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Technical note: Assessing lameness in tie-stalls using live stall lameness scoring

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ABSTRACT

Video stall lameness scoring (SLS) has been shown to be comparable to video locomotion scoring for evaluating lameness in dairy cows housed in tie-stalls and may be a more practical and easier method to measure lameness in a herd. We compared live SLS to video SLS and to live locomotion scoring. A total of 685 lactating cows subsampled from 27 commercial dairy herds were examined for lameness through live and video SLS. Cows scored with the live or video SLS system were scored for 4 behavioral indicators while still in their stall: weight shifting (shift), standing on the edge of the stall (edge), uneven weight bearing while standing (rest), and uneven weight bearing while moving from side to side (uneven). Two observers live scored and video scored for SLS. Lameness prevalence from video SLS and live SLS were similar (31 vs. 30%, respectively). Prevalence of the behavioral indicators varied from 0.59 to 58.2%. Sensitivity and specificity of live SLS was calculated using video SLS as the gold standard for lameness detection in tie-stalls. Sensitivity of live SLS was 0.83 and specificity was 0.94. False positives and false negatives for lameness were 14.4 and 16.8%, respectively. When comparing the prevalence of lameness measured through video or live SLS at the herd level, live SLS for lameness was correlated to video SLS (r = 0.91) with a Cohen's kappa coefficient of 0.79 (95% confidence limit = 0.73–0.84). Average exact agreement in the behavior indicators observed ranged from 80 to 100%. A subsample of 250 cows from 5 herds were scored for live SLS and live locomotion by a third observer. Intra- and interobserver reliability for live SLS and live locomotion scoring were found to have a kappa coefficient of 0.53 (95% confidence limit = 0.43–0.64) when determining a cow as lame through SLS or locomotion scoring. Live SLS was correlated with live locomotion scoring (r = 0.92). However, lameness prevalence was lower when using live SLS (28.4%) compared with locomotion scoring (38%). In summary, live SLS may be an acceptable method to replace video SLS to identify lame cows and rank tie-stall herds in terms of lameness prevalence without having to remove the cows from their stalls or view videos to score; however, it may underestimate lameness prevalence compared with locomotion scoring methods.
Key words: lameness, stall lameness scoring, dairy cow, tie-stall

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Easy and reliable welfare measures are important for the future of the dairy industry as dairy producers are being required to provide assurances regarding animal welfare (Rushen et al., 2011; Barkema et al., 2015) to build public trust. Lameness is widely regarded as a major welfare issue in the dairy industry in all housing and milking systems and assessment of lameness prevalence is an important aspect of animal welfare assessment (e.g., Whay et al., 2003; Vasseur et al., 2015). In Canada, lameness prevalence has recently been recorded to be 21% for cows in free-stalls with a milking parlor (Solano et al., 2015), 15% for cows in farms with automated milking systems (Westin et al., 2016), and 24% for cows in tie-stalls (Charlton et al., 2016). An accurate and easy method to score lameness in tie-stalls is needed as producers with tie-stall barns tend to put less effort into lameness control and monitoring (Higginson Cutler et al., 2015) and tie-stall barns represent 50% of US dairy farms (USDA, 2010) and 71% of Cana-

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dian dairy farms (Canadian Dairy Information Centre, 2015). The stall lameness scoring (**SLS**) method was developed by Leach et al. (2009) as a means of detecting lame cows in their stalls, and SLS using video was later validated against locomotion scoring using video by Gibbons et al. (2014), which showed that SLS is an adequate method to score lameness in the stall. Locomotion scoring requires long corridors free of obstacles to reliably observe and score the gait of the cows; these are areas most tie-stall barns do not have. Live SLS does not require such areas and, additionally, does not require more time and extra equipment to record and score lameness, unlike video SLS. Consequently, live SLS may be more practical and less time consuming for producers, veterinarians, and field advisors. However, validating live SLS against video SLS is necessary before it can be used with confidence. Our objectives were to compare live SLS to (1) the previously validated video-based method of SLS and to (2) live locomotion scoring.

To address our first objective, a study was conducted in which a total of 685 lactating Holstein cows on 27 commercial tie-stall herds (between 14 and 40 cows per herd) in Ontario and Quebec, Canada, were observed. All methods used to collect data were approved by the University of Guelph's Animal Care Committee. Cows were selected as part of 2 other studies, where selection was based on DIM and parity, as one of the key outcome measures was lying time, which has been shown to be affected by DIM and parity (Vasseur et al., 2012). Each cow was video recorded and live SLS scores were taken, using the method adapted from Leach et al. (2009) and described in Gibbons et al. (2014) while the cow was in the stall. First, any lying cows were encouraged to stand by an experienced cow handler, who stood near the cow and vocally encouraged her to get up. If the cow did not respond, she was lightly tapped on the spine until she began to rise. If this was not enough, the cow was tapped on the flank and near the spine to encourage rising. If the cow did not rise, a new attempt was made at a later time until the cow had been assessed. Each cow was required to be standing undisturbed for a minimum of 3 min before the rest of the SLS protocol was followed. Adjacent cows were not filmed/scored immediately after each other, to prevent the disturbance of filming a cow from affecting the filming/scoring of the neighboring cows. The protocol was performed by 2 individuals: an experienced cow handler who controlled the camera and handled the cow and 1 trained observer who performed live scoring of the cow. The cow was filmed with a camcorder placed on a tripod. First, the cow's hind legs were filmed for 10 s with the camera about 1 m directly behind the cow. Then, the camera was moved to the left of the cow to film a side view for 10 s, followed by the same step performed to the right of the cow. The camera was then returned to the position directly behind the cow and the cow handler encouraged the cow to step from side to side 2 to 3 times per side. To do this, the cow handler first walked to one side of the cow in an attempt to encourage the cow to move in the opposite direction. The cow handler then repeated this in the opposite direction. If the cow did not respond to the handler's movements, the movement was repeated while the handler tapped gently around the cow's pin bone or flank on the side opposite to the direction the cow was being encouraged to move. If this did not work, the cow was gently prodded using a pen or finger on the pin bone or by quickly and lightly tapping the hoof on the opposite side to which the cow was required to move. This process of encouraging the cow to move was repeated a minimum of 4 times, and as many times as the live observer needed. During this process the observer stayed next to the camera to ensure a similar viewing angle between the camera and the observer. If at any point the cow started to urinate or defecate, the recording was stopped and scoring was attempted later to prevent the stance taken during these behaviors from potentially affecting the observations.

Video analysis was performed by the same observer who did the live scoring. Videos were scored between 2 and 6 wk after live scoring/recording. In an attempt to reduce scoring bias, the videos were randomized and no more than 4 videos from a single farm were scored sequentially. A total of 685 videos were scored by 2 observers (n = 196 for observer 1 and n = 489 for observer 2).

The SLS method focuses on hind limbs and targets 4 behavioral indicators. Each of the 4 behavioral indicators observed are described by Gibbons et al. (2014) and assessed on whether they were present or not: (1) weight shift: regular, repeated shifting of weight from one hoof to another, defined as lifting each hind hoof completely off the ground at least twice. The hoof had to be lifted and returned to the same location; stepping forward or backward did not define this indicator. (2) Stand on edge: the cow places one or both of her hooves on the edge of the stall while standing stationary. This did not include times when both hind hooves were in the gutter or when the cow briefly placed her hoof on the edge during a movement or step. (3) Uneven weight: repeatedly resting one foot more than the other, indicated by the cow raising a part or the entire hoof off the ground. This did not include raising of the hoof to lick or during kicking. (4) Uneven movement: uneven weight bearing between the left and right feet when the cow was encouraged to move from side to side. This was demonstrated by a more rapid movement by one