

# A SYSTEM FOR RATING EDEMA IN DAIRY CATTLE

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## Story in Brief

Our objective was to evaluate a subjective, edema rating system to quantitate edema severity. Edema was evaluated with twenty Holstein heifers from 3 wk before their expected calving date until 3 wk postpartum. Severity of udder edema was evaluated independently daily by 5 people throughout the 68-d experiment; a 10-point rating system (0 = no edema, 10 = severe edema) was used. One of the persons developing the scoring system served as the official scorer. The accuracy of the rating system (the closeness of test scores to official scores) was highest for scores 2 to 8. The precision of the system was similar for each score in the rating system. The large number of defined points in this rating system, and the similarity between official and test scores in this study, indicate the usefulness of this tool to evaluate precisely the severity of edema in dairy cattle.

(Key Words: Dairy Heifers, Udder Edema, Scoring System.)

## Introduction

When evaluating edema in dairy cattle, subjective assessment must be used. Several subjective scoring systems have been developed (Emery et al., 1969; Greenhalgh and Gardner, 1958; Nestor et al., 1988; Randall et al., 1974); most systems have 5 categories, and the specific characteristics associated with each category typically are not identified clearly. Our objective was to develop and test a precise, subjective scoring system for evaluating edema.

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## Materials and Methods

Twenty Holstein heifers were evaluated for presence of edema daily from 3 wk pre- to 3 wk postpartum. Because the heifers did not all calve on the same day, it was necessary to score edema daily for 68 d. Care and feeding of animals have been described elsewhere (Lema et al., 1991).

Severity of edema was evaluated independently by 5 people on each day of the experiment at approximately 1 h after the p.m. milking; a 10-point rating system (Table 1, Figure 1) was developed to quantitate edema. This system is modeled after the 5-point system of Nestor et al. (1988), with modifications designed to improve its accuracy and precision. With our system, a score of 0

Table 1. Scale used in rating udder edema.

Score	Definition
0	No edema apparent.
1	Edema in the base of the udder around 1 or 2 quarters.
2	Edema in the base of the udder around 3 or 4 quarters.
3	Edema covering the lower half of the udder.
4	Edema beginning to show in the midline and navel.
5	Extensive fluid accumulation along midline and navel.
6	Edema covering entire udder. Median suspensory ligament crease has disappeared.
7	Midline fluid accumulation extended to the brisket.
8	Midline fluid accumulation extended dorsally. The subcutaneous abdominal vein is indistinguishable.
9	Fluid accumulation extended to the thighs.
10	Severe edema. Marked fluid accumulation in the vulva. Edema extensive in all of the areas mentioned above.

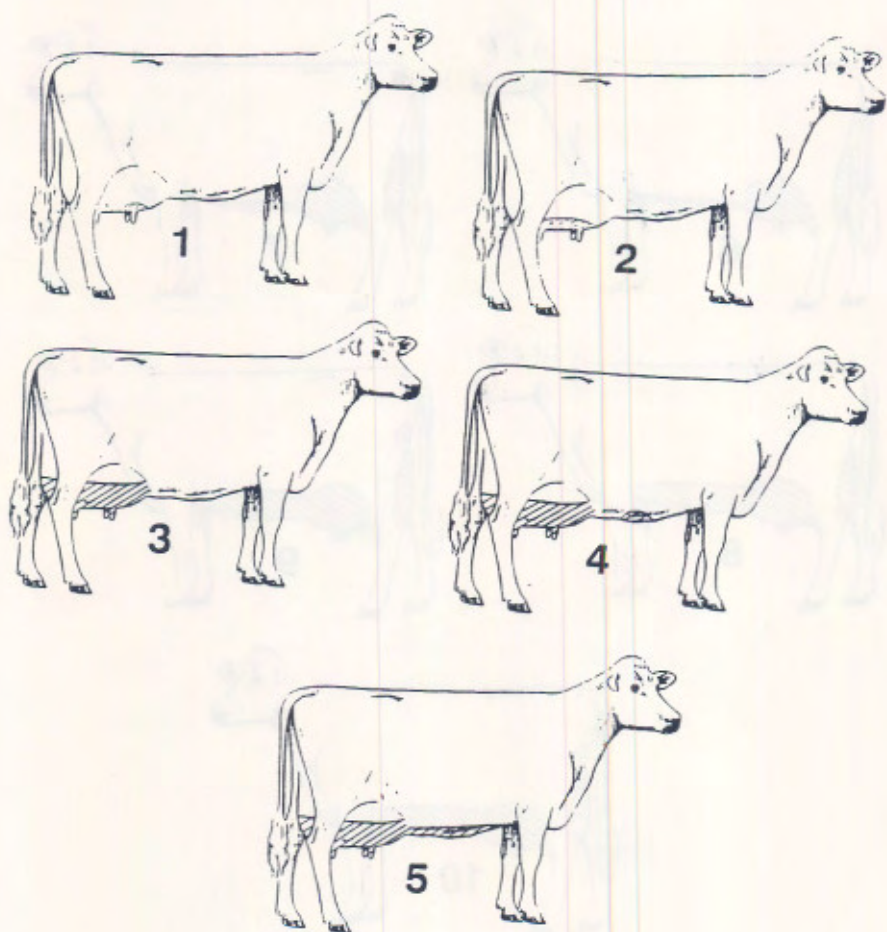


Figure 1a. Edema scores (1 to 5). Hatched areas represent locations of edema.

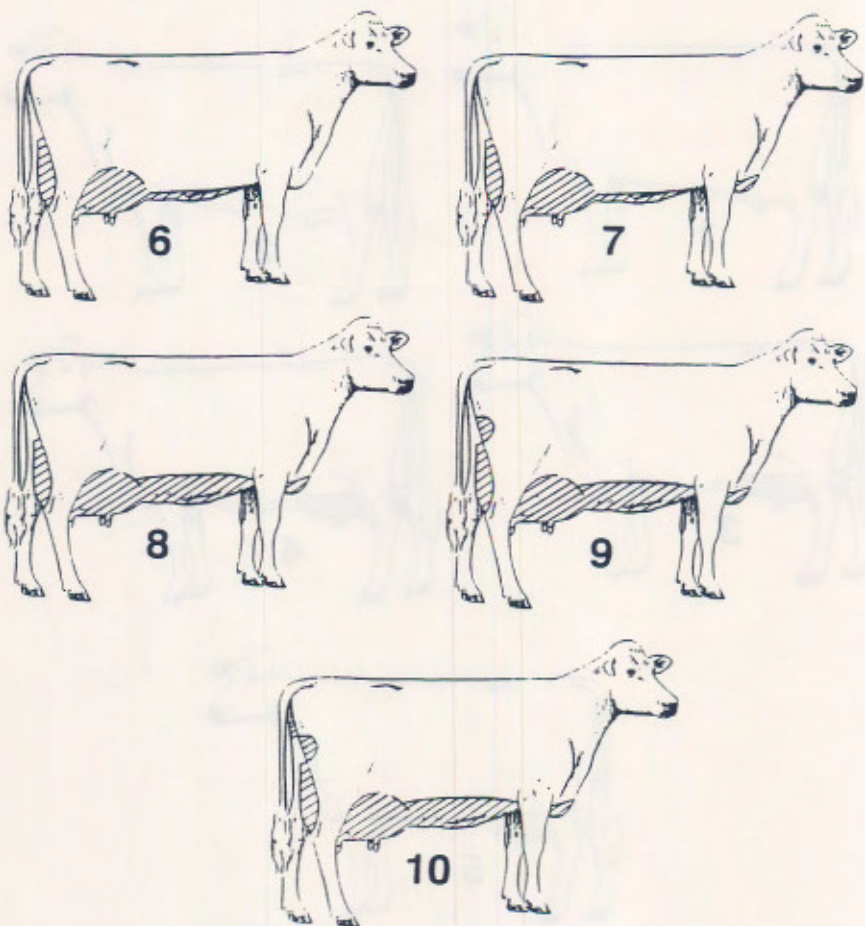


Figure 1b. Edema scores (6 to 10). Hatched areas represent locations of edema.

was assigned if there were no visual or tactile indications of edema. Visual cues included a taut, glossy or waxy appearance of the udder epithelium, udders that were shaped abnormally or distended due to accumulation of interstitial fluid, and wave-like movement of fluid beneath the skin in the non-mammary epithelium as the animal moved. Tactile cues include increased rigidity of epithelium, and "pitting". Pitting was identified by applying pressure to the epithelium with a fingertip; slow disappearance of the resulting depression in the epithelium indicated that edema was present.

Two, 2-h training sessions were conducted before the study to familiarize evaluators with the rating system. Three of the five evaluators had limited experience with dairy cattle. One of the five evaluators was involved in the development of the edema scoring system and was identified as the official evaluator; the others were identified as test evaluators.

## Results and Discussion

Table 2 and Figure 2 compare official edema scores (OFF-SCR) with test edema scores (TEST-SCR). Analysis of all scores assigned during the study (Table 2) reveals that mean TEST-SCR was .4 points higher than the OFF-SCR but the correlation coefficient was .937. The smallest and largest differences between mean OFF-SCR and mean TEST-SCR of individual scorers were .057 and .557, respectively. The average SEM for OFF-SCR and TEST-SCR were 2.38 and 2.43.

Pearson correlation coefficients (Table 2), comparing OFF-SCR with TEST-SCR, were highest for the middle range of the scoring system (scores 4 to 6;  $r = .701$ ,  $P < .001$ ) and lowest for the highest range (scores 8 to 10;  $r = -.045$ ,  $P = .84$ ). With the exception of the 8 to 10 score range, mean scores for OFF-SCR and TEST-SCR were remarkably similar (Figure 2). The highest score given by the OFF-SCR throughout the study was 8.5. When the official scores were in the range of 8 to 10, the mean score for TEST-SCR was 7.4, indicating that the TEST-SCR evaluators had difficulty identifying edema in the brisket and edema that extended dorsally on the sides and into the thigh and vulva regions of the cows.

Figure 3 presents a comparison of OFF-SCR and TEST-SCR for each point on the scoring system. Agreement of OFF-SCR and TEST-SCR scores were highest in the middle of the scale. The largest difference (1.16 points) between means for OFF-SCR and TEST-SCR was at an official score of 8.5, indicating difficulty in identifying dorsal extension of edema on the sides of the cow. The SEM for TEST-SCR means were fairly constant as edema score increased from 0 to 8.5.

In summary, we developed a subjective rating system (0 to 10) to evaluate edema in periparturient dairy cattle. The accuracy of the rating system,

**Table 2. Mean edema scores and Pearson correlation coefficients for the official and test scorers.**

Overall means	Official scorer	Test Scorers				
		X	1	2	3	4
Mean	3.062	3.445	3.481	3.448	3.619	3.005
n	808	651	678	883	883	876
SEM	2.388	2.430	2.188	2.772	2.655	2.413
R	.....	.937	.858	.917	.899	.896
<i>P</i> <sup>a</sup>	.....	<.001	<.001	<.001	<.001	<.001
Official score = 0 to 2						
Mean	.685	.947	1.366	.784	1.117	.763
n	342	243	257	336	338	338
SEM	.747	1.011	1.443	1.128	1.340	.992
R	.....	.640	.530	.513	.496	.493
<i>P</i>	.....	<.001	<.001	<.001	<.001	<.001
Official score = 2 to 4						
Mean	3.017	3.131	3.495	3.049	3.443	2.723
n	247	184	194	247	244	240
SEM	.739	1.346	1.290	1.628	1.592	1.547
R	.....	.623	.503	.591	.537	.507
<i>P</i>	.....	<.001	<.001	<.001	<.001	<.001
Official score = 4 to 6						
Mean	5.091	5.164	4.839	5.596	5.523	4.742
n	280	210	217	279	278	275
SEM	.752	1.113	.925	1.462	1.305	1.354
R	.....	.701	.529	.704	.627	.568
<i>P</i>	.....	<.001	<.001	<.001	<.001	<.001
Official score = 6 to 8						
Mean	6.553	6.579	5.938	7.223	7.034	6.137
n	133	104	105	133	133	131
SEM	.767	.941	1.115	1.045	1.187	1.193
R	.....	.576	.560	.289	.462	.544
<i>P</i>	.....	<.001	<.001	<.001	<.001	<.001
Official score = 8 to 10						
Mean	8.080	7.435	6.854	7.680	7.760	7.375
n	25	23	24	25	25	24
SEM	.187	.939	1.876	1.030	1.012	1.304
R	.....	-.045	-.178	.03	-.004	.131
<i>P</i>	.....	.837	.406	.886	.983	.541

<sup>a</sup>Probability of correlation to official scorer.

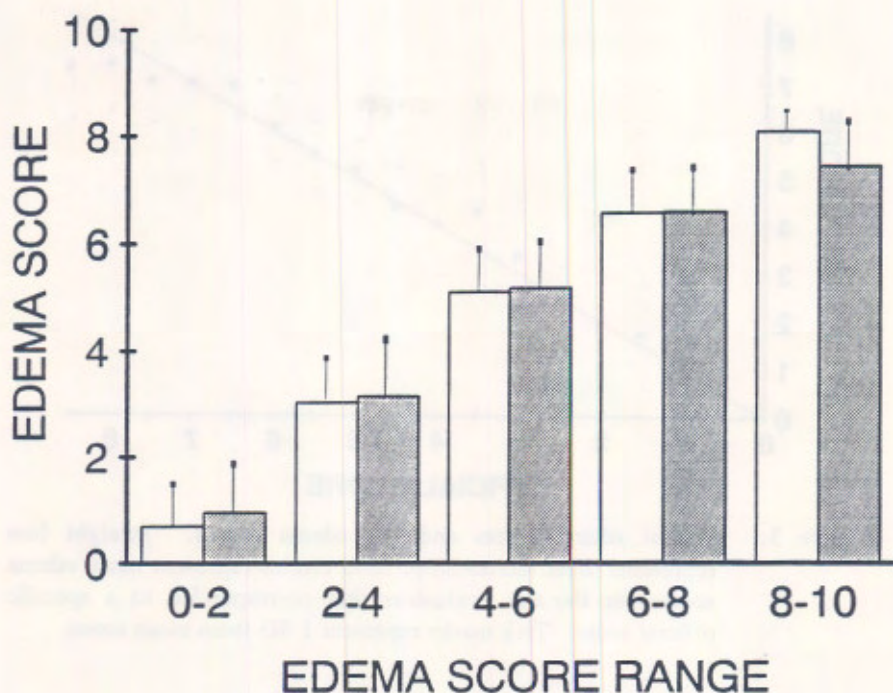


Figure 2. Official edema scores (white columns) and means of the four test evaluators (dark columns) when the official edema score ranged from 0 to 2, 2 to 4, 4 to 6, 6 to 8, and 8 to 10.

defined as the closeness of test evaluator to official scores, was highest for scores from 2 to 8. The precision of the system, as identified by SEM, appeared to be fairly constant for all scores in the rating scale. The largest disagreement between official and test evaluator scores was evident with lactating cows. The large number of defined points in this rating system, and the similarity between official and test scores in this study, indicate that this system should provide a useful tool for more precisely evaluating the severity of edema in dairy cattle.

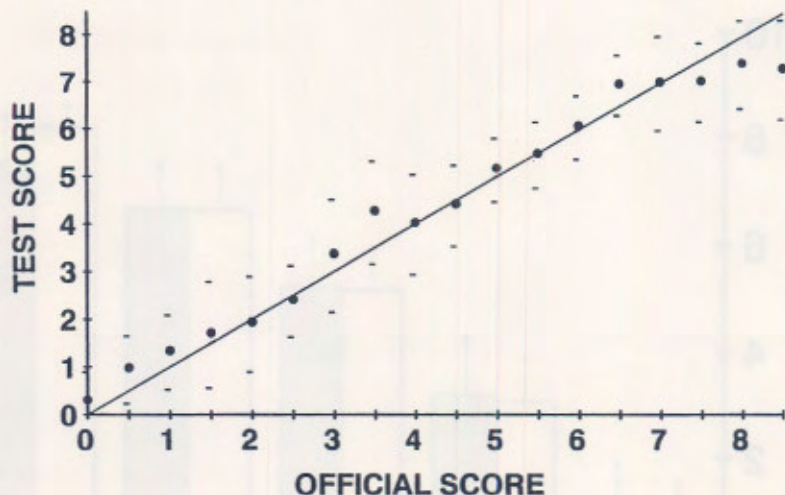


Figure 3. Official edema scores and test edema scores. Straight line represents ideal relationship; solid circles represent mean edema scores for the test evaluators that corresponded to a specific official score. Tick marks represent 1 SD from mean score.

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