LA-01

A prospective cohort study into the association between early-lactation mastitis and the development of sole ulcers in dairy cows

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Objectives: Sole ulcers (SU) are a major cause of lameness in dairy cattle and their incidence is highest in early to mid-lactation (1). SU take 8-12 weeks or more to develop, and it has been suggested many originate from an insult in the periparturient period (2). The risk for clinical mastitis is highest in the first 30 days in milk (DIM) (3) and we postulate a potential link between early-lactation mastitis incidence and later development of SU. A preliminary study that was carried out by our group involving 455 animals on 3 commercial dairy farms found that cows were significantly more likely to develop SU in early lactation if they had mastitis in the first month post calving (4). The aim of this prospective cohort study was to further investigate this association employing a much larger dataset and more intensive recording of lameness-causing foot lesions.

Materials and Methods: Data were collected from 2186 Holstein-Friesian cows and heifers raised in four commercial dairy farms in the UK. Data were collected from each animal on three occasions: - at drying off or 30-60 days before their expected first calving, in the first 10 days post calving and at 50-120 days post calving. On each occasion, feet were lifted and presence and severity of SU was recorded by a qualified veterinary surgeon. Mastitis episodes were recorded by trained farm staff. A series of univariable analyses were initially performed. Outcome of interest was the presence of a SU in early lactation. In order to account for potential confounding factors, a multivariable logistic regression model was also fitted to the data.

Results: 21.4% of cows that had mastitis in the first 30 days post calving developed SU in early lactation, whilst only 4.9% of cows that did not have mastitis in the first 30 DIM developed SU in early lactation (P = 0.0028). After correcting for parity group (primiparous versus multiparous), farm, and the presence or not of a SU at enrolment, cows that had mastitis in the first 30 days post calving were found to be 6.66 times more likely to have a SU in early lactation (CI 2.50-17.73, P <0.0001) comparing to cows that did not have mastitis in the first 30 days post calving. Multiparous cows were 1.64 times more likely (CI 0.95 -2.85, P = 0.078) to have SU in peak lactation than cows that were in their first lactation. Finally, cows were 13.3 times more likely (CI 6.36 – 28.02, P < 0.0001) to

have an SU in peak lactation if they already had SU at enrolment comparing to cows that did not have SU at enrolment.

Conclusion: These initial results are consistent with those described previously by Griffiths et al. (2018). A strong association has been found between mastitis in the first 30 days and the presence of SU in peak lactation. The mechanism responsible for this association is not yet clear and warrants further investigation.

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Keywords: Dairy cattle, lameness, sole ulcer, mastitis.

LA-02

Metagenomic analyses of the bovine foot skin microbiome; associations with development of Bovine Digital Dermatitis.

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Objectives: Previous studies have described the microbiome of the different lesion stages of Bovine Digital Dermatitis (BDD). The present study was designed to examine the healthy bovine foot-skin microbiome and determine differences in microbial populations associated with future development of BDD lesions.

Materials and Methods: Swabs were taken from the heel bulb region of the back-left foot of 259 Holstein-Friesian cows from three commercial UK dairy farms 3-4 weeks prior to calving. Feet were re-examined at one, four and 8-10 weeks post-calving to record any lesions that had developed and classify cows into four foot-health groups: those that remained healthy (HtHt), those that became infected (HtIn), those that were always infected (InIn) and those that were infected at enrolment but recovered (InHt).

16SrRNA gene amplicon sequencing was carried out for all samples using the Illumina® HiSeq 2500 platform, and taxonomic assignment of OTUs carried out using QIIME and the RDP classifier. Chao 1, Shannon and Simpson indices were calculated to describe alpha-diversity, and weighted and unweighted UniFrac distances were analysed using Principal Coordinates Analysis and used to describe beta-diversity for

foot health groups and farms. Robust response screening (JMP Pro 12, SAS Institute Inc., USA), was performed to evaluate differences in relative abundance of OTU assignments at genus level between samples from the HtHt and HtIn groups.

A subset of five samples from the HtHt and HtIn groups were used for shotgun metagenomic analysis to provide higher taxonomic resolution and detect differences in the functional profiles of the microbiome. Prepared libraries were sequenced using the Illumina® HiSeq 4000 platform and results analysed using LefSe to determine taxa most likely to explain differences between the two groups. HUMAnN2 was used to functionally annotate read data to show biological pathway abundance and completeness.

Results: Differences in sample richness and evenness were identified between foot-health groups. Alpha-diversity metrics overall suggested that HtHt samples had significantly greater microbial diversity than InIn or InHt samples, and a tendency to greater microbial diversity than HtIn samples.

Focussing on comparing HtHt to HtIn groups (where samples originated from morphologically healthy feet), PCoA showed clustering between HtHt and HtIn groups, indicating that overall the two groups share the same species. However, response screening showed at genus level that *Macrococcus* spp. and *Brachybacterium* spp. were more abundant in samples from the HtHt group, whilst *Succiniclasticum* spp., *Porphyromonas* spp., *Acholeplasma* spp., *Fastidiosipila* spp., *Peptoclostridium* spp. and *Prevotella* spp. were more abundant in samples from the HtIn group. *Treponema* spp. were present in the top 20 most prevalent genera for HtIn samples, but not for HtHt samples.

Shotgun metagenomic analysis showed some differences in taxa present in HtHt compared to HtIn samples. HtHt samples had increased relative abundance of many gram positive bacteria from the phylum Actinobacteria which would be expected to be part of the healthy foot skin flora. HtIn samples showed biologically relevant increases in wall-less bacteria from the *Tenericutes* phyla, which has previously been found to be more abundant in BDD lesions. Taxonomic assignment of reads was low and therefore the significance of these findings is uncertain; however, there may be some agreement with the 16S rRNA gene sequencing analysis in finding increased *Acholeplasma* spp. in HtIn samples and increased *Brachybacterium sp.* in HtHt samples.

Eight functional pathways were identified as significantly more abundant in the HtIn group. One indicated production of 4-deoxy-L-*threo*-hex-4enopyranuronate, which is a uronic acid resulting from the degradation of many polymers. These include plant polymers such as pectin and gellan, but also important components of connective tissue such as heparin, heparin sulfate, hyaluronan and chondroitin sulfate.

Conclusion: This is the first study to associate taxonomical differences in the healthy foot-skin microbiome with future development of BDD lesions. Our data suggest that loss of diversity may begin before the appearance of morphological lesions, and that *Macrococcus* spp and *Brachybacterium* spp. may be protective whilst *Succiniclasticum* spp., *Porphyromonas* spp., *Acholeplasma* spp., *Fastidiosipila* spp., *Peptoclostridium* spp. and *Prevotella* spp. may initiate dysbiosis that leads to lesion development. Upregulation of a functional pathway associated with polymer degradation may indicate the beginning of a pathogenic process in HtIn samples detectable prior to development of visible BDD lesions.

Keywords: Digital dermatitis, Microbiome, Metagenomics, Lesion development, Lameness.

Initial validation of an intelligent video surveillance system for automatic detection of dairy cattle lameness

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Objectives: Lameness is a major welfare challenge facing the dairy industry worldwide. Monitoring of herd lameness prevalence, early detection and treatment of foot lesions are important aspects of lameness control. The objective of this study was to evaluate the performance of a commercially available video surveillance system for automatic detection of dairy cattle lameness (CattleEye Ltd.). Our aim was to investigate the validity of the mobility scores provided by the system by comparing them against those recorded by two experienced assessors. Additionally, we examined the system's ability to detect cows with at least one potentially painful foot lesion.

Materials and Methods: CattleEye utilizes an inexpensive 2D surveillance camera placed above the passageway exiting the milking parlour. Footage of cows exiting the milking parlour is sent directly to company servers where it is stored and processed. The final result of the analysis is a number between 0.0 and 100.0, indicating the degree of lameness. This variable is then transformed into 0-3 scale score (score 0 for 0-24, score 1 for 25-49, score 2 for 50-74 and score 3 for 75-100).From November 2020 to February 2021 three farms equipped with the CattleEye mobility scoring system were visited once a week by an experienced scorer (Assessor 1). During each visit, the entire milking herd was scored using the Agricultural and Horticultural Development Board (AHDB) 0-3 scale scoring method. Reports containing CattleEye scores were also stored but were not available to Assessor 1 before the end of the study. Assessor 1 also recorded lesions found during foot-trimming visits for two of the farms. Finally, a second experienced scorer (Assessor 2) recorded mobility scores on those two farms once during the study and within 48 hours of the last visit by Assessor 1. Percentage of agreement and Cohen's Kappa was calculated comparing the scores recorded by Assessor 1 and the CattleEye system in binary form (Lame/ Not Lame). The same analysis was performed for all possible pairs on the dataset containing scores from Assessor 1, Assessor 2 and the CattleEye system. Using the lesions recorded and their severity, cows were classified as having at least one potentially painful lesion or not. Lesions included in this analysis were: M2 stage of digital dermatitis, toe ulcer, sole ulcer and severe white line disease lesions. Confusion matrixes were calculated using the binary lesion score as reference and the binary form of Assessor 1 scores and the CattleEye scores as predictors.

Results: By the end of the study 6,040 mobility scores were collected by Assessor 1 that also had a corresponding CattleEye score, from which 1,102 also had corresponding scores from Assessor 2. Foot lesions from 84 cows were recorded.

Assessor 1/ CattleEye

Agreement between the binary scores of Assessor 1 and the CattleEye system for Farms 1, 2 and 3 were 82.6%, 84.1% and 88.9% respectively. The Cohen's Kappa for the same combinations were 0.44, 0.34 and 0.41 respectively.

Assessor 1/ Assessor 2/ CattleEye

For Farm 2, agreements between Assessor 1 and Assessor 2, Assessor 1 and CattleEye, and Assessor 2 and CattleEye were: 80%, 77.6% and 81.6% respectively. Cohen's kappa for those pairs were: 0.30, 0.26 and 0.30. Agreement among the same pairs but for Farm 3 were: 90.1%, 88% and 85% respectively. Cohen's Kappa for those pairs for Farm 3 were: 0.44, 0.40 and 0.32 respectively. Kappa values for agreement between Assessors 1 and 2 for farms 2 and 3 (0.30, 0.44 respectively) were very similar to those between Assessor 1 and CattleEye throughout the entire validation process (0.34, 0.41 for farms 2 and 3 respectively).

Assessor 1/ CattleEye/ Foot lesions

When using the lesion score as reference and Assessor 1 binary scores as classifier the confusion matrix produced a combination of 35% sensitivity and 88% specificity. Positive predictive value (PPV) was 38% and negative predictive value (NPV) was 87%. When using CattleEye scores as classifiers the confusion matrix produced a combination of 71% sensitivity and 81% specificity; PPV was 43% and NPV was 93%.

Conclusion: This study shows that the CattleEye system had a comparable performance to two experienced scorers when mobility score was used as a reference and outperformed the human scorer when lesion presence was used as the gold standard.

Keywords: Automatic lameness detection, dairy cattle.

LA-04

Sole Soft Tissue Thickness changes over the Periparturient Period and its Association with Sole Ulcers in Dairy Cattle

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Objectives: Sole ulcers are a leading cause of lameness in dairy cattle. Despite their importance, we are still yet to fully elucidate their aetiopathogenesis. The sole soft tissues, which includes the digital cushion, has been theorised to play a role in the development of these lesions (Newsome et al., 2017). This abstract describes preliminary analyses of SSTT data collected longitudinally on a large number of dairy cows. The objective of this analysis was to describe periparturient changes SSTT measurements and its association with a number of explanatory variables.

Materials & Methods: Across four commercial UK dairy farms, 2,352 Holstein Friesian cows were prospectively enrolled prior to a calving date expected to occur between April and September 2019. Animals were assessed at four time points relative to their calving date; prior to calving (mean: -55 days, standard deviation (SD): 18), immediately post-calving (mean: +5 days, SD: 3), during early lactation (mean: +84 days, SD: 14) and again in late lactation (mean: +200 days, SD: 31). At each check the animals were mobility and body condition scored, all four feet were assessed for infectious and non-infectious foot lesions and these were graded for severity. An image of the digital cushion on the lateral claw of the hind left foot was taken using B mode ultrasonography for measurement at a later date.

In total 7,866 digital cushion images were analysed by a single assessor blinded to cow, farm and stage of lactation and using Image J software. Univariable analysis was undertaken. Simple linear regression models were constructed, from which least square means were calculated and Tukey HSD tests undertaken (R Core Team, 2020). The SSTT was the outcome variable.

Results: The SSTT nadir was shortly after calving, with SSTT then increasing throughout lactation (P <.0001). Parity was significant, with lower parity animals having significantly thinner SSTT compared to higher parity animals (P <.0001), this was especially apparent for primiparous compared to multiparous animals. There were significant differences in SSTT between farms (P<.0001), and a farm by stage interaction was noted (P<.0001). Two distinct patterns of SSTT change over the course of the lactation emerged. The first is as previously described, the SSTT starts relatively high, drops at calving and then increases in size again throughout lactation. This was evident on two of the farms. The other pattern featured a decline in SSTT from the dry period through to the nadir at early lactation, the SSTT then recovers in size by the late lactation visit. An interesting parity by time point of measurement by sole ulcer incidence interaction was also observed. Primiparous animals that developed a sole ulcer in early lactation exhibited a greater drop in SSTT thickness at calving compared to those primiparous animals which did not develop a sole ulcer. This change was echoed in the multiparous animals, but was not as sizeable. Initial analysis has also indicated that taller cows had thicker SSTTs, whilst cows with thinner sole horn had thicker sole soft tissues.

Conclusion: To the best of the author's knowledge this is the largest study of sole soft tissue thickness measurements. Initial analyses have highlighted that freshly calved animals and heifers have significantly thinner sole soft tissues and our project adds further evidence that fresh cow management and heifer management are important stages for managing the risk of lameness in the production cycle of dairy cows.

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Keywords: Dairy, Lameness, Sole Ulcer, Digital Cushion.

LA-05

Use of intra-articular administration of isopropyl alcohol for facilitated ankylosis of the distal interphalangeal joint in cattle with septic arthritis

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Objectives: To determine whether intra-articular (IA) injection of 70% isopropyl alcohol and hoof block application to the adjacent healthy claw will result in clinical ankylosis of the distal interphalangeal joint (DIPJ) in cattle with septic arthritis (SA), and whether lameness scores will be improved.

Materials and Methods: Four beef cows were diagnosed with SA of the DIPJ via clinical and radiographic exam (4), and/or culture of synovial fluid (2). Lameness scores were recorded. Six to 20 mLs of 70% isopropyl alcohol was administered into the affected DIPJ following regional intravenous perfusion of 2% lidocaine. A wooden hoof block was affixed to the adjacent healthy claw. Cattle were re-examined, lameness re-scored following hoof block removal, and clinical determination of ankylosis performed at follow-up visits at 2.5 – 7 (average 3.8) months later. Radiographs were repeated if economics permitted (2 cases). Long-term follow-up (> 1 year) was obtained by clinical and radiographic exam (1), by video (1), and/or via contacting the owner by telephone (all cases).

Results: All 4 cows had improved lameness scores and clinical ankylosis of the affected DIPJ. Long-term follow-up indicated that all cattle were pasture sound. Two cows had calved and all 4 were rebred. All owners expressed satisfaction with the outcome.

Conclusions: Clinical ankylosis and improved lameness scores were observed following an IA injection of 70% isopropyl alcohol into the DIPJ in cows with SA. All cows remained in the herd and were productive. Additional studies are warranted to determine efficacy of this procedure.

Keywords: Lameness, cattle, septic arthritis.

LA-06

Impact of hoof lesions and moment of occurrence in milk production in dairy cattle

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Objectives: Lameness is one of the main reasons for early culling in dairy cattle. Most lameness cases are caused by lesions in the hooves with dramatic consequences in cow's life. Thus, we aimed to describe the impact of lameness in milk production, depending on hoof lesion type and moment of occurrence.

Materials and methods: In this retrospective study, we used records of 5.565 cows from four farms located in the UK, which included data from 86,407 Milk Test records between September 2014 and October 2019. Lactations with less than five records were removed from the dataset. Lameness was considered as affecting MY if observed at least 21 d before the milk test day, and was scored as 1) horn lesions, and 2) infectious diseases of the hoof. Non-specified lameness lesions were removed from the databank. The effect of lameness on milk yield was studied based on the drop in MY when cow was lame. Firstly, we removed all lameness records from the data and fitted a wood's curve (WC) for each cow and lactation number. Secondly, we returned the lameness data to the databank and tested the effect of lameness in each WC parameter following the model: $MY = (1 + 1 \times Lame) \times Wk^{2 + 2 \times Lame} \times e^{-(3 + 3 \times Lame) \times Wk}$, where 1, 2 and 3 were parameters determined for each cow, 1, 2 and 3 were the effect of lameness on MY, Lame is the binary occurrence of lameness, and Wk is the week of lactation. The lameness score (LS) was tested on all parameters. Lastly, a general WC was fit including in the general WC to estimate the MY loss throughout the lactation. Farm was included as random effect in all models. The model was run using PROC NLMIXED (SAS University edition) and parameters were considered different when $P < 0.05$.

Results: A total of 180 cows had, at some point of their life, a LS recorded. There were 87 cows with LS 1 and 93 with LS 2. Number of lactation when lameness occurred varied from 1st lactation to 10th lactation. Also, there was a big variability of occurrence among days in milk (from 4 to 443). The LS did not impact 1 ($P = 0.119$) but did affect 2 ($P = 0.029$) and 3 ($P = 0.046$). Additionally, lameness did not impact 1 parameter ($P = 0.397$), thus one equation was fit for each LS as follows: LS = 1) $MY = 34.064 \times Wk^{0.160 - 0.025 \times Lame} \times e^{-(0.018 - 0.002 \times Lame) \times Wk}$; and LS = 2) $MY = 34.064 \times Wk^{0.160 - 0.080 \times Lame} \times e^{-(0.018 - 0.007 \times Lame) \times Wk}$. Compared to her colleagues, a lame cow had a lower milk yield at lactation peak. Lame cows with an infectious disease had a peak production of 38,5 kg/d and 36 kg/d at peak for cows with hoof horn lesions, while healthy cows had on average 41,5 kg/d of milk production at peak. Milk loss was, on average, between 0,9 kg/day and 1,8 kg/day. Our analysis revealed that in some cases, infectious disease had no impact in milk loss (late lactating cows). On the other hand, cows with hoof horn

lesions had a milk yield loss from 0,25 kg/day to 4,5 kg/day. Week of lactation where lameness occurred had a strong impact in milk production. Highest loss was detected between weeks 12 and 19 of lactation, and percentage of total milk loss during this period was up to 4,7% for horn lesions and up to 12% for infection diseases of the hoof.

Conclusions: In conclusion, lameness impacted milk production and it is lower for infectious diseases than for hoof horn lesions. Additionally, the lameness impact is related with the time of lameness occurrence, being higher during weeks 12-13 of lactation.

Keywords: Lameness, dairy cattle, milk losses.

LA-07

A Disinfection Field Trial to Remove Bovine Digital Dermatitis Treponemes from Hoof Knives after Foot-Trimming

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Objectives: Although lameness caused by bovine digital dermatitis (BDD) is widespread and much researched, the mode of transmission has not been clarified. Hoof knives become contaminated with BDD treponemes during foot-trimming(1), and these bacteria may survive for up to two hours under aerobic conditions on hoof knife blades(2).

This study tested a protocol for disinfecting hoof knives to mitigate the risk of transmitting BDD during foot-trimming. Three disinfectants were previously identified as candidates for hoof knife disinfection *in vitro* using a 20 second contact time(2). The current study tests these three disinfectants: 1:100 FAM30®, 2% Virkon® and 2% sodium hypochlorite- under field conditions during foot-trimming.

Materials and Methods: This study was approved by the University of Liverpool Veterinary Research Ethics Committee (Ref: VREC662).

Samples were collected on three commercial farms during foot-trimming of 133 BDD-affected feet from lactating dairy cattle. Swabs were taken from each hoof knife before trimming (as a negative control) and after trimming. Knives were briefly rinsed in water to remove gross contamination, then the blade was submerged for 20 seconds in one of three disinfectants (1:100 FAM30®, 2% Virkon® and 2% sodium hypochlorite) or water only for comparison. A third swab was taken to provide post-disinfection samples. There was no hoof knife contact with the BDD lesion during trimming in 22 cases, whilst contact was made with the lesion in 111 cases for treatment purposes.

Detection of bacteria from the *Treponema* genus, and from three known BDD-associated pathogenic phylogroups, was undertaken via two methods. Nested PCR of sample swabs taken directly from the hoof knife blades, and nested PCR of samples extracted from cultures given six weeks to grow was carried out according to previously established protocols (2). The former method is more sensitive for detecting *Treponema* DNA and the latter provides a measure of bacterial viability demonstrated by an ability to grow in liquid medium.

Results: Where direct contact was not made with BDD lesions during trimming, 12/22 (54.5%) of swabs taken from hoof knives were positive for at least one of the three pathogenic phylogroups after trimming using nested PCR. After disinfection 10/22 (45.4%) remained DNA positive. In terms of microorganism viability, pathogenic treponemes were detected by nested PCR of cultures after six weeks in 1/22 (4.5%) of these cases after trimming, and disinfection using 2% Virkon® removed culturable organisms.

Where contact *was* made with BDD lesions (n= 111), 100% of swabs taken from hoof knives after trimming and tested directly were DNA positive for at least one of the three pathogenic phylogroups. After disinfection 38/111 (34.3%) of knives remained DNA positive. Pathogenic treponemes were detected by nested PCR of cultures after six weeks in 47/111 (42.3%) of cases after trimming. All three disinfectants (and water alone) were effective at removing culturable organisms (Table 1).

Conclusions: BDD-associated treponemes can be cultivated from hoof knives in 4.5% of cases after foot-trimming of BDD affected feet where no contact is made with the lesion. Where contact has been made with BDD lesions, BDD treponemes are culturable in 42.3% of cases. Rinsing hoof knives briefly in water then disinfecting the blades for 20 seconds in 1:100 FAM30®, 2% Virkon® or 2% sodium hypochlorite was shown to be effective for removing culturable BDD-associated treponemes from hoof knives.

Table 1. The effect of disinfectants on viable treponemes on hoof trimming knives (determined by PCR of cultures), before use, post-trimming and post-disinfection. In all samples knife-BDD lesion contact occurred during trimming.

Disinfectant	PRE-TRIMMING		POST-TRIMMING		POST-DISINFECTION	
	Treponema genus	BDD phylogroups	Treponema genus	BDD phylogroups	Treponema genus	BDD phylogroups
2% Virkon® (n=32)	0/32	0/32	18/32	13/32	0/32	0/32
2% sodium hypochlorite (n=21)	0/21	0/21	10/21	10/21	0/21	0/21
1:100 FAM30® (n=20)	0/20	0/20	12/20	10/20	0/20	0/20
Water (n=38)	0/38	0/38	24/38	14/38	0/38	1038
Total (n=111)	0/111	0/111	64/111 (57.7%)	47/111 (42.3%)	0/111	0/111

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Keywords: Digital dermatitis, Treponeme, Lameness, Foot-trimming, Disinfection.

LA-08

Comparing the effect of timing of routine early lactation foot inspection and trimming (if required) on fertility performance in high yielding dairy cows

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A randomised, positive-controlled trial to compare the effect of timing of routine early lactation foot inspection and trimming (if required) on fertility performance in high yielding dairy cows.

Objectives: Routine, early lactation foot inspection and trimming (if necessary) is a common preventative strategy used to reduce lameness and improve productivity. The perceived benefits are well accepted across the industry and some evidence does exist to support the use of this intervention (Oultram and others 2017, Griffiths and others 2018). However, evidence regarding the optimal timing of this intervention is scarce. Anecdotally, it is suggested that handling animals for routine foot inspections and treatment (if required) very early in lactation (and therefore around the end of the voluntary waiting period), could provide enough stress to have a detrimental effect on fertility. This randomised controlled trial was designed to assess the subsequent fertility of dairy cows that were randomly allocated at calving to one of two different treatments, receiving early lactation foot inspections and trims at either 26-64 days in milk (early routine inspection +/- trim, EIT), or 76-114 days in milk (late routine inspection +/- trim, LIT).

Materials and Methods: The study was conducted on a single large dairy unit in the UK and all cows were inspected/trimmed by the same qualified foot trimmer who was blinded to the treatment groups. 1,885 were initially randomly allocated (at calving) to one of the two different treatments. Data related to animals' reproductive performance were available from the farm's management software. Multivariable logistic regression and Kaplan-Meyer time to event analyses were used for data analysis.

Results: 1,885 animals were initially randomly allocated to one of the two treatment groups but only 985 of them did actually receive a trim. From these animals, 543 did receive their trim within the correct, randomly allocated, time window. This was due to unforeseen circumstances associated with farm staffing. Of the 543 cows eventually used for data analysis, 304 were in the EIT treatment group and 239 were in the LIT treatment group. Lactation group was a significant predictor of pregnancies per artificial insemination (P/AI) to first service. An effect of treatment group could not be supported for P/AI to first service, time to conception or time to first service analyses. Median time to conception (95% lower and upper confidence limits) was 106 (94 − 112) days for EIT and 112 (97 − 129) for LIT (P = 0.99).

Conclusion: Industry standard timing for early lactation routine inspection +/- trimming is usually at 80-100 days in milk. Our data provide a degree of confidence that subsequent reproductive performance will not be affected, if animals are inspected earlier. An earlier foot inspection and trim if required, may help remodelling of the foot prior to sole ulcer formation, but further work is required in order to test this hypothesis.

Keywords: Dairy Cattle, Lameness, Fertility, Routine Trimming, Conception.

LA-09

Evaluation of the use of ketoprofen for the treatment of digital dermatitis in dairy cattle: a randomised, positive controlled, clinical trial

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Objectives: Digital dermatitis (DD) is one of the main diseases causing lameness in dairy cattle and it is described as an infectious dermatitis of the digital skin that can be painful to touch (Krull et al. 2016). Given that DD is a painful condition, the use of NSAIDs alongside antibiotic treatment may be justified on welfare and possibly on economic grounds; however, this is yet to be proven. The objective of this randomized, positively controlled study was to explore the potential benefits of a single administration of ketoprofen when treating active digital dermatitis lesions.

Materials and Methods: 158 cows that presented signs of active DD (M1, M2 or M4.1 stage) were randomly allocated to either the control or the treatment group. All cows were treated with topical application of oxytetracycline spray. The treatment group additionally received an intramuscular injection of ketoprofen (3 mg/kg, Ketofen 10%, Ceva Animal Health). Cows were mobility scored just before they were treated and then again one week later. Information regarding their daily milk production was also collected. Treatments for each animal from both the control and the treatment group were administered by one person, who also performed the lesion examina-

tion. The mobility score assessor was not involved in treating the cows. Multivariable regression models were used for data analyses.

Results: Animals in the control group were at 2.57 (95% C.I.: 0.82-8.01, *P* = 0.10) times higher odds to be lame at the second evaluation compared to those that received ketoprofen as well. This was a numeric but not statistically significant difference. When only cows that were lame prior to treatment were considered, cows that did not receive ketoprofen were at 20.20 (95% C.I.: 1.40 – 291.29, *P* = 0.03) higher odds of remaining lame a week post treatment comparing to cows that did receive ketoprofen. Cows that received ketoprofen did produce more milk per day the week after treatment than the cows in the control group with adjusted means (± standard error) being 45.35 ± 0.71 and 42.37 ± 0.87 kg per day respectively (*P* < 0.01). The effect of ketoprofen administration was more prominent on cows that were freshly calved and lame at enrolment; these cows produced 58.38 ± 1.85 kg per day the week after treatment if they were in the ketoprofen treatment group comparing to the control ones that produced 47.89 ± 1.81 kg per day (*P* <0.05) .

Conclusions

The addition of ketoprofen in the treatment of active DD lesions appears to have potential benefits for animal welfare as it was associated with an improvement in lameness status and for animal productivity as it was associated with an increased daily milk production. Further research would prove useful to solidify the value of NSAIDs when treating active DD lesions.

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Krull AC, Shearer JK, Gorden PJ, Scott HM, Plummer PJ. Digital dermatitis: natural lesion progression and regression in Holstein dairy cattle over 3 years. J Dairy Sci. 2016.

Keywords: Digital dermatitis, Lameness, NSAIDs, Ketoprofen.

LA-10

Investigating the use of thermal imaging as a diagnostic tool for the detection of different stages of Digital Dermatitis in dairy cattle

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Objectives: Bovine Digital Dermatitis (BDD) is one of the major causes of lameness in dairy cattle with increasing economic and welfare importance[1]. The use of Infrared Thermography (IRT) imaging could prove a non-invasive and reliable diagnostic tool for the early detection of BDD lesions. Our aims were to (1) determine how interdigital skin temperature (IST), measured using infrared thermography, was associated with

different stages of digital dermatitis (DD) lesions and (2) develop and validate models that can use IST measurements to identify cows with an active DD lesion.

Materials and Methods: This study was conducted on four dairy farms in the UK. Between March 2019 and March 2020, infrared thermographic images of hind feet were taken from 2,334 Holstein cows. We recorded the maximum temperature reading from infrared thermographic images of the interdigital skin between the heel bulbs on the hind feet. A Flir E8 Wi-Fi Thermal Camera was used. Pregnant animals were enrolled approximately 1 to 2 mo precalving, reassessed 1 wk after calving, and again at approximately 50 to 100 d postpartum. At these time points, IST and the clinical stage of DD (M-stage scoring system[2]: M1–M4.1) were recorded in addition to other data such as the ambient environmental temperature, height, body condition score, parity, and the presence of other foot lesions. A mixed effect linear regression model with IST as the dependent variable was fitted. Subsequently, the capacity of IST measurements to detect the presence or absence of an active DD lesion (M1, M2, or M4.1) was explored by fitting logistic regression models, which were tested using 10-fold validation. A mixed effect logistic regression model with the presence of active DD as the dependent variable was fitted first. This model was then restricted so that only explanatory variables that could be practically recorded in a nonresearch, external setting were included.

Results: A total of 2,334 cows were included in this project, providing a total of 12,221 hind feet with lesion records and thermal images for analysis. The mixed effect linear regression model showed that Interdigital skin temperature was associated with DD lesions; compared to healthy feet, IST was highest in feet with M2 lesions, followed by M1 and M4.1 lesions. The average area under the curve for mixed effect logistic regression model was 0.80 when its ability to detect presence of active DD was tested on 10% of the data that were not used for the model's training; an average sensitivity of 0.77 and an average specificity of 0.67 was achieved. Validation of the simplified logistic regression model demonstrated an average area under the curve of 0.78, a sensitivity of 0.88, and a specificity of 0.66 for 1 of the time points (precalving). Lower sensitivity and specificity were achieved for the other 2 time points.

Conclusion: The study showed that IRT imaging can be effective in detecting active BDD lesions. M2 stage lesions resulted in the highest IST which was significantly higher than that of any other stage. Additionally, we highlight the potential for infrared thermography to be used for routine on-farm diagnosis of active DD lesions.

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Keywords: Digital dermatitis, thermography, dairy cattle.

LA-11

Time-series observations of cattle mobility: accurate label assignment from multiple assessors, and association with lesions detected in the feet.

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Objectives: To provide accurate diagnostic labels to machine learning algorithms for automated mobility analysis in cattle, we compared repeated subjective lameness scores from multiple assessors with the presence of lesions at repeated hoof examinations. We aimed to determine the extent to which mobility classification by multiple assessors and its variations using video capture was associated with identifying lesions during sequential hoof-trimmer examinations.

Materials and Methods: We recorded videos of 40+ cows fortnightly on 9 visits (405 recordings), and the 4 hoof examinations (HE) performed monthly (176 records). The recorded videos were assessed individually by expert assessors - 3 on visits 1-5 and 4 on visits 6-9. The "AHDB-Dairy" system (scores 0,1,2,3; 0 no abnormality - 3 severe lameness) was used throughout. Evaluators were shown calibration videos (AHDB 0-3) before scoring each visit. Assessors could record a second score if they were not confident in their assessment. A convergent score (ConvS) was constructed for each cow and visit where the maximum agreement was sought from second scores where the first scores differed among assessors. After completing individual scoring for each visit, the assessors convened to discuss each video and agreed to reach a consensus score (CS) for each cow. Each score ConvS and CS were converted to a binary score in which 0/1 became 0 (not lame), and 2/3 became 1 (lame), giving binary convergent scores (ConvSB), and binary consensus scores (CSB). The probability of lameness (P_L) of any animal was estimated with the Bayesian loss function using the 1st AHDB scores. A binary score for the hoof lesions (HLS) was derived; 1= any of white line disease, sole ulcer, digital dermatitis, stones, cracks, underrun; 0=none of these. The scores from all scoring methods were used as the dependent variables in generalized linear models (GLM) with the scores from HLS and lactation number as explanatory variables. The performance (coefficients and p-values) of the GLMs were compared among the scoring methods for the visits immediately preceding and following a foot examination. The Bonferroni correction was applied to give alpha = 0.002 as 24 association tests were conducted. We calculated the Cohen's and Fleiss' Kappa K inter-rater reliability (IIR) statistic for the individual ratings for each visit.

Results: In total 393 videos were retained for scoring after eliminating unsuitable videos. The IRR between assessors ranged from poor (K = 0.0038) to moderate (K = 0.565) agreement. K values and percentage agreement differed significantly between scoring methods (ConvSB> ConvS > CSB > CS) and visits (no consistent pattern observed). The GLM showed a weak effect on lactation number (p ranged 0.01-0.64), and only weak associations were seen between lameness and the presence of lesions: 2 out of 24 GLMs showed statistically significant relationships between mobility score and the presence of lesions ($p<0.002$), both of them from the P_L for the 4th HE (Visit-8~Exam-4 ($p=0.0011$, coeff=0.31), Visit-9~Exam-4 ($p=0.0016$, coeff=0.32). The choice of the outcome variable (scoring methods or loss function) did not significantly affect the p-values or the coefficients in the GLMs ($p>0.05$). However, there was a significant negative effect of visits on the p-values of the GLMs with HLS (average for all visits, p = 0.030) and a significant positive effect on the coefficients (average for all visits = 0.22).

Conclusions: The agreement among raters when using the AHDB scoring method was poor but was improved by binary transformation and convergent scoring. However, the system used for aggregating scores and assigning labels did not significantly affect the strength of the GLM models. Throughout the study, agreement among raters improved, and the relationship between hoof lesions and all mobility score methods became significantly stronger, as indicated by diminishing p-values and increasing coefficient estimates. The addition of an extra scorer after visit5 might also have been a factor. We consider that the loss-function approach to aggregating multiple assessments performed slightly better than the other approaches and is worth further investigation. Our findings highlight the challenges of making reliable mobility assessments in cows to be used as labels for automated lameness detection.

Keywords: Lameness, mobility classification, time-series, labels, automated detection.

LA-12

Can a three-point locomotion scoring system reflect the actual claw health?

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Objectives: The detection of lame cows is the first task when it comes to dealing with lameness on dairy farms. Early identification of lameness and thus of claw problems enables immediate treatment and therefore prevents further disease progression. This not only leads to reduced treatment costs, but also minimises production losses, reduces early cow replacements and increases cows' individual wellbeing. The aim of this study was to validate a three-point locomotion scoring system to evaluate its suitability for future lameness scorings.

Material & Methods: The investigated locomotion score was established as an in practice applicable reference system in 2017 during a project about indirect automatic lameness detection. With this scoring system, cows with an irregular, asymmetric and uneven gait are scored as "lame" (score=3), cows without gait alterations, but showing signs like head bobbing, an arched back or a compensatory posture are considered "unsound" (score=2), and animals who present without any of these features are categorised as "sound" (score=1).

In a first examination, this locomotion score was tested on two different Bavarian dairy farms in a new project on indirect automatic lameness detection. Locomotion scoring was performed one day prior to farm claw trimming by examining video recordings of the cows leaving the milking robot. The results of locomotion scoring were compared to the findings of the farm claw trimming together with a pain test carried out with claw pliers on each claw. A three-level lesion score was assigned to the observations recorded during claw trimming. Score 1 was given to animals with a negative pain test without any visible findings or with minor disorders like sole bleedings, stage 1 digital dermatitis or chronic defects like stage 4 digital dermatitis. Cows with either a positive pain test without findings or the combination of a negative pain test and clinical findings like white line disease, ulcers, tylomas, laminitis or acute digital dermatitis (stages 2 and 4.1) were rated as score 2. Score 3 was given to animals experiencing pain and concurrently suffering from noticeable claw diseases.

The analysed data was comprised of two different datasets, each including two different claw trimming dates. The first dataset included data from 110 cows from November 2020 and May 2021 and included findings documented by claw trimmers as a reference. The second one consisted of data from 115 cows from July and November 2021 and had the results recorded by a veterinarian as a reference.

In a subsequent investigation, the intra- and inter-rater agreement were calculated for the locomotion scoring system using observations from 355 cows on one project farm.

Quadratic weighted Cohen's kappa (K), the 95% confidence interval (CI) as well as the percentage of agreement (PA) were calculated for all datasets of both examinations.

Results: Regarding the comparison of lesion and locomotion score, K was 0.51 (CI=0.34-0.68) for the first dataset and the PA was 66.4%. The results of the second dataset on the other hand showed better results (K=0.72, CI=0.58-0.86, PA=80%), which imply that the actual value might be moderate to almost perfect.

For the intra-rater agreement, the computed PA yielded 93% and the K 0.89 (CI=0.84-0.94), indicating an almost perfect agreement. The inter-rater reliability resulted in a PA=82 % and K=0.72 (CI=0.64-0.81), meaning the inter-rater reliability was substantial to almost perfect.

The examination of the first dataset showed deficits which might have been caused by missing claw health information, as some findings may have not been documented by claw trimmers. More promising results were achieved with the validation of the second dataset and the inter-/ intra-rater agreement.

Conclusion: In conclusion, the validation based on the second dataset and the examination of the inter-/ intra-rater agreement show that in this study the three-point locomotion scoring system was a reliable reference system for claw health. In order to generalise and confirm the presented results additional comparable data sets from other farms and observers should be examined.

The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany. The Federal Office for Agriculture and Food (BLE) provides coordinating support for digitalisation in agriculture as funding organisation.

Keywords: Lameness, Claw Health, Locomotion Scoring.

Effectiveness of tildipirosin injectable solution for the treatment of naturally-occurring acute, bovine interdigital necrobacillosis (foot rot) caused by *Fusobacterium necrophorum*

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Objectives: Foot rot disorders in cattle are necrotic diseases that affect the connective tissue of the interdigital region and are caused by bacteria, mainly *Fusobacterium necrophorum.* The aim of the study was to evaluate the efficacy of a treatment with a single subcutaneous dose of tildipirosin injectable solution (Zuprevo®) against naturally occurring foot rot.

Materials and methods: Fifty-nine Crossbred bulls (*Bos taurus × Bos indicus*), aged between 18 and 24 months and 300 to 500 kg BW, from a commercial feedlot farm, located in Buritizal, São Paulo, Brazil, were included. Animals were randomized into two groups: *Tild-Group* (n=29) were treated with a single subcutaneous administration of tildipirosin at a dose of 4 mg / kg body weight (0.022 mL Zuprevo®/ kg BW); the *Control-Group* (n=30) was treated subcutaneously with 0.9% saline at the same volume (0.022 mL / kg BW). Before and after treatment, both groups were housed in the same paddocks during rainy season. At inclusion, experimental cattle presented lesion scores ≥ 2 (Lesion Score Guide) and lameness scores ≥ 3 (Lameness Scoring Guide). Before treatment, bacteriological samples were collected from the infected hooves of the enrolled cattle. Lesions and lameness were also assessed on Days 2, 4 and 7. On Day 7 another sample for a bacteriological examination was collected from all animals and all samples were evaluated by PCR. Efficacy was determined by a reduction of the lesion and lameness scores and the results of the bacteriological examination of the animals infected by *Fusobacterium necrophorum* 7 days after treatment compared to day 0. Statistical analysis was performed by *Fisher's Exact Test* of *FREQ* procedure of *SAS* (*v. 9.2;* SAS Institute Inc., Cary, NC).

Results: Comparison of the claudication scores between days 0 and 7 revealed that 100% (29/29) of the *Tild-Group* under evaluation presented a reduction of at least one point in the score, whereas the *Control-Group* presented 56.7% (17/30). *Tild-Group* group had 20.69% animals that showed a reduction in lameness and lesion status and other 20.69% that had improvement on their foot rot lesion status, and lesions became milder (*P=0.05*). On the other hand, only one

animal of the *Control-Group* (3.33%) reduced lameness and lesion scores post treatment, and 10% improved their lesion status. Prior to treatment, 68.96% (20/29) and 60% (18/30) of animals were positive for *F. necrophorum* in the *Tild-Group* and *Control-Group*, respectively. After treatment, 37.93% (11/29) and 73.33% (22/30) animals were positive for *F. necrophorum* in *Tild-Group* and *Control-Group*, respectively. *Tild-Group* showed a statistically and clinically significant decrease (*P<0.05*) in the occurrence of *F. necrophorum* 7 days after treatment (P<0.05) compared to day 0.

Conclusion: This study demonstrates the efficacy of tildipirosin in the treatment of naturally occurring *F. necrophorum* related foot rot in cattle under typical feedlot conditions in Brazil.

Keywords: Foot rot, tildipirosin, cross-breed bulls, Brazil.

LA-14

Associations of host genotype with foot skin microbiota profiles and digital dermatitis related bacteria

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Objectives: Associations between host genetics and skin microbiota profiles have been shown in humans[1] and mice[2]. We have recently described the bovine foot skin microbiota using 16S rRNA amplicon and shotgun metagenomic sequencing and showed associations with the development of digital dermatitis (DD) in dairy cattle. Here we used genome wide association and regional heritability mapping approaches to provide first evidence for significant interactions between the host's genotype and the bovine foot skin microbiota profiles.

Materials and Methods: Swabs were taken from the heel bulb region of the back-left foot of 259 cows from 3 UK farms 3-4 weeks before calving. 16SrRNA amplicon sequencing was carried out for all samples using the Illumina® HiSeq 2500 platform, and taxonomic assignment of OTUs carried out using QIIME and the RDP classifier. Chao 1, Shannon and Simpson indices were calculated to describe alpha-diversity, and weighted UniFrac distances and non-metric multidimensional scaling values were used to describe beta-diversity.

Cattle genomic DNA samples were genotyped using a 50K SNP chip. Genome wide association analyses (GWA) and regional heritability mapping (RHM) of consecutive 20 SNPs were performed to identify genomic regions associated with various diversity indices and with the relative abundance of genera found to be associated with the development of DD lesions.

Results: Host genotype was not found to be associated with the overall richness and diversity of the foot skin microbiome. However, significant associations were found between the host's genotype and two bacterial genera associated with DD. The heritabilities for relative abundances of *Peptoclostridium* spp. and Treponema spp. were 0.59 ± 0.18 and 0.52 ± 0.00, respectively. One suggestive SNP on BTA6 and one significant SNP on BTA 19 were associated with relative abundance of *Peptoclostridium* spp. Four significant and two suggestive SNPs on BTA1, one suggestive and one significant SNP on both BTA9 and BTA17, one significant SNP on BTA16, and one suggestive SNP on BTA2, BTA6, BTA8, BTA19, BTA21 and BTA29 were associated with relative abundance of *Treponema* spp.

On BTA1, the region associated with relative abundance of *Treponema* spp. explained 9.88% of the total genomic variance and included the genes *GMPS* and *PLCH1*. *GMPS* encodes guanine monophosphate synthetase which plays a role in de novo synthesis of guanine nucleotides; the cyclic GMP was shown to be associated with immune signaling pathways[3]. *PLCH1* is a member of the phospholipase enzyme family that generates the secondary messengers inositol 1,4,5-trisphosphate (IP3) and diacylglycerol (DAG) by cleaving phosphatidylinositol 4,5-bisphosphate (PtdIns(4,5)P2). Phospholipases were shown to be involved in inflammation mechanisms[4], especially the expression of *PLCH1* were shown to be downregulated by lipopolysaccharides (LPS)[5] which is found in the outer membrane of Gram-negative bacteria[6]. These associations may explain the role of the genomic region on BTA1 in immune and inflammatory response against the Gram-negative Treponema[7] infections. The region associated with relative abundance of *Treponema* spp. on BTA16 explains 34.78% of the total genomic variance and includes the gene *PTPRC* encoding a transmembrane tyrosine phosphatase which was shown to be upregulated after administration of external bacteria to the intestine of mice[8].

Conclusion: In the present study, DD-linked foot skin microbiome traits were investigated using GWA and RHM approaches, leading to a first understanding of the genomic architecture of these traits.

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Keywords: Digital dermatitis, Microbiome, Genetics, Genomics, Lameness.

LA-15

Association of subclinical ketosis with lameness, locomotion score and hoof lesions in post-partum dairy cows

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Objective: Lameness is a debilitating condition that negatively affects animal welfare and productivity. Subclinical ketosis (SCK) is associated with most metabolic diseases in post-partum dairy cows but its link with lameness is not adequately researched. The aim of this study was to investigate the association of SCK with lameness severity and hoof lesion type in Holstein dairy cows during the post-partum period.

Materials and methods: The study was conducted at a large commercial farm located in Northern Greece and included 288 first parity Holstein cows. All cows were blood sampled and locomotion scored on a five-point scale weekly, during the first 13 weeks of lactation, by an experienced veterinarian. Cows with a locomotion score (LS) ≥2 were considered lame; cows were hoof trimmed by the same veterinarian, who identified, recorded and scored all lesions on a 1 to 3 severity scale (mild, moderate and severe, respectively); appropriate treatment was subsequently provided. Concentration of β-hydroxybutyric acid (BHBA) was measured by a spectrophotometer and SCK was defined as BHBA≥1,100 μmol/L. Lesions were categorized as either claw horn lesions (e.g. sole ulcer, white line disease etc) or infectious (e.g. digital dermatitis, pododermatitis etc). During the study period, cows would be hoof-trimmed and lesions identified and recorded multiple times if needed (a new case was defined as LS≥2, 4 weeks after the previous diagnosis). Cases of lameness were classified in one of the following groups, based on lesion and severity score: a) CHL (n=196): cases with only or predominately claw horn lesions, b) INL (n=153): cases with only or predominately infectious lesions and c) CHL_INL (n=48): cases with both type of lesions, of equal severity. The data set included 3,676 observations (BHBA measurements and locomotion scores) and 397 cases of lameness. For each observation, cows were classified as SCK or non-SCK. Herd level association of SCK with cow lameness, LS and case classification (CHL, INL and CHL_INL) was estimated with Cox regression survival analysis. Kaplan-Meier survival analysis was used to estimate cow median survival time (MST) of repeated observations within each hoof lesion group. All analyses were performed with SPSS ver. 25. Statistical significance threshold was set at P≤0.05.

Results: Incidence of SCK and lameness was 23.96% and 82.29%, respectively. Cows with SCK were 2.7 (1.7-4.7) times more likely to be diagnosed as lame compared to non-SCK ones. Cows with SCK were 4.1 (2.1-8.3) times more likely to be scored with a LS of 3 compared to non-SCK ones; SCK was not significantly associated with LS=-2 and LS=4+5. Cows with SCK were 3.2 (1.7-6.1) times more likely to be diagnosed

as lame due to CHL and showed a tendency to be diagnosed as lame due to CHL_INL (P=0.06), compared to non-SCK ones. Impaired locomotion due to INL type was not significantly associated with SCK. Cases classified as SCK+CHL were diagnosed earlier, compared to non-SCK+CHL: (MST median±se) 5.00±1.65 vs. 9.00±0.43 weeks. Cases classified as SCK+INL had a significantly shorter MST (median±se), compared to non-SCK+INL ones: 2.00±1.96 weeks vs. 7.00±0.61. Cases classified as SCK+CHL_INL had a significantly shorter MST (median±se), compared to non-SCK+CHL_INL ones: 2.00±0.82 weeks vs. 7.00±1.01.

Conclusion: Subclinical ketosis significantly increased the odds and severity of lameness; in addition, SCK was associated with claw horn lesions but not with infectious ones. Occurrence earlier in the lactation period in subclinically ketotic cows is expected to aggravate the harmful effects of lameness. Management efforts to reduce incidence of SCK would favor hoof health and cow welfare.

Keywords: Lameness, subclinical ketosis, dairy cows.

LA-16

Genetic selection can reduce the incidence of claw horn lesions in dairy cattle

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Objectives: Sole haemorrhage (SH), sole ulcers (SU), and white line lesions (WL) are often grouped under the collective term "claw horn lesions" (CHL) (Offer et al. 2000). Claw horn lesions have a high prevalence in dairy cattle (Offer et al. 2000) and, relative to other foot lesions, CHL have been associated with the most severe pain responses (Pastell et al. 2010), economic impacts (Bruijnis et al 2010), and environmental consequences. In 2018, a genetic selection index for lameness, termed "Lameness Advantage", was published by the UK Agricultural and Horticultural Development Board (AHDB). The Lameness Advantage index is calculated using lameness events from farm records (collected via milk recording organisations) in combination with traits from type classification. The objective of this study was to determine the association between the Lameness Advantage genetic index and the frequency of four outcomes: sole haemorrhage (SH), sole ulcers (SU), white line lesions (WL), and lameness during mobility scoring.

Materials and Methods: We enrolled 2,352 Holstein dairy cows from four farms in the UK. Cows were mobility scored and foot lesions recorded at four time points from before calving to late lactation. Over 90% of foot lesion identification and recording was performed by a single researcher. Cows were genotyped and genetic indexes were assigned to each cow following national genetic evaluations. Lameness records and

genetic indexes were successfully matched for 2,107 cows. Four separate multivariable logistic regression models, which included farm and parity as covariables, were used to quantify the association between the Lameness Advantage index and SH, SU, WL, and lameness.

Results: The odds ratios (95% confidence intervals) for one point increase in the Lameness Advantage index were 0.79 (0.72 - 0.86), 0.68 (0.59 – 0.78), 0.94 (0.84 – 1.04), and 0.82 (0.74 – 91) for SH, SU, WL, and lameness, respectively. The same trends were present when the sire's Lameness Advantage index was evaluated in place of the animal's own, although the strength of this association was generally weaker.

Conclusion: The Lameness Advantage index is associated with SH, SU, and lameness, therefore selection on the Lameness Advantage index could be considered in herds aiming to reduce lameness. Where genomic testing of heifers is not conducted, sire Lameness Advantage index may still be effective to reduce SH and SU incidence.

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Keywords: Genetics, lameness, lameness advantage, claw horn lesions.

LA-17

Hormonal profiles and serum biomarkers for fat mobilisation and their association with sole ulcers in dairy cows

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Objective: Sole ulcers (SU) are painful, non-infectious lameness causing lesions. Relaxin and insulin have been speculated as playing an important role in their development, through the relaxation of the suspensory apparatus at calving or insulin dysregulation induced damage to the corium. Periparturient fat mobilization has also been implicated in their development. The objective of this study was to evaluate whether serum biomarkers for fat mobilisation and specific hormonal profiles are associated with the odds of a cow displaying a SU in the early lactation period.

Materials and Methods: As part of a larger study, 371 Holstein cows from two commercial dairy farms that were due to calve between April and September 2019 were prospectively enrolled prior to calving. Animals were assessed at four time points relative to calving date; prior to calving (mean: -59 days, SD: 30) immediately after calving (mean: +5 days, SD: 4, fresh), approximately two weeks after calving (mean: +12 days, SD: 4, fresh 2) and in early lactation (mean: +77 days, SD: 10).

At each visit, body condition (BCS) was assessed. The animal was restrained in a foot trimming crush, and all feet assessed for the presence of infectious and non-infectious disease, with lesions graded for severity. Serum samples were collected from each animal at fresh, fresh 2 and the early lactation time points. Animals were excluded from the study if a serum sample was missing. All eligible primiparous animals (60) were enrolled and a further 140 multiparous animals were randomly selected from the rest of the enrolled population. Relaxin, insulin, β-hydroxybutyrate (BHB) and non-esterified fatty acids (NEFA) were measured using commercially available kits.

Univariable analysis was undertaken and a multivariable logistic regression model was then fitted with presence of a SU at the early lactation check as the outcome. BHB and NEFA concentrations were categorised into normal or elevated based on reference ranges (1.2mmol/l, and 0.7mmol/l respectively). Relaxin and insulin concentrations were analysed as quartiles.

Results: In total, 600 serum samples from 200 animals were analysed for relaxin, insulin, BHB and NEFA at three time points (fresh, fresh 2 and early lactation). Eighteen animals (9%) exhibited a sole ulcer at the early lactation check.

At univariable analyses, parity ($P= 0.014$), serum NEFA concentrations at fresh 2 ($P= 0.014$), and serum relaxin concentration at fresh ($P= 0.004$) were statistically significantly associated with the presence of a SU. The latter highlighting that animals in the first quartile (lowest relaxin concentration) were more likely to display a SU. Trends were also noted; animals with greater serum BHB's at fresh 2 ($P= 0.068$), and NEFA at fresh ($P= 0.078$) were more likely to display a SU, as were animals which displayed a SU in the fresh time point ($P= 0.067$).

Odds ratios (95% confidence intervals) for variables retained within the final multivariable logistic regression model were calculated for an animal exhibiting a SU in early lactation. Animals with elevated BHB concentrations at fresh 2 and NEFA concentrations in early lactation were at 11.12 times (2.07-59.69, $P= 0.005$) and 3.76 times (0.92-15.35, $P= 0.065$) higher odds of being affected with a SU (comparing to animals below the elevated levels threshold) respectively. Animals with an insulin concentration in the fourth quartile (highest concentration) in early lactation were 11.57 times (1.19-112.53, $P= 0.035$) more likely to display a SU than those in the first quartile. Those in the second and third quartile were 5.49 (0.56-53.55, $P= 0.14$) and 5.86 times (0.57-60.54, $P= 0.14$) more likely to display a SU than those in the first quartile.

Conclusions: This preliminary analysis has confirmed the importance of previously described risk factors (excessive periparturient fat mobilization) and identified novel associations between serum biomarkers and the development of sole ulcers. Further analysis is required to fully characterise this

association between high serum insulin concentrations in early lactation and the development of SU's that could further our understanding of the disease's aetiopathogenesis.

Keywords: Sole ulcers, dairy, relaxin, insulin.

LA-18

Complexity of the relationship between behaviour, performance, and claw health in dairy cows

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Objectives: Lameness in dairy cows is a sign of pain and an important welfare issue. Cows tend to hide signs of pain, making visual lameness detection difficult for farmers and vets. Furthermore, research shows that farmers only recognize about a quarter of lame animals on their own farms.

Digitization in dairy farming has the potential to improve health monitoring of individual animals. Previous studies have attempted to combine automatically collected behaviour and performance data to indirectly detect lameness in dairy cows, but have only achieved moderate levels of prediction accuracy, possibly due to the differences between individual farms and animals and also due to the correlation between parameters as well as the interactions thereof.

The aim of this study was to gain a deeper insight into the relationship between claw health, behaviour, and performance in dairy cows to improve indirect automatic lameness detection methods.

Materials and methods: Data was collected between April 2017 and June 2018 on four commercial dairy farms and one research farm in Bavaria. Claw health reference data was collected manually by scoring the locomotion of all animals every fortnight through videos using a three-point score. All cows in the study were fitted with pedometers (ENGS Dairy Solutions, Israel). The pedometers measure activity, lying and feeding behaviour.

The data from the pedometers as well as data from two milking robots were combined into an SQL-database calculating daily values for each parameter and each cow. The reference claw health data and data from monthly milk-yield tests for farms with milking parlours were added to the database.

Data analysis was carried out using RStudio (R version 3.6.2). The data were cleaned, centred, scaled, and balanced using the SMOTE algorithm. A generalised linear model with all variables from the dataset and combinations thereof was run using 10-fold cross validation to find relevant interaction parameters. A random intercept was added for the individual cows and the full multilevel model was reduced by non-significant predictors using backward step regression.

Results: The final dataset contained 71.497 data points from 381 different animals. The final model had 25 predictors, of which 15 were interaction effects. The findings in the study support those found in literature, such as a higher

feeding duration (FD, odds ratio OR = 0.51, confidence interval CI 0.49-0.53) and a later stage of lactation (OR = 0.61, CI 0.58-0.64) being a protective factor for lameness and that the ratio between lying duration during daytime and night-time (OR = 1.17, CI 1.13-1.22) and an increased lying duration per day (LD) (OR = 1.42, CI 1.36-1.48) increased the probability of an animal being lame.

The interaction effects were particularly interesting as they offered insight into the complexity of the relationship between the single predictors. The interaction effect between the average daily milk yield (MMY) and FD for example, shows that with mean and above average FD, MMY hardly influences the probability of a cow being lame. With a low FD however, an increased MMY has a strong positive effect on the probability of being lame. Similarly, a higher parity number in combination with a low number of lying bouts (LBN) are associated with a higher risk of lameness, possibly indicating less willingness to stand up often. Cows in their first lactation, however, have a higher probability of being lame if they have a high LBN. This could be an indication of enhanced social stress in heifers after first being integrated in the herd after calving, which affects cows' behaviour and their time budget. If this effect, which leads to spending less time feeding and lying, is more prominent in heifers, it could in turn affect their hoof health more than in older cows.

Conclusions: Using automatically collected behaviour and performance data to detect lame animals could be a promising tool for early lameness recognition. However, using single behaviour and performance parameters to try and predict lameness doesn't reflect the complexity of the relationship between claw health, behaviour, and lactation data. Further research is needed to understand this type of interaction both on a herd and an individual-animal level.

Keywords: Claw health, precision dairy farming, lameness, behaviour, performance.

LA-21

Evaluating the Effectiveness of Organic Therapies for the Treatment of Bovine Digital Dermatitis

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Objectives: Bovine digital dermatitis (DD) is an infectious bacterial disease that causes acute and chronic lameness in dairy cattle. DD has created welfare concerns within the dairy industry since its discovery in the United States during the 1980s. Common effective topical therapies for DD often include antibiotics. This makes it difficult to manage DD in organic production systems while abiding by the United States National Organic Standards Board. The primary objective of

this prospective randomized clinical trial was to identify one or more effective and organic-approved products to provide improved treatment outcomes for DD.

Materials and Methods: Dairy cattle (n=385) with DD lesions were enrolled at D0 on two, similarly managed, commercial organic dairy farms. Cows were blocked by days in milk and lactation number for randomization and assigned to one of four topical treatments: a.) 15 grams of copper sulfate, b.) 20 grams of iodine, c.) 20 grams of honey, and d.) 20 grams of hydrogen peroxide. All treatments were lightly wrapped with a bandage and removed after 3 to 5 days. The assigned treatment was applied on D0, D7, and D14. The cows were evaluated in a hoof-trimming chute on D0, D7, D14, D28, D56, and D112. All data were collected by trained veterinarians and professional hoof trimmers. Metrics of locomotion score (LOCOSCORE: 1 = best, 2, 3, 4, 5 = worst), an adapted digital dermatitis scoring system (DDSCORE: 1 = best, 2 3, 4, 5 = worst), and an algometer pressure reading (ALGOSCORE:1 = worst through, 10 = best) were collected at each evaluation to determine the effect of the assigned treatments on changes in metrics since enrollment. Body condition scores and digital photographs of the lesion were collected and recorded at each evaluation. Treatment failures were switched to a 50:50 copper sulfate and iodine topical solution. Statistical analyses were performed using ordinal (proportional odds) regression for DDSCORE and LOCOSCORE versus linear regression for ALGOSCORE. Farm was treated as a fixed effect while treatment by day effects were modeled in full factorial designs. Margin means were estimated for each treatment at each day. For ordinal outcomes the probability a cow exhibited either score 1, 2, 3, or 4 was the outcome of interest, with increasing probability of lower scores the desirable outcome. For ALGOSCORE, a more rapid rise towards higher scores was desirable.

Results: The results of this study show copper sulfate was clearly the most effective treatment to rapidly and significantly improve all outcome measurements over the 112-day trial. Copper sulfate treatment showed a significant (P<0.01) increase in relative odds of becoming a lower category DDSCORE in each post treatment evaluation. With lower scores, the physical appearance of the lesion is drier and more regressed. Cows treated with copper sulfate were estimated to exhibit an ALGOSCORE of 7.1 (95% CI 6.41, 7.69) at D28 compared to 3.4 (95% CI 2.47, 4.26), 4.0 (95% CI 3.16, 4.75), and 2.7 (95% CI 1.91, 3.49) for honey, hydrogen peroxide, and iodine respectively. The ALGOSCORE, or pain-free pressure applied to the lesion, increases as the lesion regresses. The analysis for LOCOSCORE resulted in copper sulfate producing the most rapid recovery and highest probability of an ideal LOCOSCORE of a 1, no visible lameness, throughout each follow-up evaluation. All three statistical analyses showed global significance of treatment (3 degrees of freedom), period (5 degrees of freedom) main effects and their interactions (p<0.05).

Conclusion: Of the four organic-approved treatments tested in this trial, copper sulfate was by-far the most effective treatment in decreasing DDSCORE and LOCOSCORE most rapidly as well as increasing ALGOSCORE indicating lesion regression and healing. While the other treatments improved over time, none showed significantly improved changes throughout the four interim evaluation points and there were no

significant differences between the non-copper sulfate groups. All cows did show improvement over time, with cows remaining in the study at D112 having improved outcome measures compared to D0; in addition, differences were non-significant (P>0.05) among all treatments at D112). However, the effects of culling and switching to the alternative treatment at D28 may have confounded those findings. Copper sulfate is the superior topical treatment to manage bovine DD.

Keywords: Digital dermatitis, locomotion, organic.

LA-22

The Effects of Lameness on Weight Gain and Carcase Classification of UK Finishing Cattle

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Objectives: Lameness in UK dairy cattle is widely reported to have significant effects on yield, fertility and welfare. However, the effects of lameness of UK beef cattle is unknown. Furthermore, there is minimal information regarding the effects of lameness on beef cattle internationally. There is however evidence suggesting a lower price can be expected at slaughter for cattle having experienced lameness.

The absence of appropriate information regarding the impact of lameness makes treatment and prevention planning more complicated, in particular making it more difficult to determine intervention points. This lack of evidence may potentially lead to lameness being undervalued as an issue, and therefore not treated or prevented adequately.

Knowledge regarding the impact of lameness on production measures would support veterinarian and farmer decision making, highlighting the importance, and justifying treatment and prevention measures. With beef finishing units, Average Daily Live Weight Gain (ADLWG) is useful measure of performance as faster growth will lead to shorter time on farm and generally lower total input costs. Carcase classification is another measure of performance, which represents the conformation and fat coverage at slaughter. Carcass classification will affect the price per Kilogram paid to the farmer.

This study identified the effects of lameness on growth rates and carcass classification of finishing cattle on three UK farms.

Materials and Methods: A longitudinal observation study was carried out on three farms located in England between July 2018 and August 2019. Animals of interest were housed cattle, in the finishing period and being reared for beef production. Three farms were recruited, where eligible animals were weighed and locomotion scored approximately monthly from the start of the study for the duration of their time in the finishing group. Slaughter dates and carcass grading information was obtained.

Results: Farm 3 results have been presented here. On this farm, 275 animals received at least two locomotion scoring

visits before being finished. Of these animals, 265 were Aberdeen Angus (AA) or AA crossbred. The mean age at slaughter was 20.4 months (standard deviation (SD) 1.7 months). 82 of these animals were lame at least one locomotion scoring visit, with 34 being lame for multiple visits. Animals being scored as lame during one or more locomotion scoring visit were more likely to have a lower ADLWG (p<0.001) than animals never having been scored as lame. The ADLWG from first scoring to last scoring was 1.37Kg (SD 0.43) for animals not experiencing lameness, compared to 1.1Kg (SD 0.48Kg) for animals that experienced one or more lameness events. The ADLWG for cattle that were lame at all scoring visits was 0.66Kg (SD 0.59Kg). Details of other farms are discussed, along with carcass grading information and the association with lameness.

Conclusion: The ADLWG was lower for animals experiencing at least one lameness event compared to animals not experiencing a lameness event, which would correlate with production loss data available for the dairy industry. In the dairy industry, some evidence suggests that higher yielding cattle are more likely to become lame than lower yielding cattle. This study doesn't identify whether faster growing beef cattle are more likely to become lame, but if true, this may be masking some of the effects of lameness on ADLWG.

This research suggests that prevention of lame animals may be important to increase growth rates and achieve better carcass classification, increasing productivity and farm profitability.

Keywords: Lameness, Beef, Finishers, Mobility, Locomotion.

LA-23

Comparison of thiamphenicol and oxytetracycline based topical treatments for the control of digital dermatitis lesions in dairy cows: a multicentric randomized clinical trial

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Objectives: This trial compared the effect of the topical administration of thiamphenicol (Taf Spray® and oxytetracycline (Oxytétrin®) on the curation of Digital Dermatitis (DD) lesions of various evolution stage.

Materials and methods: A multicentric randomized clinical trial was set up in four flocks with a history of high DD prevalence. The study involved 116 Prim-Holstein and 8 Montbéliardes cows ranging in age from first to fifth lactation and diagnosed with DD lesion on the first examination. On the first examination (D0), hindlimb and forelimb hoofs of included cows were cleaned, washed with clear water, dried and trimmed by a professional hoof-trimmer, and the number, stage (M1-M4) and localization of DD lesions were recorded by a single operator. Stainless steel forceps that allow holding the interdigital cleft open were used for a precise assessment of DD lesions. A multicriteria lameness score was also attributed to each cow on standing position. Photographs of each cow in standing position and of each hoof were submitted to another expert for an independent evaluation. Cows were randomly assigned into either the oxytetracycline group (OTC) or the thiamphenicol (TH) group. The topical treatments were administrated for 3 seconds on each DD lesion by the same operator in a trimming cage, during 3 consecutive days, after the hoofs have been cleaned and dried. For animal welfare and ethical reasons, the study did not include a non-treated control group. DD lesions and lameness were further evaluated at D0+7, D0+14 and D0 +28 days using the same protocol.

All initial M1, M2 or M4 DD lesions that were subsequently scored M0 on D7, D14 or D28 were regarded as cured, and uncured otherwise. The probability of cure was modeled using mixed multivariate logistic models, with the DD lesion as the epidemiological unit. The estimated effect of the treatment group was adjusted on herd, DD lesion stage at D0, hoof level factors (number of DD lesions at D0 observed on the hoof) and cow level factors (number of affected hoofs, lactation number and days in milk at D0). A treatment group x DD lesion stage interaction was tested into the models, and a cow random effect was included. Separate models were fitted for D7, D14 and D28.

Results: In total, 225 DD lesions, including 77 M1-stage (34.2%), 113 M2-stage (50.2) and 34 M4-stage (15.6%) were diagnosed at D0 on 156 foots from 116 cows. A majority of cows (77, 66.3%) had only one affected foot, 37 (31.9%) had two affected feet and only 2 cows had three affected feet. Almost all DD lesions were observed on the plantar surface of the hoof (205, 91.0%) with 49.3% of them located in the interdigital cleft. At D28, the overall cure rates were similar for both treatment groups (OTC: 76.6%; TH: 79.9%, p=0.63) with M1-stage lesions being almost all healed (OTC: 97.1, TH: 92.7%, p=0.62). Adjusting for potential confounders, the cure odd was marginally statistically higher in the OTC group than in the TS group (p=0.04) at D7, but not at D14 (p=0.70) and neither at D28 (p=0.52). No significant treatment group x lesion stage interaction was found. Compared to M1-stage lesions, M2-stage lesions were at a lower odd to be cured at D7 (OR= 0.17; 95%CI: 0.04-0.65, p=0.009), D14 (OR=0.10, 95%CI: 0.06-0.61, p=0.0125) and D28 (OR=0.23, 95%CI: 0.06-0.89, p=0.029). Whatever the date and the treatment group, M4-stage lesions had the lowest cure rate (OTC:35.2%, TH: 27.8% at D28, p=0.72).

Conclusion: In this study the use of thiamphenicol or oxytetracyclin based topical treatments yielded similar cure rates. The high cure rates found for M1-stage lesions was probably partially due to spontaneous healing, that might have been favored the foot washing and drying before all examination and treatment administration. This observation reinforces the pivotal role of foot hygiene in the control of DD. Finally, the fact that only a low proportion of M4-stage lesions was cured after a 28 days' follow-up emphasizes the need to avoid chronicity for a higher probability of positive outcome.

Keywords: Digital dermatitis, topical treatment, randomized clinical trial, thiamphenicol, oxytetracyclin.

LA-24

A study on the association between occurrence of Digital Dermatitis and reproductive performance in a cohort of maiden heifers

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Objectives: Digital dermatitis (DD) is an infectious bovine foot lesion first described in the early 1970's[1] as a painful, erosive, wart like lesion. It is a common condition in dairy cattle globally and has been shown to affect heifers too[2]. Given it is a painful condition which has high herd level prevalence, DD is an important disease for the modern dairy herd. Heifers experiencing the disease pre-calving were more likely to experience it again in 1st lactation[2]. They also had significantly lower conception rate and longer days open in the 1st lactation[2]. To our knowledge, there has been no work looking at the association of DD with maiden heifer fertility. The aim of this study was to investigate whether one or more DD events in the 3-month period before and after first service was associated with reproductive performance in maiden heifers.

Materials and Methods: Data were collected from 530 Holstein heifers from one commercial dairy unit in the UK between April 2021 and December 2021. Heifers were enrolled at an average age of 388 days and observed at monthly intervals for a total of 3 observations. At each observation body weight and body condition score were recorded. The hind feet of the heifers were washed with water before being inspected for DD using a mirror with LED lights. DD lesions were scored based on physical appearance using the M-stage classification system. Active lesions (M-stages 1, 2 and 4.1) were treated with topical oxytetracycline spray. Fertility data were collected after the end of the study period. Any animals that became pregnant during the study were not inspected after confirmation of pregnancy. Univariable and multivariable analyses were conducted on the data.

Results: 530 heifers were enrolled into this study of which 502 heifers had 3 inspections for digital dermatitis during the study period. Pregnancy diagnosis data was available for 406 heifers at the time the data was initially analysed. DD period prevalence was 45%.

Univariable regression with conception rate at 1st service as the outcome showed that the variable season during which 1st insemination took place was statistically significantly associated with conception at 1st service (p-value <0.001) and there was a tendency for inseminator to be associated with it too (p-value = 0.08). Two multivariable logistic regression models were run using conception at 1st rate as an outcome variable and, accounting for these confounding variables. Neither having DD at the 1st inspection nor having DD ever during the study was statistically significantly associated with conception rate at 1st service.

Cox proportional hazard analysis with time to conception as the outcome variable showed that season at 1st insemination and season of birth were statistically significantly associated with conception at 1st insemination (p-values < 0.00 and 0.005 respectively). Prevalence of DD at first inspection was not statistically significantly associated with age at conception (p-value 0.30). However, this was a preliminary analysis and a total of 116 heifers were right censored due to no conception data at the time.

Cox proportional hazard analysis showed that DD at 1st inspection was not statistically significantly associated with time to first insemination (p-value = 0.39). Season of birth and daily liveweight gain between birth and 1st observation were statistically significantly associated with this outcome (p-values = 0.004 and <0.001 respectively). As expected, growth rate was strongly correlated to age at 1st insemination (for every 1 kg increase in daily liveweight gain the risk ratio for reaching the first insemination was 9.1 with a 95% confidence interval between 3.66 and 22.88).

Conclusion: This study has shown that DD period prevalence in maiden heifers can be high. A previous study showed that DD events in pregnant heifers increased the risk of future DD events and affected fertility in 1st lactation[2]. Preliminary analysis of our data (data collection is still ongoing) showed that DD was not associated with growth rate or fertility in the studied cohort of maiden heifers.

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Keywords: Digital dermatitis, Heifers, Fertility.

LA-25

Modified Thomas splint-cast use in cattle limb fractures: characteristics and predictors of long-term survival of 185 cases (2013-2021)

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Objectives: Traumatic limb fractures are an important cause of premature animal loss. Generally, the most cost-efficient and humane way to handle injured cattle is emergency slaughter on site. However, in the EU, this is only an option if the animal has an acute injury making transport impossible for welfare reasons, is in a further healthy condition, and has not received any medication with a withdrawal period (Eurlex 2004). Furthermore, given the cost involved, it is generally only carried out on animals with a certain weight to avoid incurring more costs than can be gained by slaughtering.

For calves and animals under withdrawal period, salvage options are limited and often expensive. Walking-casts are limited to lower limb fractures and have a weight limit in gen-

eral. Repair trough surgical reduction with internal or external fixation is costly and specialized, also due to the need for general anesthesia. External coaptation methods like the Thomas splint, initially developed for humans, stay relevant to date in a modified form for cattle due to their low cost and relative ease of use on-farm. Studies differ in opinion on their success rate, and relatively few data are available on long-term success to slaughter which makes treatment decisions hard. As such, in order to evaluate survival rate and treatment success, the aim of this study was to describe the long-term outcome and related characteristics of cattle with limb fractures treated with a modified Thomas splint-cast (MTSC), by use of their medical records and national cattle database (SANITEL) data.

Materials and methods: To perform this study, the hospital file of 211 cases of cattle having received a MTSC between September 2013 and December 2021 were retrieved from the clinic database system (SAP). After removal of duplicates (9), MTSC use for other reasons then fracture (5) and animals not retrievable in the national database (12), 185 cases were withheld. Data retrieved included gender, breed, birth date, site of fracture, time since fracture and cause of fracture. From the national herd database (SANITEL), date and type of death was retrieved to perform follow-up until 10 weeks after placement of the MTSC for all animals and a follow-up until death or slaughter for animals deceased.

Results: In 80 % of cases, cattle that received a MTSC were presented for a tibial fracture. Of all animals treated with a MTSC, 42.16 % survived to be slaughtered, 41.08 % died naturally or were euthanized, and 12.43 % was still alive at the time of data retrieval (4.32% was lost to follow-up). Of the animals that did not survive until slaughter, 84.21 % died within 10 weeks after placement of the MTSC, with significantly higher odds of non-survival >10 weeks if their weight was above 275 kg (OR 2.59 p<0.05). There was no gender difference on survival. Cause of fracture was recorded in 49 % of cases: the main risks were manipulation (15.7%) and the placement on pasture (13%). Twenty-five percent of fractures where a time since fracture was known were presented two or more days after fracture, with outliers to 15 days after initial fracture.

Conclusions: MTSC have their use in practice as a salvage procedure to raise young animals that suffered from a limb fracture until an acceptable slaughter weight can be reached. The prognosis drops with increasing weight, and placement of MTSC should as such be reserved for young animals below 275 kgs. Animals were presented for cast placement only after two or more days in 25 % of all cases. Even though prognosis was not different in this study, this could be a severe welfare issue for the affected animals.

Keywords: Cattle, Limb fractures, Trauma, Modified Thomas Splint-Cast.