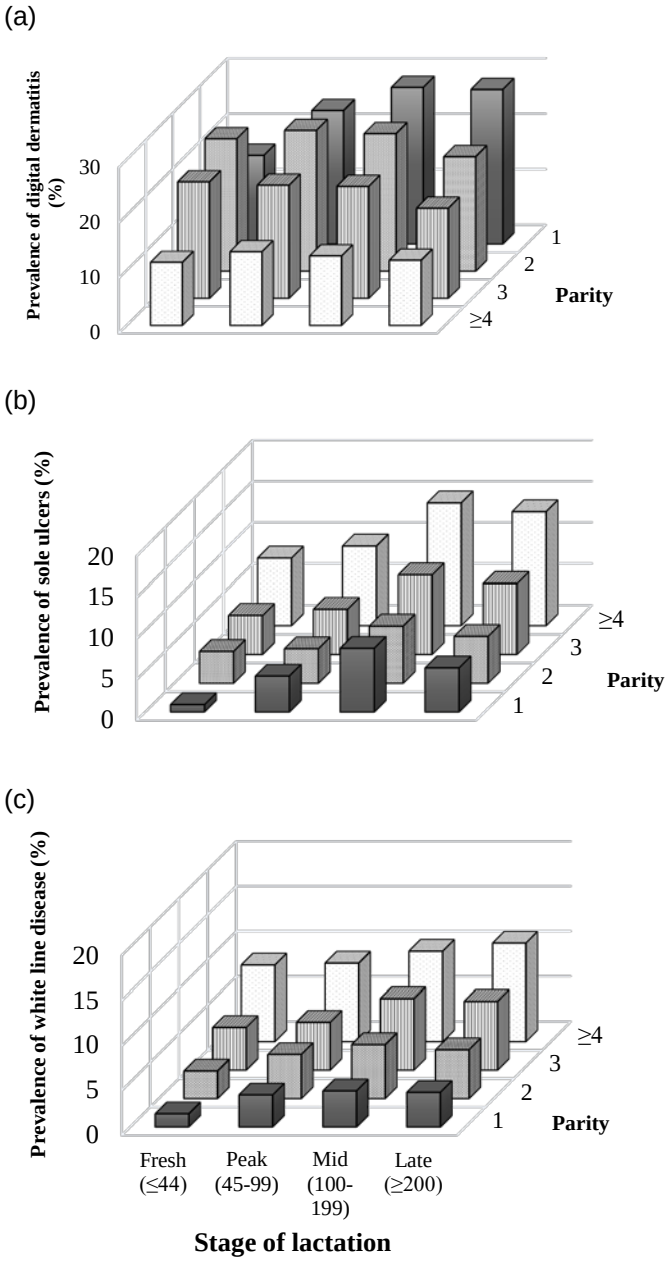

Figure 1. Percentage of dairy cows with (a) digital dermatitis, (b) sole ulcers and (c) white line disease by parity and stage of lactation. (Solano et al., 2016)

Data from hoof examination records should include information on cow ID, date of trimming, affected limb or hoof, type of hoof lesion (according to standard definitions) and treatment (i.e., wrap, block, antibiotic, anti-inflammatories). Regardless of method of recording, for effective monitoring and use data must be entered in the on-farm software. Hoof lesion history from a few previous years would aid in assessing epidemiological trends and individual factors (parity and stage of lactation) that are lesion specific. For example, we know that primiparous cows have higher odds of DD but lower odds of SU and WLD than older cows (Figure 1). Cows in mid lactation and late lactation have higher odds of SU and WLD than cows at other stages of lactation, regardless of parity (Solano et al., 2016). With this kind of information, hoof health programs can be tailored for a particular herd with strategies that are lesion-, age-, and farm-specific.

■ Breaking the Problem into Smaller Parts

Knowledge of the magnitude and root (infectious or non-infectious) of the lameness problem makes a good starting point to develop and evaluate a plan. That plan usually consists of breaking the complex lameness problem into smaller parts to address the reduction of prevalence (existing cases of lameness at a specific point in time) and incidence (new cases of lameness occurring over a period of time) of lameness. To reduce lameness prevalence, we want to find and properly treat lame cows. To reduce lameness incidence, we want to prevent cows from becoming lame, for which we identify herd-level risk factors that may increase the likelihood of developing lameness. Overall, if the predominant hoof lesions are infectious, attention should be paid to factors related to hygiene, biosecurity, and footbath management. If the predominant hoof lesions are non-infectious, attention should be paid to factors related to cow comfort (comfort of walking and lying surface, standing time on concrete, stocking density, etc.), animal handling, feedbunk management and transition cow management. In this article, let's focus on general recommendations based on the three main hoof lesions that can serve as a roadmap when evaluating and developing a hoof health program.

Lame Cow Detection, Treatment and Management

The most effective way to detect, treat and follow-up lame cows is by having a trained, designated person to perform these tasks. That person can be a farm employee or an external advisor that implements routine locomotion scoring every two to four weeks. Despite efforts to emphasize the need and importance of early detection and prompt treatment, farmers often report the time from detection to action to be 'a couple of days' or 'at the next hoof trimmer visit'. To increase recovery rates and decrease recurrence, moderately and severely lame cows should be inspected in the trimming

chute as soon as possible—with the same urgency we would apply to a case of mastitis or metritis—and should be treated with the best possible treatment. Over the past five years, evidence has accumulated on the role of inflammation in lameness and the benefits of using anti-inflammatory drugs (e.g., meloxicam, ketoprofen) in addition to a curative trim and block, when treating SU and WLD. The anti-inflammatory and pain-relieving effects of these drugs improve cure rates, but this effect differs depending on lameness chronicity; newly or mildly lame cows had higher recovery rates if treated with anti-inflammatories, whereas there was no difference in recovery rates for chronically lame cows. Therefore, we need to provide new cases of lameness with the best care because these cows have the best chance of recovery before they become chronically lame. After being treated, lame cows should be taken out of the environment that caused the lameness and ideally be moved to a straw pack pen or an outdoor area. Lame and blocked cows should be re-examined 30 days later.

Preventive Hoof Trimming Program

The aim of hoof trimming is to distribute and balance weight bearing within and between digits to prevent lameness and to find and correct hoof lesions. Hiring a hoof trimmer and having a hoof trimming routine is a common practice in North America. A hoof trimming program that is an effective preventive strategy involves more than just ensuring that each cow is trimmed once or twice per year. More important than trimming frequency is the 'which/when/how' cows are being trimmed. There is little scientific evidence on appropriate frequency and timing of hoof trimming. However, based on the stages of lactation that are known high risk periods for development of lesions (Figure 1), we recommend trimming lactating cows at dry-off and mid-lactation. Sole ulcers and WLD most commonly affect older cattle (≥3rd lactation), whereas DD most commonly affects primiparous cows (50% of DD cases occurred in primiparous cows; Solano et al., 2016). In addition, up to 13% of within-herd DD prevalence has been reported in young stock (Jacobs et al., 2017) and there is a high correlation between lactating herd DD prevalence and DD presence in young stock. Thus, it is likely that in high DD prevalence herds, DD infection is present in young stock as well. In addition, the barn environment impacts hoof wear. Cows housed on concrete floors and sand bedding usually have their hooves wearing at a higher rate than cows in deep-bedded straw pack pens. Therefore, hoof trimming frequency and timing should be customized to the specific conditions of a farm. Lastly, it is extremely important to ensure that trimming is being done correctly and that it is not doing more damage than good. The American Association of Bovine Practitioners' factsheet on "Assessing a herd hoof-trimming program" offers a seven-point check list on how to detect and evaluate trimming errors (AABP, 2017) regardless of trimming technique.

Infection Control

For infectious lesions, strategies should be tailored to control the spread of bacteria in the herd. Manure and slurry can be a source of infection by DD-associated bacteria. The survival and growth of these bacteria can be limited by increasing or improving external and internal biosecurity practices and by providing an environment that is as clean and dry as possible. When developing a control plan for DD control, we need to focus on:

- early identification and prompt treatment of DD lesions in both young stock and adult cattle
- an optimal footbath protocol and footbath design
- improvement of leg hygiene by decreasing wet and muddy conditions and slurry contamination
- increasing external biosecurity with respect to purchased cattle, participation in shows, and cleanliness of external equipment, vehicles, boots and clothing coming on farm
- increasing internal biosecurity through consideration of manure removal frequency and direction, manure-contaminated water troughs, manure removal vehicles used in other activities, etc.

Findings from our recent research indicate that cows in barns with automatic scrapers were 2.6 times more likely to have DD compared with cows on farms with manual (e.g., skid steer) scraping systems. However, automatic scrapers are widely used (30% of U.S. operations and 80% of Canadian freestall facilities) because they save labour and resources. In spite of their limitations, improvements can be made in the way, the time and the frequency that scrapers are used.

With regard to footbathing practices and footbath design, our research in Alberta pointed out a gap between evidence-based management practices and on-farm implementation. By simply implementing a standardized footbath protocol and design according to current scientific literature, prevalence of DD decreased from 22% to 14% and prevalence of feet with no DD lesions increased from 39% to 48% (Solano et al., 2017). Based on evidence from this and other research, the basic principles for implementing an effective footbathing system include:

- Monitoring cows' hind feet to assess levels of infection and adjusting the footbathing protocol accordingly: Determine the proportion of cows with active (i.e., M2 and M4.1 stages) and chronic (i.e., M4 stage) DD lesions. Roughly, the goal should be that less than 5% of cows have active lesions.

- Frequency of use: the number of times per week footbaths should be used depends on the farm's DD prevalence and hygiene. On an average Canadian farm with around 20% DD prevalence, four times per week* is acceptable. If prevalence is low (less than 5%) frequency can be reduced to two times per week. Increase frequency to five to seven times per week if DD prevalence is high or if there is an outbreak. Assess levels of infection after four to six weeks of use and adjust frequency. Ideally, footbaths should be used as little as possible. *Note: "times per week" refers to the number of times each cow should pass through the footbath, preferably at intervals spread over the week. The use of cleaning agents like soap/1% bleach/salt/water is acceptable (although there is not much evidence of effectiveness) but does not replace the frequency at which antibacterial chemicals should be used.
- Consistency: think of DD prevention in the same way that you think of mastitis prevention and teat dipping. At the chosen frequency, footbathing needs to be done regularly to be effective.
- Replacement of solution: approximately every 200 cow passes or after 24 hours if fewer than 200 cows have passed through the footbath or if the depth of the solution is insufficient to immerse the foot up to the coronary band.
- Product concentration: the preparation of solutions must accurately and consistently achieve the desired concentration every single time! Make sure you follow the product's label directions. Desired concentrations of common products are: formalin: 2% to 5%; zinc sulfate: 5% to 10%; peracetic acid: 1%; copper sulfate: 2% to 5% (5% concentration is most acceptable for copper sulfate, 2% can be used on farms with very low DD, and 10% can be used in the case of an outbreak of active lesions), acidified copper sulfate: 3%, maintaining a pH of approximately four.
- Footbath design: length: 10–12 ft (3-3.7 m) to ensure that rear feet are immersed at least twice; width: 20–24 in (50-60 cm) to minimize product required; step-in height: 10 in (25 cm) to retain more solution; fluid depth: 4–6 in (10-15cm) to cover the coronary band (Cook, 2017).
- Other tips: wash cows' feet with a medium-high pressure hose before they enter the footbath. This will remove caked-on dirt and manure and expose DD bacteria to air which reduces their survival. Try to run dry cows and heifers through the footbath; at minimum, run the close-up group through the footbath.

Cow Comfort

Over the past 15 years, a large and growing amount of evidence points toward the importance of designing facilities and adopting management

practices intended to improve cow comfort to decrease lameness prevalence. A lot of attention has been focused on how barn design and management influence lying and standing time, and consequently, hoof horn growth, wear, concussion and damage. There are many common factors affecting the prevalence of lameness and non-infectious hoof lesions including flooring type and slipperiness, the quantity and type of stall bedding, stall dimensions, housing type (i.e. deep bedded packs vs. freestalls) and access to pasture or an exercise area. From our research across three Canadian provinces involving 140 freestall farms, over 5,600 cows and several hours on each farm collecting data on dozens of factors hypothesized to affect lameness, we found very few important factors associated with lameness (Solano et al., 2015). Farms with low lameness prevalence provided more comfortable lying and walking surfaces by using sand or dried manure as the stall base, by having deep bedded stalls and by maintaining non-slippery floors. It doesn't mean that we can forget about the many other factors that play a role in cow comfort and lameness, but it means that we have good evidence to support changes made to the stall bedding depth and floor's traction. In addition, results from a follow-up study provided more evidence on the importance of stall and floor comfort. Farms that participated in the original study (Solano et al., 2015) and made changes to their facilities were compared with farms that had not participated in that study nor made any changes. The farms that made changes to their facilities had, on average 8-11% less lameness, 3-6% fewer body injuries and 1.9-2.4 more hours/day of lying time than the other farms (Morabito et al., 2017). And which specific changes did these farms make to their facilities? Well, 40% grooved the flooring in the crossover or feed alley, almost 50% increased bedding quantity and 87% changed bedding frequency or type.

More recently, we completed a project designed to identify housing and management factors that contribute to the development of hoof lesions on individual farms. The project was based on completion of a lameness risk assessment questionnaire (RAQ; Solano, 2018) by producers alongside their herd veterinarians, serving as a tool to identify risk factors for lameness and propose changes. Veterinarians were trained to conduct the RAQ in four-hour seminars describing effective management strategies for lameness control. The specific risk factors identified most frequently on participating farms were related to:

1) poor comfort of the lying surface (84% of farms had mattress, rubber, waterbed or concrete as the stall base and 65% of farms used less than two inches of bedding depth)
2) lax biosecurity (76% of farms do not require visitors to wear disinfected, disposable or farm-supplied boots or coveralls)

3) footbathing practices (on 90% of farms, dry cows or close-up cows do not walk through a footbath, 74% of farms had a footbath shorter than 10 ft, and 70% of farms do not rinse cows' feet before entering the footbath)

4) poor comfort of flooring with risk of trauma (on 70% of farms, cows stand on concrete in the holding pen and on 46% of farms, cows are required to make sharp turns as they travel to or from the milking parlor)

For a complete summary of risk factor frequencies by farm, see Solano, 2018.

The most frequently proposed changes by veterinarians were related to:

1) hoof trimming protocol (i.e., keep hoof lesion records, buy a trim chute, increase frequency and optimize timing of trimming)

2) footbathing practices and infectious lameness control (i.e., modify frequency, concentration and refill of footbath products, change footbath design and set up, increase scraping frequency)

3) management practices for pregnant heifers and dry cows (i.e., use more bedding, run dry (close-up) cows through footbath, reduce stocking density, examine and trim hooves)

Transition Period

"Treat the transition cow as a princess". I heard this expression from a Dutch mastitis expert and I think it applies as perfectly well to lameness as it does to mastitis. Transition is a key period for development of SU and WLD. Ensure cows enter the transition period with properly trimmed feet and experience a stress-free transition that minimizes standing and competition for resources. Focusing efforts in the transition period will make a difference in lameness, mastitis, and reproduction. Consider keeping all cows (heifers and especially older cows) on a straw pack for five to seven days post-calving.

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