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Invited review: Udder health of dairy cows in automatic milking

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ABSTRACT

Automatic milking (AM) is increasing in modern dairy farming, and over 8,000 farms worldwide currently use this technology. Automatic milking system is designed to replace conventional milking managed by a milker in a milking parlor or in tie stalls. Cows are generally milked more frequently in AM than in conventional milking, and milking is quarter-based instead of udder-based. Despite improvements in the milking process and often building of a new barn before the introduction of AM, udder health of the cows has not improved; on the contrary, problems may appear following conversion from conventional milking to AM. This review focuses on udder health of dairy cows in AM, and we discuss several aspects of cow and milking management in AM associated with udder health. Finally, adequate management methods in AM are suggested. According to several studies comparing udder health between automatic and conventional milking or comparing udder health before and after the introduction of automatic milking in the same herds, udder health has deteriorated during the first year or more after the introduction of AM. Automatic detection of subclinical and clinical mastitis and cleaning the teats before milking are challenges of AM. Failures in mastitis detection and milking hygiene pose a risk for udder health. These risk factors can partly be controlled by management actions taken by the farmer, but AM also needs further technical development. To maintain good udder health in AM, it is imperative that the barn is properly designed to keep the cows clean and the cow traffic flowing. Milking frequency must be maintained for every cow according to its stage of lactation and milk production. Careful observation of the cows and knowledge of how to use all data gathered from the system are also important. "Automatic" does not mean that the role of a competent herdsman is in any way diminished.

Key words: udder health, automatic milking, mastitis detection, dairy cow

INTRODUCTION

Automatic milking (**AM**) is one step in series of measures taken to automate dairy production. In many countries, the dairy industry is undergoing structural changes with farms growing larger. Because of high labor costs, automatic milking is becoming more common. Over 8,000 AM farms exist worldwide, 90% of which are in the northwestern Europe, including Scandinavia (de Koning, 2010).

Concern about cow udder health arises when housing or milking systems change, and particularly with an increasing herd size. Udder health may be affected by structural renovations in the barn, changes in management, and changes in cow-based factors. Along with the change from conventional milking (**CM**) to AM, cow cleanliness and cow movement, feeding systems, transmission routes of infections, and detection methods for diseases change. As dairy farms grow larger, staff time spent per cow decreases and the throughput of cows at milking increases. The milking process is different in AM and CM: milking frequency and intervals between milking, settings of the milking equipment, and procedures for teat dipping differ. Cleaning the teats before milking is done without the visual control of the milker, which increases the requirements for clean cows. Detection of mastitis is carried out automatically, without visual examination by the milker, who can notice at least clinical mastitis in CM. Furthermore, AM is quarter-based, which prevents the spread of IMI between teats of a cow and reduces overmilking. Possible spread of IMI between cows can no longer be prevented by milking order, but can be reduced by flushing or steaming of the liners between individual milkings.

Mastitis, an inflammation of the mammary gland that is almost always caused by bacterial infections (IDF, 1999), decreases milk quality and milk yield, causes economic losses and an increased workload for the farmer, and affects animal welfare. To maintain udder health of dairy cows, we need to understand the complex nature of the interaction between the cow, environment, management, and milking. In this context, AM is a rather new concept, and in this paper we review the present knowledge of the effect of AM on udder health.

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Table 1. Comparison of cow SCC in different published studies between farms with conventional milking (CM) or automatic milking (AM)

Farms (no.)	Type of study[1]	Period	Cow SCC		Unit	Reference
			CM	AM		
69	Converting	1997–2000	5.15	5.20*	Log SCC	Rasmussen et al., 2001
81	Converting from 2× milking	1994–2000	149	193*	Weighted-average cow SCC/herd, $\times 10^3$ cells/mL	Kruip et al., 2002
12	Converting from 3× milking	1994–2000	153	228*		
252	Converting	2000–2001	5.91	6.07***	Log_2 SCC[2]	Mulder et al., 2004
223	Different	2000–2001	5.88	6.06***		
88	Converting	1999–2006	4.89	4.96***	Log SCC	Hovinen et al., 2009
94	Different	1999–2006	4.89	4.93^{NS}		

[1]Comparisons were made either on the same farms converting from CM to AM, or between different CM and AM farms according to test-day data.

[2]Binary logarithm, logarithm to the base 2, counted from SCS instead of SCC.

*$P < 0.05$; ***$P < 0.001$.

UDDER HEALTH IN AUTOMATIC MILKING—WHERE ARE WE NOW?

Udder health of cows has been studied in epidemiological studies covering large numbers of dairy farms or at research farms having both AM and CM and evaluated using individual cow SCC in the milk, proportion of new high cow SCC, or number of mastitis treatments. Comparisons have been made between different AM and CM farms, and within farms before and after the introduction of AM.

Epidemiological studies have, in general, indicated deteriorating udder health among cows after the introduction of AM (Rasmussen et al., 2001; Kruip et al., 2002; Mulder et al., 2004; Poelarends et al., 2004; Pedersen and Bennedsgaard, 2006; Rasmussen, 2006b; Table 1). In a recent study conducted in 88 Finnish herds, the average cow SCC per herd and the proportion of new high-SCC cows was higher over the first year after the introduction of AM (Hovinen et al., 2009). Somatic cell count continued to be higher throughout the first year after the change. When these AM farms were compared with CM farms (nearly 200 farms in total) during the first year after the change in housing and milking systems, AM herds had more new high-SCC cows, and in mo 4, 10, and 12 after the change, a higher mean cow SCC than CM herds (Hovinen et al., 2009). Test-day SCC of first-parity cows from more than 250 Dutch farms increased after introduction of AM, and the increase lasted for 2 yr after the introduction. When AM farms were compared with CM farms (more than 400 farms in total), a higher test-day SCC in first-parity cows was found in AM farms (Mulder et al., 2004). According to Danish data from 69 farms, SCC and the proportion of new high-SCC cows increased after introduction of AM (Rasmussen et al., 2001) but decreased after the adaptation period of a few months, although the proportion of new high-SCC cows among cows at risk was higher throughout the first year after the introduction. An adaptation period of a few months was also seen in Hovinen et al. (2009). In AM, milk SCC of the cows fluctuated more from low to high, indicating more new infections (Rasmussen et al., 2001). A more recent study of Rasmussen (2006b) on 478 AM farms supported earlier results, because the increase in the proportion of new high-SCC cows among cows at risk was still detectable after 4 yr with AM. The increase did not depend on the year of the introduction or on the automatic milking system (**AMS**) brand.

The number of treatments of mastitis decreased after changing to AM in first-parity cows but increased in older cows (Hovinen et al., 2009). Changing to more intensive farming may leave less time to deal with individual cows and their treatments. Consequently, focus may be put on therapy at drying-off or premature drying-off of an individual quarter during lactation. The study of Pedersen and Bennedsgaard (2006) supports this, as they found that the proportion of cows with a blind quarter almost doubled during the first 6 mo after changing to AM. On the other hand, in support of our results in older cows, Bennedsgaard et al. (2004) reported an increase in antibiotic treatments for mastitis in 20 farms after the introduction of AM. Some of the farmers increased treatment frequency because they trusted the alerts from the automatic mastitis detection system, which may lead to an unnecessary increase in the use of antimicrobial drugs.

In contrast, studies comparing AM and CM in the same farm with similar environment and management indicated no differences in udder health of the cows measured as mastitis incidence (Wirtz et al., 2004) or cow SCC (Berglund et al., 2002; Abeni et al., 2008), although quarter SCC was lower in AM (Berglund et al., 2002). In that study, teats were cleaned both automatically and manually, which makes interpretation of