Preliminary Evaluation of Two Methods for Estimating Lameness Prevalence on Western US Dairies

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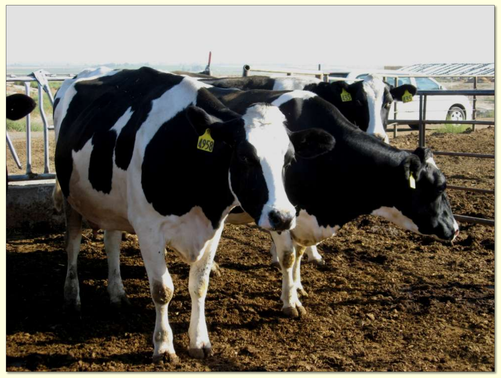
Objective

The purpose of this study was to evaluate two methods for estimating lameness prevalence on large Western dairies.



Introduction

Lameness can reduce milk production and reproductive performance (Juarez 2003, Sprecher 1997, Hernandez 2005, Hernandez 2001), and increases culling (Booth, 2004, Sprecher 1997). Additionally, lameness is an indication of limb pain and therefore has a negative impact on animal welfare (O'Callaghan 2003, Whay 1997).

Lameness is commonly assessed using a locomotion score (Table 1). The Dairy Farmers Assuring Responsible Management (F.A.R.M.) program includes an animal welfare assessment and requires that <10% of cows have a locomotion score ≥ 3 on the 5 point scale (National Milk Producers Federation 2010).

Previous studies in the United States estimated lameness prevalence near 20% by locomotion scoring entire herds (Cook 2003, Espejo 2006). Monitoring prevalence and detecting lameness in individual cows is the first step to reducing lameness. If monitoring is to be more widely adopted, an efficient, validated strategy for assessing lameness that is compatible with current dairy management is necessary.

Two strategies recently suggested to estimate lameness prevalence include strategic sampling of cows as they exit the milking parlor (Main 2010) and observing back position as cows are standing (Thompsen 2009). However, these studies were based on farms with less than 275 cows with many housed in one group, whereas half of the US dairy herd is on farms with greater than 500 cows that are housed in multiple, heterogeneous pens (USDA NASS, 2009).

Table 1. Locomotion Scoring System (Based on Sprecher 1997).

Score	Gait Description
1	Cow stands and walks with a level-back posture. Gait is normal.
2	Cow stands with level-back posture but develops an arched-back posture while walking. Her gait remains normal.
3	An arched-back posture is evident while standing and walking. Gait is affected and described as short-striding one + limbs.
4	An arched-back posture is always evident and gait is best described as one deliberate step at a time. The cow favors one or more limbs/feet.
5	The cow additionally demonstrates an inability or extreme reluctance to bear weight on one or more of her limbs/feet.

Materials & Methods

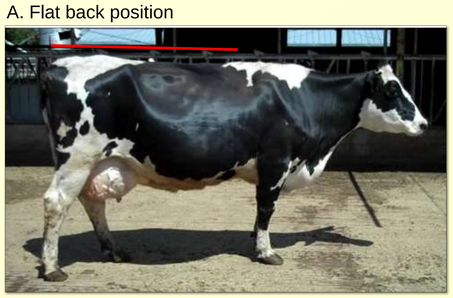
Estimation of lameness prevalence based on sampling cows from the middle of the parlor exit order

Locomotion score and parlor exit order were recorded for 886 cows in six pens (62-144 cows per pen) as they exited the milking parlor single file on one farm. Herd and pen level lameness prevalence (% locomotion score ≥3) was calculated for all cows scored and also from a sample of cows in the middle of the parlor exit order. Sample number was determined using a quadratic equation (r^2=0.31, P < 0.001) published by Main, et al 2010: sample size = −0.001 n2 + 0.498 n +6.785, where n = number of cows in a pen (equation determined based on the number of cows from the middle of the milking order needed to estimate prevalence within 5% of true prevalence on 67 UK farms). A sample was taken from the data set for each pen. The start and end of the sample was calculated for each pen by finding the cow in the middle of the exit order, then subtracting half of the sample size to determine the first cow in the sample, and adding half the sample size to determine the last cow in the sample. Lameness prevalence within the sample was calculated for each pen and the pen samples were pooled to calculate herd prevalence.

Estimation of lameness prevalence by based on back position

Back position (arched or not arched) was recorded for 200 cows in three pens locked at the feed bunk on a single farm. Back position was assessed from in front of or behind the cow standing in a headlock. Back position was considered arched if it was convex from withers to tail-head (Figure 1). Cows were individually released from headlocks and locomotion scored. Lameness prevalence was calculated as % locomotion score ≥3 and as % cows with an arched-back for the herd and for each pen. Sensitivity and specificity were calculated for presence of arched-back as a test for locomotion score ≥3 in individual cows and Kappa statistic was calculated for agreement between locomotion score and presence of arched back.

A. Flat back position



B. Arched back position

Figure 1. Examples of back position used to estimate lameness prevalence.

Results

Parlor exit order: The herd level lameness prevalence based on locomotion scores of all pens was 34% and pen level prevalence ranged from 8.5% to 44% (Table 2). When calculated based on a sample from the middle of the parlor exit order, herd level lameness prevalence was estimated to be 35% (95% CI: 31 to 40%) and pen level prevalence ranged from 6.1% to 51% (Table 2). The pen level prevalence estimates based on the sample were numerically higher than the entire pen prevalence for 5 pens and lower for 3 pens (*P* >0.05). The pen level prevalence estimates from the sample were different from the herd lameness prevalence for 2 pens (3 and 16, P<0.05).

Table 2. Comparison of lameness prevalence based on locomotion scores (≥3) of entire pen versus sample from middle of parlor exit order by pen.

	Entire Pen		Middle of Parlor Exit Order			Difference in
Pen	#	% Lame	#	%Lame	95% CI	Pen Estimates
1	118	35	53	32	21 to 46	-3
3	59	8.5	33	6.1	0.7 to 21	-2.4
5	88	32	44	36	24 to 51	4
11	79	25	40	38	24 to 53	13
13	119	44	52	38	26 to 52	6
14	114	42	59	44	32 to 57	2
15	135	22	56	25	15 to 38	3
16	144	40	57	51	38 to 63	11
Herd	856	34	394	35	31 to 40	1

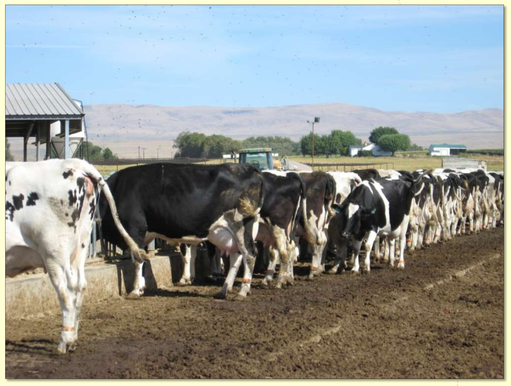
Back position: The herd level lameness prevalence based on locomotion score was 16% and ranged by pen from 9% to 20% (Table 3). Estimated lameness prevalence based on arched back position was 11% (95% CI: 6.9 to 16) for the herd and ranged by pen from 4.5% to 17%. Presence of an arched back while standing in the lock-up predicted lameness in individual cows with 44% sensitivity and 96% specificity (Table 4). Agreement beyond chance for the two methods was considered "moderate" (Kappa=0.41).

Table 3. Comparison of lameness prevalence based on locomotion scores versus back position by pen.

Pen	Lameness prevalence based on locomotion score ≥3	Lameness prevalence based on back position being arched	
	%	%	(95% CI)
1	19	9.5	4.1 to 20
3	9.0	4.5	1.0 to 13
4	20	17	9.9 to 28
Herd	16	11	6.9 to 16

Table 4. Characteristics of back position as a test to identify lame cows (locomotion score ≥3).

	Back Position	
Locomotion Score	Arched	Not Arched
≥3 (Lame)	14	18
<3 (Not Lame)	7	161
Sensitivity	44%	
Specificity	96%	
Positive predictive value	67%	
Negative predictive value	90%	



Discussion

The sampling strategy using milking parlor exit order was effective at estimating herd prevalence when samples from all pens were combined. However, pen level variation still requires sampling all pens. The presence of an arched back position in cows in lock-ups predicts lameness in those cows, but these preliminary data suggest that this lameness assessment strategy underestimates herd prevalence. Despite this, lameness assessment using arched back position has promise for wide adoption as it could easily be incorporated into routine herd management procedures. Further work is needed to refine and validate the arched back method.

Acknowledgements

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