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Validation of sampling strategies for estimating lameness prevalence in dairy herds

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Introduction

Lameness is an important problem in dairy herds because it lowers production and reproductive performance, increases culling, and has a negative impact on animal welfare and longevity. Monitoring farm lameness prevalence has utility for dairy producers and veterinarians in their efforts to reduce lameness, animal welfare assessment programs, and research. Locomotion scoring is a method used to quantify lameness and calculate prevalence. On large farms, locomotion scoring is not done regularly because of the time necessary to locomotion score each cow. Thus, a herd sampling strategy that allows one to score less cows would be useful but must be validated for accuracy in comparison to true lameness prevalence.

Objective

The purpose of this study was to assess the accuracy of three previously suggested methods of estimating lameness by strategic sampling of a dairy herd.

Methods

Sampling strategies tested include:

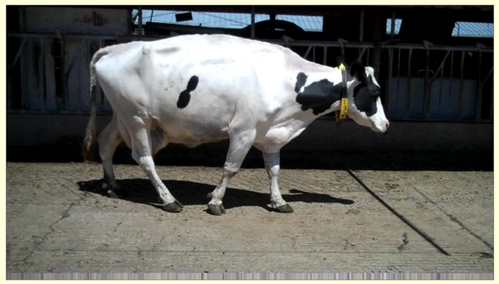
(1) sampling a calculated number of cows in the middle third of the milking parlor exit order (described by Main, et al. 2010)
(2) sampling a calculated number of cows weighted across pens and distributed evenly within each pen, and
(3) sampling all cows in a high production pen, a low production pen, and the hospital pen.

All lactating cows on five dairy farms in Washington and Oregon were locomotion scored to determine true herd level lameness prevalence. Locomotion score > 2 in a five point scoring system (Sprecher et al., 1997) were considered lame. Additionally, milking order and order observed in pen were recorded for each cow. Information on pen grouping strategy was collected by interview with farm management. Sampling strategies were then tested using the locomotion score data set.

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

Description of Locomotion Scores

Score	Means	Description
1	Normal	The cow walks and stands with a flat back. She walks normally.
2	Slightly abnormal gait	The cow stands with a flat back but arches her back while walking. She walks normally.
3	Moderately lame	The cow stands with an arched back and walks with an arched back. She short-steps while walking.
4	Lame	The cow stands with an arched back, walks with an arched back and walks with decreased weight bearing on a limb (limps).
5	Severely lame	The cow stands and walks with an arched back and refuses to bear weight on a limb.



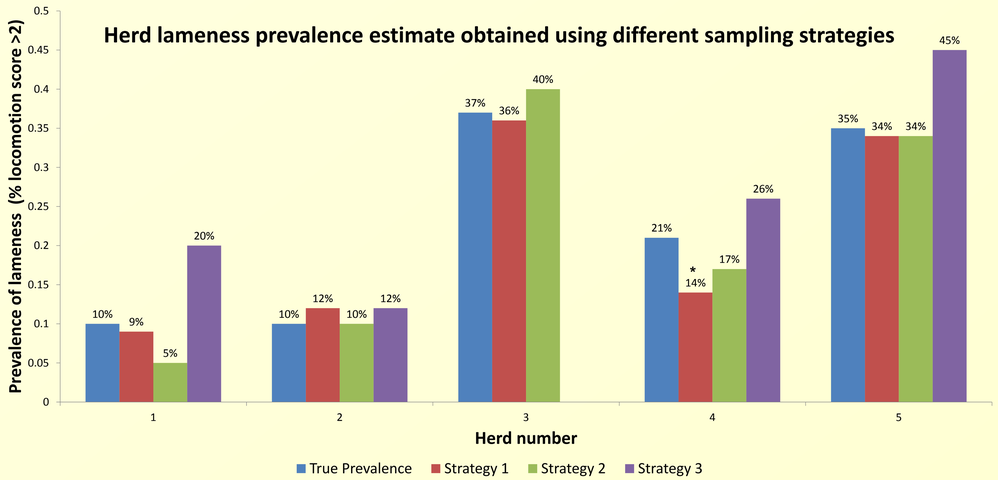


Figure 1: Lameness prevalence estimate obtained using different sampling strategies:
Strategy 1: A calculated sample size taken from the middle of milking parlor exit order
Strategy 2: A calculated sample size distributed evenly across and within pens
Strategy 3: All cows in a high production, low production, and hospital pen (Herd 3 was omitted from strategy 3 because there were only 3 pens)
*For herd 4, An entire pen was omitted from sampling strategy 1 due to missing milking order data. True prevalence for strategy 1 comparison was 15%

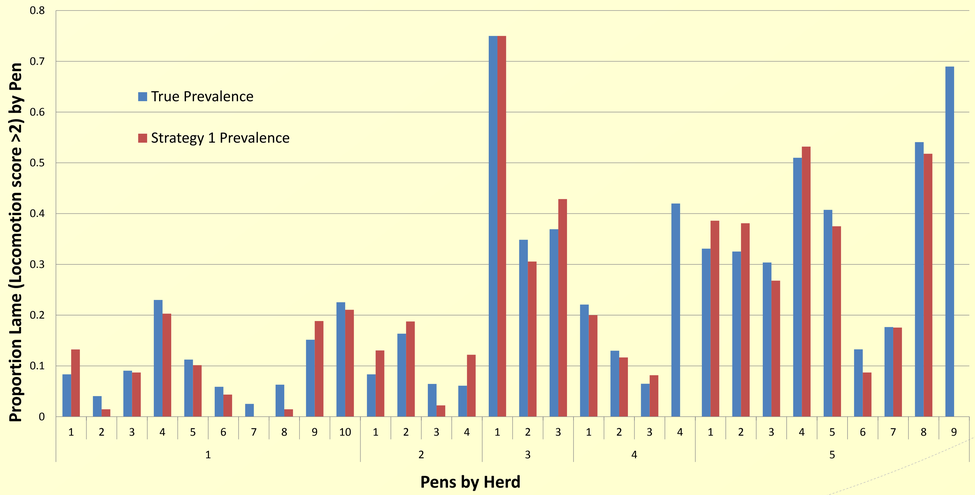


Figure 2: Lameness prevalence by pen – true prevalence and prevalence obtained using sampling strategy 1
Strategy 1: A calculated sample size taken from the middle of milking parlor exit order

Results

Of all cows for which locomotion score data were gathered (n=4,550), about 48% were locomotion score 1 (n=2183), 34% were locomotion score 2 (n=1554), 13% were locomotion score 3 (n=596), 4.6% were locomotion score 4 (n=207), and 0.2% were locomotion score 5 (n=10). Lameness prevalence ranged by herd from 9.8% to 37%. For pens with greater than 50 cows per pen, lameness prevalence per pen ranged from 2.5% (278 cows in pen) to 54% (135 cows in pen). Out of 29 pens total, 13 of them had significantly ($p<0.05$) different prevalence compared to the herd prevalence. For two farms, (farm 2, farm 3) there were no significant differences between pen level prevalence and herd prevalence. Of the 13 pens with estimated prevalence significantly different from the herd prevalence, seven were higher and six were lower than herd prevalence.

Estimated prevalence using sampling strategies 1 and 2 were not statistically different than true herd level prevalence ($p<0.05$), as true lameness prevalence fell within the 95% confidence interval of the sample proportions. Strategy 3 accurately estimated the lameness prevalence on one farm, but overestimated prevalence on three others.

Table 2. Location, approximate size, and breed distribution of participating farms.

Herd	Number of lactating cows	Breed(s) %		
		Holstein	Jersey	Jersey X Holstein
1	2,800	17	59	24
2	400	0	100	0
3	145	100	0	0
4	580	83	4	13
5	1,100	100	0	0

Conclusions

The sampling strategies using the middle of milking parlor exit order and a calculated sample distributed across the herd accurately estimate herd lameness prevalence.

A limitation of sampling strategy 1 (sample from the middle of milking parlor exit order) is that it requires observing cows over an entire milking shift, as opposed to sampling strategy 2 (sample distributed between and within pens) in which observation of cows can occur at any time because it does not depend on milking time.

Sampling strategy 3, a sample of all cows in a high production, low production, and hospital pen, tended to overestimate herd lameness prevalence.

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