Efficient hoof management
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It’s a well known fact that if an animal is unwell or sore, she will not only reduce her food intake, production level and milk quality in order to deal with pain or infection, but she will display certain behavioural and physiological characteristics that will also make her appear ill. Animals can’t tell us how they feel or if they are unwell, but they do give us plenty of signs or signals we can use to assess if all is well. Healthy hooves are an essential aspect of your dairy cow’s daily requirements and are absolutely essential for their comfort and high productivity. Dairy cows are expected to give high yields of milk. In order to synthesise milk, eating, drinking and rumination (particularly when lying down) are the most important things they need to be able to do. A cow must therefore be able to comfortably access feed and water, and to lie down and stand up again – all very difficult with sore or damaged feet.

Cows’ hooves can’t remain healthy by themselves; every livestock manager has to dedicate some time towards promoting healthy hooves. A good manager includes this in his/her daily schedule, striving to prevent problems rather than continually treating lame cows.

Increasing costs and reducing profit margins inevitably put pressure on the dairy industry. One response is to increase herd size, but this can place pressure upon the existing facilities and cows, a common outcome being an increased incidence of lameness.

This booklet aims to highlight the importance and cost of lameness and the multi-faceted nature of the problem. We will address the effects of efficient and preventative management, diagnosis of arising problems, assessment of animal health, and the consequences if lameness occurs. We would like to provide you with a solid understanding of the anatomy of the hoof, the significance of weight bearing surfaces and the effect on cow behaviour, production and manifestation of lameness. We will also focus on the value of a good environment, quality feed and the importance of using observation tools to help you get the best out of your cows.

We hope we can offer practical advice on preventative methods and perhaps give you insight into some aspects of this problem you may have been unaware of, or unsure about, in the past.
II. Incidence of lameness – where are we today?

The incidence of lameness worldwide has risen over the years to approximately 25 percent of all dairy cows being treated every year, and around 15 percent of cows being culled for lameness-related problems. With almost 128 million dairy cows in the world (United States Department of Agriculture, 2008), that’s a staggering number of sick or problematic animals – which is only set to rise as we demand increasingly more from our production systems.

A common problem in recording the incidence of lameness is that many farmers do not “see” or recognise the level of lameness they have on their farm until they are informed of it. A producer who sees the same cows with the same problems every day may become desensitised or immune to them, and perhaps think that they are normal. Usually, however, the problem is realised after a new product or management regime is implemented, or a study trial started, and attention is focused on that particular area. This is then often wrongly perceived as the source of the problem as the incidence of lameness on the farm was not acknowledged beforehand.

A trial conducted in Kansas City, US in 2005 looked at many different aspects of management on 68 farms, in order to document what constitutes good and bad hoof management practices. Cows were scored for locomotion and hoof health, and the producers were asked several questions. The trial produced many interesting results, but one of the most striking was that on average the farms had 28 percent lameness whereas the owners had estimated only six percent – pretty shocking!

The clear message is to monitor your cows constantly, especially if you plan to introduce a new product or if your animals participate in a study. You should always be aware of the health status on your farm, but it is doubly important to record this before changing anything in your routine so that you can accurately assess if things improve or worsen. (See “Lameness detection and diagnosis” for surveys and other tools you can use).

Lameness, especially infectious lameness, most commonly occurs on the hind feet, with approximately 80 percent of cases being diagnosed here. Cows often stand with their front feet in the cubicles and their back feet in slurry, predisposing them to increased infection and disease transmission. Most traumatic lameness occurs on the outer or lateral claw of cows, due to weight bearing. If a problem occurs on the front feet it is most often the inner or medial claw of a heifer that is affected, for the same reason. We will explore the reasons why in the “Lameness causes and prevention” section.
Lameness is recognized as a problem worldwide, and is considered one of the most important welfare issues in the dairy industry today. Third only to mastitis and fertility, lameness is a major disease cost in dairy production. When the cost per case is calculated and extrapolated, the figures are quite disturbing.

Source: Dienst Landbouwkundig Onderzoek Instituut voor Milieu – en Agritechniek J. Stefanowska M.C.J. Smits C.R. Bramm 98-00 The Veterinary Record (Papers and Articles) Faull, Hughes, Clarkson, Downham, Manson, Merritt, Murray, Russell, Sutherest Ward.

Reports vary widely, but generally the cost per case of lameness in Europe is currently considered to average EUR 250, depending on the problem or cause. In the US, it’s considered to be around USD 345. Considering that around 25 percent of your animals could be affected and that cases can easily recur, it makes sense – and is particularly important – that susceptible cows (such as sick cows, heifers, freshly calved or dry cows) are well managed to prevent this.

A lame cow is more susceptible to contracting other diseases such as mastitis, is likely to produce less milk, to be less fertile and a serious burden on your pocket! When considering the costs of lameness, we should therefore take into account three main components: indirect costs such as economic losses from reduced productivity and fertility; more direct costs such as treatment costs, veterinary time, labour and extra husbandry requirements; and also the more difficult ones to measure, such as the welfare costs of a suffering cow in addition to the potential stress or inconvenience for the producer.

Lameness costs may also depend on the type of dairy system used. For instance, those on a grass-based system experience different types and causes of lameness than those in an
intensive free-stall or loose-housed system. These entail differing costs and different levels of prevention or treatment. Later, we will explore how the environment influences lameness. (See “Lameness causes and prevention”).

Another way of looking at the economics of lameness is to compare the production life span of your animals with your culling rate, and associated reasons and costs, and the costs of replacement animals. On average, 10–15 percent of cows are culled for reasons directly related to lameness, but around 30 percent are culled for fertility problems, which can often be attributed to previous lameness. In Europe, the average lactation age is 2.5-2.8, depending on the country and how intensively the cows are reared. However, a cow can easily produce for more than ten years and it’s estimated that a dairy cow is most valuable during her sixth lactation. So what’s happening? Why aren’t we managing to achieve this? What this means is that, in many cases, producers are only just breaking even rather than profiting from their cows due to the short life and productivity of the animals and the high costs of culling and replacing them. It’s clear that if cows are well managed and treated, and consequently have lower disease and lameness rates, they will live longer with a greater lifetime production. In addition, far fewer cows would be culled for lameness problems. The lactation age would therefore increase, fertility rates would improve, calving intervals would be shorter, and the producer would ultimately be more profitable. (See “Physiology and performance losses” for details on how lameness affects fertility).

There are now many economic calculators available to record lactation ages, fertility rates, production, treatment, culling and replacement costs. We recommend using one to understand what’s happening in your herd. This will help you increase the lifespan and productivity of your animals by preventative means rather than culling.
IV. The hoof – functional anatomy

Understanding the factors that affect hoof health is one thing, but understanding how the different parts of the hoof interact and why, or how, these factors affect hoof health is another. Understanding the structure of the hoof should help you realise the importance of good hoof health and how easily lameness problems can occur.

The hooves are one of the most important parts of the cow’s body, as without these she cannot move around, exercise, feed, reproduce, etc. The hoof grows very similarly to a human nail. Many factors can affect the growth process, such as diet, reproductive state or condition, genetics, living conditions, general wear and weight bearing forces. This is evident in the rings that often occur on an animal’s hooves; due to variations in these factors, the horn is produced at different rates. The cow’s weight is distributed between all four hooves, with the front hooves usually bearing approximately 50–60 percent (it’s more equal in a young calf or heifer). When the cow is standing squarely and the claws are of even height and stability, the part of the body-weight borne by the hind legs should be evenly distributed over the two legs. The same should be true of the two fore legs.
She should be able to walk and stand easily with proportional weight bearing or load. It is therefore important to keep all four feet healthy so that weight bearing does not alter and place extra pressure on one or more of the feet, which can cause abnormal wear. The ideal hoof angle is around 45–50 degrees, and the claws should be slightly spaced.

Along with diseases that can contribute to uneven horn growth or overloading of the claws and weight bearing on the heel bulb area, environmental hazards can also affect hoof wear and growth. If a cow is lame, it normally indicates a hoof disorder that has deteriorated to the point she experiences immense pain and consequently alters her gait or stance to cope. In this instance, speedy treatment of the animal is essential in order to ease her suffering and to prevent unnecessary culling or loss of production (see “Lameness causes and prevention” and “Treatment of a lame cow” for more details).

It could be said that if you have lame cows you have already lost the hoof health battle, but by regularly checking feet for any problems and acting at an early stage we should be able to prevent lameness. To a certain degree, this can be achieved by practicing preventative trimming – giving the hoof its protective and weight bearing shape back – and through general good management practices that keep the hoof clean, dry and in good condition. This is no easy task, of course, and many aspects of management need to be considered. But the point is that prevention is far better, easier to routinely manage and cheaper than treatment.

The hoof itself consists of two digits, the outer (or lateral) claw, and the inner (or medial) claw. The outer wall of the claw is called the abaxial surface and extends back to the bulb where it ends with a shallow indentation: the abaxial groove. The wall folds around the toe and the inner wall, or axial surface, joins the bulb to form a deep groove: the axial groove. The space between the claws, which separates the two heel bulbs, is called the interdigital cleft, and the skin is called the interdigital skin.
On the hind feet, the lateral claw is usually slightly larger than the medial claw as it carries more weight and circumvents the udder during walking. The rear feet are used to push off, or for propulsion, whereas the front feet are used for flight response and to move to the side. Hence here, the medial claw is usually larger than the lateral claw (see “Cow behaviour” for more details). If cows are forced to move quickly, the claws are often put under greater pressure than normal, which can cause stress, structural damage or other injury to the foot. This can result in a lame cow if left untreated (see “Lameness causes and prevention” for more details).

Described from the outside in, the hard hoof that encases the foot (which can be viewed like a shoe encasing our foot) is formed from one type of tissue, but the claws have two further tissue components underneath: the corium or quick, which contains all the nerves and blood vessels, and the pedal (coffin) bone, navicular bone and associated structures.
The hoof
The hoof horn is a hard surface that forms a protective layer around the sensitive tissues and bones within the foot. It is structurally similar to a human nail but functionally more like the epidermis of the skin; it allows easy movement of the cow, yet provides excellent shock absorbency and protects the inner tissues from damage. The hoof is specially designed to protect the feet from excessive moisture loss or gain, heat, infection or disease and injury. While it is fairly resistant, if it is continually challenged problems will occur.

There are four areas that make up the hoof: the periople, the wall, the sole and the heel.

The periople
This is a band of soft horn, which separates the hoof wall from the coronary band. It provides a smooth, waxy surface over the hoof, which prevents excess water loss and the hoof from becoming brittle. This band is continuous on both claws and merges at the rear of the foot, or bulb of the heel.

The wall
The wall is formed at the papillae, small finger-like projections of the corium just below the coronary band. These are covered by the germinative layer of the epidermis, which is responsible for horn formation. These cells fill with a hardening substance, which matures to produce keratin (also found in the hair, tooth enamel, skin and often in the teat canal of a dairy cow). These cells provide strength for the hoof, and extend from the papillae in a series of tubules or pipes.

Cells containing keratin also grow from the sides and the base of the papillae and act as glue that binds the horn tubules together to form the intertubular horn. These run longitudinally down the hoof and vertically through the sole. It is common for a cow’s hooves to get weaker or softer as she grows. This is because the number of horn tubules is fixed at birth and so they do not regenerate; growth occurs instead by expansion of the intertubular horn. These wall bands grow down the foot towards the toe, a distance of 75mm, at a rate of 60–80mm a year or 5mm a month depending on age and nutrition.

A series of laminae runs down the inside of the hoof wall, providing the dual function of being firmly attached to the underlying structures and allowing a small amount of movement and cushioning.

The sole
The horn of the sole is made from papillae and consists of horn tubules that are softer than those of the wall. The horn grows down from beneath the pedal bone and where the horn of the wall meets the horn of the sole, there is a non-pigmented junction of tubular and interlaminar horn: the white line. This area is resilient, yet softer than both the wall and sole. It has the ability to move slightly and then return to its original shape when the animal is at rest. The white line runs from the bulb of the heel to the toe and around the first third of the axial wall until it ceases to be a weight-bearing surface. This is a point of weakness due to both the immaturity of the laminar horn cells produced by laminae in the white line and the incomplete keratinisation of the cells that join these to the sole. The white line is therefore easily damaged or impacted by debris and is therefore a prime entry point for infection.

Changes in posture lead to overloading of specific hoof components, as do rough edges, depressions and raised areas on the underside of the hoof. If the pressure on the sole is greater than it can withstand, haemorrhages and bruising can occur at the point where the pedal bone presses on the sole. As the white line is very sensitive, pulling forces such as sideways movements, sharp turns or extreme compression of the shock-absorbing tissues can lead to haemorrhaging or tearing (white line disease). Haemorrhages or bruising on the sole can easily become irritated or infected, resulting in sole or white line ulcers.

Did you know?
The two digits of a cow’s hoof are analogous to the third and fourth fingers of the human hand. The claws are named by their relative location on the foot. The first and fourth fingers are equivalent to the accessory digits, and the thumb has totally disappeared.

Did you know?
It takes approximately 15 months for a cow’s hoof to completely re-grow. That’s the distance from the coronary band to the toe divided by growth per month (75mm / 5mm).
The heel

The heel or bulb is continuous with the coronary band and merges with the axial and abaxial wall and the sole. It is a rounded, soft and rubbery area consisting of incompletely keratinised horn tubules and is a continuation of the perioplic layer. As it is soft, it compresses during weight bearing and returns to its normal shape when the pressure is removed. This continual shape changing causes considerable pressure on the adjacent hoof wall and could be why white line disease is more commonly seen at the sole-heel junction of the abaxial wall.

The corium

The corium, the second tissue component, is considered the support tissue of the foot and totally lines the inside of the hoof. It is a nutrient-rich tissue that contains nerves and carries nutrients for hoof formation and blood to the tissues within the hoof, especially those surrounding the pedal bone. The corium is equivalent to the quick of the fingernail or the dermis of the skin in humans, in that it is painful if damaged and continually produces new cells that are gradually pushed away from the corium. As they are pushed away, the cells die and produce the hard, new outer growth that we see both in our own nails and in hoof growth. At this point, the cells are said to have been keratinised, or cornified. The new growth emerges at the coronary band, the point where the hoof meets the hairy skin on the animal’s foot. The soft, new hoof growth that has just come to the surface is referred to as the perioplic horn, as described earlier.

At the heel, the corium contains fat, and fibrous and elastic tissue, forming the digital cushion. Its function is to act as a shock absorber, compressing when bearing weight to dissipate the forces of impact and prevent jarring, returning to its original shape when pressure is removed. The digital cushion plays an important role in blood circulation, acting as a pump that draws blood out of the foot and into circulation as the heel makes contact with the ground when the animal steps. The blood vessels in the corium also expand and contract through muscle action in weight bearing, and bypass mechanisms enable blood to circulate across the top of the foot at the same time. This explains the importance of exercise for the formation of new hoof horn, as it maintains optimal blood circulation through the whole of the foot. A lack of exercise restricts these pumping, expanding and contracting mechanisms, thus impairing circulation – and therefore horn formation.

Pedal/coffin bone

This is the major bone in each claw. It provides the framework for the general shape of each claw and is key to the animal’s movement. The pedal bone fits snugly in the fore foot, suspended by laminae on the abaxial wall and over the front of the hoof, separated from the horn only by a thin layer of corium. The deep flexor tendon is attached to the posterior of the pedal bone and is critical for locomotion and flexion of the foot.

When the cow walks, there is little movement of the bone at the toe, but towards the rear of the heel and axial wall where the bone is not anchored, movement is much greater. Along with this movement on the thin corium, and the stretching and depressing forces caused during walking, the shape of the pedal bone is also very angular towards the rear edge. This is often the cause of pinching of the corium and bruising of the sole. Blood vessels that are damaged in the corium release blood cells, which mix with new horn as it forms and grows towards the surface. Sole ulcers are often seen directly under where the pedal bone would sit, but bearing in mind that horn grows at roughly 5mm a month and that the sole is approximately 10–15mm thick, in reality the bruising occurred 8 to 12 weeks earlier! (See “Risk animals” for further information.)

Associated structures

The pedal/coffin joint is the junction between the second and third (the third is the pedal bone) phalanges and is very vulnerable to injury due to its location in the foot. Tendons are used to bend the leg, one end being attached to the muscle and one to the bone. The two major
tendons in the foot are the extensor tendon, which extends the joints of the leg and helps pull the leg forwards, and the flexor tendon, which pulls the leg back and flexes the foot. Pedal joint injuries often occur when the deep flexor tendon becomes detached from the pedal bone, resulting in the claw turning up.

The navicular bursa is a lubricated area that lies between the tendon and the pedal bone, allowing smooth movement between the two structures. The navicular bone facilitates movement of the tendon where it changes direction within the heel bulb.
A cow should be given the ability to behave naturally, including walking normally and freely, and have enough space and light to do so. If she is unable to walk freely, her gait, stance and ability to feed, drink, rest, produce and reproduce will all be compromised.

The Farm Animal Welfare Council in the UK (1979) compiled a list of “five freedoms” to focus on when assessing animal needs and welfare. They are:
1. Freedom from thirst, hunger or malnutrition
2. Freedom from discomfort and exposure
3. Freedom from injury and disease
4. Freedom of movement and the opportunity to express most normal behavioural patterns
5. Freedom from fear.

This is relatively easy to achieve in a grass-based system where cows are outside all year round, but can be extremely difficult to achieve and maintain in an intensive system where cattle are housed. Whatever system you use to rear your cows and produce milk, you should bear these freedoms in mind and aim to enable them as far as possible under your particular circumstances.

**Natural walking behaviour**
If a cow stands and walks well, there is little overloading of her joints, tendons or hooves, as weight bearing is more or less equally distributed between claws and legs, and each sole and wall are loaded proportionally. A healthy cow in ideal conditions or on pasture, should walk with large strides placing the rear foot into the position vacated by the front foot on the same side. On slippery floors, or in dark conditions that alter a cow’s confidence, she places her rear foot outside the track of the front foot while altering her stride, step length and walking speed.
An adult cow uses her rear feet for propulsion. As she pushes off to stride, most pressure is on the lateral claws of her back feet, especially if she is trying to flee a stressful situation such as pressure from a more dominant cow. She will lean sideways onto another cow by using her hind foot to propel her away from the danger. This is why most traumatic injuries occur on this claw in cows. In heifers, however, the opposite is true. They are often pressured by more dominant cows but use the medial claws on their front feet to push back and away from danger. Therefore, traumatic damage in heifers is mostly seen in the front medial claw.

Environmental influences on behaviour

Environmental conditions unquestionably influence behaviour. Cows in a grass-based system are outside all year round and not housed in a barn, so are likely to experience most of the five freedoms and be able to display the most natural behaviour. Even here, there will still be constraints however; for instance if the pasture is poor quality or the weather is bad, and particularly when it’s milking time. Cows are herd animals and have 360 degree vision, but they only have 3D vision directly in front, so this is the only direction in which they can estimate distances well. They therefore need time and space to walk at their own pace, enabling them to use their head as a counter balance and to watch where they are placing their front feet. By placing her rear foot in the position vacated by the front foot, the cow also safeguards her back feet. In a grass-based system, cows need to travel long distances to and from the parlour, so good hoof health is vital. Problems occur when animals are pushed too quickly up the track and into a collecting yard to be milked, especially if track management is not optimal. Most lameness in these systems results from wear and tear on the hooves or damage to the sole, white line or interdigital skin. This is discussed further in the section “Lameness causes and prevention”.

In a loose-housed or free-stall cubicle barn, the duration and timing of standing or lying behaviour (which is crucial for milk synthesis), can be influenced by the quality of cubicles or bedding. The choice of flooring and lighting influences walking behaviour, foot health (including the severity and location of claw horn lesions) and movement. Foot placement, length of stride, step and walking speed provide indicators of cow health and the quality of the environment. For instance, cows walking slowly but not displaying any signs of lameness are often a sign of poor quality walkways rather than something wrong with the feet.

Factors influencing the ability to display natural behaviour, such as housing design, stocking density and competition, temperature, ventilation and humidity, floor hygiene and bedding are explored in the “Lameness causes and prevention” section.
Daily time budget

In order to judge whether cows are displaying natural behaviour, if they are comfortable or if they are showing signs of lameness, it’s important to know how a cow acts naturally. To do this we can look at daily time budgets for lactating cows and examine if the animals in question are showing normal behaviour patterns and, if not, where the variation lies.

Under normal conditions, a TMR-fed, loose-housed dairy cow spends around three to five hours a day feeding, 0.5 hours a day drinking, up to two hours a day standing in the stall, around two hours a day standing in the alleys socialising and approximately 12–14 hours a day lying down.

Importance of lying behaviour

Lying down is hugely important, as the cow ruminates during most of this time; a reduction in lying time reduces milk production. Lying down also gives a cow time to rest her hooves and give them a chance to dry, it means there is more space for the others to walk around, and the blood circulation in the udder increases by up to 25–30 percent, meaning production can be increased.

If lying time is significantly reduced, there is generally a good explanation – uncomfortable beds, for example. This is probably the most common reason for a reduction in lying time.
Many studies emphasise that a reduction of three hours lying time per day can have a detrimental effect on claw health. The extent of this is often determined by the nature of the standing surface available between bouts of lying, and if the surface is particularly hard there may well be problems with a large proportion of the herd.

Lactation stage also affects lying time, with those cows in early lactation often spending more time lying than those in later lactation or dry. However, Huzzey et al (2005) reported that cows approaching parturition stand more often than those before or after.

**Lame cow lying behaviour**

It is important to be aware that although cows with a locomotion score of 1 will most likely not display much difference in time budget behaviour between reasonably soft bed surfaces, lame cows do. They are very sensitive to the material used as it can hinder their ability to rise or lie, and this can be seen in graph opposite. This study used a locomotion scoring system of 1–4 and compared sand beds to mattresses filled with rubber pieces. Cook (2004) shows that although the non-lame cows do not particularly differ in their lying time between either surface – leading to the assumption that either is fine to use (although they stand in the alleys slightly less often with sand) – the lame cows lie for a much shorter time on the more uncomfortable rubber filled mats. For a cow that is already lame, this poses many problems, so it’s also important to research the effect surfaces will have on the less able cows. (See “Lameness causes and prevention” for more information). A further complication can be that the cows not only stand, but they stand still, which means the blood-pumping mechanism of the heel and digital cushion is inactive. This results in inefficient blood circulation into, around and back out of the hoof, causing poor horn formation.

A study performed in the UK by Blackie et al (2008), and many others, documents that lame cows with a locomotion score of 3 spend longer lying once they have got down than non-lame cows, which could influence the level of milk production. It is suggested that watching the lying behaviour of cows could also be used to detect lameness (see the “Lameness detection and diagnosis” section for more information). A hugely important point to remember is that crucial as the bedding surface is, so too is the cubicle design as the problem is multi factorial. See the “Lameness causes and prevention” section for further information on cubicle design.
VI. Physiology and performance losses

Fertility
Studies have confirmed that claw disorders and lameness can impact negatively upon fertility. Lame cows eat less, lose weight, and are less mobile, thereby preventing active display of heat/oestrus and heat detection. Hernandez et al (2000) found that cows with abscesses or sole ulcers had 63 more days open than healthy cows, while cows with two or more claw disorders had 76 more days open, compared to cows without claw disorders. Furthermore, a lower percentage of cows with abscesses or sole ulcers were pregnant at the end of lactation, compared to healthy cows.

Other studies also confirm that lameness may also impact fertility by lowering first service conception rates and increasing the incidence of ovarian cysts. In a study by Melendez (2002), cows that were clinically lame due to a claw disorder in the first 30 days postpartum had a 58.9 percent drop in first service conception rates, a 125 percent increase in ovarian cysts and an 8.2 percent decrease in pregnancy rates at 480 days postpartum. Early lactation lameness created significant concern. More than 30 percent of the cows that were lame during the first 30 days postpartum were culled before recording any reproductive event, compared to 5.4 percent of the control cows.

Sprecher et al (1997), found that compared to cows scoring 1 or 2, cows scoring 3 or more were nearly three times more likely to have increased days to first service, 15.6 times more likely to have more days open and nine times more likely to have an increase in services per conception. Additionally, these cows were eight times more likely to be culled (see table below).

Dry matter intake and milk yield
Robinson (2001) compared milk production losses among locomotion-scored cows. Cows that scored 3 produced 5.1 percent less milk than cows that scored 1. For cows scoring 4, the average milk loss was 17 percent, while cows that scored 5 experienced an average milk loss of 36 percent..

In simple terms, one cause of reduced milk production is a lower dry matter intake because lame cows eat less. The lower percentage reductions (those associated with scores 2 and 3) for milk yield reflect the high priority need for energy to maintain body tissues; this means the full impact of reduced dry matter intake is not initially seen in reduced milk production. However, in an effort to sustain milk production at a higher level than is possible based only on the nutrients consumed in the diet, body reserves are mobilised, condition score decreases and milk production will decline to levels that can be sustained by the actual level of nutrients being consumed. There is a negative correlation between locomotion scores and body condition scores, with body condition scores decreasing as locomotion scores increase.

<table>
<thead>
<tr>
<th>Reproductive Performance Failure Risk For Lameness Score &gt; 2</th>
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<tbody>
<tr>
<td>Increased days to first service</td>
</tr>
<tr>
<td>Increased days open</td>
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<tr>
<td>Breeding herd days</td>
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<tr>
<td>Increased services / conception</td>
</tr>
</tbody>
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The effect of lameness on reproductive performance
Source: adapted from Sprecher et al (1997)
VII. Lameness detection and diagnosis

Knowledge levels and the ability to detect and diagnose lameness and its causes can vary greatly between veterinarians, scientists, advisers and farmers. This means that treatment and prevention methods vary greatly too, which can result in cows going undiagnosed and untreated for too long – until the case is extremely severe.

The first step towards decreasing lameness is the ability to recognise a problem, determine the incidence, level of severity and cause and then decide how best to alleviate the associated pain. This is often affected by the farm’s financial constraints, but severe welfare problems can arise if a cow is left to suffer. Record keeping is a valuable tool to help the farmer devise prevention or treatment regimes to improve the situation.

For an advisor, veterinarian or hoof trimmer, completing a farm survey both before and after assessing lameness problems on a farm can be very valuable. There would be little use in filling in a survey after assessing cows and putting them on a prevention regime without a pre-assessment record; it would be impossible to compare whether the situation improved. Farm surveys, such as the one provided in the appendix, can quickly tell you about the cows, parlour, daily routines, housing, existing trimming or foot bathing regimes, the current hoof health status and other general information (see “Appendices”).

**Early detection**

Early detection is essential in order to prevent cows suffering, but learning to recognise a lameness problem is not an easy task. Farmers should be fully trained and sensitised to the importance and severity of lameness. The most effective way to detect lameness is by watching your cows daily for clues that something could be wrong. The indication may be small, but it could be something affecting the whole herd that has gone unnoticed. Try to “see” lameness by asking yourself what your cows are showing you. Watch them rise and lie down, their lying pattern, their feeding pattern, etc., whenever possible. Check if certain cubicles are not used, how many cows lie versus stand and regularly check hooves.

Dairy managers typically underestimate the incidence of lameness on their farm as demonstrated by a study in Kansas City, US. While trying to document what constitutes good and bad hoof management practices on farms, McKinzie et al (2005) found that on average the farms had 28 percent lameness whereas the owners estimated just six percent!

Various manual aids exist to help identify lame cows, including locomotion scoring and hoof scoring. The extent of a farm’s lameness problem can also be graded according to how many cows are affected at any one time (Esslemont and Kossaibati, 2002).

- **A** (a good target) would indicate that around 9 percent or fewer animals are affected
- **B** (tolerable) indicates 9–20 percent are affected
- **C** (problem) indicates that 21–36 percent are affected
- **D** (considered a major problem) indicates over 36 percent of animals are affected by lameness.

When you look at today’s average statistics for lameness and consider that around 25 percent of animals are said to be affected, it’s clear this is a problem on most farms.

**Locomotion scoring**

Locomotion scoring was developed to simplify the task of identifying affected animals. It is a simple way of evaluating an animal’s back posture, both standing and walking, by assigning a qualitative score as an index of their ability to walk normally.

Various scoring systems are available but in Sprecher et al’s (1997) 5-point system, cows are visually scored from 1 (cow with a normal posture and gait) to 5 (cow is severely lame, often only bearing weight on three legs).

Scores of 2 and 3 are generally considered to represent cows that are sub-clinically lame and where problems caught should be treatable. Scores of 4 and 5 represent cows that are clinically lame and experience severe difficulty walking and extreme pain. A score above 1 does not indicate why a cow’s gait is affected; it merely shows that she has some degree of gait abnormality.
Locomotion scoring assists in early identification of potential claw disorders before they become painful, as cows with claw abnormalities change their back posture and the movement of their feet and legs to offset pain. The objective is to identify cows scoring 2 or above as candidates for corrective trimming or treatment, and to assess the prevalence of herd lameness (Zinpro, 2005).

Scoring should be carried out on a flat surface, free of obstacles and debris, with cows walking at a normal pace. Around 25–50 percent of the herd should be scored every two to four months to assess if lameness is becoming more or less prevalent and to determine if measures to decrease lameness are effective.

### Locomotion Score Chart

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1.0   | Normal with flat back  
|       | Cow stands and walks with a level back. Gait is normal |
| 2.0   | Mildly lame  
|       | Cow stands and walks with a level back, but develops an arched back to walk. Normal gait. |
| 3.0   | Moderately lame  
|       | Arched back is evident while standing and walking. Walk with a short lame stride. |
| 4.0   | Lame  
|       | Arched back is always evident and gait is one deliberate step at a time. Cow favours one or more legs/hooves. |
| 5.0   | Severely lame  
|       | A three-legged cow which demonstrates an inability or extreme reluctance to bear weight on one or more limbs/hooves. |

Source (adapted from): Steven L. Berry, DVM, MPVM; Univ. of Davis, CA, and Zinpro® Corporation 1997, in J Hulsen, Cow Signals

It may be impossible to eradicate all lameness on farms but the goal should be to eliminate clinical lameness and achieve a level whereby around 65 percent of the herd has a score of 1 and only around 5 – 10 percent has a score of 4. Those with a score of 5 should be removed from the main herd to recuperate in a treatment area.

Locomotion scoring does not identify why a cow is lame, it only serves an indicator of which cows may be lame. Bear in mind that a poor locomotion score may not always be due to a problem with the hooves or legs, but could also indicate conditions such as acidosis or a displaced abomasum.

This type of scoring system can also be used to assess the extent of an expected reduction in dry matter intake and milk yield due to lameness and thereby to calculate potential revenue loss. That loss can be used as a criterion to determine whether intervention is required and/or warranted. The next stage is to diagnose the problem before a treatment regime can be devised, often carried out when hoof trimming.

**Body condition scoring**

Body condition scoring can be used to check whether your cows maintain, gain or lose condition (see “Appendices” for scoring system). It is probable that lameness and reduced feed intake cause a loss of condition, as there is a strong negative correlation between locomotion scores and body condition scores. Body condition scores decrease as locomotion scores increase (i.e. lame cows are thinner). It’s a good idea to check the condition of the animals regularly (i.e. monthly), especially those that have recently calved.

**Hoof scoring**

To gain a clear picture of the exact hoof health status of the herd, it’s a good idea to observe and record all hoof disorders and severity at the same time. For example, an ideal time is when a hoof trimmer is trimming a group or the whole herd, as picking up the feet is easier while the animals are restrained, so they don’t panic and slip or fall.

**Digital dermatitis (DD) lesion scoring**

To assess the severity of infectious diseases, scoring systems such as the following one can be used. The table indicates the size and severity of lesions and a descriptive key to help identify them. The lesions increase in severity, pain and lameness down the table.

<table>
<thead>
<tr>
<th>Size</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: no lesion</td>
<td>0: no lesion</td>
</tr>
<tr>
<td>1: 0-15 mm</td>
<td>H: Hyperkeratosis</td>
</tr>
<tr>
<td>2: 15-25 mm</td>
<td>U: Ulcerative red strawberrylike lesion</td>
</tr>
<tr>
<td>3: &gt;25 mm</td>
<td>G: Granulomatous, grey terry cloth like lesion</td>
</tr>
<tr>
<td></td>
<td>P: Papiliform, hair-like projections</td>
</tr>
</tbody>
</table>
Lesions transition between stages i.e. they heal or move to another stage that may be desirable or undesirable (see table below). This can be studied after a period of treatment or preventative foot bathing to determine if lesions are entering stages of less severity. Ideally, we would like to see an increase in lesion transitions that promote healing and prevention (curative, no change – to promote) and decrease those lesion transitions that are a sign of clinical aggravation (aggravating and no change – not desirable) (Dopfer et al, 2008, Lopez-Benavides et al, 2008).

From this, we can determine whether the problems associated with DD are also improving. This highlights also that not all cows suffer from the same degree of infection, or have the same infection history and cure prospect. Every cow needs individual assessment.

### Lesion scores

<table>
<thead>
<tr>
<th>Current visit</th>
<th>O</th>
<th>H</th>
<th>P</th>
<th>G</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous visit</td>
<td>nc-p</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>nc-p</td>
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<tr>
<td>a</td>
<td>nc-p</td>
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<td>c</td>
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</tr>
<tr>
<td>a</td>
<td>a</td>
<td>nc-nd</td>
<td>c</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>a</td>
<td>nc-nd</td>
<td>c</td>
<td>c</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>nc-nd</td>
<td>c</td>
</tr>
</tbody>
</table>

nc-p = no change – to be promoted; nc-nd = no change – not desired; c = curative; a = aggravating

### New technology

Technological detection devices can also be used, the most common type being pedometers worn on a limb at the fetlock, or activity meters worn around the neck. These are primarily used to detect oestrus levels by measuring the number of steps, or head bobs compared to an individual’s rolling average, but in terms of lameness they can be used to detect a decrease in activity.

Other technologies are under development in the effort to find a fail-proof detection system, for example by using cameras or measuring weight distribution. It will be interesting to see whether these actually provide farmers with the practical means to prevent lameness, or whether they will merely be expensive detection tools that are too technological, difficult to use, or unreliable.
Lameness can often involve many factors that combine to cause severe problems. These factors are difficult to avoid, but the effects should be minimised as far as possible to ensure the optimal, most comfortable situation for the cows. A successful producer will create a cow environment that minimises stress, competition for feed and water, and the potential for injury and disease. The main influences on hoof condition are the environment, management, nutrition, toxicity and other miscellaneous factors, all of which – particularly when combined – complicate the task of both determining the cause of lameness on a farm and the preventative measures to take.

The risk of spreading infectious hoof diseases like DD is high in a herd, especially those that are housed. Once you have DD in your herd, it is extremely difficult to eradicate – nearly impossible in fact, but there are things you can do to help limit the spread. Keeping cows in the driest possible conditions, for instance, will limit both the spread of infection to other animals and also the susceptibility of cows to get this or other infections. Hard, dry hooves provide good protection from infection and injury, whereas hooves that are constantly damp absorb moisture and soften, making the sole more likely to be penetrated and damaged, and the corium bruised. Sick animals should be separated where possible from the main herd until the infection has died down, and preventative measures such as foot trimming and foot bathing or spraying can be used to keep infectious hoof disease levels to a minimum.

It is always difficult to know if newly bought cows are healthy or not, and this can be a huge problem for farmers who unknowingly introduce disease from outside the farm. If you are expanding your business and need to grow your herd rapidly, the preferred option is often to buy cows in, and it’s always advisable to get them thoroughly checked by a veterinarian before mixing them with existing animals. Rearing the animals yourself is a much easier way to know the health status of those you put into the herd but this, of course, takes time.

Cows with existing infections such as mastitis or metritis are far more susceptible to lameness, so sick animals should always be rested somewhere comfortable to recuperate, only returning to the herd once the risks have been reduced.

Management and environmental factors

Risk animals

Young or new cows in a herd are especially at risk of contracting infectious diseases but are also more prone to hoof damage. This can be due to bullying by aggressive, older or more dominant cows or from being unaccustomed to using the housing system they are put in to and injuring themselves (particularly in a loose-housed system).

Dry cows are another risk group. As these cows are about to calve, their immunity is often suppressed since the body uses all its reserves for the calf. This makes them highly susceptible to infection or hoof damage, particularly sole ulcers. It’s especially critical during this period that these animals have a soft surface to walk and lie on. This will not only prevent the risk of hoof damage, but will encourage them to rest sufficiently, thereby avoiding long periods of standing, and promote increased blood flow to the uterus, which will benefit the foetus. Placing the cows outside on good quality pasture is ideal but if the weather makes this impossible, then a soft bedded straw yard, for example, can be very effective.

If a dry cow develops a sole ulcer, for example, this can often go unnoticed until two or three months after she has calved and is back in the herd, at which point she will be lame. As we saw in the hoof anatomy section, horn grows at roughly 5mm a month and the sole is approximately 10–15mm thick. Therefore it can take 8 to 12 weeks for bruising to emerge, exposing a problem that has been there for weeks or months. If a dry cow or a cow that has just calved has a lameness problem she is unlikely to feed properly, which could be detrimental not only for the calf, but also for herself once she is put back into the herd to be milked. Her production is unlikely to
be as high as it should, and she could experience a negative energy balance and so lose condition, predisposing her to metabolic problems such as abomasal displacement or ketosis.

**Integration and training of heifers**

Untrained heifers are often placed straight into cubicle systems after calving, when they are not used to the loose-housed free stall design. They are equally unused to having older, more dominant cows around. The result is that they tend to lie less as they are forced out of the cubicles by more dominant cows, and it has been suggested that this can contribute to longer standing times, which may result in subsequent lameness. Another factor affecting heifers is that they often struggle to get to the feed fence, meaning they also stand longer trying to feed.

Heifers and young stock should ideally be trained early on in how to use a barn with cubicle dividers, automatic scrapers, and all the things they will experience in the main cow barn. This way they learn to use a cubicle-based system, including lying in the stalls, walking on concrete or slats, using the feed table, avoiding obstacles like automatic scrapers, thereby avoiding trauma or injury to hooves and reducing stress levels once put into the main herd. Training heifers in a barn with a self-locking feed fence can be useful so that the first insemination can be easily performed (when using artificial insemination) and pregnancy checks can be easily made. Early training, followed by integration, is a good way to help these animals develop relationships within the rest of the herd and fit into the social hierarchy before they have their first calf.

It’s important for a freshly calved cow to increase her feed intake quickly to minimise the duration and effects of negative energy balance. A cow that is completely new to a herd first has to find her place in the social hierarchy. This can make feeding very stressful and result in a lower dry matter intake, a lower yield and very likely an immunity suppression that renders them susceptible to hoof damage as well as mastitis and respiratory problems. If the heifer has already spent some time with the herd before calving, although she may have to re-establish herself somewhat, it should be a much less stressful experience and occur reasonably quickly.

**Space, freedom and fear response**

Every cow has her own comfort zone and when another animal or human passes the border of this zone she will react by attacking, socialising or escaping. The size of the zone depends on the character of the cow; a calm cow will tolerate a smaller personal space than a nervous one. Heifers need more personal space than older animals. As cows age, they frequently become higher ranking too, so they are no longer afraid of other cows. All herds have a social hierarchy, usually expressed by head butting, pushing or avoidance. Social interactions are an important part of natural herd behaviour, but it’s important to have good conditions in the barn, such as space at the feeding area, adequate water troughs, and enough comfortable cubicles to rest in.
Stocking density and competition

Overcrowding often increases the negative effects of social interactions, with heifers, cows new to the herd and less dominant cows regularly being bullied or placed in aggressive or competitive situations. This results in more sole lesions on the medial claws of their front feet caused by pushing or backing away in an attempt to avoid the more aggressive cows. This places more pressure on the medial claw and often twists it at the same time. Structural damage can also be caused to the hooves in these situations. Plenty of training and space should therefore be given so that the less dominant cows have an escape route and don’t get trapped, panic and injure themselves in the process of fleeing.

Overstocking can also decrease lying time dramatically. As described previously, sufficient lying time is important for the cow to keep her hooves dry and healthy, to rest and ruminate and to increase blood flow to the udder for milk synthesis. This is especially relevant with younger, less dominant cows or heifers, as dominant cows will displace low ranking cows from the stalls, forcing them to stand for longer periods.

Overstocking can also aid in the transmission of disease. Overstocked barns often have a damp, ammonia-type smell, probably exacerbated by poor ventilation and light, but also indicative of too many animals in close proximity, whereby fighting disease becomes much more difficult.

As a general rule, cows should have enough space so that they can all feed at the same time (allowing 60–76cm of space per cow at the feed table), they can all lie at the same time (at least one cubicle per cow), that cubicles are large enough for them to lunge and rise comfortably (it is recommended that stalls be 245–250cm long) and that they have enough space and sufficient troughs to drink comfortably (there should be 3–4m space around a water trough to reduce aggression). These details are highlighted and described further in the DeLaval Efficient cow comfort booklet.
Stockmanship and farmer behaviour
Many studies describe the effect of an impatient farmer who shouts and uses a stick to hit or a
dog to chase cows compared to those who allow the cows to move along at their own pace. In
particular, Chesterton’s studies in New Zealand (2004 – 2008) highlight that the incidence of
lameness is greater in the grass-based system when cows are forced along tracks too quickly.
This is also true of more intensive systems where cows are forced along alley ways and
crowded too tightly in the waiting area to be milked (see the “Farming type” and “Housing de-
sign” sections below). A trained, knowledgeable farmer with a calm nature is far more able to
display good stockmanship when tending cows. Cows react well to a calm voice and a relaxed
environment and demonstrate lower levels of stress or flight responses. Production is known to
be higher and lameness risks lower in these systems.

Knowledge about lameness recognition, causes and preventative techniques, as well as record-
ing and treating cases early, are all examples of expertise necessary for handling dairy cows.
Nothing is as valuable as observing your cows on a regular basis as this is will provide you
with any signs of poor hoof health or other welfare concerns.

Farming type

Loose-housed/free-stall system
In a loose-housed/free-stall barn, cows are usually housed on concrete with cubicle beds for the
winter months, and on some farms all year round. This has a detrimental effect on hoof health
due to the hard surfaces cows have to stand and walk on, the damp and often overcrowded condi-
tions, and the high risk of disease transmission. To reduce susceptibility to hoof problems, and to
help prevent the spread of disease, cows should be kept in conditions that are as dry as possible.

Infectious hoof diseases often account for a large proportion of the lameness seen in these
types of systems (approximately 20 percent is attributed to DD), as well as wear and tear
cau sed by walking on hard surfaces every day. Infectious lameness (DD and foul of the foot/
interdigital phlegmon) is seasonal and typically occurs more often in winter when cows are
inside and exposed to slurry. When farmers put their cows out in the summer, the problem is
relieved and infection rates normally reduce. In a study of 900 cows over 18 months, Blowey
et al (2004) found that lameness occurred throughout lactation but peaked three months after
calving, digital dermatitis and foul of the foot were primarily winter diseases, and sole and
heel ulcers occurred all year round. White line disease occurred in four month cycles.
Straw yard system
Cows housed in straw yards probably experience lower levels of physical trauma or stress damage to their hooves, but could still experience infectious diseases such as mastitis if their bedding isn’t regularly changed. It is generally recommended that straw yards should have ten kg of straw per cow per day in order to keep them clean and comfortable. Levels of infectious hoof diseases are also generally low in straw yards as exposure is low and conditions are much drier than in free stall-based systems. Straw can also potentially have an abrasive cleaning effect on the claws, meaning that slurry is less likely to dry on the hooves.

Tied-up system
Lameness is usually observed during milking or by moving through the alleys when cows are active. In tied-up systems, this is more difficult and normally carried out during exercise periods if they exist; if not it can be difficult to detect mild or subtle cases of lameness. Tied cows are known to experience physical wear and tear type hoof problems but generally have lower levels of infectious disease as they do not often mix and are not exposed to slurry in alleys for long periods. Some studies have documented that rubber mats in tied-up systems can significantly reduce sole lesions, compared with concrete for instance.

Grass-based system
Cows in these systems are on grass all year round and generally experience few infectious hoof problems. Trauma issues mostly occur when the cows are being moved, causing high levels of sole ulcers, separation of the white line, interdigital skin damage and abscesses forming under the hoof wall.

When cows are being moved to the parlour for milking, they should ideally be allowed to wander at their own speed. Cows have a ranking and a walking order they will follow every time they go up the track. The most dominant cow sets the walking speed and the others follow. If a more dominant cow stops, the cows behind will stop and wait for her to move forward. If forced or pushed along the track too quickly, the order is disrupted, the cows become stressed and aggressive, bunch up, and foot wear and trauma becomes a problem. Because the cows are unable to take the time to watch where they put their front feet, they will often damage themselves on stones or other obstacles. The rear feet no longer follow the vacated position of the front feet and are placed outside the track of the front feet, and the stride and step length are compromised. When cows bunch up in this way they can no longer use their heads as a counter balance; they are forced upwards making the cows much more likely to stumble or step on something painful. This situation mainly occurs as a result of a farmer chasing the cows on a motorbike, on horseback or with a dog, rather than letting them walk freely at their own speed. Following or encouraging the cows to keep walking is fine, as they are followers and will automatically go with the flow of cow traffic, but it is important not to rush them.
**Track management**

Good management of cow tracks is essential to prevent unnecessary lameness. A comfortable track will aid walking speed and automatically reduce lameness. Bark or wood chips make an ideal top surface, whereas material such as gravel should never be used.

Tracks should ideally be less than one kilometre long. The minimum width depends on the number of cows you have, but for herds of more than 250 cows it should be no narrower than approximately 6m. Tracks should be level, straight, have an even width with no bottlenecks, have a crowned surface so water can run off (ideally with a slope of 3–5 percent but no more than 8 percent), have a non-abrasive top surface, good drainage, and should widen towards the parlour collecting yard. Tracks should be checked often and be well maintained; for example, any stones that collect should be removed so they don’t pose a risk to cows’ feet.

**Housing design**

**Milking and parlour**

Just as it is important not to rush cows up a track, the same is true when collecting cows for milking so that the animals remain content. As on tracks, cows will drift along in a certain order and speed, which is set by the dominant cow. This is often disrupted through cows being rushed and forced into a small waiting area or holding yard. Lower ranking cows are forced among cows of higher dominance, aggression surfaces, animals become stressed and careful foot placement is no longer possible, leading to potential hoof damage. If you can see cow heads raised up over the backs of other cows, there is not enough space available and additional pressure will be put on the feet through cows pushing and not being able to place their feet comfortably.

This is true of any farming system where the animals are herded too quickly into the waiting area to be milked and generally the size of the waiting area and parlour are proportional. By contacting a DeLaval representative and the Global Customer Project Design and Support units, you can have a waiting area sized correctly for you. In a loose-housed free-stall system, herding animals for milking usually involves bringing the cows through the building along alley ways that are wet and slippery, so extra care should be taken not to rush these animals. Cows often urinate and defecate when collected for milking, especially when stressed, so the alley ways and waiting area should be cleaned between milkings if possible. It’s a good idea for the waiting area to be on a slight incline to drain so it is not too wet and slippery. The slope should only be around 3–5 percent, otherwise cows will feel unsafe standing on it or walking up it – a situation made worse if the area is wet and slippery.
Cows should not be brought in too early and should ideally be collected in small groups so that the cows towards the end of a group don’t have to stand too long with extra pressure on their hooves.

If you watch carefully at the parlour waiting area, you will see that subtle changes in position take place as the cows readjust themselves to enter the parlour in a slightly different order. A cow that walked relatively near the back of the group may enter the parlour in the middle or even at the front and needs enough space and time to get through. Adjustments continue as she enters the parlour and other cows replace her. The other cows will not go into the parlour until she has entered and if herded up too tightly, not allowing this cow through, the herd will be forced into the parlour in the wrong order by the milker coming out of the parlour to chase them or by use of a crowding gate. When chased, they are likely to turn quickly away from the stimulus, spinning on their feet and risking damage to the lateral claw on their rear feet in particular. Given time, cows learn to readjust to their milking order and flow in to the parlour naturally, and respond well to a calm, friendly voice, thereby preventing unnecessary damage to their hooves.

The floors of the waiting area and parlour should be hygienic, comfortable to walk and stand on, and have an even, slip-resistant surface without being too abrasive. If concrete is used, a brushed pattern often gives enough grip to make it non-slip. It’s also now common to put a rubber floor covering here to provide some cushioning helping them to walk much more comfortably and safely, as the cows will be standing for some time.

When cows are pushed too much with a crowd gate, squeezed, their heads come up and they are unable to balance or see where to place their feet and on top of this the surface is abrasive on the hooves. This not only causes severe hoof health problems, but stresses the animals and makes them harder to handle in the parlour as they are not relaxed. A crowd gate should be used as a gentle warning to the cows to move forward, and never to push or squeeze them up towards the parlour. A short alarm of a few seconds to warn that the gate will move followed by small incremental movements (1m at a time) is enough to encourage the animals to move.

Sick animals should never be rushed. They are often the last group to be milked when a farmer wants to finish and go home, meaning they may not be given the time they need to walk. Those that are lame especially need extra time and care, as they are in a lot of pain, and should be handled gently. If an animal is in pain you should consider that her comfort zone is probably different to that of a healthy cow; she will experience a higher level of stress if she finds it difficult to avoid the stimulus. For this reason, consider giving lame cows more personal space than normal.
The entrance to the waiting area or parlour should not be dark and narrow, as cows will not enter if they can’t see where they are going. A light, well ventilated space will be much more enticing and promote better cow flow. The parlour exit should be clean, non-slip and have no sharp turns or restricting obstacles. As the cows have just been milked, it’s crucial that they can exit easily so they are not at risk of splashing their udders with manure or slipping over and getting their teats dirty.

Cows should be allowed to rest as soon as possible after milking, often having spent some two hours in the waiting area and parlour, so the quicker these animals are off their feet again the better for hoof health. Past advice has often been to wait for the teat orifice to close before allowing cows to lie down, to prevent bacteria from entering the teat canal after milking. However, this is a lengthy process, so as long as a good teat dip has been used and beds are reasonably clean, it should not be a problem to let these animals rest. Another important need for cows leaving the parlour is water. Free access to clean, fresh water must be provided directly after leaving the parlour, with plenty of space around troughs to prevent competition.

**Automatic milking system (AMS)**

In this system, cows are not herded up into one large group in a waiting area, but go to the milking robot by choice. This gives rise to fewer hoof conditions caused by the stress of being pushed into one small area and also gives the farmer a lot more time to concentrate on other jobs. It has been well documented that cows are a lot calmer in these systems, probably due to not having huge stresses placed upon them twice or three times a day at milking. Good hoof health is even more vital in this system and needs to be a point of continued concentration when entering into this method of production.

The crucial issue to remember here is that cows need to be able to walk soundly as they are not being collected for milking. If the animals are to go voluntarily to the milking box, they need to be free of pain or they simply won’t go. Although in general lame cows lie less, they will exhibit extended lying bouts along with irregular milking interval patterns. Their milkings may be delayed or they may not go to be milked at all. This can lead to a decrease in milk yield and a higher risk of mastitis, and the animals will ultimately need to be fetched by the farmer – counteracting the reason for buying this machine in the first place.

Any farmer considering investing in an AMS should be aware of the potentially negative factors, meaning that management needs to be as different as the milking system is itself. Animals need to learn new behaviour and adapt to the system, which may initially include long waiting times in front of the AMS. This should only be the case in the early weeks after installation and
should settle down once the cows are used to the system. As this can be a trying time, DeLaval offers a start-up plan to use when installing their VMS (voluntary milking system), including how to guide and train cows to use the new system. The farmer has to learn to adapt to the new system too: to actively watch the cows and check for disease, to read output from the software system and develop the skills to recognise when something is wrong.

In terms of lameness, the waiting area for the AMS should always be kept clean along with the milking box itself. Every cow being milked has contact with this platform and machine so good hygiene is essential.

The waiting area should be comfortable to stand in, as should the box, and be slip resistant. The exit lane from the box should also be kept clean and slip-resistant so that the freshly milked cows do not splash dirt on their udders and can quickly and easily return to their clean beds. Fresh water should be available right after the cows leave the AMS.

**Floor surfaces and alley ways**

Locomotion is an important action for all cows. In grass-based systems, cows may have to walk a long distance to the parlour and so they keep reasonably fit. Although this is limited in loose-housed systems, there is still a significant amount of locomotion associated with social and other activities.

**Floor surfaces**

Floor quality or condition in cattle housing systems is an important environmental factor and significantly affects performance. A poor floor will lead to an increase in leg injuries and claw disorders and a higher incidence of sole ulcers on the cow’s rear lateral claws. This is due to the pressure involved in walking or avoiding conflict, and this is often exacerbated by the abrasive nature of the concrete often used in alley ways. An ideal floor is clean and comfortable for cows to walk on, and is even and slip-resistant without being too abrasive to hooves. Floors must be simple to construct, durable and easy to manage and maintain. All concrete should be grooved to make it less slippery. Before placing cows on freshly poured and grooved concrete, be sure to smooth off rough or sharp edges and abrasive patches to prevent hoof injury.

Concrete has long been the most common material for floors in confined animal systems, but is not very animal-friendly as it enhances the physical effects of load bearing on the feet; the unyielding nature of the floor irritates the corium and increases blood flow causing accelerated horn growth. A softer, more resilient material like rubber might be a future alternative as it can be
added on top of concrete making the surface less abrasive to hooves and providing more friction. The floor becomes less slippery and more cushioned, allowing the claws to sink into the surface. Rubber is documented to allow cows a longer stride and lower stride frequency, and is considered to reduce the risk of slipping to a greater extent than concrete or asphalt. A less slippery surface reduces injuries and increases mobility to feed, water and resting areas. It is well documented that, given a choice (e.g. Telezhenko et al, 2006), cows often prefer to stand on a rubber surface rather than concrete. Consider installing rubber mats to improve the daily routine of eating, drinking, walking and resting. In barns with worn out concrete, the addition of rubber covering can help prevent hoof problems. A rubber surface also encourages oestrus activity to be displayed as cows feel more comfortable, and therefore fertility is enhanced.

If you notice cows walking very slowly or timidly with rear feet splayed wide, it could be a sign of poor traction. Skid marks are another indication that the floor is probably too slippery. However, rubber can also result in an overgrowth of the claws due to its low abrasion. This has been questioned in other studies, which indicate that overwear may be reduced, but so too is overgrowth and that the net growth rate on rubber mats does not exceed that on concrete. In order to make sure overgrowth does not occur, hooves should be checked regularly and hoof trimming routines followed as necessary (see “Trimming” section).

Slatted floors normally stay cleaner than solid floors with no additional labour required for manure removal, but these are documented to cause more hoof damage. Poor drainage of slatted floors can occur when cow traffic is too low or when there is too much bedding material or food on the floor. Scrapers on top of the slatted floor improve hygiene.

The cleanliness of solid floors can be improved by sloping, with frequent scraping or flushing. The slope should have a maximum incline of 1.5 degrees, positioned towards the middle of the alley and longitudinally towards the dung channel. The liquids can drain easily from sloped floors, which results in drier surfaces. One disadvantage is that manure will be spread over this dry surface by the manure scrapper, which is why some farmers prefer a non-sloped surface in combination with a scraper system. Solid floors have the advantage of being more natural and comfortable for cows to walk on. Using a lot of bedding is another way of keeping the floor and hooves drier, as bedding kicked out of cubicles will absorb some of the moisture from the floor and can then be scraped away. It also provides a soft cushion for animals to stand on with their rear feet when they don’t stand fully in the cubicle. The hygiene of barn floors has a considerable impact on animal health. Problem floors impact the hoof, the udder and milk quality. Floor design is therefore very important for long-term, consistently profitable, milk production. The floor is the part of the barn with which the animals are in closest contact.

**Alley ways**

Alley ways should be wide enough to maintain good cow flow around the barn and to encourage integration of new members to the herd. Wider alley ways also provide a greater area for slurry accumulation and reduce the risk of exposure.
Scraping
A good way of judging how often to scrape is to look at the number of cows in your herd and their cleanliness. If you have a lot of animals, or they get very dirty, scraping should be conducted on a regular basis (every few hours, for example) in order to keep alley ways clean and dry. Using an automatic or a robotic scraper can save you a lot of time compared with doing this manually. Automatic scraping can even be done while the cows are still in the barn, rather than waiting until they are taken out for milking, but they need to be trained slowly as the risk of injury caused by contact with the scraper is high if the cows are not expecting it. Care should also be taken to ensure that the chain used to pull the scraper is not one that the cows could step on and injure themselves. It should either be made of material that will not injure the cows’ feet, sit in a channel slightly beneath the alley surface or have a protector/cow safety cover over it to prevent damage to both the scraper and hooves.

![Image of cows in a barn with a scraper]

Some countries use “flushing” systems to flush water through the alley ways to clean them. While this method is useful in some set-ups, these systems can result in higher incidences of infectious hoof diseases as the dirty water acts as a disease carrier. If this type of system is used, it’s important that flushing is only carried out when the cows are not in the barn to reduce the risks. Alley ways should be properly draining and allowed to dry before cows re-enter.

Bedding treatment
A bedding treatment with good slip resistance can be added to areas of particular concern for extra grip and moisture absorption. This can be especially important in feed passages and around water troughs where the floor is often wet. A bedding treatment will also stick to the hooves and help to dry them.

![Image of a hoof wearing a bedding treatment]
Cubicle box
There are many different stall designs, most of which will work well. It is very important to observe the cows’ reactions to stalls. Don’t just get out the tape measure, watch cows get up and down in the stalls, especially the largest cows.

Cows in a stall should rise to stand as they would outside on pasture. Cows need to bob their heads down and forward so that they can shift their weight from their back legs when they stand. In a stall, cows can either bob forward or to the side. It is difficult to give specific measurements for cubicles because of the size differences between dairy breeds and cows have also grown over the last 10 to 20 years. It is normally recommended that cows have at least 47cm of head space and 168cm of space for their body. On top of that, lunge space must be provided (at least 30cm). Therefore, the stall should be 245cm long unless cows are able to lunge forward into the space beyond the stall – such as into an opposite cow stall, alley or outside of the barn. If a stall is barely 215cm in total length, it must allow the cow to lunge sideways as she gets up. Bending the bottom of the stall loop out of the cow’s way (either higher or lower) will allow cows to lunge sideways. Install a brisket board on the stall floor. Brisket boards should be 168cm from the stall curb and 15–20cm high with a 60 degree angle. They help prevent the cow from crowding to the front of the stall, brace her as she gets up and keep the stall cleaner. The cubicle base should drop by 10 cm from front to rear to help drainage, and should have a step of no more than approximately 18 – 20 cm down into the alley way. This gives a slope of around 4% to the cubicle box. If the step is too low, the cubicles are more likely to become soiled or contaminated, particularly with the flushing systems used on large farms in the US.

Problems occur most often on farms that use old buildings to house their cows, or those that increase their herd size or continue to breed larger cows for higher production but never change the size of the stalls.

Uncomfortable stalls or bed surfaces are likely to result in less frequent or shorter resting periods and increased standing time on hard surfaces. As shown in a study by Galindo and Broom (2000), this alters cows’ natural behaviour cycles and overburdens their claws, potentially increasing structural hoof damage and making them more susceptible to sole, interdigital and heel lesions. If beds are uncomfortable, a cow may choose to lie in the alley way, exposing her to the risk of bacterial infection and mastitis. Stalls should be comfortable enough to encourage cows to lie down there rather than somewhere else.

If stalls are too small or the wrong shape, preventing cows from rising comfortably, they will delay trying to rise through fear of hurting themselves on a neck rail or by not having enough space to lunge using their head as a balance. These cows are therefore inclined to lie for too long, eat and drink less, go to the feed area less frequently and consequently consume less dry matter. This leads to a yo-yo feed intake pattern where individual meals are fewer but larger
and cows will probably produce less milk. This can be associated with an increased risk of laminitis; to avoid this, cows should eat small meals often (see the “Nutritional factors” section for more details).

Other common problems with stalls that are the wrong shape, too small or have protruding curbs, are injuries and abrasions to the inside (or medial) of the hocks. If these are continually banged or rubbed on the curb, hair loss, open sores, swelling and infection can occur, often resulting in lameness. Use of bedding often helps to prevent this but it should be of good quality and regularly changed or cleaned.

**Bed surface and bedding material**

There are several critical factors that must be considered when planning free stall surfaces. The surface must be durable and easily maintained. It must be well drained and/or resilient to water. It should not be slippery and should give secure footing to prevent potential injuries. The flooring should be soft and comfortable rather than hard, cold and damp. The surface should be made of inert material so pathogenic organisms will not grow. The cost of the surface has to be considered relative to its potential for reducing or increasing animal injuries.

There are various recommendations for tied-up and loose housing systems. The main one is that the cow stands and lies down on the same flooring. For this reason, cow mat solutions for tied-up systems should provide soft bedding and support solid standing. A hard or uncomfortable bed surface is detrimental for cow lying and rising behaviour; lame cows are especially sensitive to the material used as it can hinder their ability to do so. They will avoid lying and rising if their bed is hard because it is painful. Cook (2004; 2006) demonstrated this in studies where the use of sand particularly benefitted mildly lame cows, rather than unyielding harder surfaces, due to its ability to supply cushion and traction that allowed the cows to rise and lie down more easily without fear of slipping. Cook therefore recommends the use of sand to improve stall use and thereby promote resting time and good claw health.

The most common bedding materials worldwide are sand, straw, sawdust and lime. Research (such as the above-mentioned example) shows that cows prefer sand for lying down in the stalls, but mattresses are close behind. If switching over to sand bedding, please bear in mind that all manure handling equipment needs to be adjusted for sand, because sand and manure should be separated. The main disadvantages of sand are cost and availability. Sand is more expensive than other materials and is not available in all regions.

Organic bedding materials contain carbon, which is food for bacteria (including those of infectious hoof diseases). But carbon is not sufficient to support bacteria growth by itself. Bacteria also need warm temperatures (close to body temperature) and moisture (from leaking milk, urine, manure or wet feet). If one of these conditions isn’t available, bacterial growth will be limited. As we can’t control either of these conditions, bedding treatment can be used to inhibit bacterial growth and prevent transmission of infectious hoof diseases (see “Bedding treatment” section below). Cow mattresses are a good bedding type for barns. Try to use adequate straw, sawdust or hygienic bedding material. This will keep the bedding clean and dry, depress bacterial growth and keep the cows clean for easier milking.
Cubicle assessment
It is possible to assess cubicle design on four critical points as described by Nordlund and Cook (2003). These are adequate surface cushion, adequate body resting space, lunge room for head thrust and an unobstructed bob zone, and adequate height below and behind the neck rail. It’s also important to remember that stalls can have multiple problems and may not only be affected by one factor!

Bedding treatment
A bedding treatment can be added to the rear third of the cubicle to help to absorb moisture on the bed as well as the hooves. If it is slip-resistant, it can also serve as grip for rising or lying, which is particularly useful for lame cows.

Feed table
Through continual observation of your cows, you can learn many things about your farm and your animal health. For instance, if your cows are straining to reach food it’s likely that they are overloading their front claws, resulting in uneven growth and wear, and also that they are hungry. Cows spend around four hours a day at the feed fence and it’s a good initiative
to push feed towards them a few times a day and also to tilt the feed fence forwards slightly (approximately ten degrees) so they can reach the feed table easily. The table should neither be positioned too low or too high, so that cows are forced to get on their knees or to step up to get to the feed. The table should be ideally be around 10–15cm higher than the floor where the cows are standing.

**Ventilation**

It is especially important in a housed system that ventilation is adequate, to help prevent the transmission of disease and to prevent cows suffering from heat stress in the summer. Dairy cows eat and transform feed energy into milk and meat, but they also breathe, defecate and urinate – all of which release moisture and gas into the air. The primary role of any ventilation system is to provide an adequate supply of fresh air inside the barn all year round, to obtain acceptable levels of moisture, gas, dust and odours and also to warm the building during colder months (see DeLaval Efficient cow comfort booklet for more details on ventilation types).

**Disease**

When animals are sick, they shed pathogens, and if these are not expelled by the building’s ventilation system and fresh air, the bacteria will infect other animals, increasing the risks of infectious hoof diseases. Young animals (especially calves), or those calving, have a lower or less developed immunity than older animals, meaning they have little protection and are more susceptible to disease. Areas where these animals are housed should be warm but particularly well ventilated.

**Humidity**

High humidity in the barn also contributes to higher levels of airborne pathogens that make animals more susceptible to hoof problems and the like. In a well ventilated building, a cow’s coat will be free from moisture.

**Dust**

Every farm collects dust, consisting of both organic and inorganic material. A large proportion of dust is organic and comes from feed, dried manure, hair and skin, pollen, insect parts, moulds, fungi, viruses and bacteria. At high levels, these particles can be particularly irritating to the respiratory tract and cause breathing problems and coughing. This can cause cows to stand still rather than exercise so they don’t aggravate the respiratory system. This results in reduced blood circulation to the hoof.

**Ammonia**

Ammonia is released when bacteria decompose the urea in manure. High levels of ammonia in the air can suppress the animal’s immune system, causing reduced growth rates along with respiration problems, increased stress and lower production. Maintaining a barn and manure temperature close to that of the outside air can help limit the release of ammonia.

**Insects**

Insects are also attracted by barn odours. Insects carry a risk of bacterial and viral transmission between animals, equipment and into the milk itself, so good ventilation is essential to help keep these away.

**Heat stress**

The effects of heat stress on dairy cow physiology and productivity have been well documented. The first signs of heat stress can be seen at 20°C, where sweating and accelerated respiration may be observed. Heat stress can cause milk yield to decrease by about 10 percent or more, and reduce reproductive performance, while heat stress during late gestation has been reported to reduce birth weight and subsequent milk production. Heat stress is a major health risk as it can dramatically affect hoof health as well as somatic cell count.
Temperature and humidity combined determine the level of heat stress (THI index). In a hot environment, a cow controls her metabolic heat production by reducing her feed intake, which leads to a decline in milk production. Heat stress occurs when a cow’s load exceeds her capacity to lose heat, and as reported by Zinpro (fact sheet – heat stress), cows exposed to heat have a lower rumen pH than cows exposed to more moderate temperatures. Shearer and van Amstel (2003) and Grant (1997) explain that this in turn causes metabolic acidosis, vasoconstriction/vasodilation, laminar destruction and weakened claws due to a breakdown of the supportive connective tissues and poor quality horn formation. This leads to an increase in claw lesions and lameness. Cook (2004) found that the incidence of hoof lesions were highest in September and could be the result of heat stress over the previous two or three summer months.

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**Bedding treatment**

Adding a bedding treatment could help to absorb extra moisture from the barn air as well as beds and help eliminate manure and ammonia smells. This in turn will help reduce insects, raise productivity and reduce ventilation costs.

**Worker safety**

Poor air quality and high dust levels not only affect the animals but farm workers too, increasing their risk of contracting respiratory diseases or problems, especially in winter. If levels of dust and ammonia are high, workers are advised to wear a mask that covers their mouth and nose to prevent inhalation.

**Exercise**

Good blood circulation in the hoof is maintained through exercise as the heel and digital cushion force blood to flow around the hoof and out again. Cows that lie down for too long risk their hooves weakening due to the lack of good blood supply and nourishment required for horn formulation. Sick animals should also be encouraged to move around in order to maintain hoof strength.

Although exercise is important, too much exercise can be detrimental to the hooves as this can lead to excessive wear on the soles, which can be easily damaged. As Blowey (1993) describes, lameness in young heifers or bulls introduced to a cubicle shed can often be attributed to this.

**Trimming**

The goal for regular and functional (preventative) claw trimming is to correct asymmetric claws, equalise weight distribution and reduce the risk of claw lesions and lameness through early detection. Most overgrowth occurs at the toe, preventing the cow from walking naturally and resulting in a short, stiff gait. When the toe is long, the sole at the toe becomes thick, forcing the weight-bearing axis back toward the heel, often resulting in the weight bearing forces being concentrated over the sole and heel ulcer sites. By reducing the toe length and sole thickness with trimming, the weight bearing axis can be moved forward again away from the sole and heel ulcer sites, thereby decreasing the potential for ulcer development. As described by Kloosterman (2004), routine trimming is meant to prevent lameness but, if overdone, lameness can also be caused. It is therefore important to consider the farm conditions when deciding how much trimming is necessary.

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**Did you know?**

An easy way to check whether your barn is appropriately ventilated is to check that the temperature is no more than 5ºC higher than outside and that there is no strong smell of ammonia. i.e. “If it smells like a barn it needs more ventilation” (Graves, B. cited by Tyson, J.). If moisture condenses on the inside of the building and equipment or cobwebs collect, ventilation or air flow is not adequate. Other signs can include animals coughing, nasal discharge or cows breathing through the mouth.

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The diagram shows the preventative trimming needed to shorten the claw and trim the abaxial wall. The claw tilts forwards and outwards so that the body weight is shifted in that direction. The claw will then rest more on the wall, where a strong vertical connection helps to absorb the force of the body weight. This means the corium in the sole is loaded more evenly and less heavily.

In the case of lameness, curative trimming is often necessary in order to transfer the weight bearing from the painful claw to the healthy one (see the “Treatment of a lame cow” section). Overgrowth, overburdening and altered weight bearing mean that the claws of dairy cows require regular evaluation and trimming. In some cases, the rate of horn wear is in balance with the rate of horn growth, despite the effects of weight bearing, and trimming is not required. In other cases, horn growth exceeds the rate of wear and trimming is required to correct weight bearing disparities. In free stall-housed dairy cattle, the wear rate often exceeds the growth rate and trimming only exacerbates an already serious problem. Good foot care and claw trimming requires an understanding of the anatomy of the foot and the dynamics of claw horn growth.

It is recommended that claws are checked at least two or three times a year and trimmed if necessary. This is normally done just before cows are dried off, two or three months post-parturition and once more if required. You can trim the whole herd at once, trim in groups or practice individual trimming. Only an experienced individual should trim the hooves, using sharp tools as well as restraint equipment to prevent injury to both person and animal.

Foot bathing
Various management tools are available to help reduce lameness and the losses resulting from it, as documented above. Infectious lameness, however, is particularly hard to combat. Prevention of infectious lameness is far better, cheaper, and more successful than treatment and foot bathing is recommended for the control and prevention of infectious hoof disease. In outbreaks of disease, foot bathing is necessary to prevent animals from becoming chronically infected. But footbaths should always be used routinely as a measure to control infectious hoof diseases and not to cure them, just as teat dips are used daily to control mastitis. Footbaths are not a substitute for good hygiene management, but they do assist in the control of the environmental factors that make hoof management so complex.

Footbaths and solutions
Footbaths are most commonly used to prevent and control DD. The most widely used formulations including formalin solution (5–10 percent), zinc or copper sulphate and quaternary ammonium compounds, or other commercial multi-compound products, in various strengths. Veterinarians sometimes also prescribe antibiotics for use in footbaths, but antibiotic treatment is expensive; it involves a milk withdrawal period and it is thought that the bacteria that cause DD can become immune to it, so it is generally advised to only use antibiotics minimally. Some footbath solutions have drawbacks and should be used carefully. Formalin is banned in many countries as it is known to have carcinogenic properties and is very unpleasant to handle; use of this product is therefore not recommended. Heavy metals like copper and zinc salts are also rapidly becoming more tightly controlled due to potential damage both to animals (copper
toxicity of ruminants) and the environment, as these substances build up and are completely non-biodegradable. To prevent hoof diseases effectively, while limiting the effect on the environment, biodegradable hoof care solutions are generally recommended.

Placement
The best location for a footbath is in the exit lane from the parlour or AMS, with enough space to prevent a build-up of cows. In an AMS, the best position is at least one cow length after the exit of the milking station in order to minimise exit times. Footbaths can also be placed between the feeding and resting area in these set-ups if well defined and separated by one-way gates. It is also possible to put a two-way separation gate at the exit of AMS. One way the cows can exit normally, the other way would take them through a foot bath. With this gate, the farmer can establish an automatic foot bathing routine for his cows and can keep it clean on the days it’s not used. Most baths are singular, walk-through style, but a wash bath can also be used in a twin footbath set-up.

It’s important that footbaths are placed in a well lit area, alley ways are kept clean and dry and baths are either regularly cleaned or cows can go via another route when the baths are not in use. Cows often have to walk through an empty bath and, if manure is allowed to collect here, it will become a slurry pit and a reservoir for disease. An alternative option is a plastic or fibreglass footbath that can be lifted out of the way when not in use, or an automated footbath that is flushed out automatically at preset times during the day to eliminate manure. It is also important to ensure that the area has good drainage, otherwise manure, water and footbath solution may collect in puddles.

Footbaths should be at least two cow strides long, as every hoof should ideally enter the solution at least once. The solution should be deep enough to bathe the interdigital space (approximately 12cm deep) and foot bathing should be carried out at frequent intervals depending on the level of infectious disease in the herd. Recording and documenting foot bathing (see the “Lameness detection and diagnosis” section) can help to determine this level.
**Frequency of use**

To maintain a low level of disease in a herd (less than 5 percent for example), foot bathing once or twice a week is generally considered sufficient by some advisors or experts. However, if the level is higher (10 percent or more) the frequency should be increased to perhaps three or four times a week. In a herd where the level of disease is high at around 20 percent or more, foot bathing should be carried out every day following the product dosage instructions.

Note that this frequency indication is only a guide and a veterinarian should be consulted if the incidence of disease in your herd is high. Prompt and proper treatment of a lame cow with painful lesions (see the “Treatment of a lame cow” section) should never be avoided.

Infectious hoof disease and hoof health can take a while to improve and if you switch products, or start using a new product, it could be a number of months before a marked improvement is seen. Remember, these solutions are meant as a preventative method not as a cure. It’s therefore important to be patient and not stop using a product after only a couple of weeks if your cows still appear lame. Lesions go through important changes that reduce their severity and stopping treatment too soon will also stop this positive action. Some farmers prefer to rotate between products, although it’s unclear whether this necessarily helps the situation or just eases the mind of the farmer.

Footbaths should be replenished at least after every 200 cows (more often in an AMS as the solution sits for long periods of time) and fresh solution should be used for each bath. Many footbath solutions are neutralised by the addition of manure, or over time, and so need to be replenished to make sure the cows receive the full benefit of the solution. Leg hygiene scoring is a good way to see how clean or dirty your cows are. Cook (2007) describes leg hygiene scoring as an indicator of how regularly foot bathing should be carried out. He recommends that manure accumulation on the rear hooves and legs of at least 20 percent of the herd should be scored on a 4-point scale. In herds where less than 25 percent of the cows score a 3 or 4, foot bathing can be carried out as necessary; DD will rarely be a problem. Conversely, in herds where 75 percent or more cows score a 3 or 4 then foot bathing is probably necessary seven days a week.

**Leg Hygiene scores. Source:** Cook, 2007.

<table>
<thead>
<tr>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
<th>Score 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Clean" /></td>
<td><img src="image2" alt="Slightly dirty" /></td>
<td><img src="image3" alt="Moderately dirty" /></td>
<td><img src="image4" alt="Very dirty" /></td>
</tr>
<tr>
<td>Clean</td>
<td>Slightly dirty</td>
<td>Moderately dirty</td>
<td>Very dirty</td>
</tr>
<tr>
<td>Little or no manure contamination.</td>
<td>Where the lower limb is lightly splashed with manure</td>
<td>There are distinct plaques of manure on the foot, progressing up to the limb</td>
<td>Where there are confluent plaques of caked-on manure on the foot and higher up the limb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion of cows with Hygiene Scores of 3 and 4</th>
<th>Suggested footbath</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25%</td>
<td>As required</td>
</tr>
<tr>
<td>25 - 50%</td>
<td>2 days / week</td>
</tr>
<tr>
<td>51 - 75%</td>
<td>5 days / week</td>
</tr>
<tr>
<td>&gt; 75%</td>
<td>7 days / week</td>
</tr>
</tbody>
</table>
Pre-wash bath
If twin baths are used, with a wash bath prior to the main footbath, the wash bath should be located 1.5–2m in front to prevent carry-over and dilution of the active footbath solution in the second bath. It’s common for mild soap solutions to be used in a wash bath, to allow manure to be loosened and air to reach the interdigital space. Wash baths can be easily employed in the footbath regime but should not be used instead of chemical solutions as they do not disinfect. They do, however, mean that the footbath solution has a better chance of getting to the desired location on the foot that needs treating.

Weather
Particular care should be taken when foot bathing in cold weather and it should never be done in freezing conditions as the solution will freeze, making the alley ways and footbath extremely hazardous for your animals. An increase of infectious hoof disease is often attributed to the difficulty of foot bathing in the severely cold months of winter.

Spraying
Spraying in the parlour or in an automated system is another preventative measure that can be taken. Hooves should be cleaned prior to spraying so that the solution has a chance to penetrate into the infected area and using correct dosage instructions sprayed directly onto the rear of hooves/lesions. This method is often noted as more effective than foot bathing, as you have the opportunity to treat the hoof directly with a full strength solution that is not neutralised by manure or heavily soiled with bacteria. The dilution rate for spraying is often different than that for a footbath, so always read the product dosage instructions.

Nutritional factors
The role of nutrition in lameness has been investigated all over the world, but it is a clear factor. Feeding diets resulting in a prolonged drop in rumen pH will result in a dramatic increase in lameness (Vermunt, 2004).

Nutrition
Nutrition is hugely important for a high yielding and healthy cow. Sudden changes of diet should be avoided (especially when rearing young), particularly diets that contain high concentrate. A cow’s condition particularly at calving is important as overweight cows are prone to a loss of appetite so intake of fibre decreases, and the animal becomes susceptible to acidosis and laminitis. Dry cows should have a condition score of around 2.5–3.0 and be maintained at this level until calving.

High energy rations are being fed to dairy cows more and more as they are required to produce higher yields. When this happens, not enough fibre is fed to the cow to promote proper chewing, saliva production and rumen function to maintain a rumen pH above 6.2. High fibre diets, e.g. silage and hay, stimulate rumination, increase saliva flow and neutralise the acid produced in the rumen.

Rumen acidosis
Sub-acute rumen acidosis plays an important role in the initiation of laminitis and subsequent lameness. Feeding of excessive grain, non structural carbohydrate or other feed that is rapidly
fermented in the rumen, are common factors in the development of laminitis as they incite rumen acidosis. The risk of laminitis development is lower if the concentrate to forage ratio is kept around 60 / 40.

Laminitis predisposes lameness due to claw lesions including white line disease, sole ulcers and sole haemorrhages; a disturbed circulation precedes the development. Nutrition is therefore important in the aetiology of laminitis although it is multi-factorial (Vermunt, 2004). Dairy cattle that are fed high energy diets may under some circumstances slug-feed for various reasons. When they consume large quantities of feed containing highly fermentable carbohydrates in a short period, they typically produce a lot of rumen acids, which can greatly reduce the rumen pH. When the rumen pH drops to a certain level, it tends to kill off many of the rumen organisms and endotoxins are released, impacting on the blood vessels throughout the body, including the hoof area. This can cause vasoconstriction and vasodilation and, subsequently, damage to the blood vessels. This in turn leads to serious and painful conditions; the episode is often marked by a distinct ring on the hoof horn as growth is disrupted.

Prevention of acidosis is accomplished by managing the cows’ diet. Fibre-based diets with adequate roughage, feeding buffering compounds and providing facilities where cows can eat without being rushed and forced to gulp down their meals all help to minimise acidosis. This is especially important for the younger animals in a herd as they are usually low in the social order hierarchy and therefore have limited opportunities to eat.

Protein
Some researchers believe that feeding too much protein also plays a role in the development of laminitis, as protein products degraded in the rumen produce ammonia, but the extent of this is unconfirmed. Other sources say that sulphur-containing amino acids contribute to sulphur bonds that give horn tissue the strength and resilience necessary to minimise lameness. It is known that poor quality feed increases the risk of claw lesions, particularly white line and sole lesions, and diets with an overall crude protein content of above 18 percent should be avoided.

Fat
High rations of fat (over 4 percent) can lead to secondary acidosis and should be avoided. This is due to low fibre digestion because microorganisms in the rumen become coated with fat.

Trace elements
Trace elements, particularly zinc, manganese, copper and cobalt are a key component of the nutrition programme formulated to minimise lameness. These improve a cow’s immune system, promote reproduction and tissue growth, improve energy utilisation, increase rumen fermentation and digestion and are good for bone development and strength. Stresses on a cow’s body, such as lameness, mastitis and pregnancy, increase the need for trace minerals. Ensuring the diet contains trace elements can improve hoof health and reduce lameness disorders.
Zinc in particular has a role in improving hoof condition, due to its healing effect, increased rate of epithelial tissue repair and improved cellular integrity. Zinc is also required for maturation of keratin in claw horn tissue. Manganese helps minimise feet problems by maintaining leg conformation through proper bone and collagen formation. Copper plays an important role in strengthening both the horn and connective tissue of the foot. Cobalt functions in the formation of vitamin B12 in the rumen.

**Biotin**
A ruminant is traditionally considered to be self sufficient in B vitamins, but recent studies have shown that supplementing high yielding cows with B vitamins can promote a range of performance benefits, including increased yields and reduced lameness. Feeding high concentrate diets can cause rumen acidosis and reduce the synthesis of biotin. The biotin level needs to be built up slowly after calving, but is said to reduce the number of cows requiring repeated treatment for lameness in the same digit, reduces the rate of sole ulcers and improves the healing rate of hoof lesions. Therefore, it could be said that diets that minimise rumen acidosis and its effects should be fed (Blowey, 2005).

**Toxicity and other factors**
Acute illnesses can cause horn production to be slowed down or even halted temporarily, depending on the severity. Changes occur in the hoof wall, which make it much more prone to damage, thereby rendering these animals very susceptible to hoof problems.

**Changes at calving**
A comfortable, low stress environment is particularly critical during the transition period following parturition to promote a rapid increase in feed intake and to minimise the duration of negative energy balance. These cows are also at particularly high risk of hoof damage due to a disruption in horn formation during pregnancy. It is well documented that lameness is more common during the first few months after calving, the most common problems being sole haemorrhages and laminitis. The reason for this poor horn formation is unproven, but it means that the corium is very fragile and more susceptible to bruising. Other stresses are often placed on the cow at the same time, such as a change of diet to a very rich concentrate-based feed, and introduction to a new housing system, both of which can also give rise to hoof problems. It’s also common for these cows to be more susceptible to other infections such as mastitis, as the immune system is weakened in pregnancy and parturition.

**Breeding and genetics**
Farmers today generally want their cows to be bigger and to produce more milk. However, more importantly is that, combined with good milk production, cows are selected for conformation – particularly of the legs, the hooves and the heels. It is essential that we breed cows that have good claw shape and gait and are therefore less susceptible to hoof infections. We should particularly look for animals who do not have flat feet and walk more upright, those that are not prone to sole ulcers or have genetically weak hooves and those who are not susceptible to other infectious diseases.
Lameness is a general term that indicates an animal’s walking pattern is somewhat different from normal. As we have already seen, there are several causes that can result in lameness, and there is a general consensus among hoof care experts around the world on the most common ones. Lameness problems can be divided into non-infectious and infectious, and can be caused by 17 different disorders. We will describe the most common below (see also the Treatment of a lame cow section).

**Non-infectious**

**Sole ulcers**
Sole ulcers are a very painful type of hoof lesion, whereby infection forms between the sole and the underlying tissue. Although they can arise for a number of reasons, sole ulcers are mainly associated with trauma, and can result in severely lame cows. Lesions are often caused by stone bruises or related to haemorrhages resulting from acidosis. These should be managed by either a well trained hoof trimmer or a veterinarian familiar with treating hoof problems. They may require the opposing claw to be fitted with a block to elevate the hoof so that the affected claw is relieved of pressure and has an opportunity to heal.

**White line disease**
White line disease is caused when the sole separates from the side wall of the hoof, allowing material to penetrate and infect the area, and results in a very painful condition. Walkways and waiting or holding areas need to be kept as free as possible of stones and debris. It is also important that cows are not forced to pivot rapidly which can place excessive force on the hoof and result in a separation of the sole from the hoof wall.

**Infectious**

**Foot rot**
Lameness sometimes results from bacteria invading the soft tissue of the hoof and this is often termed foot rot, or interdigital phlegmon. When the bacteria penetrate the tissue and become embedded in the hoof and between claws, they multiply and cause significant swelling resulting in pressure, which is very painful. Animals suffering from foot rot will resist placing any weight on the affected hoof and their ability to walk is severely limited. Treatment for this condition needs to be in consultation with a veterinarian who will likely treat the condition with an antibiotic preparation to try and eliminate the infection.

Foot rot is common where cattle are kept on wet pastures and around drinking areas where small sharp pebbles may be present. The causative bacteria may live in the mud in these areas and if they are driven into the hoof tissue they will initiate infection.

**Digital dermatitis (DD)**
For dairy farmers another cause of lameness has emerged over the past 20 years, whereby a lesion develops in the interdigital cleft of the claws, or at the rear of the heel, primarily on the rear hooves. These lesions occur in several stages, some of which are very painful and can produce severe lameness. Lesions are classified by severity, ranging from no lesion (O), hyperkeratotic (H), proliferative or papillomatous (P), granulomatous (G) and ulcerative (U) (see the Hoof scoring section).
This disorder goes by several commonly used descriptive terms including strawberry heel, Mortellaro’s disease and digital dermatitis.

The most commonly referenced predisposing factors for this problem include cattle being housed on constantly wet surfaces and walking continuously in manure slurry. These conditions tend to be commonplace in cubicle or free-stall housing facilities typical of many countries in Europe and North America.

In these environments, species of Treponema bacteria appear to thrive in the wet, anaerobic (oxygen free) conditions. It is postulated that these bacteria may penetrate the skin tissue in the hoof region and initiate an infection that may lead to the lesions seen in DD. The lesions that develop can take several forms, some of which are more painful than others. The ulcerative and granulomatous stages in particular can be very painful. Therefore, to reduce the number of cows that exhibit severe lameness, the management objective must be to reduce the number of these lesions to a stage that is less painful.

Unhygienic housing conditions
The aim of treatment is to alleviate pain, and treatment success is determined by early and effective intervention. Early intervention is only possible if a lame cow is identified at an early stage and immediate action is taken. Researchers have found that almost all dairy farmers underestimate the prevalence of lameness in their herd. This means that a significant number of lame cows go untreated because the farmer does not recognise them as lame. It is therefore important that the farmer or other people working with the cows are trained to recognise lame cows. Regular observation of the cows’ gait is the only way to recognise lameness at an early stage and should be part of the daily management.

Treating lame cows is a job that is easily postponed on many farms due to the time pressures of other jobs. But a lame cow is a financial burden as well as a welfare concern, and therefore immediate action is essential. Treatment of lame cows should be planned into the daily or weekly work routines, and not just when there is some time free.

Effective intervention is only possible with a good understanding of what to look for and what to do. A treatment plan should be made together with the herd veterinarian. The person treating the cows should be trained to recognise the different diseases as it is important to find the right cause of the lameness before treatment commences. It is not unusual to find a number of abnormalities or a mixture of infections on one claw, with one causing more discomfort for the cow than the other. In this case, it is important to find them all and treat each one as necessary.

Most lameness in dairy cows is related to lesions in the claws. Only a few cases are related to upper leg problems. To be able to have a good look at the claws and to treat them well, the leg of the cow must be lifted. The safest way to do so is by using a trimming chute. A good trimming chute should be placed in an area where it is easy to bring the cow, with plenty of light and space. It is important that the job be carried out in a way that is safe for both the person and cow.

Recording treatments plays an important role in identifying the causes of lameness on the farm and steering the prevention programme (see “Lameness detection and diagnosis” section for more details).

Treatment of a claw always starts with curative or corrective trimming and sharp trimming knives are essential for this job. Overgrowth should be removed, bearing surfaces should be flat to preserve outer weight bearing, and loose horn should be removed. In the case of a non-infectious claw disease like a sole ulcer or white line disease, the hard horn around the affected area has to be removed to prevent pressure and irritation. Practical training is essential to do a good trimming job.

In the case of an infectious claw disease, the lesion needs to be cleaned and dried. A topical medicine such as a spray, gel, or paste should then be applied. The medicine or disinfectant used should comply with local regulations and discussed with the herd veterinarian. The claw should be checked after three days, and the topical treatment repeated. In severe cases, and where there is a lot of swelling and the foot is hot below the fetlock joint (foot rot/interdigital phlegmon for example), parental antibiotic treatment can be necessary. Consider that while antibiotic treatments are sometimes necessary and important, they are frequently misused as most lameness cases only require pain relief. Antibiotic treatment also means that the cow needs to be marked and the milk withdrawal period must be observed.

Sometimes a bandage can be used to protect a lesion or infection and make sure the medicine stays in place. It is important that the claw is well cleaned before putting a bandage on and that the bandage does not pinch off. It’s essential that the bandage is removed after three days otherwise it can provide an excellent environment that some bacteria thrive in. A bandage that is not removed in time will also start to irritate and pinch the skin with severe open lesions as a result.
Resting the affected claw is highly beneficial to promote healing and pain relief. Sometimes the weight bearing can be relieved from the affected claw by extra trimming to make it longer than the sound claw. If the claw needs longer to heal and the cow is in a lot of pain, the sound claw can be elevated by applying a claw block to relieve the weight bearing from the affected claw altogether. This encourages the cow to move around again and to feed as the pain is relieved. In most cases, it also means that she can be returned to the herd. There are several types of block but they all need to be applied to a dry, clean claw. The block should be appropriate for the claw shape and size and it is important to ensure that the block is not placed too far forward as this will make the cow walk on her heels and therefore be more susceptible to infection. Claw blocks should be checked regularly to make sure they remain correctly positioned to provide weight bearing relief for the affected claw.

With some severely irreversible claw problems, or for conditions such as septic pedal arthritis, amputation of the claw can definitely be considered as an option. In most cases, amputation is associated with rapid recovery and immediate, dramatic pain relief.

When treating the claw of a cow that is lame on one particular leg, it is a good idea to check the claws on the other legs as it is not uncommon to find lesions there too.
Lameness is also a major health and welfare problem in sheep and goat herds. As with cows, it creates pain for the animal and economic losses for the farmer due to decreased herd performance. Lame sheep and goats have a lower body condition, a lower wool value (sheep), a decrease in milk let down, reduced growth rates in the young and a lower fertility rate.

Effective management of hoof health in these animals is difficult but should be based on good nutrition, good management, preventive measures, accurate diagnosis, hoof trimming and prompt treatment where necessary. It should be noted that sheep are very susceptible to contagious diseases such as Foot and Mouth Disease (as are cows), which can also present itself as lameness initially.

As with cows, high stocking should be avoided and a healthy diet (including zinc supplements to promote healthy horn growth) should be fed. Low roughage diets or sudden access to large amounts of high energy feed can create hoof problems and laminitis in these animals too, which in turn leads to severe laminitis problems and severe lameness.

A good herd health plan for sheep and goats should contain:
• Vaccination programme
• Control of internal and external parasites
• Pasture management
• Foot bathing

A successful foot bathing regime should include walking the animals through a pre-wash bath if the feet are extremely dirty, followed by a fresh, clean footbath solution, and letting them stand or rest in dry, clean areas (housed or on pasture) after bathing.

Stand-in zinc based footbaths are normally used rather than walk-through baths to allow the solution to start working. Commercial products can also be used as long as they do not contain copper and do not harden the hooves.

Caution: copper-based footbath solutions should not be used for sheep as it is very toxic for these animals. Copper-based products can be used for goats however.

Lameness problems in sheep and goats can be divided into non-infectious and infectious.

Non-infectious

**Shelly hoof**
This common condition appears as a pocket as the outer wall of the claw loosens. A cavity forms between the horn and hoof, which fills with soil and manure. The lameness often affects one foot, usually at the front. Merinos are more susceptible to this disease than European and British breeds.

**Foot abscess**
Abscesses develop from bacterial infection of a foot where trauma has previously occurred and was not treated promptly. Animals suffer from severe pain and are very lame. Swelling usually occurs above the coronary band with pus often bursting out. After this, it appears that the animal has recovered. Foot abscesses most commonly affect the front feet of sheep and goats.

**Arthritis**
Arthritis can affect animals of all ages, but is usually more common in young animals than older ones. Infection arises from lambing in unhygienic conditions, usually entering through
the umbilical cord. The animal becomes lame and “carries” the infected leg. In many cases the infected leg is swollen at the knee joint. In most cases, arthritis can only be treated with large doses of antibiotics. Prevention is preferable and can be achieved by keeping lambing sheds and pasture areas clean.

**Infectious**

**Foot rot**

Foot rot is a highly contagious disease in sheep, commonly present in soil and manure. Wet, muddy and dirty conditions cause the interdigital space to soften and become more susceptible to contamination. Hill ewes are less susceptible than lowland breeds. After invading the interdigital space, the bacteria penetrates deep into the tissue and horn, leading to separation of the horn near the heel. Symptoms include swelling, pain, severe lameness and a foul smell, and in mild cases, reddening of the skin between the claws. Treatment should involve topical treatment with an antibiotic, foot bathing and separating infected animals from the herd. Vaccination against foot rot should form a vital part of the health control programme.

**Scald (interdigital dermatitis)**

Scald is easily spread through the herd and affects animals of all ages, but particularly young animals. Animals kept on long, wet grass are especially susceptible. The skin between the claws becomes inflamed, moist and swollen, but there is no separation between the horn and the skin. The best method to prevent scald is foot bathing.

**Contagious ovine digital dermatitis**

This condition is highly contagious and spreads quickly through the herd, often affecting over 40 percent of the animals. First symptoms occur at the coronary band rather than the interdigital space. The cause of this disease is not yet understood, however many bacteria, including Treponema spirochaetes (strains similar to those found in cows) have been identified. There is little that can be done to prevent this disease other than keeping flocks in dry pastures or housing.
A key challenge with hoof care products is that they need to be sufficiently effective under high soiling conditions. This results in formulations with relatively harsh ingredients, classified as dangerous preparations. This section discusses different safety aspects of hoof care products.

1. User safety
Hoof care product users are exposed to the product in several situations: during dilution, filling, cleaning and refilling of the footbath. Most hoof care products are highly concentrated solutions. They contain somewhat harsh ingredients because microbicidal efficacy is challenged by severe contamination such as manure. Therefore, such products are often classified as dangerous preparations. For most hoof care products, it is recommended that protective clothing, gloves and safety goggles be worn, particularly during dilution where the user is exposed to the concentrate. The danger symbols and safety precautions are clearly stated on the product label, which should always be read carefully before use (in particular the risk and safety phrases!). More detailed information can be found on the materials safety datasheets, which should accompany any chemical with dangerous properties during transport and use.

2. Cow safety
The cow is normally only exposed to the diluted hoof care solution, and the only exposed areas are the hooves and to a lesser amount the lower legs by splashing. Local reactions on the hoof are possible, but are not expected for most products because the formulas have been developed and tested so as not to pose any risk to the target species. In healthy hooves, significant absorption of footbath solution components is unlikely and therefore no residues are anticipated in meat or milk. Only in the case of open wounds is an increase in absorption an issue, possibly resulting in tissue residues.

3. Environmental safety
Waste water from footbath solutions may end up in the environment through the land, disposal into surface waters and at the waste processing plant. The disposal of waste from dairy farms depends on national and local regulations and the danger classification of the solution should also be taken into account.

A product’s danger classification is based on the concentrated solution. However, the diluted product is not necessarily classified as dangerous for the environment. Depending on national and local regulations, waste water from footbath solutions may indeed be spread over the land in some countries, but in most countries such waste water (possibly mixed with manure) is regularly collected by a waste processing organisation. In all cases, the biodegradability of such waste is very important. Little actual data is available on the biodegradability of formulations, but this can be estimated by evaluating the biodegradability of relevant individual components. For example, surfactants should comply with the biodegradability criterion (≥60 percent in 28 days) according to the European Detergents Regulation. Furthermore the biodegradability or persistence of other ingredients such as active ingredients and solvents can be evaluated. With the upcoming entry into force of the Biocidal Product Directive (BPD), it is expected that suppliers of biocidal hoof care products will pay more attention to the environmental risks of their products, possibly resulting in more environmentally-friendly hoof care products. Hoof care products fall into the BPD category “Product type 3: Veterinary Hygiene.”
Biocidal Products”. In this category, formaldehyde and some quaternary ammonium compounds (but not all) are supported for registration. If these active substances are accepted after finalisation of the review process, they will continue to be allowed in footbath solutions. It is expected that only efficacious and safe active ingredients will make it through the BPD review process. Copper sulphate is not supported for Product Type 3 registration and it will therefore not be permitted in hoof care products in the future. Finding a balance between acceptable efficacy and reduced hazard to the environment for hoof care products will be a challenge in the near future.
XIII. Acknowledgements

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References and links


## DeLaval Farm survey

Survey Date: __________________________

Dairy Name: __________________________ Owner: __________________________

Address: __________________________

Phone: __________________________ Email: __________________________

Survey Performed By: __________________________

Staff Names - Contact: __________________________

### COWS

- **Breed:**
  - Holstein
  - Jersey
  - Guernsey
  - Ayrshire
  - Brown Swiss

- **Total number - Milking:**

- **What foot care is provided to heifers before entering the milking string?**
  - Nothing
  - Treatment - if needed
  - Trimming & Treatment
  - Walked through foot bath for _____ days

- **What happens to lame cows?**
  - Segregated
  - Returned to remainder in milking string after treatment

- **Replacement practice:**
  - Purchased
  - Raised
  - Raised & Purchased

### PARLOR

- **Parlor flushing system:**
  - No
  - Yes

- **If "Yes" type:**
  - Hose
  - Surface Flush
  - Other: __________

- **Flushing frequency:**

- **Flushing water source:**
  - Potable
  - Lagoon
  - Plate Cooler Water
  - Rain Water
  - Wash System
  - Other: __________

### DAILY PROCEDURE

- **Number of milkings/day:**
  - 2 Times
  - 3 Times
  - 4 Times
  - > 4 Times

- **Standing time in holding pen:**
  - (Calculation: Time for last cow, minus first cow, divided by number of cows, or total time)

### HOUSING

- **Housing Type:**
  - Free Stalls
  - Dry Lot
  - Pasture Grazed
  - No Stalls (stanchion)

- **Passage way type:**
  - Concrete
  - Grooved Concrete
  - Slatted Floors
  - Rubber Floors

- **Bedding type:**
  - Sand
  - Straw
  - Green Shavings
  - Dried Shavings
  - Dried Manure
  - Rubber Mats
  - Mattresses
  - Other: __________

- **Passageway cleaning method & frequency:**
  - Scraper
  - Automatic Scrapper
  - Dried Shavings
  - Dried Manure
  - Rubber Mats
  - Mattresses
  - Other: __________

- **Water source, if flush:**
  - Potable
  - Lagoon
  - Plate Cooler Water
  - Rain Water
  - Wash System
  - recycle
  - Other: __________

- **Bedding maintenance and refresh frequency:**
  - Daily or more
  - 1-2 Times/week
  - Weekly
  - Monthly
  - Never

- **Bedding cleanliness - % if area wet or soiled in back half of stall:**
  - Observed 1-2 hours prior to milking:
    - 0 - 20%
    - 21 - 40%
    - 41 - 60%
    - > 60%
## Hoof Trimming
**Frequency of Hoof Trimmer’s visits:**
- [ ] Daily
- [ ] Weekly
- [ ] Bi-Weekly
- [ ] Monthly
- [ ] 6 Months
- [ ] As needed

**Eligibility:**
- [ ] Lameness only
- [ ] Dry only
- [ ] Lameness & Dry
- [ ] Heifers
- [ ] Maintenance all cows

**Hoof trimmer is:**
- [ ] Employee
- [ ] Independent

**Warts (DD) - treatment method:**
- [ ] Topical Spray
- [ ] Treatment with Wraps
- [ ] Treatment without Wraps

**Treatment product:**
- [ ] None
- [ ] Antibiotic
- [ ] Commercial Non-Antibiotic
- [ ] Custom Mixture

## Footbath
**Types of footbath(es):**
- [ ] Treatment
- [ ] Pre-Wash & Treatment
- [ ] Automated
- [ ] Depress

**Number of baths:**
- [ ]

**Bath volume:**
(Take measurement in inches to calculate volume.)

- [ ]

**Location of bath(s):**
- [ ] Parker Exit
- [ ] Other:

**Current footbath product:**
- [ ]

**Recent product changes:**
- [ ] No
- [ ] Yes - When?

**Alternating products, if applicable:**
- [ ] Product:
- [ ] Dosage:
- [ ] per

**Dosage of footbath product:**
(Measure in cwt or per horse, if possible)
- [ ]

**Frequency of footbathing:**
- [ ] Mornings
- [ ] Noon
- [ ] Evening

**Refresh:**
(Number of cows between refresh)
- [ ]

**Benefit perceived from footbathing:**
- [ ] Prevention
- [ ] Care/treatment of existing condition
- [ ] Other:

**Previous product routine:**
- [ ]

## Herd Health - Current
**Overall lameness:**
- [ ] Estimate (by owner or herdsman):
- [ ] Measured (by locomotion score):
- [ ] Yes
- [ ] No
- [ ] % of herd examined:

## General
**Is there vet assistance for lameness?**
- [ ] Yes
- [ ] No

**Advice for hoof care given by:**
- [ ] Vet
- [ ] Trimmer
- [ ] Nutritionist
- [ ] Extensions
- [ ] Dealer

**Other:

## Comments
- [ ]
Body condition score

<table>
<thead>
<tr>
<th>Body condition score chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body condition Score</td>
</tr>
<tr>
<td>1. Severe under-conditioning</td>
</tr>
<tr>
<td>2. Frame obvious</td>
</tr>
<tr>
<td>3. Frame and covering well balanced</td>
</tr>
<tr>
<td>4. Frame not as visible as covering</td>
</tr>
<tr>
<td>5. Severe over-conditioning</td>
</tr>
</tbody>
</table>


**BCS = 1.5**
This cow is too thin and this is hopefully rarely seen on a farm. This cow will not milk well or reproduce and probably isn’t healthy. The vertebrae, short ribs, hooks, pins, and tail head are very sharp and visible. One-half of the length of the transverse processes is visible. The ligaments are easily seen and the area around the tail head and the dish of the rump (thurl) are very dished. There are folds of skin seen between the tail head and pins.

**BCS = 2**
This cow is very thin, causing low milk production and poor reproduction although her health may be OK. The spine and short ribs can be easily seen, but the individual vertebrae are not really apparent. The short ribs appear scalloped. The upper surfaces of the short ribs can be felt. One-half to a third of the length of the transverse processes is visible. The hooks and pins stand out. No fat can be felt on the pin bones. The ligaments are sharp and easily seen. The areas around the tail head and the thurl area are very dished. There are folds of skin between the tail head and pins.

**BCS = 2.5**
It is a reasonable goal not to have more than 10 percent of the herd scoring 2.5 or less. This is the lowest acceptable condition score. A cow with a score of 2.5 has vertebrae showing but they cannot be seen as individual bones. The short ribs can be counted but are not scalloped. One-third to a quarter of the length of the transverse processes is visible. The ligaments are easily seen but not as sharp as with a BCS of 2.0. Both the hooks and pins are angular but some fat can be felt on the pin. The areas around the tail head and thurl are dished.
**BCS = 3.0**

This cow could be a healthy, high-producing cow. But, if a cow calves in at a score of 3.0 or less, she may not have enough body fat to use for high peak milk production and to carry her through until dry matter intake increases. At this score, the dish of the rump (thurl) is at the transition between looking like a “U” and looking like a “V”. Any cow under a BCS of 3.0 has a thurl area looking like a “V”. The backbone can be seen but the individual vertebrae are rounded. Covering the short ribs is half to one inch of flesh. Less than quarter the length of the transverse processes is visible. There is fat covering the ligaments but they are still obvious. The hooks and pins have some fat that can be felt. The area around the tail head is dished but no folds of skin are seen.

**BCS = 3.5**

Dry cows and calving cows should have a body condition score of 3.5. On this cow, fat can be felt on the backbone, short ribs, and ligaments. The hooks and pins are rounded. No individual transverse processes can be seen. The thurl is somewhat dished. The coccygeal (tail head) ligament is barely visible but the sacral ligament can still be seen. The area around the tail head is rounded and filled in but not fat.

**BCS = 4.0**

Cows calving in at this condition will eat less, lose more weight and have more metabolic problems. This cow’s back is flat because fat has filled it in. The short ribs can not be seen individually but they can just barely be felt. The hooks and pins are obviously fat. The “U” between the hooks and pins is very flat with no depression. The ligaments cannot be seen. The area around the tail head is filled in and folds of fat are seen.

**BCS = 5.0**

This cow is extremely fat and will have metabolic and breeding problems. The backbone and short ribs cannot be seen and are hard to feel. The hooks and pins are buried in fat and hard to feel. The thurl is totally filled in. The tail head is buried in fat.