DAIRY CATTLE LAMENESS - PRACTICAL SOLUTIONS TO A PERSISTENT PROBLEM

Introduction

Dairy cow lameness continues to be a serious problem on many farms, with little apparent improvement over the past 20-30 years (studies by Liverpool University in 1993 and Bristol University in 2001). However, over this same period there have been significant changes in the breeding and milk production of dairy cattle in the UK which are considered to be factors which have put an upward pressure on the level of lameness. Therefore, although the industry has made positive attempts to improve lameness we still do have very long way to go.

But why is lameness such an important issue? Should we not just accept it as part of modern dairy farming? Definitely not. It is painful to the animal, it is a serious welfare issue as cows suffer and is costly to the dairy farm business. The average case of lameness is estimated to be in the region of £180. Various studies, such as that by Bristol University in 2001, show that the incidence of lameness is extremely varied between farms but averages around 55 cases per 100 cows per year, with a prevalence at 22% (i.e. at any one snap shot 22% of the cows are lame). The average incidence equates to a financial loss of around £14,850 for the average 150 cow herd. This is the equivalent of around 1.3p/litre! In herds where digital dermatitis is a problem the cost alone is around £30 per cow in the herd, i.e. £4,500 for the average 150 cow herd.

Although we can not eliminate lameness, there is good evidence that it can be greatly reduced on all farms – a farm moving from an average incidence of lameness to the top 10% will save at least the equivalent of 1p/litre. And lameness is exceedingly painful, often compared to the equivalent of the pain humans would feel if walking directly on the lunula (quick) of their nails! Lameness also predisposes cattle to other diseases such as mastitis and ketosis and causes loss of production and reduced fertility. In addition once a cow becomes lame in one lactation she is more likely to have a lameness problem in the future.

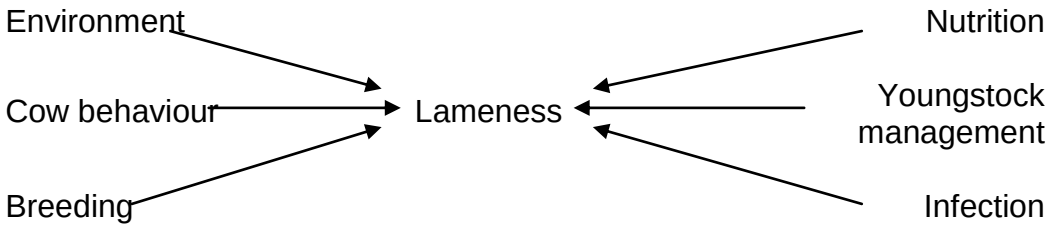
Contrary to perceived opinion, evidence coming out from the Defra funded 'Robust cow' research at the Scottish Agricultural College does suggest that high milk yields in themselves do not impinge on cow welfare any more than low yielding cows. What is clear is that there is a significant range in both incidence and prevalence of lameness between farms. This means that some farmers are considerably better at managing lameness than others This benefits both the cow's and herdperson's welfare and the profitability of the farming enterprise.

Know the problem

Lameness is a multi-factorial disorder and is generally the result of an adverse interaction between the cow and her environment. However, very many cases of lameness could simply have been avoided by paying better attention to the environment, especially the underfoot conditions. Action required is often very simple and not necessarily expensive. Even though environmental factors may not be the prime reason for an outbreak of

lameness, less than ideal conditions make matters worse and may adversely affect the success of any treatment.

What is lameness? One of the problems our industry has is how individuals define lameness. For example, many producers only consider a cow is lame when she has a diseased hoof. These producers do not take account of hock damage, sores, cuts or bruising when considering lameness. Arguably the best definition is any abnormality that causes the animal to change the way it walks (it's gait). Therefore lameness can be caused by a wide variety of foot and leg conditions, be they disease, husbandry or environmental factors. The causes and their prevention will each be dealt with separately.



Husbandry Factors

The main husbandry factors involved with dairy cattle lameness are:

- Environment (housing and underfoot conditions)
- Nutrition
- Breeding
- Cow Behaviour
- Youngstock management

Environment

Housing

Detailed information on cow housing was presented at the Defra Animal Welfare campaign held in 2005 on "Housing the Modern Dairy Cow", which can be downloaded from www.defra.gov.uk/animalh/welfare/farmed/advice/adas0506.htm#3, on the Defra CD-ROM "Reducing Injuries in Dairy Cattle" and can also be found in the DairyCo CD on Housing the 21st Century Cow.

Traditionally, straw yards have been associated with lower levels of lameness than cubicles, with cows suffering less risk of damage to knees, hips and hocks. However, straw yards have the disadvantage of requiring large quantities of bedding (usually straw), high levels of management and have a higher risk of environmental mastitis.

However, practical evidence around the world shows that cubicles need not be worse for lameness compared with straw yards. Cubicle divisions based on space sharing principles, with cubicle dimensions based on cow size and cow lying and rising behaviour together with a suitable bedded surface means that the level of lameness can be low.

Added advantages include a wider availability of type of bedding and smaller quantities (lower cost) and a lower risk of environmental mastitis.

Irrespective of the housing system chosen, the facility must provide a comfortable place for the cow to lie. A method for assessing cow comfort is to measure lying times. A cow will choose to lie down between 10 and 15 times per day with each lying bout usually of around 60 minutes duration. A cow will not lie down for too long in a single bout, as she becomes uncomfortable - her body weight causes high pressures on those points of her body in direct contact with the ground. Observational studies indicate that cows will lay down for a total of around 11.0 hours per day when at pasture.

Obviously, the less time that a cow spends lying down increases the time she is standing in passageways, loafing areas or at the feed stance. Repeated trauma, such as standing around too long (for whatever reason) affects blood supply to the hoof and so reduces horn growth and its quality. This inevitably increases the risk of the animal to develop foot related problems, i.e. to become lame.

Management of the heifer is of prime importance. Studies show that claw lesions can be evident in young, growing heifers (less than 12 months of age) . Heifers exhibiting these lesions are 28 times more likely to become lame in their first lactation. This inevitability reduces the first lactation performance. Therefore, any success in fighting lameness must start with the young animal. However, the evidence as to what housing system is best for heifers and cows is inconclusive.

Straw yards – cows prefer to lie down along the outside walls of straw yards and therefore a rectangular yard is preferable to a square yard. The distance from the bedded yard to the feed area should be as short and direct as possible and should not exceed 10.0m from the back wall to the feeding passage. This also minimises the risk of animals treading on each other as they move around the yard, reducing another risk of leg damage and hence lameness.

Lameness inevitably increases when yards are over-stocked. With the drive to reduce the unit costs of production, herd size has risen but in many cases the total area available for housing has not risen sufficiently. Also, due to the influence of breeding, cows are much larger now than even 10 years ago. This is not always taken into account when investigating lameness. In 2005, the British Standards Institute revised their space allowance recommendations for dairy cattle housed in straw yards and these are significantly different to those previously used by the industry; see Table 1 (see over).

Water troughs should not be positioned on the bedded area, as otherwise the area becomes wet and sodden which over time softens hooves. The water troughs should therefore either be located within the feed fence (which can create problems with feed contaminating the trough during delivery) or on the edge of the bedded yard but protected by a block wall so cows can only drink from the feed stance. The trough should not protrude into the loafing area as this will affect the ability to scrape the area completely.

Table 1 Minimum area allowances for dairy cattle housed in straw yards

Mass of animal (kg)	Bedded area (m^2)	Loafing area (m^2)	Total area / cow (m^2)
200	3.5	2.5	6.0
300	4.5	2.5	7.0
400	5.5	2.5	8.0
500	6.0	2.5	8.5
600	6.5	2.5	9.0
700	7.0	3.0	10.0
800	8.0	3.0	11.0

The loafing area also includes the standing area in front of the feed trough.

Cubicles - these should be of a size, type and design to provide a comfortable lying area. They must encourage cows to lie down more (this may mean that existing cubicles need to be adapted to increase lying space) and designed to stop cows from creeping forward (which will reduce their lunging space). It is vitally important to provide at least 5% more cubicles than cows in any management group. There are many supportive reasons for this requirement, including the fact that over crowding decreases lying times in cubicles. Cows lower in the social hierarchy will forfeit their place to more dominant animals, leading to extended periods of standing and a deterioration in foot health.

Both research and practical experience have shown that cubicle usage increases with cubicle size. The total length of the cubicle needs to provide body space, head space and lunging space. When rising naturally, a cow will choose to lunge forward and open fronted cubicles allow greater lunging room Although a head to head cubicle configuration provides extra lunging space, in reality animals are reluctant to lung forward into a space occupied by another cow. Cubicles which are closed at the front, such as against a wall, often reduce the forward lunging unless the cubicle length is increased. Where a closed front cubicle is too short the cow is likely to lunge to the side and a cubicle partition which allows this lunging action is imperative. However, cows which have to lunge to the side also tend to lie at an angle which can increase soiling and mastitis.

As with straw yards, the revised BS 5502 suggests cubicle dimensions which are considerably larger than found on many farms. However, recent research from the USA has demonstrated improved occupancy with even longer cubicles, with benefits to the level of lameness. These dimensions are shown in Table 2.

Table 1 – USA guidelines on cubicle length

Weight of cow (kg)	Total length of bed (m) (open front)	Total length of bed (m) (closed front)
500	2.05	2.05
600	2.15	2.15
700	2.30	2.55
800	2.40	2.70

It is important that a cubicle is wide enough to allow the cow to recline and rise easily. There are numerous types of cubicle partition currently available on the market. The overall requirement of any partition is to provide the cow with maximum comfort, while ensuring that she is correctly positioned. It must be attractive to cows, avoid exerting pressure on any part of the cow and allow cows to "share" space, to provide lunging space and to be strong and durable.

The partition also needs to impart a degree of protection to prevent injury from neighbouring animals. Many of the traditional partition designs have sections of the partition that impinge on the area the cow may choose to spread. Lower rails (often installed 400mm above the bed surface) can lead to cows becoming trapped and many partitions with a rear support leg cause damage to cows hocks and pelvis. Currently, the suspended Cantilever partition is generally considered to be the most appropriate division for cows, allowing some space sharing while easing rising. Certainly divisions with rear legs should be either adapted or replaced if lameness is to be improved.

Cubicles do need to be fitted with a brisket board, the purpose of which is to position the cow correctly when she is lying down. When the brisket board is correctly located, the cow will dung into the scrape passage and be able to rise without difficulty. The board should be angled towards the front of the cubicle to allow for the natural shape of the cow's neck and be no more than 0.1m in height. The distance from the rear edge of the brisket board to the rear kerb should normally be 1.6–1.8m.

The purpose of the head rail is to position the cow when she enters the cubicle, before she lies down. If it is too close to the kerb, it will limit the occupancy of the cubicle and cause the cow to stand "two feet in and two feet out" with the detriment to rear legs and feet. Conversely, if it is set too far forward on the partition, although the cow will stand with four feet on the cubicle, she can soil the back of the bed increasing the risk of environmental mastitis.

The height of the head rail should be between 1.2–1.25m above the base of the cubicle bed, which is commonly around 200 mm below average withers height. If the rail is set too low then it can cause injury to the cow when she reclines and rises. The head rail should be around 1.6–1.8m from the cubicle kerb. Small changes can have a large impact on occupancy, cow injury and bed cleanliness. A useful check measurement is the diagonal distance between the headrail and edge of the heelstone – it should be around 2.1m.

The height of the kerbstone/heelstone should normally be between 0.15–0.2m, with the final height of the kerb dictated by the method of slurry removal. Long scrape passages may require a slightly higher kerb to prevent slurry contaminating the back of the beds. A slatted scrape passage will allow the kerb to be reduced in height. The kerb height should not be reduced below 0.15m, as this can encourage some cows to lie partly in and partly out of the cubicle, increasing the risk of injury and lameness. Where mats or mattresses are fitted, their height should be considered in the kerb depth calculation.

One risk of injury to cows' feet and legs is where the animal slips off the back of the heelstone, jarring her rear legs. Where mattresses or mats are fitted the back edge of the material may be sufficient to allow the animal to realise her position in relation to the heelstone. The fitting of a pipe or batten at the back of the cubicle base has also been

successfully used to guide the cow. However, this can create problems with free drainage of the cubicle base and effective cleaning, so creating mastitis risks.

To minimise the risk of hock damage, contact sores, abrasive injuries and lameness in general, the cubicle lying surface needs to be comfortable to the cow and encourage high occupancy. It also needs to be easy to keep clean, non-slippery and durable. If the bedding surface is comfortable, in combination with the correct cubicle dimensions, the cows will be encouraged to spend increased time lying which will have a direct bearing on the condition of their feet and the incidence of lameness.

Studies, particularly in the USA, have found that sand based cubicles and those with mattresses were more comfortable than other surfaces (as measured by cow occupancy) and that culling tended to be lower with sand than mattresses. This was a reflection of a lower incidence of lameness with sand based cubicles than mattresses.

Passageways, collection and dispersal yards

Optimising lying conditions will minimise the time that cows are on their feet. There should never be “dead ends” within cattle buildings, such as at the end of a cubicle passage, as this increases opportunities for bullying and the consequent increased risk of slipping and lameness. Subordinate animals must be able to freely move away from dominant cows. Access points also need to be as wide as possible to prevent cows from being pushed against posts and walls and to minimise bullying - all of which increases the level of lameness. Cattle should always be moved in a calm and gentle manner, i.e. moved at their own pace and not chased by dogs or stockperson. A knowledge of cow behaviour is essential if cows are to be moved with minimal risk of injury. Over exercise, especially on hard surfaces, has been associated with the acute onset of laminitis, whereas a significant reduction in the amount of exercise (such as due to inadequate space availability and loafing areas), leads to a decrease in blood flow through the corium (nail bed) of the claw making it more susceptible to insult. Therefore we need an environment that ensures gentle movement of stock.

Poorly designed and maintained concrete floors can cause considerable sole and hoof wall injury. Excessively abrasive floors, such as new concrete, may also cause sole injury. Concrete walkways should be easily cleaned and provide adequate traction without being excessively abrasive. The floor should provide sufficient slip resistance when covered in slurry to prevent injuries from slips and falls.

Ponding of slurry has been shown to have a significant effect on cow lameness. Floors that are wet or where the cow hoof is covered by slurry increases the risk of digital dermatitis, reduces hoof hardness and increases the susceptibility to wear and damage to cows feet. As a consequence it is now recommended that the floor should be installed with a fall of around 2.0% (1:50) to assist drainage of slurry, although falls over 5% have been found to be successful. The aim is for the maximum depth of slurry to be less than 25 mm, i.e. below the coronary band. The larger the floor area available to cows then the depth of slurry is reduced, improving foot condition. Aim for at least 5m^2 of floor space per cow in the housing and feed area. In collection and dispersal yards you must allow at least 1.5 m^2 per cow. Minimise the amount of time that cows are held in the collection yard, which may mean that you need to group the cows.

Cubicle scrape passages need to be at least 3m wide and the feed standing (feedstance) at least 4m, increasing to 5m where cows back off the cubicles on to the feed passage. To minimise any degree of bullying, you need to provide at least 0.7m of feed barrier space per cow even with fully *ad libitum* feeding systems. Work from Sweden has found that putting dividers along the feed barrier at 0.8m intervals further reduces bullying. However, this is at a cost. The feed system should be as near to the cows' lying area as possible – it reduces the distance that cows have to walk but also encourages cows to feed. There should also always be plenty of feed available so that the cows can have their fill when they want and then lie down.

Where automatic scrapers are used, constructing a step 0.1 m high, 0.5-0.6m deep and with a fall of 3% away from the feed barrier has been found to reduce disturbance. The trough level needs to be also raised by 100mm, so that the level remains 0.15m above the cows front feet. This prevents cows over reaching for food, minimises pressure on the neck and minimises slipping and injury.

There has been much recent interest in the installation of rubber matting in passageways to improve underfoot conditions for the cows. These textured mats, which are designed for cattle housing, allow the foot to penetrate into the mat to provide grip and reduce the pressure on the soles of the hoof. The mats generally interlock to prevent movement during use.

A study in the USA compared rubber mats in the scrape passages with grooved concrete flooring. This study was unable to demonstrate any significant difference in several indices of lameness between the two floor surfaces. Whereas a study in Germany which looked at rubber mats on scraping passages, compared a standard slatted scrape passage (40mm slots) with a rubber coated slatted scrape passage. The researchers demonstrated that bruising on the sole of the hoof was reduced on the rubber coated floor and that there was a significant reduction in lesions of the hoof wall caused by slippage. Cows on the rubber floor also showed a significant change in behaviour by exhibiting twice as much caudal licking. This grooming behaviour is considered an excellent method to monitor floor quality as it requires the cow to lift her rear leg which increases the risk of her opposite front foot slipping.

Rubber mats can also be placed on the feed standing in front of feed mangers. A Canadian study compared a 1.85m strip of rubber mat in front of the feed fence with a grooved concrete floor. The researchers concluded that the rubber mat increased the time cow's spent at the feeders and the cows ate 0.8kg more of the total mixed ration (TMR). However, it is important that only rubber matting specifically designed for cow use is installed.

Handling facilities

There are numerous cattle handling facilities available. Regardless of the type they need to have non slip surfaces, be sited to avoid tight turns, be in well lit areas and without any projections on gates, hurdles, etc, on which animals (and operator) could injure themselves. The footbath should be sited on the exit route from the parlour (but not so close as to impinge on free cow flow). Double footbaths are considered better because they allow dirt etc., to be washed off prior to treatment. The first bath also tends to activate the dunging reflex which means that the second (treatment) bath remains active for longer.

Cattle are less sure-footed on downward slopes and prefer to move up gradual inclines rather than steep slopes. Handling facilities should therefore be sited on either a flat anti-slip tamped concrete surface or a slight incline with the cattle flow up hill.

Whatever type of crush is used the better the facilities the more likely that treatment will be thoroughly and completely carried out. This is definitely the situation with foot inspection and trimming.

The use of backing gates in the collection yards of milking parlours are a useful tool if used correctly to improve cow flow. This can speed up the time spent milking, which not only releases time for other husbandry tasks and maintenance, but minimises the time that cattle have to involuntarily stand.

However, they must be used sensitively and electric backing gates are strongly discouraged. Cows are very sensitive to electrical current and standing on concrete on often wet floors aggravates the problem. In addition the animals getting the shock are not usually those the herdsman is wanting to move. This increases stress, will often lead to cows scrambling around and slipping and certainly increases the incidence of lameness.

Underfoot conditions

All surfaces must have good falls to allow drainage and to prevent pooling of slurry and foul water. In a great number of dairy units, the concrete slabs and floors have been down for a considerable number of years and consequently show signs of deterioration by either being broken, cracked and eroded or being worn. Rough or broken concrete can cause abrasion of the sole and puncture wounds and must be either repaired or replaced, ensuring that you leave a non-slip surface.

Concrete that is well worn is likely to be smooth and slippery. Slipping can lead to bruising of the sole and to other foot and leg damage. Worn concrete need not be replaced if it is structurally sound but can be grooved thereby reducing the risk of injury. Good results have been obtained by cutting grooves 40 mm apart which run at right angles to the direction of cow movements. The grooves should be 6–10 mm deep and 10 mm wide for optimum affect. Grooving at right angles provides better resistance than grooves which run parallel to the direction of cow traffic. Squares and diamond shapes are discouraged, although squares can have a role where there is random cow movement.

Farms using sand based cubicles report that the passageways can soon become smooth, due to the wearing affect of sand between the cows feet and the concrete, and therefore remedial action must be taken.

For new concrete areas the concrete should be well compacted and care taken to ensure that a non slip finish is provided. Traditionally, a light tamp at right angles to cattle movement has been used to provide the appropriate finish but care should be taken to avoid creating a too pronounced ridge which may cause damage to feet. To "soften" the ridges, drive up and down new concrete with the slurry scraper filled with old bricks prior to sweeping clear.

A grooved finish can be provided on new concrete. Some contractors have concrete laying machines which will cast a grooved pattern into the concrete while squeezing the concrete through compacting rollers. However, for new concrete a hexagonal pattern should be formed, as this has been found to provide good skid resistance with minimal pressure on the feet. The hexagon should have sides of 46mm and the groove should be 10mm wide and 6 – 10mm deep (see BS 5502-40:2005).

There are many types of slats available for cattle housing. It is important that the slats are well constructed with no rough edges or abrasions. The width of the slat and their spacing is a compromise between the provision of adequate support for the cow's foot and effective self cleaning. For a mature dairy cow, the width of the slat is likely to be around 140–160mm and the spacing between slats between 35–40mm.

Although the slats themselves eliminate slurry pooling, adjacent concrete areas often have a significant build up of slurry. The solution is cross passages which are slatted or priority is given to hand or tractor scraping. Even where slats are fitted the design may mean that there is a build up of slurry at the edge, such as at the back of cubicles. Again manual scraping is required.

Automatic scrapers can be considered as a beneficial technology. However, practical experience suggests that irrespective of the frequency of operation, unless scraped runs are kept below 25m, there is likely to be a build up of slurry in front of the scraper blade. However, although this 'bow wave' of slurry does not appear to concern the cows, who will wait until the blade is nearly in contact with their feet, before stepping over the blade and continuing their activity, the soiling of the foot and lower limb can have a significant negative impact on foot health – especially digital dermatitis. Therefore the installation of a slatted cross passage every 25m should be given serious consideration as it will significantly reduce the pooling of slurry in front of the scraper blade.

Flood washing (flushing) cubicle passages is becoming increasingly popular, where water is allowed to flood the passageways and then is collected for recycling. There is evidence that passageways keep cleaner with improved foot health. However, cows should not be present during the process (about 3 times per day) as any disease organisms in the water could create potential lameness problems. Any splashing of the flush water can also increase the risk of dirty udders and mastitis.

The slope of the scraped passage is critical to maintain the momentum of the flood water. A slope of 2–4% will maintain the momentum with a minimum volume of water. The success of the system depends on creating a wave of water around 20m in length, 75mm in depth moving at a velocity of 2m/sec. This will generally allow the water to be in contact with the slurry for 10 seconds. Once a passage has been flood washed, the water is stored and re-used. The more often the water is re-used, the more contaminated it becomes with slurry and the thicker it becomes with increased risks to cow health. To minimise the problems it is recommended that 20% of the volume of the stored water is changed each day. This will make the system inoperable in some situations, due to the cost of water and availability in times of drought.

Farm tracks and paths

Cattle will walk significant distances when grazing and these distances can increase considerably when walking to and from milking. It is therefore important to consider how the cows are moved and the nature and condition of the surfaces they are walking on.

When allowed to walk at their own speed, cows are able to place their feet carefully to avoid obstacles or rough sharp objects and will generally walk in single file along established tracks. If forced to hurry, they will bunch together and can not choose where to place their feet, thus becoming much more likely to sustain damage from sharp stones and other debris.

Where there is loose and possibly sharp material on the track, as well as being extremely uncomfortable to walk on, it can lead to bruising of the sole or it's penetration. Gateways, narrow tracks and areas surrounding water troughs require special attention as they can often be covered with sharp stones, rubble or gravel and are also liable to become muddy in wet weather.

Specialist cow tracks have become more popular in the recent past but to be successful must be well maintained to allow the cows to walk in comfort. Many have badly deteriorated due to ineffective maintenance and resulted in an increase in cow lameness. These tracks are dedicated purely to the cattle and are typically 1.0-2.0 m wide and finished with a soft surface such as shredded bark. Regardless of type of track used, remember cow tracks are not tractor tracks!

The most permanent track is concrete. But whether used by tractors or just cows, they do need to be brushed clean regularly to remove all stones and other hard and sharp debris that is brought on to the track from the field or road. To fail to do so will only lead to lame cows. If the walking distance is more than 500m, then a hard track should not be used.

Nutrition

Certain types of lameness are caused or aggravated by the cows' nutrition, often due to the influence on the corium (nail bed) of the hoof. The corium is an area of soft tissue containing a myriad of nerves and blood vessels. These blood vessels bring oxygen, amino acids (the protein building blocks), minerals and other nutrients to sustain horn growth. Horn is formed when living epidermal cells move slowly towards the outside of the foot, accumulating a hard protein structure called keratin.

One form of lameness is laminitis, or inflammation of the whole area of the corium. The immediate effect of acute laminitis is pain and limping, with the pain being caused by the inflammation/swelling within the enclosed confines of the hoof, i.e. it is the pressure that causes the pain.

Laminitis can occur sub-clinically (symptoms not obvious) and results in minor changes of the normal structure in the whole area of the corium. These changes can affect horn production for the remainder of the animal's life. This is because the epidermis (sole) of the hoof has no direct blood supply and therefore the living epidermal cells acquire oxygen and nutrients by diffusion from the corium. This reliance on diffusion makes these cells very susceptible to any disturbance in the micro-circulation within the corium and therefore even small changes can have significant influence on the cow's feet.

The importance of nutrition on foot health is clear, though discussion continues in the scientific and veterinary field as to the balance between nutritional and other factors. One opinion is that any restriction to the blood supply to the feet affects horn growth resulting in softer feet which may become misshapen and more prone to injury and disease – typically white line disease and sole ulcers.

The feeding system may have a significant effect in restricting blood supply to the feet. Most cases of lameness appear 8 weeks after calving with peak foot lesions occurring 16-24 weeks into lactation. As horn growth takes about 6-8 weeks, this suggests that nutrition around calving and early lactation could play a significant role.

The important nutrition factors affecting lameness are acidosis (and forage/fibre supply), protein content of the diet, fibre digestion, mineral and vitamin levels.

Acidosis - acidosis is a lowering of rumen pH meaning that there is too much acid in the rumen. This is mainly brought about by over loading the rumen with too much concentrate feed, especially starch. In normal digestion, diet components are largely broken down to propionic, acetic and butyric acid, and the balance between these are important for good rumen health. Concentrates are largely broken down to propionic acid which is directly absorbed into the blood stream. Too high a level of concentrates in the diet, or too much fed at once, cause metabolic pathways and bacterial populations to change, and lactic acid accumulates. The extent of the acidosis will depend on how well the desirable rumen organisms can be maintained, and the level of lactic acid controlled. When lactic acid is absorbed into the blood stream it upsets the cows metabolism and affects blood circulation reducing blood supply to the feet.

The increased acidity of the rumen also kills some of the microbes, their decay producing toxins which are absorbed into the blood stream. These toxins release histamine, which together, causes permanent damage to blood vessels.

Studies at ADAS Bridgets in the 1990's reported that cows fed high starch diets, compared with high fibre diets, developed longer feet with softer horn. The haemorrhages that did develop in sole horn of cows on the high fibre diet were more superficial. The results suggested that cows given high fibre diets are less susceptible to laminitis. In a further study, heifers fed high starch diets tended to have higher locomotion scores than those fed high fibre diets (the same energy intake), with both groups becoming more lame after calving.

Further studies also indicated that although high concentrate diets had detrimental effects on foot lesion scores in heifers compared to low concentrate diets, the type of housing had a greater impact. In this instance cubicles were worse than straw yards.

The inference is generally that high levels of concentrate and starch in dairy cow diets have an adverse impact on lameness. Modern genetics and improved management systems may change certain relationships in laminitis, but whenever nutrient dense diets are fed steps must be taken to see that an acidotic diet cannot arise.

Forage/Fibre – ruminant animals are designed to utilise fibre, and it is as much a shortfall of forage in diets that allows acidosis to develop. More than this, providing sufficient fibre in the diet to maintain good rumination could be significant in minimising laminitis. But all

forages/roughages are not equal. Very wet, acid silages (low pH value) may have restricted intakes and will increase rumen acidity directly. Silage's high in ammonia and poorly fermented are likely to reduce intake and require supplementation with additional concentrates, potentially creating problems. Very leafy (high D-value) silages contain less fibre. This may not be a concern so long as the silage forms a greater part of the diet and dependence on concentrate is reduced.

In all diets for high yielding cows there is a need to be more conscious of the chop length of forages. Short chop length will benefit consolidation of drier material in the clamp – which is important, but it does little to stimulate good rumination and saliva flow. Where diets contain high amounts of short chopped maize or wholecrop, it is especially important that the chop of the grass silage is long, or additional long (5cms+) forage as hay or straw are added.

Protein –The extent to which excess protein is responsible for lameness incidences remains unclear. The concern is that too much protein in the diet creates high ammonia levels in the rumen which can be potentially toxic. Greater knowledge of rumen protein digestion indicates that utilization of protein is tightly linked to the diet energy supply. Work at the Scottish colleges in the late 1980's found a significant link between high protein diets and lameness. High protein content in diets resulted in significantly higher locomotion scores and also increased the duration of lameness. However, the effect of management appeared to have a greater impact. Cows on a 16% CP diet whose feet were untrimmed had a similar degree of lameness than cows fed a 19% CP diet but whose feet were properly trimmed. However, much of the research carried out in the 1980's was undertaken with British Friesians – would Holsteins show similar results?

Other studies have found that an increasing level of protein had no influence on the prevalence of sole haemorrhages associated with laminitis, whereas work from New Zealand suggests that pastures high in protein (22% CP) in the dry matter may be implicated in causing laminitis.

What is clear is that there is little research information available to indicate what levels of protein are high enough to cause laminitis and what mode of action protein (or ammonia) plays in the disease development process. The safe option would appear to be to avoid high protein diets and to maintain a balance between rumen degradable protein and fermentable energy so that the simpler forms of protein are fully utilised in the rumen. Many farms will find some reduction in protein supply is possible without reduced feed intakes and milk production. This is also desirable for health and financial reasons. Sulphur containing amino acids (i.e. methionine) may improve horn quality, though confirmation is required to support additional inclusion.

Minerals, Vitamins and Trace Elements – these are often overlooked yet essential for correct horn growth and development. Horn quality, that is the process of keratinisation of epidermal cells, is influenced by:-

- Vitamins A, D, E & Biotin Vitamin H
- Minerals, Calcium & Phosphorus
- Trace elements, Zinc & Selenium

Many of these , such as Calcium, Zinc and Biotin are activators or co-factors for enzymes that are essential for normal horn production. Deficiencies of minerals, vitamins and trace element lead to disturbances in the keratinisation process and result in a decrease in horn quality.

Feeding systems should provide a sufficient and balanced supply of minerals, vitamins and trace elements. A large amount of these will come in the feeds included in the diet. The supply of the major minerals (calcium, phosphorus, magnesium in particular) should be part of the diet formulation. Trace elements and vitamins may be added via compound feed or a mineral/vitamin supplement. A methodical approach should be taken to trace element/vitamin addition as an excess is as undesirable and potentially as costly as deficiency.

Therefore always review what the diet provides, compare this with recommendations and supplement as necessary. Horn growth is a slow process, and it may be many months before changes made to the trace element / vitamin supply are likely to become evident in horn quality.

Nutritional Check List to Minimise Lameness

So what does this mean in practice? Dairy farming is a business and as such has to optimise returns, i.e. the aim is to achieve a diet that delivers good milk production at the same time as maintaining good health (especially rumen health) and fertility.

Concentrate	Feed little and often. Maximum 4 kg per feed.	Maintain constant rumen pH and avoid fluctuations in rumen pH. Avoid acidosis. Ideal maximum is 2kg concentrate per feed, although not always practical. TMR is very beneficial in this respect.
	Max 28% starch/sugar in the diet dry matter.	To avoid acidosis. However, some cows are fed higher levels without problem. What is critical is the combination of high starch / sugar with low fibre diets.
Protein	Avoid excess: 18-19% CP for high yielding cows.	
	Balance energy & protein.	
Forage	Minimum 40% of diet preferably over 50%	Ensure sufficient fibre in the diet.
	Ensure good forage intake.	Aim to provide high dry matter silage with low fermentation acids and ammonia content. Plenty of feed space and good trough hygiene.
	Avoid too much oil in the diet (less than 6%).	Some oils tend to inhibit fibre digestion in the rumen. Choose fat sources with care.
Management	Don't make sudden changes to the diet.	It takes the rumen about two weeks to fully adjust to new rations.
	Provide good access to some long forage.	Particularly important when leafy wet, short chop silage or lush grazing is fed. If cubicles or straw yards are well bedded then bedding straw may be sufficient.
	Avoid fat cows at calving.	Aim for a Condition Score of 3. Fat cows have lower intakes.
	Don't feed mouldy forages or feeds.	Mycotoxins produced from moulds, can induce various undesirable problems.
	Offer salt, if low sodium forages fed. Consider	The cow has a tremendous ability to buffer diets naturally with saliva. Provide salt if desired, and

	sodium bicarbonate if feeding very acid silage and / or excess starch.	bicarbonate if necessary (50-150 grams/day).
	Ensure a smooth transition from dry cow diet to milking cow diet.	Essential for heifers but important for higher yielding cows.
Minerals, vitamins & trace elements	Can be important.	Not a panacea.

Finally, much is made of the adverse welfare effects of high yielding cows and that we should take a step backwards. The problems are seen in both high and low input systems. It has to be accepted that the modern genetics has created some of the problems. However, as FAWC acknowledged in the 1997 cattle report that milk yield *per se* was not the major issue but that breeding and levels of management must be suitable to minimise the health and welfare problems. In practice much of the problem with today's cow is that the facilities, in particular, have not kept pace.

In many herds the change to higher yields using superior genetics has moved faster than the quality of diets required and the quality of the feeding management. Well planned diets (and in particular good forages) together with a careful and monitored approach to feeding management will give good milk production and good health.

Although evidence is not always clear as to the effects of feeding on lameness, the following consensus applies:

- Heifers in particular must be allowed to acclimatise to the feeds in the post-calving/milking ration, before calving.
- Dry cows in higher yielding herds (7000 l plus) must move to a transition diet around 2 weeks before calving.
- Higher starch/sugar diets require that feeding management is good, if adverse affects on feet are to be avoided.
- Avoid unnecessarily high levels of protein in the diet.
- Avoid abrupt changes in the ration even when the cows are part way through their lactation.
- Avoid wet, highly acidic silages if possible. Where they have to be offered ensure that dry forage is also available.
- Monitor the intake of forages. The analysis may look fine but if intakes are lower than expectation then the forage:concentrate ratio will be less than ideal.
- Feeding can have an important role to play in preventing the development of laminitis. Any feeding mismanagement will provide a risk factor to foot health.
- Follow a planned feeding strategy, appropriate to the level of milk output and body condition in order to minimise the risks of lameness and other health and welfare concerns.
- Avoid major changes to the diet, particularly at calving.

Breeding

The leg and foot conformation of a cow is influenced by both the environmental effects (predominantly feeding) but also by the animal's breeding. The cow's feet and legs are essentially shock absorbers. An adult cow will typically now weigh around 700kg, and this

significant weight (and force when moving) is transferred down through the legs and feet and focused on a very small area – the outside of the foot. The weight borne on each leg of a cow standing equally on all 4 feet is therefore in the region of 175kg, although slightly weighted to the rear legs. This increases with movement, and the cows motion is often in less than ideal conditions – on rough and broken concrete, muddy tracks and awkward buildings.

There are breed differences, with no one breed being better overall than others, although Jerseys and Ayrshires would be considered to be less susceptible to foot related problems. The Brown Swiss is prone to corkscrew claws, laminitis and sole ulcers, while white line score was worst in Guernseys while heel erosion and digital dermatitis were worst in Holsteins and Friesians. Evidence suggests that Jerseys tend to have harder feet and less lameness, perhaps linked to the fact that cows with "black" horn are less prone to lameness. This links to the increased interest in cross breeding to red Scandinavian breeds.

So what conformation will minimise a predisposition to lameness?

The shape of the foot, depth of heel and hock and pastern angle are inherited characteristics and combine to produce the overall locomotion of the cow. Breeding sets out to achieve the optimum for each of theses characteristics.

The legs (side view) should not be too straight as excessively straight legs make the animal vulnerable to joint injury and claw problems. Straight legs are also not efficient shock absorbers. Conversely, if the leg is excessively sickled this throws too much weight on to the heels and places too much pressure on ligaments. The optimum is the middle position, i.e. a leg that is neither too straight or too sickled.

The hocks (legs, rear view) should not be too close together as this pushes the toes outwards, and often forwards, giving the cow a poor gait and uneven horn growth. The optimum is for straightness with feet carried directly underneath the hook bones.

With regards to the feet themselves the optimum is a reasonably steep angle, ideally 45 degrees, with around 7.5cm to the front of the foot producing a good depth of heel. Long toes and low heels have marked adverse affects on locomotion and therefore need to be avoided. We need to breed cows so that there is an equal balance of force between the inner and outer claws.

Bull's progeny are scored for locomotion, particularly UK bred bulls, which acts as a reliable composite of the individual traits although individual trait scores may vary widely. Cows can also be scored for locomotion which will help deselect those not suitable for breeding replacements.

When assessing herd conformation, look at the heifers first as they have not been as affected by age and management as older cows. However, do not ignore the cows whose quality of locomotion will show their ability to cope with their environment and your management. Certainly never breed from any animal that has a history of lameness.

Although improving conformation and minimising the risks of lameness through breeding is a long term strategy, it must never be given lesser importance than other conformation

traits or overall lifespan. The phrase “prevention is better than cure” is just as apt with breeding as it is with housing and nutrition, where changes can bring about an immediate benefit.

There are literally hundreds of bulls to choose from in the UK. No one bull is the perfect sire and breeding will always be about compromise. Bulls that are linear assessed for positive locomotion will almost invariably also improve legs and feet but could have a rear leg set that is too straight or too sickled for your herd. Select the bull to do a particular job with a specific group of cows, use a team of bulls and change the team at least annually. Bear in mind that we are looking for a middle leg set (not too straight or too sickled), consistently selecting for a straight leg would not be ideal. We must also never forget that half the genes of the offspring come from the dam, a near to perfect sire can not work miracles on a less than perfect cow! Therefore breeding objectives can be summarised as:

- Breed only from cows with good locomotion, legs and feet
- Select for production traits first
- Select lifespan, locomotion and trait composites second
- Check those bulls selected for specific traits to improve legs and feet as well as udders and other desirable traits
- Cows with average legs and feet can survive well under good management
- Do not breed from cows with a history of clinical lameness, with badly deformed feet and legs or suffering from sole ulcers
- Use corrective mating where appropriate
- Cull any animals suffering from chronic lameness

Finally, excellent feet and legs can be ruined by poor management and poor legs and feet can be tolerated under good management. Foot trimming helps make the best of what is available but is not the only solution - if the quality of horn is poor then the cow will continue to have problems.

Veterinary Factors

Introduction

The number of lame cows per year and the percentage of the herd that is lame can vary tremendously from farm to farm. Severity of lameness can also vary (subclinical to severe). Clinical lameness is costly (approximately £180 per case) but this cost can be reduced with prompt treatment, especially if lameness is caught during the subclinical (early) stages. The principles of lameness scoring are useful for early lameness detection and for measuring overall herd lameness (herd mobility score), and the principles of effective lameness treatment are both essential starting points in the control of lameness.

Factors that contribute to the cost of lameness include:

- Infertility
- Reduced milk yield
- Milk quality
- Increased culling/loss of slaughter value
- Vet and med costs
- Secondary disease
- Increased labour

The main veterinary factors involved with dairy cattle lameness are:

- Culling/welfare
- Lameness scoring
- Effects on staff morale
- Restraint
- Dry Matter Intake (DMI)
- Diagnosis
- Oestrous behaviour
- Treatment
- Fertility

Remember that lame cows are not fit for travel, except on the advice of a veterinary surgeon when the lame animal can be taken direct to veterinary facilities for treatment or direct to the nearest available place of slaughter. Always consult your vet if you are at all uncertain about an animal's fitness to travel.

Where a mildly lame animal is transported direct to a slaughterhouse or the veterinary practice it should be penned separately, with sufficient space to lie down on a deep bed and the driver should take special precautions to drive with care and consideration for the animal.

Lameness scoring

Lameness can be any sign of discomfort during movement. Signs include:

- Limp
- Reluctance to move
- Abnormal foot placement
- Spine Arching
- Head Nodding
- Difference in speed of limb swing

The severity of signs can be graded:

Table 1 Lameness scores and descriptions

Category of score	Score	Description of cow behaviour	Suggested action
Good mobility	0	Walks with a flat back; even weight bearing and rhythm on all four feet. Long, fluid strides possible.	No action needed but may benefit from routine (preventative) claw trimming.
Imperfect mobility	1	Steps uneven (rhythm or weight bearing) **OR** strides shortened; *affected limb or limbs not immediately identifiable*.	May benefit from further observation and routine (preventative) claw trimming.
Impaired mobility	2	Uneven weight bearing on a limb that is immediately identifiable **AND/OR** obviously shortened strides (usually with an arch to the centre of the back, that may increase as the cow begins to move).	Lame and likely to benefit from treatment.
Severely impaired mobility	3	Unable to walk as fast as a brisk human pace (cannot keep up with the healthy herd) **AND** signs of score 2.	Very lame and likely to require immediate attention; nursing and probably further professional advice, possibly even culling.

Proportion of herd with clinical lameness

The main factors affecting the amount of clinical lameness include:

- Environment (including yards, tracks and season)
- Breed and other animal factors
- Nutrition and other management factors.

Proportion of herd with clinical lameness

Every milking herd will have some lameness. The proportion of lame cows in a herd depends on the number of cases that go from subclinical to clinical (cows treated per year) and the rate of recovery.

Rate of clinical to subclinical:

- Harshness of the environment, robustness of the cow and how she is managed, plus

- Whether the early (subclinical) lesions are effectively treated (regardless of whether detected or not e.g. digital dermatitis may be treated with a footbath without the farmer realising the problem).

The rate of recovery from lameness:

- Harshness of the environment, robustness of the cow and how she is nursed
- Effectiveness of treatment
- Type of lesion e.g. sole ulcers are slow to recover, if they recover at all.

The average herd has between 20-70 new cases of lameness per 100 cows per year (incidence) and 20-30% of the herd is lame at any one time. A herd should aim to maintain clinical lameness below 14%. Reducing treatment rates should not be a short term target – that rate depends on variable factors that take time to reduce.

A five point plan to reduce lameness.

To minimise the severity of lameness, the following measures can be highly effective:

1. Inspect the gait of every cow, every day (e.g. during herding) and treat every case of clinical and subclinical lameness effectively and promptly (within 24 hours for clinical lameness). This is easier said than done, as looking for lame cows as they enter the parlour does not appear to be very effective except for the very long herringbone parlours.
2. Manage transition cows (3 weeks before and after calving) and lame cows on well-managed straw yards (or in extremely comfortable cubicle housing) during the housing period.
3. Lift, inspect and if necessary trim all feet of all cows at least once yearly (drying off and perhaps also mid-lactation provided this does not coincide with housing or turnout).
4. Footbath all animals in the herd (including dry cows and youngstock if practical) with an effective disinfectant and foot conditioner at least once weekly. When digital dermatitis is a problem then daily disinfection may be more appropriate.
5. Provide level, dry and well-drained walking or standing surfaces, free of hard stone or gravel.

Lameness treatment

It is not the intention for this handout to cover the practical aspects of routine claw trimming but an introduction to the examination of the foot, basic principles of effective claw trimming and pointers to effective treatment.

Lameness treatment should follow some simple principles:

- Lift and examine the claws and between the claws as soon as abnormalities are detected. 99% of lameness originates around, in and between the claws, so there needs to be a readily accessible and easily usable means for examining the feet. Whatever method is used for examination it must be safe, efficient and welfare friendly for both the cow and operator. Being accessible and welfare friendly will encourage prompt examination and treatment, and improve morale for time-constrained farm staff.

- Only trim if experienced and preferably trained to use the Dutch 5-step technique (see Appendix 1).

- Do not over trim. The hoof is a hard piece of insensitive tissue that covers the sensitive tissue called the "quick" or the corium. Over zealous trimming can expose the "quick", greatly increasing pain and prolonging recovery. The maxim of "a bit more can be trimmed off in a few days time" is far better than over trimming.

- Prevention of lameness is of paramount importance followed by prompt effective treatment. A correct diagnosis enables the most effective treatment and changes in management to be instigated to facilitate recovery. Many use the term foul for all lameness conditions however, this is not the case.

- The most common lesions are:
  - Sole haemorrhage
  - White line disease
  - Digital dermatitis
  - Interdigital dermatitis
  - Interdigital growths
  - Foul in the foot
  - "Laminitis"
  - Pedal sepsis
  - Penetrating injuries.

- Some may require antibiotic therapy but some require effective hoof trimming.

- The main principles of trimming are:
  - Return hooves to correct shape and balance
  - Remove necrotic and infected tissue to allow new healthy horn to grow
  - Remove horn to allow drainage to prevent abscess formation
  - Remove horn around a lesion to reduce the pressure on the lesion and reduce pain allowing the lesion to "heal".

The majority of hoof lesions are in the outer claw of the hind leg and inner claw of the fore leg.

To reduce pain and allow time for lesions to recover may involve "blocking" the unaffected claw which prevents the affected claw being continually traumatised by contact with the floor.

Summary of digital dermatitis control

The control of digital dermatitis should focus on:

1. Biosecurity to prevent new strains of digital dermatitis entering the herd
2. Cleaner feet to prevent digital dermatitis spreading and becoming established
3. Foot disinfection using footbaths to wash off new infection
4. Prompt and effective treatment
5. Control disease in the whole herd, not just milking cows

Control measures

- High standards of biosecurity and hygiene, even if you have digital dermatitis already:
  - Once you've got it you have it forever
  - Avoid buying in different "strains" or mixture of "strains" (multiple families of bugs could produce more severe disease problems)
  - Ideally operate a closed herd but even then you may still have a breakdown (slurry from vehicle wheels, boots, contaminated foot kit)
  - Buy from "free" herds but inspect and treat on arrival. Isolate for as long as practical and re-inspect or retreat before introducing to herd.
  - Beware the bull (especially old hire bulls), beef stock and sheep – they can all bring it in
  - Remember disease can be spread to youngstock and dry cows on other units
  - Be hygienic when handling or treating lameness and digital dermatitis lesions.

- Herd treatment generally means an antibiotic foot bath at the right depth, right concentration and with **clean feet**. Only the power-hose, straw yards and wet pasture clean feet thoroughly. Consult your vet on best treatment protocol for your farm and:
  - Remember youngstock and dry cows
  - Always have a pre-wash bath. This triggers the dunging reflex, most of which will be deposited in the first bath, preserving the second bath.
  - If possible make a special job of it to be sure cows are not drinking antibiotics
  - Ask your vet about spray treatments if foot bathing is a problem.

- Cows at pasture - a great method of cleaning feet unless gates/tracks are muddy.

- Keep up treatment/disinfection throughout the year – this is more effective when the feet are cleaned at pasture or with regular (daily) footbathing.

- Slurry management:
  - Careful scraping is important – use a quality box scraper, drive in first gear along kerbs and feed barriers, replace worn rubber blades regularly
  - Beware increased slurry levels under certain situations (on slats, with automatic scrapers, with high yielding herds that produce large amounts of dung, densely stocked yards or narrow alleys)
  - Beware stale slurry in corners of sheds, AI pens, out-of-parlour feeders, beside round feeders, next to water troughs, along the edge of collecting yards, in crush, around foot bath, in the race
  - Beware pools of stale/standing water or muddy gates/water troughs.

- Feet cleaned & disinfected:
  - In most herds the most practical, time-efficient, cost-effective way of coping with high slurry challenge is to wash it off every day
  - Foot bathing is usually the most efficient way to do this, but careful planning is needed to make the job easy (easy drain and clean, easy fill, distant from parlour, concrete baths are more cow friendly)
  - Use the right agent, at the right depth (more than 15cm deep so disinfectant runs down the hair), replaced regularly (200litres normally does 200 cows once)
  - 5% formalin works well under most herd conditions but is not very effective on raw lesions (so use after antibiotic treatments or use a weak and rising formalin solution – see later) and is unpleasant to work with. Replace if very contaminated, if more than 1 cow per litre of foot bath has gone through it or within 48 hours
  - If using antibiotic is to be avoided, start with 3 consecutive days per week of 2% formalin solution and raise the concentration by 2% every week until 10% is reached, then drop back to 5% after 1 week. Repeat regularly and as needed
  - Copper sulphate seems to work better when acidified (e.g. with dilute FAM30) and used at high concentrations, but will result in copper salts in the slurry tank
  - Dilute hypochlorite is probably effective but is best used in conjunction with other treatments
  - Dilute peracetic acid has been shown to be effective
  - Consult your vet on the best protocol for you and your herd.

Footbathing checklist

Footbathing should be used when all other methods of control are failing. None-the-less, if done correctly, footbathing can be a very effective means of controlling digital dermatitis and foul-in-the-foot, as well as hardening feet. However, it needs to be done to high standards to be effective. Use this checklist to ensure you're meeting the highest standards.

Indicators of problems with your routine footbathing

- Outbreaks of digital dermatitis or foul-in-the-foot.
- Lameness outbreaks straight after footbathing.
- Lameness due to digital dermatitis (regular and effective footbathing should prevent this).
- Superfoul.
- Severe or chronic digital dermatitis.

- Cows weight-shifting and shaking feet (particularly after going through the footbath).
- Growths between the claws.
- Burnt skin around feet or on udder.
- Poor cow flow.
- Cows jumping through bath.
- A time consuming job.

Type of herd treatment

Please consult your veterinary surgeon on regimes, withdrawal times, precautions and dose rates for:

- Antibiotics – useful for strategic treatments.
- Disinfectant – useful for routine prevention.
- Chemical treatments – useful when antibiotics aren't an option.

Is the bath the appropriate dimensions?

- Depth should be enough to cover the heels (more than 3 inches, 75mm) and deeper the better (up to 6 inches, 150mm). Deeper baths mean more agent runs and trickles down on to heels.
- Wide enough – preferably wide enough to allow one cow to pass another.
- Long enough – 2 sections each 8 -10 foot (2.4-3.0m) long. The longer the better.

Is the footbathing agent at the correct concentration at the start and the end?

- Work out the volume of the bath and the right amount of agent you need (see specific chemical data sheet) and double check your figures.
- Some agents need dissolving in warm water first (e.g. copper sulphate).
- Dung will dilute any solution so that the last cow through gets less treatment. Under typical conditions, a 200 litre bath of formalin will treat 200 cows. Best policy is to empty and refill once the number of cows bathed exceeds the volume of bath. Some agents evaporate or bind with slurry, so refilling after 24-48 hours is also recommended. Refill if you think it looks severely contaminated.

Are the feet clean?

Feet may be excessively dirty in winter, if yards are deep with slurry, if straw is used sparingly or not at all, or if automatic scrapers are used. Foot bathing is more effective if the feet are cleaned by:

- Washing with powerhose (important for antibiotic treatments) – but show care with open lesions.
- Footbathing daily.
- Straw yards.
- Being out at pasture.

And kept clean by:

- Slurry (and straw) deactivates disinfectants. Therefore, maintain an effective footbath you should:
  - Completely clean the bath of slurry before starting – to do it properly you need running water, a sloped bath, a good squeegee or volume washer and a good drain
  - Make bathing a daily routine – cows are more relaxed and produce less dung. Use something like diluted hypochlorite solution on days between treatments
  - Ensure good cow flow – minimise the stress for cows
  - Do not run sore footed cows through strong formalin – it's cruel
  - Use a pre-wash bath – cows defecate in this which preserves the second bath
  - Do not use straw in baths (except when encouraging good cow flow at the start of a programme).

Is cow flow good?

- Put bath on normal exit route for cows (or make part of normal exit route) i.e. place the bath between parlour and feed barrier/cubicles
- Place distant from the parlour (so one row of cows can queue, especially if the bath is single cow width)
- Make bathing a part of the daily routine for cows
- Use solid baths that don't bang or clatter
- Make the bottom comfortable to walk on – no sharp ridges, old carpet can help.

Allowing treatments to work

Cows need to walk out onto a clean, dry yard for 20 minutes to allow agents to work on feet. This is hampered by:

- Walking into unscraped yards or muddy tracks/gateways
- Walking out onto pasture or straw yards
- Deep pools of water or slurry in yards.

Miscellaneous problems need to be identified and corrected

- Spread of infection at foot bathing due to dirty conditions around the footbath
- Footbath that is a hassle to fill – make sure a hose reaches the bath
- Footbath that is a hassle to drain – have a plug to pull out a sidewall drain, and use a 100 – 150 mm diameter drain. Ensure full environmental considerations
- Fumes in the parlour – make sure the bath is located away from the parlour pit if you're using formalin, and do not allow cows to walk through a foot bath immediately prior to milking
- Cold weather – dissolve copper sulphate salts with warm water
- Rain water – make sure rain water doesn't flood the bath (fix drains and gutters, refill regularly in very wet weather).
- Avoid footbaths with 'lugs' in the bottom, cows do not like them!

Please consult your vet on aspects of treatment or prescription. Remember that footbathing agents should be drained into a slurry store or similar so as to not contaminate water courses.

Summary of sole ulcer and sole bruising control ("laminitis")

- Reduce standing times on concrete, especially with wet slurry
- Improve lying comfort
- Reduce stocking density (not 5-10% spare)
- Feeding (feed access, diets and nutrition) to improve horn quality
- Heifer preconditioning (cubicle training, parlour training and exposure to concrete feed barriers several weeks prior to calving)
- Corrective foot trimming, frequency depending on the farm, season, herd production pressure and the individual cow
- Avoidance of over-trimming (give on thumb pressure is too much)
- Better feed barrier design
- Better breeding

Focussing attention on the transition cow management can be the most effective and cost-efficient way of implementing control. The use of a straw yard for the first 1-3 weeks of lactation for instance can be very effective at preventing sole ulcers.

Summary of white line control (white line abscess or separation)

- Nutrition e.g. sub acute ruminal acidosis control or adding biotin at 20mg per cow per day all year round
- Dedicated cow tracks built for good cow flow
- Cow flow around the buildings
- Avoidance of pushing (collecting yard) or hurried herding
- Collecting yard design e.g. avoiding electric backing gate, funnel design, dog legs
- Preventing bullying for resources e.g. feed barrier, blind alleys
- Reducing standing times on concrete

If you have any queries about the items covered in this document then please do not hesitate to contact your own veterinary surgeon. Remember that cow lameness, herd mobility scoring and strategies for the control of lameness and its treatment should form part of your Herd Health Plan, drawn up with your veterinary surgeon and other specialist consultants.

Further Reading:

Buildings and structures for agriculture – Part 40: Code of practice for design and construction of cattle buildings. BS 5502-40:2005

Minimising Slurry Pooling in Dairy Housing. MDC 2005

Effective Footbathing of Dairy Cows. MDC 2006

Housing the 21st Century Cow. MDC 2006