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Rationale for a Dairy Herd Lameness Investigation Strategy

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Purpose

This investigation tool is to provide a framework for evaluation and directed mitigation of lameness on dairies. Its focus is on free-stall and open-lot dairies in the West. The following further describes the investigation strategy and lists sources of more detailed information. Other investigation tools have been developed. The present investigation tool offers a format for ease of data collection that groups risk factors by on-farm location and etiologic factors.

Other lameness investigation tools:

1. Guard, Charles. Investigating herds with lameness problems. http://nyschap.vet.cornell.edu/module/foothealth/section1/lame%20herd%20invest_guard.pdf
2. Cook, Nigel. A guide to investigating a herd lameness problem. http://www.vetmed.wisc.edu/dms/fapm/fapmtools/6lame/AguidetoinvestigatingaherdlamenessproblemAABP.pdf
3. Nordlund, K.V.; Cook, N.B.; Oetzel, G.R. 2004. Investigation strategies for laminitis problem herds. *Journal of Dairy Science.* 87:E27-E35.
4. New York State Cattle Health Assurance Program: Foot Health Module. http://nyschap.vet.cornell.edu/module/foothealth/section2/foothealth2.asp

Introduction

Lameness is important to the producer and the cow

Lameness is an important disease to the dairy industry that results in economic losses by decreasing milk production (Juarez 2003; Hernandez 2005), increasing culling (Booth 2004; Sprecher 1997), decreasing reproductive efficiency (Sprecher, 1997; Hernandez, 2001), and decreasing technical efficiency (Barnes, 2011). Further, lameness is a sign of pain (O'Callaghan 2003; Whay 1997) that results in changes in cow behavior (Galindo and Broom, 2002) and is therefore a significant threat to the well-being of dairy cows. Cross-sectional observational and experimental research has shown that the cause of lameness is multi-factorial and varies between farms. Therefore, mitigation of this disease on a particular farm requires (1) investigation of many possible contributing factors to identify those of importance and (2) a concerted effort from management and service providers (veterinarian, hoof trimmer, nutritionist) to develop solutions.

All the common causes of lameness are affected by the cow's environment

There are many hoof or leg diseases that result in lameness that can generally be divided into infectious (most commonly hairy heel wart) and non-infectious, which includes claw horn lesions (e.g. sole ulcer) and leg trauma. All of these diseases have an underlying cause, or etiology. There are many aspects of the cows' environment that determine whether or not these causal factors result in lameness. The most common causes of lameness are lessened in incidence, severity, and duration by maximizing the cow's time spent lying down, conversely decreasing the time she spends standing, and keeping the surfaces she stands on maximally clean and dry (and soft, if possible) (Cook and Nordlund 2009).

Hairy Heel wart (papillomatous digital dermatitis), heel erosion, and foot rot are common lesions with infectious etiology. These infections of the hoof require not only the presence of the pathogen but some degree of debilitation to the skin around the hoof that occurs from constant exposure to wet and soiled environment which also creates anaerobic conditions (Berry, 2004). Therefore, flooring in pens and holding areas should be managed to minimize moisture and manure accumulation. Additionally, time spent lying down in stalls should be maximized because it likely allows the hooves to dry and reduces the time exposed to manure.

Claw horn lesions such as sole hemorrhage, ulcers, white line abscess, and white line disease are due to damage to the corium which may be caused by hormonal changes around calving, decreased thickness of the digital fat cushion (Bicalho, 2011) and/or subacute ruminal acidosis (SARA) which can cause non-infectious inflammation of the corium. All of these etiologies are exacerbated by increased standing time and hardness of the standing surface (Cook and Nordlund, 2009). Many of these factors are not changeable within freestall housed dairy production (calving, concrete surfaces) but minimizing physical compaction of the hoof by decreasing standing time and softening standing surfaces if possible appears to have profound effects on preventing damage to the hoof.

Therefore, the most common etiologies of infectious and non-infectious hoof pathologies are influenced by factors in the cow's environment that influence her time standing and the surface upon which she stands. Recent literature reviewing lameness has suggested that the cow's environment strongly influences both the development of and recovery from lameness (Cook & Nordlund, 2009). Many aspects of the cow's environment influences the time she spends standing and conversely, lying down. These environmental influences should receive special attention in any lameness investigation because of the broad influence on many causes of lameness.

Resources:

1. Cook, N.B. and Nordlund, K.V. The influence of the environment on dairy cow behavior, claw health, and herd lameness dynamics. *The Veterinary Journal.* 2009. 179: 360-369.
2. Cook, N.B.; Nordlund, K.V.; Oetzel, G.R. 2004. Environmental influences on claw horn lesions associated with laminitis and subacute ruminal acidosis in dairy cows. *Journal of Dairy Science.* 87:E36-E46.
3. Bicalho, R.C. 2011. New insights into the pathogenesis of claw horn disruption lesions. *Proceedings of the Cornell Nutrition Conference. http://ansci.cornell.edu/cnconf/2011proceedings/19.Bicalho.pdf*

Defining a lameness problem: Locomotion Scoring & Hoof lesion identification

Locomotion scoring is a method to quantify lameness

Locomotion scoring is a method for detecting and quantifying lameness that has been tested for inter- and intra-observer agreement (Winckler and Willen, 2001) and validated by correlation with hoof pathologies (Bicalho, 2007). A commonly used scoring system is a five point scale (Table 1). Those cows with scores of 3 or higher are considered lame. Locomotion scoring can be used to determine lameness prevalence on a herd and/or pen level. It may be useful for the identification of contributing factors if individual or pen level locomotion score is known. For example, if a particular pen or breed is affected, investigation could center on risk factors unique to that group.

Table 1. Locomotion scoring system based on Sprecher, 1997.

Score	Gait Description
1	Cow stands and walks with a level-back posture. Gait is normal.
2	Cow stands with level-back posture but develops an arched-back posture while walking. Her gait remains normal.
3	An arched-back posture is evident while standing and walking. Gait is affected and described as short-striding one + limbs.
4	An arched-back posture is always evident and gait is best described as one deliberate step at a time. The cow favors one or more limbs/feet.
5	The cow additionally demonstrates an inability or extreme reluctance to bear weight on one or more of her limbs/feet.

Strategic herd sampling can be utilized to save time

WSU researchers tested sampling strategies on five farms and determined a few methods that can be used to sample cows for locomotion scoring that accurately (within 95% confidence) estimate herd lameness prevalence.

1. *Score all the cows* – This can be done as cows exit the milking parlor or by releasing cows individually from the lock-up if the pens are small enough. This is time consuming in a large herd. However, scoring all the cows allows for identification of severely lame cows that need treatment. Additionally, it allows for epidemiologic analysis of lameness for the individual farm, which may be useful in determining problem areas and/or etiology.
2. *Score the middle third of the pen as they exit the milking parlor*. This strategy is based on work by Main, et al 2010 and was validated by WSU researchers (Hoffman, 2011). The advantage of this strategy is that it can determine pen level prevalence. The disadvantage is that it depends on milking parlor times, and requires the observer to be present for the milking of the entire herd if all pens are to be locomotion scored.
3. *Calculated sample size of cows, distributed throughout the herd*: This strategy is the one employed by the national Dairy F.A.R.M. (Farmers Assuring Responsible Management) program. A calculated sample of cows is weighted across pens and distributed evenly within each pen (Appendix 1). The advantage of this strategy is that it does not rely on the milking parlor times. In some cases, it may be difficult to observe cows walking freely in pens while keeping track of which cows have been scored already. This strategy has been easily implemented while the herd is locked up for regularly scheduled herd checks, but requires an assistant releasing individual cows from the head-lock as needed to allow for locomotion scoring. The disadvantage of this strategy is that it does not accurately estimate pen-level prevalence, only herd-level prevalence.

How much is too much lameness?

Multiple benchmarks for herd lameness prevalence have been suggested. The Dairy F.A.R.M. program states that <10% of cows should have a locomotion score ≥ 3 on the 5 point scale (National Milk Producers Federation, 2010). Previous studies in the United States estimate lameness prevalence near 20% (Cook 2003, Espejo 2006).Temple Grandin recently stated that less than 5% of dairy cows should be lame (Dairy Herd Network, 2011).

Hoof lesion identification helps focus on possible causes

Lameness is a symptom. Identifying the hoof pathology that is causing a lameness problem allows one to focus on the risk factors that are part of the etiology of that disease. However, since lameness is a multifactorial problem many of these risk factors overlap. Lesion identification is a part of this investigation tool because it helps focus the investigation of risk factors. The most convenient way to identify hoof lesions is typically by spending time with the hoof trimmer at their regular visit. Trimming technique and maintenance trimming schedule can be assessed at the same time, allowing one to rule out the possibility of lameness caused by overzealous or unbalanced trimming.

Investigate the farm to identify lameness risk areas

I. The trimming table: hoof trimming and lame cow management

Rule out: Lameness caused by infrequent preventive hoof care

Two trims per year reduced claw horn lesions and lameness when compared to one time per year trimming (Manske, 2002) and is recommended. However, judgment should be used on individual farms to evaluate hoof length, thickness, and balance at time of preventive trimming to estimate if trim frequency is adequate, as faster hoof wear may occur in some situations in which twice per year trimming could be excessive. The questions and calculations in this investigation tool confirm two times per year preventative trimming.

Rule out: Inadequate identification & treatment of lame cows

If lame cows are not identified for treatment, the prevalence of lameness increases because the duration of disease increases. Consistent, thorough identification of lame cows requires personnel that have the time and skill and an easily-implemented protocol for pulling and recording cows for treatment. Additionally, the hoof trimmer or employee responsible for treatment and records should accurately identify hoof lesions. Accurate hoof lesion records would be helpful for monitoring response to management changes as well as aid in future lameness investigation or follow up. Additionally, identification of common lesions is important in selection of appropriate treatment.

Rule out: Lameness caused by overzealous or unbalanced trimming

The recommendations in this investigation tool are based on the Dutch method of hoof trimming (Toussaint-Raven, 1985). Even if the trimmer uses a different method, these measurements should be useful to ensure that excess claw horn isn't being removed which could directly damage the hoof or increase its susceptibility to trauma.

Resources

1. Toussaint Raven, E. 1985. *Cattle Footcare and Claw Trimming.* Diamond Farm Book Publications, 1 edition.
2. Roenfelt, Shirley. How to judge a hoof trim. *Dairy Herd Management.* December 2000.
3. Van Amstel, S.R., Shearer, J.K., Haines, D.K. 2000. Maintenance Claw Trimming in Cattle with Special Emphasis on the Dutch Method. *Proceedings of the American Association of Bovine Practitioners.*

II. Milking Parlor exit alley: footbath and hygiene assessment

Rule out: Inadequate foot bath design, frequency, or concentration

There are few peer-reviewed controlled clinical trials on the use of footbaths to treat and control digital dermatitis in dairy cattle (Laven and Logue, 2006). Evidence for footbath use has been summarized and reviewed (Berry, 2004; Laven and Logue, 2006) Recommendations for footbath chemicals and concentrations consistent with clinical experience and clinical reports have been suggested by Cook (1).

Footbath dimensions: Recent work by Nigel Cook found that: *"From a behavioral study trial, the probability of rear feet receiving at least two immersions as a cow walks through the bath increases from 53 percent at 6 feet (1.8 m), to 84 percent at 8 feet, (2.4 m) to 96 percent at 10 feet (3.0 m)."* (2) He also found that use of a pre-bath did not reduce defecation in the treatment bath, and may dilute the treatment chemical.

Footbath frequency: To the authors' knowledge, there are no trials comparing frequencies of footbath use for the treatment or control of hoof lesions. Cook suggests basing frequency of footbathing on leg hygiene scoring (1). If infectious lesions such as digital dermatitis (hairy heel wart) and interdigital dermatitis are present in a particular herd, some method of control (footbathing and/or spraying with disinfectant or antibiotic) should be in place.

In summary, footbaths should be long enough (10 feet), filled to about 5 inches, have adequate concentration of chemical to be active as a disinfectant and appropriate dimensions to ensure the hooves and skin around the hooves contact the chemical.

Resources:

1. University of Wisconsin School of Veterinary Medicine. *Clinical Information and Forms – Lameness.* http://www.vetmed.wisc.edu/dms/fapm/fapmtools/lameness.htm
2. Cook, N.B. Footbaths of the Future. *Hoards Dairyman.* http://hoards.com/E_animalhealth/ah20
3. Berry, S.L.; Walker, R.L.; Read, D.H.; Hird, D.W.; Ertze, R.A. 2004. The current state of knowledge on (papillomatous) digital dermatitis in dairy cattle: with particular reference to control. *Proceedings of the 13th International Symposium and 5th Conference on Lameness in Ruminants.*
4. Laven, R.A., Logue, D.N. 2006.Treatment strategies for digital dermatitis for the UK. *The Veterinary Journal I 171:79-88.*

Rule out: Excess exposure of hooves to manure/moisture during milking parlor wait time

Prolonged exposure to moisture debilitates the skin and creates anaerobic conditions around the hoof. Exposure to manure may increase exposure to infectious organisms. This exposure would include standing in accumulated manure and water while in the milking holding pen or walking through an empty footbath in the exit alley that has accumulated manure.

III. Milking and dry cow pens: environmental assessment

Rule out: Increased standing time/ decreased lying time due to:

1. Stall dimensions too small or restrictive will decrease lying time (Tucker, et al., 2004)
2. Inadequate bedding decreases lying time (Tucker et al., 2003)
3. Wet bedding decreases lying time (Fregonesi et al., 2007)
4. Increased stocking density reduces lying time (Fregonesi et al., 2007)
5. Inadequate ventilation/cooling
6. Not enough time for the cow to spend lying down (time budget) due to long milking times

Rule out: Lameness due to traumatic injury

1. Trauma in walking areas (wounds, falls, rough walking surfaces)

2. Trauma from stall design – *hock lesions may be an important sign of this!*
    a. Stall length too short
    b. Rear curb too high
    c. Inadequate bedding

Rule out: Excessive exposure of hooves to manure/moisture in the pens

Again, prolonged exposure to moisture debilitates the skin and creates anaerobic conditions around the hoof and exposure to manure may increase exposure to infectious organisms (Berry, 2004). To minimize this exposure, manure or water should not accumulate in the barn alleyways where the cows are standing. There is not a suggested benchmark for upper limit of manure accumulation, so judgment must be used to determine acceptability of manure removal protocols.

Resources:

1. Nordlund, K.V.; Cook, N.B. 2003. Flowchart for evaluating dairy cow freestalls. *Bovine Practitioner.* 37: 89-96. http://www.ohiodairyvets.org/wp-content/uploads/2007/09/2a-a-flowchart-for-evaluating-dairy-cow-freestalls.pdf
2. Weary, D.M., F.C. Flower and M.A.G. von Keyserlingk. 2008. Lameness in dairy cattle – new research on gait and housing. In: Proceedings of the American Association of Bovine Practitioners Annual Meeting, Charlotte, SC, pp.
3. Weary, D.M. and M.A.G. von Keyserlingk. 2008. Building better barns: Designing the free stall from the cow's perspective. Proceedings of the Intermountain Nutrition Conference, pp. http://www.advs.usu.edu/files/uploads/INC%20Proceedings%202008.pdf
4. Cook N.B. (2003). Troubleshooting and evaluating cow comfort on dairy operations. 2003. *Proceedings of the OABA/OABP Spring Seminar.* April 10, 2003: 81-88. http://www.vetmed.wisc.edu/dms/fapm/publicats/proceeds/TroubleshootingcowcomfortandfreestallsPDF

IV. Feeding systems: assess possibility of metabolic causes of lameness

While not the only a contributor to claw-horn lesions, subacute ruminal acidosis (SARA) has been associated with laminitis (Nordlund, 2004), and should be ruled out in cases where the environment is found to be satisfactory and SARA is suspected. Rumen acidosis is a herd level syndrome that may include milk fat:protein inversion, diarrhea, and poor milk production in addition to laminitis, but none of these signs are specific to SARA (Nordlund, 2004). If SARA is suspected as a cause of lameness, the ration should be evaluated to rule out:

1. Inadequate ruminal buffering caused by inadequate physical fiber
    a. Small particle size leading to inadequate physical fiber
    b. Large particle size leading to cows sorting the ration
2. Inadequate ruminal buffering caused by inadequate dietary fiber
    a. Fiber content of ration
3. Excessive intake of rapidly fermentable carbohydrates
    a. High levels of carbohydrates in ration
    b. Bunk space inadequate leading to slug feeding in subordinate cows

Resources

1. Krause and Oetzel. 2006. Understanding and preventing subacute ruminal acidosis in dairy herds: a review. *Animal Feed Science and Technology.* 126: 215-236.
2. Cook, N.B.; Nordlund, K.V.; Oetzel, G.R. 2004. Environmental influences on claw horn lesions associated with laminitis and subacute ruminal acidosis in dairy cows. *Journal of Dairy Science.* 87:E36-E46.
3. Nordlund, K.V.; Cook, N.B.; Oetzel, G.R. 2004. Investigation strategies for laminitis problem herds. *Journal of Dairy Science.* 87:E27-E35.
4. Nordlund, K.V. 2003. Factors that contribute to subacute ruminal acidosis. *American Association of Bovine Practitioners Pre-Conference Seminar.* http://svmweb.vetmed.wisc.edu/dms/fapm/fapmtools/2nutr/sarafacters.pdf

V. Other

If the previous factors are judged to have minimal contribution to a lameness issue, other considerations should include genetics, trace minerals, and biosecurity measures.

- Lameness has a genetic component as well as an association with conformation traits and larger size (Boettcher, 1998).
- Vitamins and minerals are important to hoof health; their roles have been reviewed by Tomlinson and others (2004).
- Biosecurity may be a significant risk factor for infectious causes of lameness, so introduction of new animals to the herd including heifer rearing should be investigated.

Conclusion: Herd lameness Assessment and Plan

The assessment: Identification of risk factors should be followed by inference of cause

In collaboration with producer, hoof trimmer, nutritionist:

1. Discuss identified problem areas,
2. Determine out why they are a problem: Understanding of the farm management, facilities, and operating procedures should be used to extrapolate the source of risk factors. For example, excessive manure accumulation in the close-up dry cow pen caused by infrequent scraping of manure caused by… etc.
3. Come up with ideas for plausible solutions
4. Develop a plan to accomplish these solutions

The plan: coordinated effort is needed to create implementable solutions

The plan should include assessment of possible solutions to determine if they are implementable on that farm, have reasonable expectation of efficacy, and are cost effective. Because lameness is multifactorial, it is likely that mitigation of risk factors identified will fall into the responsibilities of not only management but employees and service providers as well. Therefore, identification of goals and clear communication between everyone involved is important. A clear plan with designated personnel to accomplish the intervention should be provided along with a mechanism to monitor for progress.

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Dairy Herd Network. “Grandin: “Gotta get lameness fixed.” Updated Feb 22, 2011. URL: http://www.dairyherd.com/dairy-news/latest/Temple-Grandin-discusses-improvements-on-dairy-farms.html

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