REDUCING THE SPREAD OF BOVINE DIGITAL DERMATITIS BY DISINFECTION OF HOOF TRIMMING EQUIPMENT: THE DETAIL

BOVINE DIGITAL DERMATITIS: IMPACT & CAUSE

Bovine digital dermatitis (DD) is a highly infectious foot disease of cattle, which is a problem in a large proportion of dairy herds worldwide. The lameness caused by bovine DD is a major welfare concern and there are substantial economic losses associated with this disease. The economic cost from milk production losses alone was calculated at $190 million per year for the USA (Losinger, 2006) and bovine DD has been reported to cost £99 per case in the UK (Great Britain Cattle Health and Welfare Group, 2014). Clearly DD has substantial economic implications for the dairy industry as well as being a threat to animal welfare.

Whilst a broad range of bacterial species can be isolated from bovine DD lesions, spiral bacteria known as treponemes are the only microbes routinely and consistently found within the lesions across the world and are therefore considered causal (Evans et al., 2009; Klitgaard et al., 2013; Nordhoff et al., 2008).

FOOT-TRIMMING: A RISK FACTOR FOR BOVINE DD TRANSMISSION:

Given the highly contagious nature of bovine DD (Read and Walker, 1998), it is considered that direct contact or contact with recently contaminated surfaces is key to transmission of DD (Evans et al., 2016). Fomites (surfaces contaminated with pathogens) are considered important transmission routes for infections (Mee et al., 2012; Miller and Diep, 2008). For bovine DD there is evidence that fomites, and specifically foot trimming equipment, are one of the means of disease transmission between animals, both within infected herds and between herds. The DD pathogens have been found on cattle foot trimming equipment, and studies have shown that 100% of blades used to trim DD infected, lesion symptomatic cattle became contaminated with DD treponemes (Sullivan et al., 2014). Crucially, contamination could be reduced substantially following a short disinfection of trimming blades (Sullivan et al., 2014; Gillespie et al., 2019). Furthermore, blades were occasionally (14%) DD treponeme positive after trimming of apparently healthy, DD asymptomatic cattle feet (Sullivan et al., 2014). This percentage of blades contaminated with DD treponemes from healthy feet is in agreement with another study that identified 12.5% of considered healthy feet as actually containing DD treponemes and diseased when microscopically evaluated (Rasmussen et al., 2012). Gloves have also been shown to become contaminated during the foot trimming process and again contamination can be reduced substantially following a short disinfection step (Angell et al., 2017; Blowey et al., 2013).

HOW GREAT IS THE RISK?

Recent work has demonstrated that the *Treponema* bacteria can survive (remain viable) on hoof knives for 2 hours (Gillespie et al., 2019) and previous work has demonstrated that infectious material collected from DD lesions (or the bacteria alone) can transmit the disease to uninfected animals (Gomez et al., 2012). Whilst transmission relies on both infection load and environmental factors, the threat of DD transmission through the use of non-disinfected knives is supported by epidemiological data, which showed that not cleaning blades increased the risk of a non-DD farm becoming a high (>5%) incidence DD farm by 1.9 fold (Wells et al., 1999). In addition, having a foot trimmer who worked on other farms increased the risk 2.8 fold (Wells et al., 1999). A more recent study also reported that cows within an affected farm using an external foot trimmer were 3.1 times more likely to have the disease compared to affected farms that did not use an external foot trimmer (Yang et al., 2018).

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Collectively, these microbiological and epidemiological data provide evidence that foot trimming has an important role in the transmission of bovine DD and that if the hoof trimming infection route were blocked then the likelihood of a farm having a high level of DD might be reduced substantially. Interestingly, the current UK sheep industry control plan for infectious lameness in sheep (Clements and Stoye, 2014) indicates routine trimming should be avoided. This sheep lameness control practice is in line with research demonstrating that inducing bleeding of feet during routine foot trimming increased lameness (Winter et al., 2015). It has been proposed that damage to the soft tissues of sheep feet leave them susceptible to infectious lameness, and that transmission may occur due to contaminated equipment (Dickins et al., 2016).

A HYGIENE STANDARD OPERATING PROCEDURE FOR FOOT TRIMMING:

The disinfection of cattle hoof knives (and user gloves) between animals and feet is not currently standard practice. It is known that bovine DD can be induced in normal feet by skin inoculation of DD lesional material (Gomez et al., 2012; Krull et al., 2016). Given that during the process of foot trimming without disinfection, fresh infectious material may be routinely transferred from DD feet to uninfected feet, it is clear that an intervention protocol should be developed and rolled out on cattle farms.

To try and tackle the foot knife (and user gloves) as a DD transmission route, we have developed the accompanying disinfection protocol (please see SOP document). As asymptomatic feet may have sub-clinical DD (and hence be infected with treponemes) (Rasmussen et al., 2012) and other foot/horn presentations may be DD infected (Evans et al., 2011) this protocol should be used at all times during foot trimming, i.e. when trimming both infected (all DD lesion stages), other foot/horn presentations and healthy feet also. The evidence for the efficacy of this protocol has been submitted for publication and has been shown to eliminate the viable pathogenic bacteria from hoof knives thus preventing spread of disease via this transmission route (Gillespie et al., 2019). This procedure should be used together with additional control strategies such as routine footbathing and effective slurry management on farm to help to both reduce the susceptibility of bovine skin to new infections and to reduce the spread of DD (Evans et al., 2016).

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