Lameness in dairy cows – part one

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Lameness is a 'disease' that decreases overall profitability of a dairy operation. Effects of lameness can be subtle with many degrees of severity. Invariably, lameness is associated with pain, depressed dry matter intake, loss of body condition, decreased milk production and increased reproductive failure and mastitis, often leading to expensive treatment or even culling. It is estimated that each case of lameness costs the dairy producer approximately $403 and that 15% of cows culled for slaughter are culled due to lameness.

Lameness is a multifaceted disease resulting from an array of factors inherent to dairy operations. Factors affecting lameness and locomotion include nutrition, feeding strategies, wet environment, abrasive or slippery floor surfaces, stall comfort and design and health events causing production of poor quality horn (fever, age, off-feed, metabolic disturbances, toxins/mycotoxins). Identification and management of problem areas in an individual herd can be challenging. This article will focus on those areas most often found as herd-level problems; lameness identification, housing, management and nutrition.

Evaluating cow mobility

Early detection of lameness is essential to minimising the severity and potential long term implications of lameness. Researchers at Michigan State University developed a five point system to evaluate herd lameness. This system is an excellent tool for the early diagnosis of lameness as the degree of lameness varies from virtually unrecognisable impairment in movement to complete debilitation.

With this system, the cow's gait ('locomotion') is assessed with emphasis placed on back posture. A visual assessment ranks cows from one (normal) to five (very lame). A locomotion score of two or three indicates 'hidden or sub-clinical' lameness while identification of these animals allows for early intervention and remedy before it becomes more severe and costly. Hidden lameness may be a very real problem in the dairy. Researchers in Europe, Michigan and Minnesota have all found that lameness is markedly higher than the level perceived by dairy producers (Fig. 1).

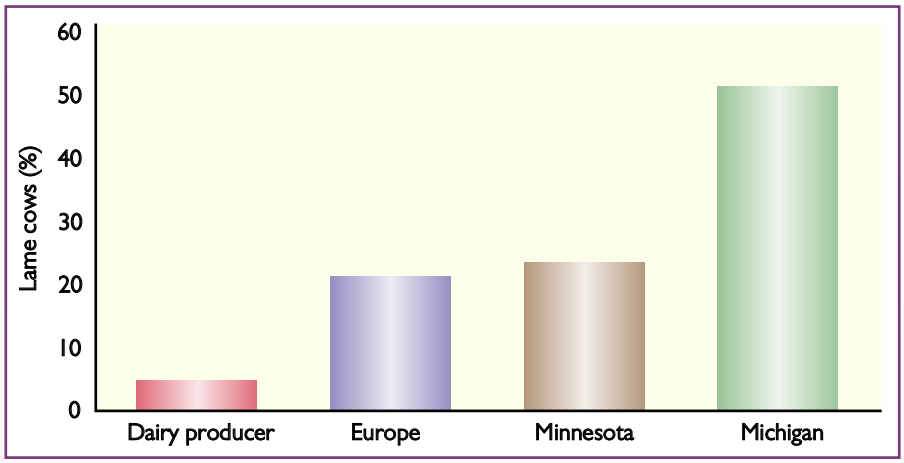

Fig. 1. Perception of lameness prevalence in dairies. (H. Whay et al, 2002. M. Kopcha et al, 2003. L. Espejo et al, 2006).

Workers at the University of California, found that, compared to cows scoring one, cows scoring a two or higher had a 2-15% reduction in milk yield (Table 1).

Locomotion score	2	3	4	5
Milk loss (%)	2	4	9	15

Table 1. Effect of locomotion score on % milk loss (P. Robinson, 2001).

In addition to decreased milk loss, cows scoring a three or greater had decreased reproductive performance. Michigan State University researchers found that, compared to cows scoring a one or two, cows scoring a three or greater were 2.8 times more likely to have increased days to first service, 15.6 times more likely to have increased days open and 9.0 times more likely to have increased services per conception (Table 2).

Lastly, these cows were 8.4 times more likely to be culled.

Although a survey of 13 Dutch dairy herds indicated that there is no relationship between reproduction and lameness, a growing database contradicts these findings. Researchers have found that cows that are lame are open between 11 and 28 days longer than cows that are not lame.

Furthermore, the type of claw disorder may affect the impact of lameness on fertility. Cows with abscesses/sole ulcers or cows with two or more claw disorders had more days open ($P < 0.05$) than cows without claw disorders (Table 3). Cows with abscesses/sole ulcers were open 63 days longer than healthy cows, while cows with two or more claw disorders were open 76 days longer. Furthermore, a lower percentage of cows with abscesses/sole ulcers were pregnant at the end of lactation than healthy cows (Table 3).

The increase in days open can be partially

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Table 2. Impact of locomotion score on reproduction and culling: risk of decreased fertility for cows scoring greater than two (Sprecher et al, 1997).

Reproductive parameter	Predictive risk of happening
Increased days to first service	2.8 x more likely
Increased days open	15.6 x more likely
Increased services/conception	9.0 x more likely
Culled (exit herd)	8.4 x more likely

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attributed to decreased pregnancy rates. In Australia, a survey representing 29,411 cows in 168 herds indicated that pregnancy rates were decreased in cows clinically and subclinically lame, in cows lame before the voluntary waiting period and in cows lame the first six weeks after the voluntary waiting period (Table 4).

Lameness may also impact fertility by lowering the first service conception rates and increasing incidence of ovarian cysts as indicated by results of a University of Florida study. Cows that were clinically lame due to a claw disorder in the first 30 days postpartum had a 58.9% drop in first service conception rates (P< 0.05), a 125% increase in ovarian cysts and a 8.2% decrease in pregnancy rate at 480 days postpartum (Table 5). Probably the most troublesome observation was that 30.8% of cows that were lame during the first 30 days of lactation were culled prior to recording any reproductive event as compared to 5.4% of non-lame (control) cows.

Variable	Healthy, no claw disorders	Digital dermatitis	Abscess/ sole ulcer	Foot rot	Two or more claw disorders
No. of cows	464	23	39	4	18
Days to first service	70	70	71	71	77
Days open	92^{y}	120^{yz}	155^{z}	106^{yz}	168^{z}
Pregnant at end of lactation (%)	97^{y}	96^{yz}	90^{z}	100^{yz}	94^{yz}

^{yz} *Within row, means differ (P < 0.05)*

Table 3. Effect of claw lesion on reproductive performance of dairy cattle (Hernandez et al, 2000).

Results of these studies indicate that the more severe the lameness, the greater the economic loss. Early diagnosis of lameness and intervention is essential for minimising the severity of lameness. Robinson (2001) reported that cows with a score of three were four times more likely to score a four or five than a two in 30 days, if no intervention and/or corrective measures were taken. Research by Hernandez et al (2006) showed that incidence of lameness was decreased by 24% when cows were routinely trimmed and/or evaluated for claw lesions versus cows only receiving treatment when clinically lame thus showing the value of inspecting claws for abnormalities and lesions on a more frequent basis.

Housing and management

Flooring surfaces, length of time standing, stall comfort and exercise all impact locomotion and development of lameness. It is important that surfaces cows walk on are finished so as to provide maximum traction with minimum chances for foot or claw injury. Holmes (1994) at the University of Wisconsin, recommended that new and older worn concrete be grooved to improve traction and decrease the potential for slips and falls. McDaniel and Wilk (1989) reported that smooth floors decrease claw wear and lead to slipping with resultant injuries, especially in early lactation.

Soft surfaces, such as bedded packs or dry fluffy manure decrease claw wear below desirable rates. Barry and co-workers evaluated rubber belting as a means of reducing claw wear and development of lesions.

They found that rubber belting installed in the holding area, walk lanes and behind headlocks decreased rate of claw growth and significantly decreased claw wear.

These authors have observed situations where cows housed in barns with rubber flooring show similar claw conformation and wear patterns to those on pasture conditions (concave sole, greater sole depth and steeper claw angle).

Wet and sloppy surfaces have many effects. Smit et al (1986) reported claws in wet conditions become softer and more prone to lameness induced by penetration of foreign objects such as gravel. The impact of moisture on claw wear is well docu-

Item	Pregnancy rate (%) Lame before voluntary waiting period	Pregnancy rate (%) Lame first six weeks after voluntary waiting period
Not lame	33	34
Subclinically lame	29	23
Clinically lame	25	28

Pregnancy rate = submission rate x conception rate.

Table 4. Effect of lameness on pregnancy rate (Morton, 1999).

mented, particularly on abrasive surfaces. Horn of claws with thin soles had higher moisture content than claws with normal sole thickness (front claws, 37 vs. 31% moisture; rear claws, 40 vs. 33% moisture).

In research on the locomotion of dairy cows on dry, wet or slurry covered concrete, Phillips and Morris reported that dairy cows significantly alter their walking rate, step length and are at greater risk of slipping on wet and slurry covered floors. They also indicated that cows altered their step angle in a manner that could cause abnormal wear and increase the incidence of shearing forces on the white line area of the claw.

Flooring surface and stall comfort may be especially important in maintaining claw integrity and preventing lameness in dairy cattle during the periparturient period.

Connective tissues suspending the pedal bone in the claw capsule collected from cows nearing parturition have more elasticity than similar tissues collected during other stages of lactation. Increased elasticity allows greater movement of the pedal bone in the claw capsule, increasing compression of corium, resulting in increased sole and white line haemorrhages and ultimately, white line and sole ulcers. Researchers theorised that the increased elasticity of connective tissue suspending the pedal bone is due to the hormone, relaxin, which softens connective tissue allowing expulsion of the calf. Thus increased standing times during the periparturient due to uncomfortable resting areas will increase the risk of cows developing claw lesions. Webster (2001) reported increases in solar haemorrhages in primiparous heifers when housed in concrete free stalls during the periparturient period versus those housed in a straw yard, indicating that minimising external stresses to the foot during the critical periparturient period, decreases lameness.

Cook and co-workers (2003) suggested that development of claw lesions in early to mid lactation may be the result of hormonal, metabolic and mechanical forces. Normal physiological changes which occur during the periparturient period along with increased exposure to concrete and non-forgiving floor surfaces may predispose cows to the development of claw lesions.

Providing a clean, comfortable place to lie is essential to maintaining claw health. Excess standing due to uncomfortable resting areas or improperly sized milking facilities has been reported to increase incidence of lameness.

Demonstrating the need for comfortable stalls, especially in early lactation, Canadian workers reported a negative correlation between lying time in the first two weeks of lactation and incidence of sole haemorrhage in week 9 and 13 of lactation. Cows that spent only 7.3 ±2.1 hours per 24 hour period lying in sand-bedded freestalls had more severe sole haemorrhages by 13 week of lactation than cows lying 10.2 ±2.2 hours per 24 hour period. There were even higher correlations between lying times and sole haemorrhage between week one post calving and sole haemorrhages by week nine of lactation. This further emphasises the need for keen focus on cow comfort in the critical period of transition and early lactation.

Weary and Taszkun (2000) and Cook (2003) showed that sand-bedded stalls provided a significantly more comfortable lying surface than sawdust or geotextile mattresses. Gebremedhin et al (1981) reported similar findings when cows were given a smorgasbord of freestall bedding materials.

They indicated that cows preferred sand

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over limestone, rubber tyres, earthen filled, concrete with rubber mats or concrete. In addition, sand, while cleaner, cooler and more hygienic, appeared to also provide improved footing on slurry covered concrete, thus decreasing the potential for slipping and injuries resulting in lame cows.

Recent research on 50 high production Holstein herds in Minnesota found the prevalence of lameness was lower in sand-bedded freestalls (17.1%) than in freestall herds with mattress stall surfaces (27.9%).

Cows and heifers are often exposed to new housing facilities prior to or immediately after parturition. In primiparous cows, these changes (flooring surfaces and lying areas) are often a significant change from their rearing environment and thus the less experienced animals are more susceptible to laminitic insults and lameness than are multiparous cows.

Vermunt and Greenough (1996) observed sole haemorrhages in Holstein heifers several months before calving. Lesions were more severe in housed animals (freestalls) than in those raised on a dry lot (straw yard). Logue et al (2000) scored sole lesions in heifers for several months before calving.

Their report indicated a peak in white-line lesions two months after calving, with a peak in sole haemorrhages four months after calving suggesting environment had a cumulative effect on claw integrity.

Minnesota workers reported the prevalence of lameness in first lactation animals was 12.8% and prevalence increased on average at a rate of 8% units per lactation.

Bergsten and Frank (1996) evaluated claw lesion development in early lactating primiparous cows tied on concrete floors or rubber mats and challenged with high or no concentrate diets. No differences were observed in claw lesion development between the groups.

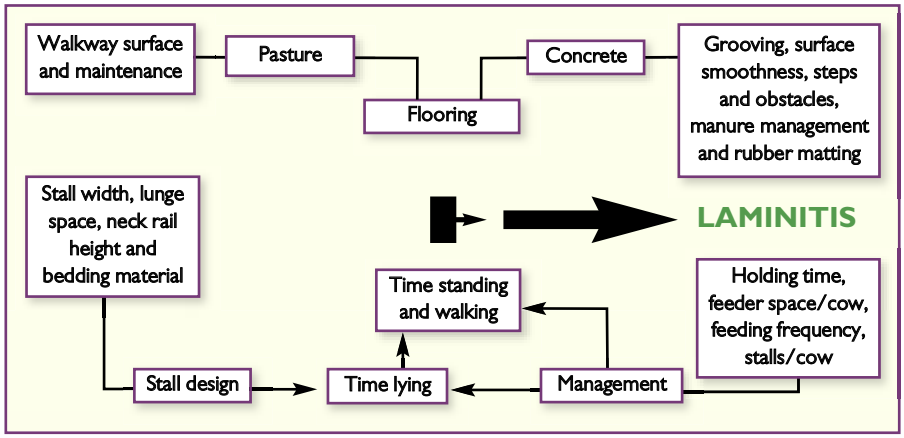

Fig. 2. Environmental and management factors that may affect time cows spend standing or walking or the quality of the surface they stand on. Flooring and time spent standing or walking may interact to result in lameness (adapted from Bell and Weary 2000).

However, these same heifers were grazed during the summer then re-grouped and housed on concrete floors or rubber mats in the fall. They were also allocated to a high or low concentrate diet.

Time of claw trimming	Concrete floors	Rubber mats
2 weeks prepartum	1	1
13 weeks postpartum	9[w]	4[x]
Net change in scores	8[y]	3[z]

[wx]Median scores lacking a common superscript letter differ, P<0.01.
[yz]Median scores lacking a common superscript letter differ, P < 0.05.

Table 6. Median sole haemorrhage scores based on sum of scores for all digits in tied heifers on concrete stalls or rubber mats before and after first calving (Modified from Bergsten and Frank, 1996b).

All claws were observed at trimming two weeks before and again 14 weeks post calving. Animals housed on concrete floors had significantly higher incidence of solar haemorrhages than those on rubber mats (Table 6).

Webster (2001) reported similar findings in animals housed in free stalls with concrete floors versus animals housed in straw bedded yards, independent of diets. They reported increased incidence of lesions about eight weeks after calving, suggesting that claw lesions result from extended exposure to hard, unforgiving walking surfaces during the periparturient period. Observations on 3,221 lactating cows housed in freestalls with grooved concrete walking surfaces showed a significant reduction in lameness in first calf heifers from 66.9-32.6% following the installation of rubber walking surfaces. The frequency of thin soles in first lactation animals was also decreased from 21.8-4% following rubber installation.

These findings emphasise the importance of low abrasion and forgiving walking surfaces on claw wear and development of lameness. Management and housing systems are interrelated with respect to maintaining claw integrity and locomotion (Fig. 2).

In order to minimise lameness, dairy managers must be sensitive to all areas of cow comfort to minimise the incidence of lameness causing factors. ■

Table 5. Effect of lameness during the first 30 days of lactation on reproduction (Melendez et al, 2002).

Item	Lame cows	Control
Days to first service	99	94
First service conception rate (%)	17.5[y]	42.6[yz]
Ovarian cysts (%)	25.0[y]	11.1[z]
Pregnant at 480 days postpartum (%)	85.0[y]	92.6[z]
Culled before any reproductive event (%)	30.8[y]	5.4[z]

Fertility of 190 cows was evaluated (cows bred under timed insemination were not included in evaluation). 65 cows showed claw lameness within 30 days postpartum. These cows were compared with 130 cows that did not exhibit lameness during the first 150 days of lactation. [yz] Within row, means differ, P < 0.05.

References are available upon request