

# A proposed structural approach to improve cow-claw health on Dutch dairy farms

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## Research Reflection

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## Abstract

Despite extensive research leading to an improved understanding of the risk factors and pathogenesis of infectious and non-infectious disorders, claw health has not structurally improved in recent decades. Several studies have shown that claw disorders harm milk production, fertility and longevity of the dairy cows and job satisfaction of the farmer. This is enough reason to structurally improve claw health on dairy farms. The focus should be on a rapid curative intervention when lameness occurs and above all the prevention of claw problems. Most claw disorder diagnoses are nowadays made during regular claw trimming by the professional trimmer or the dairy farmer. Registration of the detected disorders during claw trimming is not always done consistently, so the estimated prevalence (number of cows with a claw disorder) is in most cases an underestimation of the real prevalence. The quality of these records often makes it difficult for consultants to formulate appropriate claw health advice. To be able to give good advice on claw health, insight into the prevalence of the various hoof disorders on a farm is a key condition. However, good quality advice alone is not a guarantee for an improved claw health situation on a farm. Research has shown that in addition to high quality substantiated advice, the communication style between the consultant and the dairy farmer is essential for the interpretation and motivation of the dairy farmer to implement the advice. In this paper a 7-point plan is presented as a guidance for herd advisors who want to support dairy farmers to improve claw health.

## Introduction

Lameness in dairy cows is mainly caused by claw problems (Toussaint Raven, 1977), although occasionally other conditions such as arthritis (caused by mycoplasma infection for example) may occur. In a recent study from the University of Liverpool, an average lameness prevalence of 31.6% was found (Griffiths *et al.*, 2018). This is in line with previous studies in the Netherlands (Barkema *et al.*, 1994; de Vries *et al.*, 2013), who estimated a prevalence of 34 and 33% respectively. This shows that there has been hardly any progress in improving claw health on dairy farms in the past 25 years. Claw disorders can be differentiated between infectious (ICD; mainly digital dermatitis (DD), interdigital dermatitis/heel horn erosion and interdigital phlegmon) and non-infectious disorders (NICD; mainly sole hemorrhage, sole ulcer, white line disorders and toe necrosis; Greenough *et al.*, 2007). Another term for NICD nowadays is claw horn disruption (CHD; Machado *et al.*, 2010). ICD is primarily related to infections of skin tissue in the claw area, while CHD is related to damage to the claw horn tissue itself. The likelihood of developing ICD or CHD is determined by a combination of factors such as genetics, nutrition, housing and management (Benz, 2002; Bergsten *et al.*, 2003; van der Waaij *et al.*, 2005; Bicalho *et al.*, 2009; van der Spek *et al.*, 2015; Heringstad *et al.*, 2018). Knowledge of the risk factors, in combination with the results of different intervention studies, should lead to the formulation of good advice, which can reduce the risk of claw disorders and lameness (Somers *et al.*, 2005; Holzhauer *et al.*, 2008, 2012; Fjeldaas *et al.*, 2011; Cutler *et al.*, 2013; Gomez *et al.*, 2015; Kofler, 2017; Newsome *et al.*, 2017; Huxley, 2019). Although it is generally recognized that an analysis of the registered claw disorders on a dairy farm can provide insight into the herd problem, this appears to be done too little in practice. The reason for this is that, in The Netherlands for example, only 11% of dairy farms make recordings in the Dutch National Recording system (Digiklauw) at the time of regular claw trimming (Holzhauer and van Egmond, 2019). This makes it difficult to formulate a high quality substantiated claw health advice for a herd. In addition to the analysis of the registered claw health problems on a farm, it has recently become possible to test trace elements (zinc and manganese), vitamins (biotin) and the number of antibodies against *Treponema* spp. in bulk milk. This information contributes to a better insight into some aspects of the nutrition and DD infection pressure in herds. Due to a lack of good quality information about the claw-health situation on dairy farms, the chance of the given advice being effective is minimal. Despite the limited amount of information, often claw health advice is formulated on 2 or 3 simple topics, such as the (un-)regular use of a walk-

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through foot bath, strategic trimming or trimming twice a year and sometimes culling cows with recurrent claw problems. We, as claw health experts, fail our dairy farmers and their herds by giving limited advice based on insufficient information. With the use of higher quality information, it is feasible to improve the claw health situation on most dairy farms. However, even if all mentioned claw health information is available, implementation of such targeted advice by the farmer often proves difficult. Effective communication and the setting of achievable goals between the consultant and the farmer are essential if progress is to be made (Derks *et al.*, 2013; Ritter *et al.*, 2018; Bard *et al.*, 2019). The aim of this article is to develop or describe a tool for consultants who want to focus on claw health improvement based on a scientifically based holistic approach and provide consultants and farmers with an aid to structurally identify and mitigate the main risk factors that can affect claw health on dairy farms. We base this on a relatively brief overview of a limited range of previously published articles, in combination with the authors' own experience, and therefore recognize that this is a preliminary analysis and further work is required to implement a 7-point plan as described.

### The importance of communication to advise successfully

Beside better knowledge of the etiology and pathogenesis of both ICD and CHD at herd level, good communication between the advisor and the farmer is of great importance to motivate the farmer to actually implement a recommended advice (Derks *et al.*, 2013; Ritter *et al.*, 2018). Two recent studies from Sweden and the UK looked at different styles of communication (directive *vs.* motivational interviewing) and their effect on the farmer's willingness to implement given advice. A directive communication style generally works well if a farmer asks for a diseased animal to be treated. The client's need is clear in this situation, fix the sick cow, and the veterinary practitioner knows what to do to solve the problem. However, a motivational interviewing (MI) style appears to function better for more complex herd problems where a plan and a longer process is required to come to the intended solution or goal.

This MI style is aimed at facilitating the internal motivation of the farmer (advised person) to change. Consultants who use an MI style have a thorough knowledge of the subject, empathy, understanding of the farmers' situation and reasonable options to change, which they can communicate in a client-oriented way (Sorge *et al.*, 2010). They also follow up the given advice regularly at pre-agreed times. By taking into account the change-related knowledge, wishes, goals, situation and options of the farmer, the acceptance to implement a given advice will increase (Silverman *et al.*, 2013; Adams and Kurtz, 2017) such that a well substantiated advice based on scientific knowledge is easier for the farmer to adopt (Sorge *et al.*, 2010). If there is little interaction between the farmer and the veterinary practitioner during the communication and the veterinary practitioner shows dominant behavior, this negative relationship may obstruct the farmer's compliance to implement a piece of advice. Human research shows that the quality of the communication between a health care professional and a client can improve the compliance of the final advice by using shared decision-making (consensus) and having respect for the experiences and opinions of a client (Silverman *et al.*, 2013; Adams and Kurtz, 2017). For a consultant, asking open questions and showing empathy contributes to discovering the real drivers of the farmer's actions, and there

needs to be recognition of the direct link between the farmer's motives and his subsequent satisfaction and preparedness to implement advice (Robinson and Heritage, 2006; McArthur and Fitzgerald, 2013). These scientific findings on communication indicate that consultants can take advantage of knowledge about communication styles to enhance the value of their advice, and these improved communication skills can motivate farmers to be more willing to change their habits/working procedures. More focus on communication skills instead of more claw health knowledge might drive claw health improvements more rapidly than has been the case in recent decades. Besides good communication a structured approach to improve claw health is needed to realize even more progress. A structured plan is especially helpful for bovine practitioners, advisors and farmers who are not a specialist in claw health.

### The 7-point hoof health approach

An important question is how evidence-based hoof health knowledge can be used for the benefit of dairy cows, dairy farmers and society as a whole, all of whom will benefit from better welfare and less use of antibiotics. As described earlier, the communication style between the consultant and the farmer appears to be important for acceptance and implementation of advice (Derks *et al.*, 2013; Ritter *et al.*, 2018). Insufficient knowledge of the objectives of a dairy farm makes it difficult to provide good and appropriate advice. As a result, compliance and motivation by the farmer to implement the advice will be limited or even negligible (Sorge *et al.*, 2010). It is clear that lameness is a multifactorial and complex problem. The usual holistic approach for these disorders is essential to achieve results in the long term and is based on risk factors, the most important of which are shown in Table 1.

### The 7-point claw health plan includes:

1. Maintenance of clean and dry slatted floor or concrete and comfortable cubicles/pens
2. Use a strategic hoof trimming approach of all cows before dry off and 2–3 months after the start of lactation (record data)
3. Treat lame cows immediately (record data)
4. Use selective disinfection of the hooves of all dairy cows, depending on the herd's digital dermatitis status
5. Optimize nutrition (vitamins, macro minerals and trace elements) to improve immunity, skin and hoof-horn quality
6. Manage body condition: 3–3.5 at calving (BCS on a 1–5 scale) advised reduction of BCS 0.5 point after calving.
7. Pay attention to hoof health when selecting bulls. Cull cows with recurring ( $\geq 3$  times) hoof disorder.

### Point 1. Maintenance of a clean and dry slatted floor or concrete, comfortable cubicles/pens and systematic disinfection of claw-trimmings equipment

Clean and dry floors, comfortable cubicles and suitable biosecurity measures as well as equipment that is properly disinfected after trimming a cow with an infectious disorder and, of course, after finishing activities in a herd are necessary to limit the risk of DD (Ahrens *et al.*, 2011; Relun *et al.*, 2013; Evans *et al.*, 2016). A major objective is to avoid unnecessary standing time which gives compression of the pododerma which is a risk factor for CHD (Ossent and Lischer, 2000). Free stall housing increases

**Table 1.** Major risk factors for lameness of all types based on papers from literature review.

Environmental management factors increasing lameness in the herd	Cow/management factors influencing more lameness
Poorly maintained tracks	Poor nutritional balance between fiber and concentrate
Hard or abrasive housing surface (e.g. cubicles vs. straw yards).	Low density of diet relative to limited feed space
Prolonged housing on hard surface and associated reduced exercise	Poor quality of diet (incl. inadequate micronutrients)
Increased wet and dirt on floor surface	'Poor' ill-informed stockmanship
Increased buying-in replacements (not closed)	Failure to have a good bathing routine
Lower proportion of slatted floors <sup>a</sup>	Poor quality foot trimming and recording of lesions
Poor ventilation of housing	Previous lameness
Inadequate cleanliness of housing walk-ways <sup>a</sup>	Inappropriate use of genotypes
Reduced lying time through poor comfort	Autumn calving if cows pastured in summer
Poor cow collection technique and management at milking	Failure to train first calving cows to housing system prior to calving
Lack of biosecurity <sup>a</sup>	Increased average yield of herd
	Bigger herds (or groups)

This leads us to a structured holistic approach incorporated within a 7-point plan.

<sup>a</sup>NB primarily associated with infectious skin conditions

the exposure of dairy cows' claws to concrete walk-ways and to manure between periods of rest, and generally shows the highest rate of lameness compared with other dairy management systems. However, there is great variation within a system, and the rate of new cases of lameness can be reduced to very low levels provided time spent resting per day is maximized through good stall design, access to stalls through stocking density control and comfortable transition cow facilities. Limiting the time spent waiting to be milked, provision of adequate heat abatement and good leg hygiene are also important. Sand bedded stalls are useful as they also permit lame cows to maintain adequate daily rest and can result in less point load on the claw when cows are getting up and lying down due to a better distribution of the pressure under the sole (Cook and Nordlund, 2009). Additionally, work is needed to examine the effectiveness of improved housing and management for prevention of issues of animal well-being, such as lameness and other musculoskeletal injuries, while accounting for production gains or losses. Future investigation should focus on how to assist producers in lesser-performing groups to either better utilize or successfully adopt best management practices, in facility design, and in technologies for improved overall production performance. More work should also be done to describe how labor is best utilized on dairy farms for promoting improved overall performance (Brotzman *et al.*, 2015). In our region, there are various housing systems such as a free range or 'court' system with, for example, compost litter as perhaps the ideal top layer for preventing claw and hock problems, but the most common housing type is a cubicle-based system (Somers *et al.*, 2003; Kester *et al.*, 2014; de Vries *et al.*, 2015). The dimensions of the cubicles naturally depend on the dimensions of the cows, but the following minimum dimensions are currently recommended for Holstein Friesian cows (cross height >1.50 m): 2.50–2.70 m length with open or closed front and 1.18–1.20 m wide and knee bar at 1.70 m from the rear tube. A shoulder bar or band is placed directly behind the knee bar to prevent the cows from standing too far in the cubicles so the risk of soiling the cubicle is minimal. It is important that the cubicles are comfortable for the cow so that the cows lie down within 1 min after entering a cubicle. Similarly the design and number of alleyways and

dimensions of the feed fence as well as the density of the diet are important factors to consider. Standing on hard unclean surfaces for a long time increases the incidence of ICD and CHD disorders considerably (Bergsten and Frank, 1996; Livesey *et al.*, 1998). Also, roughening the floors can lead to more microtrauma to the skin and on wet floors the bacterial load is higher (Barker *et al.*, 2009), which can increase the infection pressure and incidence of DD. This is in line with the results of recent studies in the Netherlands, where the use of rubber on the grids is a preventive factor for both CHD and DD (Biesheuvel *et al.*, 2019). The risk of CHD lesions has to do with continued compression, resulting in ischemic necrosis of the pododerma, which results in the production of poorer quality sole horn (Lischer and Ossent, 2002). Another aspect is that prolonged compression can cause the development of spikes (exostosis) on the ventral side of the claw bone (Newsome *et al.*, 2017). The formation of these spikes increases the risk of recurring sole horn problems due to irritation of the pododerma. When cows have had their first claw disorder they are more likely to become lame than cows that have never had a claw disorder before. This means that after the first contracted claw disorder, a vicious circle can develop which often results in early culling of the animal (Huxley, 2019). Studies conducted on farms with a low DD prevalence identified that these farms had increased attention for the hygiene of the alleyways in the barn where the manure scraper does not come (for example around the drinking places) and good ventilation to keep the floors dry (Holzhauer and van Egmond, 2019). This indicates the importance of a clean dry environment, which reduces the DD infection pressure. Animal to animal transmission *via* manure seems to be the main DD transmission route, although indirect transmission through boots cannot be excluded (Rodriguez-Lainz *et al.*, 1996a, 1996b; Evans *et al.*, 2012). As we have learned from studies in Chile and New Zealand, there is a large influence of suboptimal cow tracks and climatic circumstances (rainfall, for example) (Blowey and Chesterton, 2012; Yang *et al.*, 2019) and serious attention should be paid to aspects such as the start of the pasturing season (when there are higher protein concentrations in the ration) and the end of the season with decreased quality of the pasture (Alstrup *et al.*, 2016).

### Point 2. Use a strategic hoof trimming approach of all cows before dry off and 2–3 months after the start of lactation (record data)

Systematic hoof trimming twice a year is a traditional approach on most farms, originally based on care at the beginning and end of the grazing season to avoid problems (Toussaint Raven, 1977). Due to increasing herd size nowadays, it is almost impossible to properly trim all cows within a limited time with this approach. The hoof care of large herds can also result in a lot of stress and a negative impact on animal welfare. This, combined with the insight that most hoof disorders occur in the first months after calving, suggests that strategic hoof trimming is an excellent alternative, which might yield more progress in the long run. Strategic hoof trimming is intended to anticipate and quickly detect and treat problems in this vulnerable period (first 3 months post-partum). The definition of strategic hoof trimming used here is as follows: monthly trimming of a group of cows at the start of the dry period, cows 2–3 months after calving and of cows that need extra attention due to (subacute) lameness. In this way you ensure that cows at the parturition start with sound hooves, so the cow can function optimally after calving. In a Swedish study, strategic hoof care was compared to trimming all cows at the same time twice a year. The conclusion was that strategic claw care resulted in significantly fewer disorders and abnormally shaped claws, and thus a lower risk of hoof disorders. The study confirmed that long-term strategic hoof care provides better outcomes for reducing both ICD (Odds ratio (OR) = 0.83,  $P = 0.04$ ) and CHD (OR = 0.71,  $P = 0.05$ ) problems at herd level (Manske *et al.*, 2002; Bergsten *et al.*, 2019). It is important to keep good records of the detected hoof disorders so that subsequent analysis enables good, substantiated advice. A third approach could be objective routine lameness monitoring and claw trimming of those cows identified through the monitoring without the routine preventive trimming of cows based on calving date or DIM. Studies that have used this approach for claw trimming can then be compared to the other suggested approaches. This allows the consultant and farmer to make an informed decision on which of the options best suits the on-farm situation (Chapinal *et al.*, 2010).

### Point 3. Treat lame cows immediately (record data)

Rapid treatment of both CHD and DD lesions combined with good pain management increases the chance of rapid recovery. This not only limits the loss of production (Green *et al.*, 2002) and condition, but also minimizes damage to animal welfare. By treating lame cows immediately, the cow will continue to function well in the herd, the dry matter intake will be maintained and animal health will be assured. In the case of a painful CHD lesion, prompt treatment with, among other things, a block under the healthy claw and good pain management gives the best prognosis (Thomas *et al.*, 2016). This should be combined with good recordings, which include: date of treatment, number of cow, affected leg and diagnosis according to the ICAR atlas (ICAR, 2020) as well as applied therapy. For DD, healing of smaller DD lesions has been shown to be significantly better compared to larger DD lesions, meaning rapid intervention accelerates recovery (Relun *et al.*, 2012). Rapid individual treatment of an acute DD lesion is desirable for welfare reasons (pain at this stage, Döpfer *et al.*, 1997; Bell and Vanhoudt, 2020), to prevent an increase in infection pressure for the rest of the herd and

good recordings with distinction between acute and chronic lesions. Especially during the erosive stage acute DD needs topical treatment, while in case of chronic stages the application of footbaths is advised (Bell and Vanhoudt, 2020). Both acute and chronic lesions may spread *Treponema* bacteria to herd mates increasing the risk of new DD lesions (Döpfer *et al.*, 2012; Biemans *et al.*, 2018). Once again, it is important to keep a good record of the detected claw disorders.

### Point 4. Use selective disinfection foot baths depending on the herd's DD status

The necessity of disinfection of the interdigital claw skin and the skin just above the claw capsule depends mainly on the DD infection pressure in the herd. Regular use of disinfectants in footbaths is a standard practice on many farms. Irrespective of the DD stages in a herd, the same strategy is usually followed. Claw disinfection (by foot baths or a backpack sprayer) could be done more cheaply, more effectively and more strategically than it is done currently. The footbath is an excellent choice for the 'treatment' of M4 DD lesions (actually it prevents transition to an acute painful DD lesion; Döpfer *et al.*, 2012; Bell and Vanhoudt, 2020). While there is relatively little reliable data on the best disinfectant, most seem to work to some degree. Similarly, the length of the footbath is open to question, but should be at least 4 m in length (Speijers *et al.*, 2010; Logue *et al.*, 2012; Ariza *et al.*, 2017). However, for the treatment of the highly infectious M2 DD lesions, formalin solution (4%) cannot be recommended for use in footbaths, because these solutions are toxic (Mitchell and Law, 1984). Acute M2 DD lesions are open wounds and disinfectants are detrimental to wound healing because they dry out the wound edges, which delays the wound healing process. For these M2 DD lesions, individual topical treatment with a registered product under bandage is, therefore, the appropriate therapy (Klawitter *et al.*, 2019; Bell and Vanhoudt, 2020). It is advisable to combine preventive measures with rapid individual treatment and monitoring of M2 lesions (Krull *et al.*, 2016). Depending on the type of DD lesions in the herd, the treatment advice should be different. Recently a DD bulk-milk test was made commercially available (GD Animal Health, The Netherlands) that gives insight into the amount of *Treponema* spp. antibodies present. This value is correlated with the most common DD stage in the herd. Based on this information, it is possible to tailor the best DD treatment approach at herd level (individual vs. herd 'treatment'; Holzhauser and van Egmond, 2019).

### Point 5. Optimize nutrition (vitamins, minerals and trace elements) to improve immunity, skin and claw-horn quality

Good claw-horn quality and structural and functional integrity of the claw horn are important for the maintenance of hoof health (Vermunt, 2004). Production of good skin and hoof horn quality that gives sufficient resistance to an attack from the environment, starts with well-balanced nutrition. The reduction of nutrient supply to the epidermal keratinocytes leads to the production of an inferior horn quality and an increased sensitivity to environmental chemical, physical or microbial damage (Weber *et al.*, 2013). This highlights the importance of the daily provision of the correct ration with macro elements including calcium and sulfur, trace elements copper, zinc, selenium and manganese as well as vitamins including biotin (Wedekind *et al.*, 1992; Zimmerly and

Weiss, 2001; Santschi *et al.*, 2005; Plaizier *et al.*, 2017; Seck *et al.*, 2017). The overall intake of vitamins, macro and trace elements from the gastrointestinal tract is a complicated process, highly dependent on the actual dry matter intake (Lean *et al.*, 2014; van Vuuren, 2014) and bioavailability of the individual vitamins, macro elements and trace elements. For example, competition between the different trace elements influences the availability for absorption (must be Keen and Zidenberg, 1996). For a long time, it was assumed that sufficient B vitamins such as biotin were produced by the micro-organisms in the rumen. Due to increased milk production during the last decades and the associated changed rations, it appears possible that, in many cases, insufficient biotin is formed in the rumen of dairy cows, especially those that are fed higher amounts of concentrate and may be experiencing subclinical rumen acidosis (Holzhauer and van Egmond, 2019). In this situation, the skin and claw horn quality will be impaired which results in a higher risk damage causing lameness. To monitor the supply of important trace elements like manganese and zinc and vitamins like biotin at herd level, bulk-milk tests are available that provide consultants and farmers with a better understanding of the actual available quantity. Adaptations can be made in the ration supply of these elements to more or less exclude nutrition as a risk factor for hoof problems.

#### **Point 6. Manage body condition: 3–3.5 at calving (BCS on a 1–5 scale), maximum reduction of BCS 0.5 point after calving**

To prevent a decreased quality of the shock absorbing capacity of the claw horn cushions, correct management of the body condition around calving is important (Newsome *et al.*, 2017). Optimal moments for scoring body condition (BCS) are at the start of the dry-off period, around calving and 2 months into lactation, but even better might be automatic body condition scoring, done constantly to support operational and tactical decisions (Roche *et al.*, 2009). A smaller condition decrease after calving helps to prevent all kinds of other health problems such as acute- and chronic endometritis, abomasal displacements and ketosis (Dann *et al.*, 2005), which can be prevented by an optimal transition from dry-standing period to start of lactation (Kuhla *et al.*, 2009). Research over the past decade at Cornell University has shown that the occurrence of sole ulcers and white line disease is significantly associated with the thickness of the digital cushion between the pedal bone and pododerma (Bicalho *et al.*, 2009). A more recent study has quantified the effects of the decrease in BCS. The study concluded that postpartum metabolic problems and 8% of all lameness problems could have been prevented by limiting BCS loss to less than 0.5 point (on a 5 point scale) after calving (Lüttgenau *et al.*, 2016; Randall *et al.*, 2018; Sepúlveda-Varas *et al.*, 2018). It is not only decreased BCS after calving that is important, since cows that start too thin seem to have an impaired shock absorbing capacity. Cows with a BCS of  $\leq 2$  at the beginning of the dry period were more likely to be treated for lameness in the following 4 months compared to cows with a BCS  $> 2$  (Offer *et al.*, 2004). A reduction of more than 0.5 point in BCS is usually the result of insufficient dry matter intake compared to the energy requirement for maintenance and milk production at the start of lactation (Roche *et al.*, 2009). An optimal BCS between 3–3.5 during the dry period and a maximum loss of 0.5 point after calving is a good goal to

optimize claw health on farms. A simple rule is: the less BCS loss after calving the better.

#### **Point 7. Pay attention to claw health when selecting bulls. Cull cows with recurring ( $\geq 3$ times) same claw disorder at the same leg**

In a German study, heritability estimates ( $h^2$ ) for DD, heel horn erosion, white line condition and sole ulcer were, respectively 0.14, 0.10, 0.11 and 0.06 (Schöpke *et al.*, 2013). Advances in claw health can, therefore, be achieved through breeding, but at best it is a slow process. Cattle farmers, however, use multiple selection criteria in their bull choice, so the genetic progress of hoof health is often less rapid than you would expect based on the heritability. Cows with chronic M4 lesions will have to be culled to break the DD infection circle (Biemans *et al.*, 2018). Lameness criteria with more repetitions of serious infectious or non-healing CHD lesions should be culled to reduce the infection pressure within the herd (Biemans *et al.*, 2018), increase animal welfare and ensure the social license to produce.

#### **Discussion and conclusion**

The financial loss due to hoof disorders in dairy cows in The Netherlands was calculated as an average of 81 euros per cow/year in 2011. For an average Dutch herd of 100 milking cows, this means a loss of EUR 8,100 per year (Bruijnjs *et al.*, 2010). Interventions that may reduce lameness will increase income, although the interventions will have a cost. However, the study just mentioned dated from the period in which production in the EU was regulated by the milk quota system. As a result, the costs for the loss of milk production caused by hoof disorders has changed. Additionally, in recent years, lameness criteria for lame cows presented for slaughter became more strict, resulting in fewer lame cows accepted in abattoirs. In the current market situation of dairy farming, the total costs of lameness will be considerably higher than in the 2011 study (Dolecheck *et al.*, 2019), due to a loss of milk production and the inability to slaughter lame cows.

Only a small percentage of farms register claw disorders detected at hoof-trimming *via* a central website in the Netherlands, although an unknown percentage of farmers probably register the detected claw disorders themselves. Even fewer farmers analyze and discuss these data with their claw health experts (Holzhauer, personal observation). If good data is available, it can be quite a challenge for the advisor as the farmer is clearly well motivated and informed and may already have strong opinions on the best interventions. By using all available information such as the recorded data of the prevailing claw disorders in a herd, a careful appraisal of the buildings and walkways inside (and out if appropriate), the diet including a bulk-milk test for important trace elements and vitamins that play a role in the formation of good claw horn and skin quality, good advice can be formulated. If insufficient information is available, in particular about the claw health situation, the advice may not be appropriate. It is important to have the required information before formulating an advice and improvement plan, whilst making sure that one uses an empathic communication style. Research has shown that many veterinary practitioners have difficulty advising livestock farmers, especially when initiating the change needed to improve hoof health (Tschoner *et al.*, 2021). A motivating interviewing style appears to be most effective in tackling more complex, often multifactorial, herd problems (Svensson *et al.*, 2019).

Ultimately, the advice is only effective if it is implemented by the farmer, a process that is likely to happen only if they value its relevance, and if the advice matches their goals. Consultants' insight into the goals, priorities, and respect of the knowledge of the farmer and practicalities of the changes in relation to these and the farm's structure and economics increases the chances of acceptance and implementation of the advice (Derks *et al.*, 2013; Silverman *et al.*, 2013). This also ensures that the consultant can bring added value with his claw health knowledge to the farmer and his dairy cows. For consultants who want to focus on claw health herd advice, the 7-point claw health plan has been developed to support a structured holistic approach to improve claw health in dairy herds. This plan has been developed following the successful 5 and later 10-point plans to improve udder health (Murphy, 1956; Dodd *et al.*, 1964), fertility (Trimberger and Davis, 1943; Senger, 1994) and 5 point sheep lameness plan (Clements and Stoye, 2014). By using several standard points, it is possible to determine, at a herd level, which points are most relevant for that specific herd. The plan is based on current knowledge and the available scientific literature on hoof health to date, with a focus on Western Europe. It can give direction in addressing all the relevant risk factors which play a role in hoof health. It ensures that all relevant factors can be discussed and if possible implemented by the farmer. To the best of our knowledge, this is the first time that such a structured hoof health plan has been presented as a support tool to improve hoof health on dairy farms.

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