

Cumulative effect of clinical mastitis episodes on dairy cow milk yield

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Abstract

Clinical mastitis (CM) is problematic for dairies, occurring repeatedly and causing much milk loss. Affected cows frequently fail to achieve their higher, pre-mastitic production level. We estimated the cumulative effect of all CM episodes a cow had, on milk yield (MY). We fit mixed models with an autoregressive covariance structure accounting for correlated measurements for 2567 Holsteins (two New York herds), for primipara and multipara separately. Index variables reflected when MYs were recorded, in relation to each episode's occurrence. Milk weights were classified into intervals ≥ 29 d, 22-28d, ..., and 1-7d before, and 0-7d, 8-14d, ..., 64-70d, and ≥ 71 d after diagnosis.

Primipara had 0-2 episodes. Milk loss began before 1st diagnosis, and continued; cumulative loss was 715 kg. An additional yield drop occurred with a 2nd episode, and persisted over lactation. Cumulative loss due to two episodes was 1101 kg. Multipara had 0-4 episodes. Mastitic cows had higher yield before diagnosis of the 1st episode. Then, a drop occurred, from which cows did not recover (cumulative loss: 577 kg). Cows with two or three episodes regained some of this loss; cumulative losses were 542 kg and 219 kg, respectively. A 4th episode was detrimental; cumulative loss due to four episodes was 769 kg. Accounting for all episodes, the milk loss pattern in cows with several episodes is apparent. As milk loss is calculated relative to non-CM herdmates, loss is actually greater: CM cows are generally capable of producing more than non-CM cows.

Introduction

CM is a substantial problem in the dairy industry. In a review of studies on CM's effect on MY, Seegers et al. (2003) found that CM caused both short- and long-term losses, and that CM cows were higher yielders. We studied the effect of CM's first occurrence on MY, relating when milk weights were measured to CM diagnosis (Gröhn et al. 2004). However, CM can occur multiple times, and with a sufficient number of cows with repeat cases, one can determine CM's impact on MY more precisely. Our objective was to estimate the cumulative effect of all CM episodes a cow had, on MY, using mixed models with separate index variables for each CM episode.

Materials and Methods

Calving, production, health, and culling data, and information on all CM episodes, on 2567 Holstein dairy cows, calving from October 1999 to July 2001, in two New York herds were available.

To study the cumulative effect of all CM episodes on MY, we used PROC MIXED (SAS 1999) to fit mixed models with an autoregressive covariance structure to account for correlated measurements (within-cow milk weights). We modeled primipara and multipara separately, due to their different lactation curves. The outcome was mean MY per day in a particular week of lactation. Independent variables were herd, parity (only in the model for multipara), calving season, week of lactation, diseases other than CM, and index variables (see below) for each CM episode.

We created a separate index variable for each CM episode (adapted from Gröhn et al. 2004). They reflected when MYs were recorded, in relation to each CM episode's (1st, 2nd, 3rd, and 4th) occurrence. For each episode, milk weights were classified into intervals ≥ 29 d, 22-28 d, ..., and 1-7 d before, and 0-7 d, 8-14 d, ..., 64-70 d, and ≥ 71 d after diagnosis. This allowed us to ascertain exactly when, and how much, CM had an effect on MY. Control cows were those without any CM in the study lactation, since all CM episodes are modeled simultaneously.

Results and Discussion

Approximately 11% of primipara had at least one CM episode (Table 1). The median day of diagnosis of the 1st episode was very early (16 days-in-milk (DIM)). The median DIM of a 2nd episode was much later. Among multipara, approximately 15% had at least one CM episode. The median DIM of the 1st episode (85) was considerably later than that for primipara. The median DIM of subsequent episodes occurred several weeks later. Cumulative milk loss varied with episode.

Table 1 Description of CM episodes, by parity group and episode

Episode	Primipara (n=958)		Multipara (n=1609)			
	1 st	2 nd	1 st	2 nd	3 rd	4 th
Total number of episodes	105	5	233	58	16	4
Median DIM (range) ^a	16 (1-351)	144 (102-185)	85 (1-332)	125 (5-343)	144 (47-297)	198 (139-275)
Number of cows ^b	100	5	175	42	12	4
Lactational incidence ^b	10.4%	0.5%	10.9%	2.6%	0.7%	0.2%
Cumulative milk loss (kg) ^c	715	1101	577	542	219	769

^aBased on the total number of episodes, so the median DIM for eg the 1st episode (16) in primipara includes cows with one episode and cows with two episodes (ie it is based on 100+5=105 episodes).

^bBased on the numbers of cows with exactly one, exactly two, exactly three, and exactly four episodes.

^cTotal amount of milk lost over the lactation, due to the total number of CM episodes (eg primipara that had two episodes lost an average of 1101 kg over the lactation).

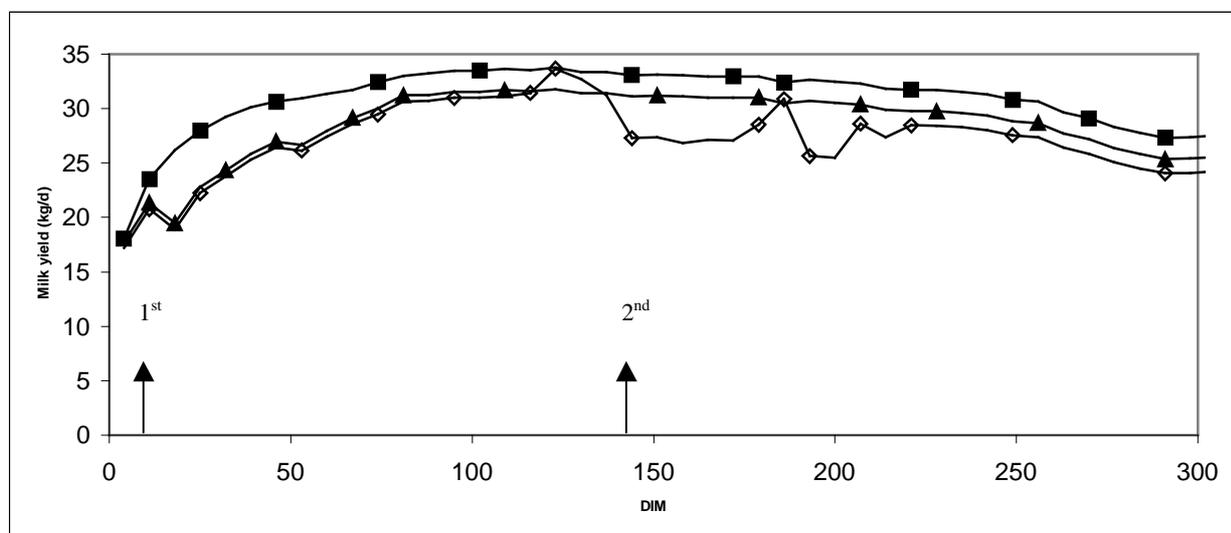


Figure 1 Lactation curves for primiparous cows with 0 (—■—), 1 (---▲---), or 2 (---◇---) CM episodes during lactation. Arrows indicate median DIM of each CM case.

Figure 1 shows lactation curves for three primipara: without CM, and with one or two CM episodes. Arrows indicate the median DIM of diagnosis of each episode. A one-episode cow had a lower lactation curve than a non-CM cow, after a drop at onset (cumulative loss: 715 kg; Table 1). For a two-episode cow, the lactation curve paralleled that of a one-episode CM cow until the 2nd episode, when a drop occurred. After brief recovery, the lactation curve for a two-episode cow remained below those of non-CM and one-episode cows. Cumulative loss from two episodes was 1101 kg.

Figure 2 shows lactation curves for five multipara: one non-CM, the rest with 1-4 CM episodes in lactation. CM was assumed to occur on the median DIM of diagnosis of each episode (see arrows). One-episode cows had slightly higher yield before CM, then dropped at diagnosis, and never fully recovered (cumulative loss: 577 kg; Table 1). Two-episode cows had higher MY, compared to non-CM and one-episode CM cows, but their MY dropped once CM occurred; they had another drop at the 2nd episode, recovered slightly, but not to pre-CM yield. Cumulative loss from two episodes was

542 kg (a “gain” of 35 kg, compared to one-episode cows). Three-episode cows had higher MY than non-CM cows early on, but later lost their advantage, with drops at each episode. Cumulative loss from three episodes was 219 kg (ie some recovery). Four-episode cows had high yield before 1st CM, but could not overcome sharp drops associated with each episode (cumulative loss: 769 kg).

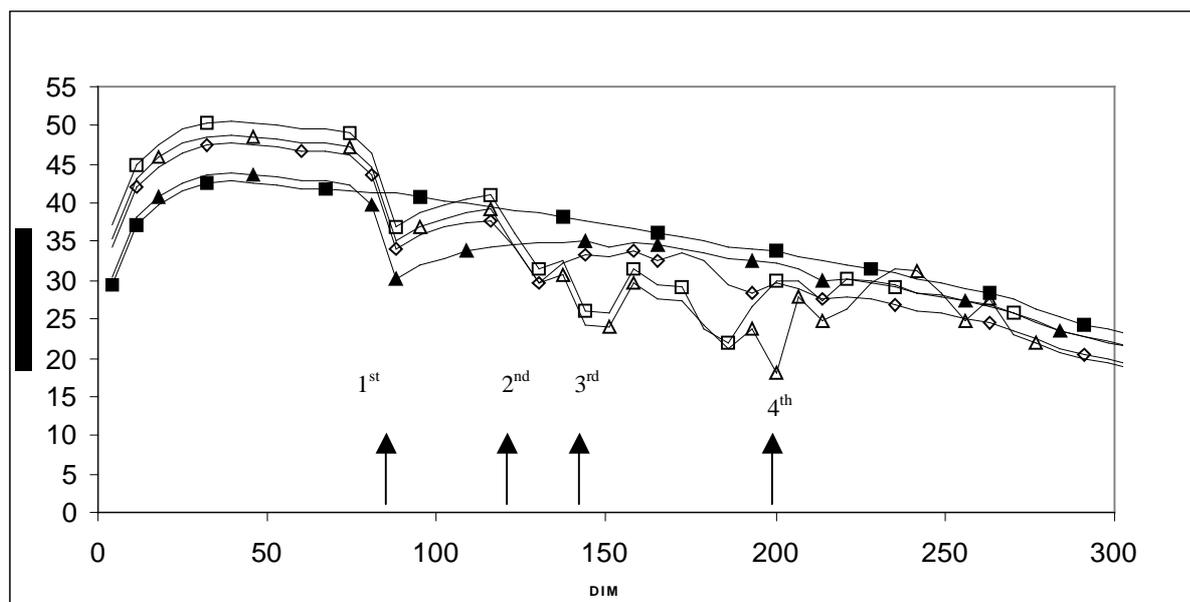


Figure 2 Lactation curves for Parity 2+ cows with 0 (—■—), 1 (---●---), 2 (-.-△-.-), 3 (....◇....), or 4 (-.-▽-.-) CM cases during lactation. Arrows indicate median DIM of each CM episode.

Our study shows the import of accounting for all CM episodes of a cow, to estimate its cumulative effect on MY, which varies with episode. Milk loss due to CM was calculated relative to non-CM cows, not to a cow’s own production potential, so is underestimated: CM cows tend to have higher yield (eg Gröhn et al. 2004) before the episode(s), than non-CM cows. However, although CM multipara had higher yield before diagnosis (Figure 2), this was not so in CM primipara, perhaps because CM often occurs earlier in primipara, so they could not achieve their potential before onset.

Conclusions

CM causes much milk loss in dairy cows. It can occur multiple times in lactation. We fit mixed models, with an autoregressive covariance structure to account for within-cow correlations among milk weights, to estimate the cumulative effect of all of a cow’s CM episodes on MY. The pattern of milk loss varied with episode number. Because CM cows are generally capable of producing more than their non-CM herdmates, losses are actually higher.

References

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