from three commercial farms were randomized within farm to one of three treatments for first AI with sexed semen: 1) **CIDR5** (d -6, GnRH +CIDR; d -1, PGF_{2a} -CIDR; d 0, PGF_{2a}; d 2, GnRH+TAI); 2) **CIDR6** (d -6, GnRH +CIDR; d -1, PGF_{2a}; d 0, PGF_{2a} -CIDR; d 2, GnRH+TAI); and 3) **EDAI** (PGF_{2a} on d 0 followed by once daily estrus detection and AI). Heifers detected in estrus 24 h before TAI (d 1) were inseminated and the protocol was discontinued. All heifers were inseminated with sexed semen (ABS Sexcel™ Sexed Genetics, DeForest, WI) from sires that were randomly allocated between treatments within each farm, and AI technicians were blind to treatment at AI. Heifers were followed for 84 d after first service to determine days to AI and pregnancy. Actual farm costs (US$) were used for hormonal treatments, detection of estrus, semen and AI, pregnancy diagnosis, and feed ($1.70/heifer/d) to calculate cost per pregnancy. Feed costs for nonpregnant heifers or heifers moved to a bull pen during the 84-d breeding period (n=112) were allocated to the feed costs for heifers that became pregnant during the 84-d breeding period. Pregnancy outcomes were analyzed using the GLIMMIX procedure of SAS with farm included as a random effect in the model. Costs were analyzed using the MIXED procedure of SAS with treatment as a fixed effect and farm as a random effect in the model. Delaying CIDR removal decreased early expression of estrus before scheduled TAI (0.004%vs. 27.8%); however, CIDR5 heifers tended to have more P/AI at 35 (52.9% vs. 45.3% vs. 45.8%) and 64 (51.8% vs. 44.8% vs. 44.9%) d after AI than CIDR6 and EDAI heifers, respectively. Overall, CIDR5 and CIDR6 heifers had fewer days to first AI and pregnancy than EDAI heifers which resulted in less feed costs than EDAI heifers due to fewer days on feed until pregnancy. Despite greater hormonal treatment costs for CIDR5 heifers, costs per pregnancy were $16.66 less for CIDR5 than for EDAI heifers. In conclusion, delaying CIDR removal by 24 h within a 5-CIDR-Synch protocol suppressed early expression of estrus before TAI, but tended to decrease P/AI for heifers inseminated with sexed semen. Further, submission of heifers to a 5-d CIDR-Synch protocol for first AI tended to increase P/AI and decrease the cost per pregnancy compared to EDAI heifers.

Udder Health and Mastitis

K30

How the milking machine influences mastitis

Ian Ohnstad.

The Dairy Group (UK).

Objectives: A fully functioning milking machine, correctly installed, maintained and operated will milk the vast majority of cows effectively, efficiently and with minimal adverse effects on udder health and cow behaviour.

Although we continually improve our understanding of the relationship between the cow, machine and operator, there remains room for improvement. Although the milking machine is often blamed for high somatic cell counts and clinical mastitis only 6 to 20% of new mastitis infections were related to the affects of the milking machine, either directly or indirectly (Mein, 2004).

Materials and Methods: However, poorly operating milking equipment can lead to sub-optimal teat conditions and, but not always, lead to udder health problems (IDF Bulletin, 1994). In addition, our scientific knowledge of the impact of machine milking and its use on udder health has often not been passed down to the milking staff.

The essential elements of a milking machine are the creation of vacuum, regulation of that vacuum at an appropriate level for the milking system and a means to alternate vacuum and atmospheric pressure in the pulsation chamber.

Continual exposure to vacuum leads to teats becoming congested with circulatory fluids leading to cow discomfort and compromised milk let down. The former leads to lowered resistance of the teat canal to bacterial invasion (Teat Club International, 2001). When atmospheric pressure is applied to the pulsation chamber the milking liner closes around the teat and vacuum at the teat end is relieved and the teat is massaged, resulting in the maintenance of blood circulation and minimising congestion. However, the closing liner applies a compressive load on the teat that can lead to excess keratin production near the teat end (Reinemann, ????), which in itself can impair the first line of the udder´s defence against bacteria.

When vacuum is applied to the pulsation chamber the liner opens and milk flows from a positive to negative pressure. A complete pulsation cycle is from the start of liner opening to the end of liner closing. The frequency varies between manufacturers, being typically 55 to 62 cycles per minute for milking cows.

Regardless of whether cows are milked in a high- or low-level system, the vacuum level at the teat end during peak flow rate should be in the range of 32.0 – 42.0 kPa (ISO 5707: 2007) to milk cows gently and efficiently.

How the milking machine influences udder health

Although the machine can cause short, medium or long-term changes in teat condition, environmental factors can also induce same. In practical situations, it will often be the combination of both that leads to increased levels of sub- and clinical mastitis.

The milking machine can affect mastitis infection rates by acting as a:

- Vector – liner slip causing teat end impacts or transferring bacteria from teat to teat (IDF Bulletin, 1987) often causing mastitis. Liner slip can be operator induced, such as by machine stripping or by incorrect matching of a liner to herd average teat size, incorrect vacuum level, inadequate effective reserve, poor cluster position and worn liners. Plus, liners can spread mastitis causing bacteria from cow to cow, if not disinfected. The machine can also spread bacteria if incorrectly cleaned and sanitised between milkings;
- Adversely affecting the first line of the udders defence. This includes physical teat damage by the milking machine or not maintaining teat skin in a soft and supple condition so influencing the first line of the udders defence.

Not only is it essential for the milking installation to be correctly installed, it must be correctly maintained and used properly. Many checks can be readily carried out by the operator on a daily and weekly basis (IDF Bulletin 396, 2005), with the plant fully serviced by a suitably trained engineer.

Monitoring teat condition and factors affecting it (as recommended by Teat Club International) has a great influence in minimising adverse udder health and leads to more effective and timeliness of the milking operation.

Conclusion: Udder health can be significantly improved by applying the knowledge we have of how the machine, cow and operator interact. Thorough and effective milk harvesting is a combination of correct operation of the milking machine and an effective milking routine, with benefits to udder health.

K31

What is milking efficiency? Why is it important?

Ronald Erskine[1], Rhyannon Moore-Foster[2].

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Objectives: This seminar will present potential pitfalls of stressing parlor efficiency as the overarching goal in a herd milking routine. The concept of milking efficiency will be discussed, especially as it relates to milk ejection and milking routine. Finally, the potential negative impact of bimodal (delayed) milk ejection on milk yield will be presented.

Background: Most dairy farms have their milking equipment evaluated and maintained on a routine basis. Although proper equipment function is necessary for milking performance, it does not guarantee it. Two management areas that can lead to poor milking efficiency are: 1) milking routines that don't achieve consistent milk letdown and 2) overmilking. Either one of these problems can leave cows 'high and dry' and expose teats to high vacuum levels.

During stimulation of teats before milking, a neuro-reflex arc stimulates the pituitary gland to release oxytocin into the blood, then to the udder. It takes about 1 to 2 minutes for oxytocin levels to increase in blood to optimally contract myoepithelial cells that surround the milk ducts, which then squeeze the milk down towards the teats. The two important points about this oxytocin release are enough stimulation (at least 10 seconds of actual *physical touching*) of the teats and the duration of the latency period, that is, the time interval between when teats are first stimulated until the cluster is attached—lag time is the time between unit attachment and milk ejection. Unfortunately, with increasing herd size, the number of cows that can be milked through parlors per hour, or parlor turnover rate, is often identified as one of the choke points of herd capacity. Thus, parlor efficiency, measured by cows milked per hour, milk produced per hour, parlor turnover per hour, etc., is emphasized at the expense of adequate milking preparation for the cow.

Results: Review of milking dynamics from over 60 Michigan dairy herds found that a mean of 25% of cows had bimodal milk ejection (range 0 to 75%) at the time of unit attachment. However, when the time of milk letdown after attachment (latency period) was compared to the milking unit on time in over 3,800 milkings, there was no correlation between these two variables Thus, milking time did not increase because of bimodal ejection.

In a follow up study of over 600 cows in a herd with a 50% frequency of bimodal milk ejection, delayed milk ejection of 30 to 60 seconds in duration resulted in a loss of 1.5 kg of milk per milking, and a delayed ejection of over 60 seconds resulted in a loss of more than 3 kg of milk per milking. This outcome was from a single milking for each cow on the trial, the impact of delayed milk ejection over longer periods, such as a week are not yet fully understood. However, preliminary work suggests that 1) for any given milking routine, there is a range of frequency of bimodal events between cows, and 2) cows that have bimodal milking ejection more frequently will also have greater losses in milk yield over time.

Conclusions: A proper premilking routine should allow for 90% of cows with immediate milk let down after cluster attachment, and milk should be flowing 95% of the time while the cluster is attached. Despite the drive to fully utilize a milking parlor in terms of cows per hour, if parlor efficiency is stressed to much over milking efficiency, it is possible to increase the amount of milk gained from a parlor each day. However, the law of diminishing returns comes into play at some point, where maximum is no longer the optimum, and the actual milk per cow per day is decreased.

K33

Who is teaching your employees?

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Objectives: This seminar will review and discuss the status and challenges of the changing employee structure in the dairy industry. Insight from employee and manager perspectives as to the gaps in traing will be reviewed, and a potential model of employee education presented.

Background: Many dairy operations worldwide are increasingly relying on hired labor, especially foreign-born workers. However, many dairy managers have limited human resource knowledge and experience; this often leads to frustration with protocol drift and a sense that employees are not motivated to enhance the success of the farm beyond prescribed instructions. Yet, a large majority of dairy managers state that hiring and retaining employees is a top priority of their dairy enterprise, even though employee turnover varies widely between dairy operations. Taken together, these gaps in dairy farm labor can be described as a cultural lag. That is, there is a gap between the human resource needs within the industry's labor force and the capacity of producers and managers to address them. Herds that believe that 'mastitis was a problem in their herd' or 'had difficulty with compliance of milking protocols', are more likely to have higher BTSCC. Thus, employee management and training, as well as producer values and attitudes regarding mastitis, are also related to milk quality.

Results: When herd owners or managers were asked in a survey, "Who trains new employees how to milk cows?", 90% responded that they perform the training. However, when the employees were asked the same question, only 23% stated they learned how to milk from the managers or owners; 78% said they learned from other employees, or they just "learned on the job". Employee responses examined by language (Spanish-speaking and English-speaking) showed that only 14% of Latino workers said they learned the milking protocols from managers or owners, which was lower than English-speaking workers. Additionally, focus group discussions found that employees strongly expressed their appreciation for education, which helped them better understand ***why*** they do their tasks and the importance of those tasks. Separately, dairy producers also noted the positive attitude of employees brought about by veterinarian-initiated education and cited several examples of improved interest and team effort on the part of the employees in the work they performed.

Conclusions: We believe that engaged employees take the initiative and work to get the desired result for the dairy operation, beyond just "doing the job." We further believe that "on-farm education", facilitated by "science teachers" who provide hands-on training, such as veterinarians, can positively impact employee engagement and thereby improve productivity on dairy operations. Proactive, routine, training, followed by 1) accountability and performance metrics, and 2) a farm culture that promotes employee feedback—such as milking efficiency analysis of a milking protocols as described in an earlier paper (Erskine) at this congress—can result in better employee engagement, more consistent protocol compliance, less employee turnover, and improved farm productivity.

Lameness

K38

Dairy cattle lameness; where does recent research take us?

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Introduction: Lameness is undoubtedly one of the most critical challenges the dairy industry faces today. The condition is painful, and described as one of the clearest indicators of compromised welfare in dairy cattle (Bicalho and Oikonomou, 2013). This talk will be focused on how research currently conducted at the University of Liverpool and elsewhere is attempting to fill gaps in our understanding of lameness. We will discuss new research regarding the aetiopathogenesis of claw horn lesions (CHL), the role of the foot skin microbiome in the development of digital dermatitis lesions and developments in the field of automatic lameness detection.

Aetiopathogenesis of claw horn lesions: Despite the importance of CHL, their aetiopathogenesis is not yet fully understood. We have enrolled 2,352 Holstein dairy cows from four farms in the UK and recorded presence of foot lesions at four time points from before calving to late lactation. Cows were also genotyped. Measurements of foot angle, heel depth, backfat thickness, longissimus dorsi thickness, digital cushion thickness, and sole and foot skin temperature were taken from all studied animals to assess their role in CHL development. Additionally, measurements of the serum concentration of beta hydroxybutyrate, non-esterified fatty acids, insulin, relaxin, proinflammatory cytokines, and endotoxins have been obtained on a subset of animals as potential contributors to the aetiopathogenesis of the disease.

The role of the foot skin microbiome in the development of digital dermatitis.

Digital dermatitis is a painful, infectious, foot skin disease that compromises the welfare of hundreds of millions of production and wild ruminants. Disruption of the healthy skin microbiome has been associated with several diseases in humans. Associations between host genetics and skin integrity and/or skin microbiota profiles have also been described. We have recently showed intriguing interactions between host genetics and the foot skin microbiota profiles in cattle but the significance of host–microbiome-pathogen interactions in the development of DD lesions has not yet been studied in depth.

Automatic lameness detection.

Early lameness detection has been shown to be an important aspect of lameness management in dairy herds (Groenevelt et al., 2014) and yet for the most part relies on visual mobility/ locomotion scoring by farm staff or trained scorers. This process, albeit useful, can be time consuming and subjective even when agreement within the same experienced assessor is examined. CattleEye Ltd has recently developed and commercialised a system for automatic lameness detection. This system is the first to utilize inexpensive 2D surveillance cameras 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.