The Adoption of Automatic Milking Systems in the Canadian Dairy Industry: Impacts on Cow Health, Farm Management and Dairy Producers

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Take Home Messages

- The use of automatic milking systems (AMS) is increasing in Canada.
- Changes to housing were necessary for the transition to AMS, but cleaning and feeding practices stayed the same, as with producers' previous conventional milking systems (CMS).
- Producers changed health management practices, but the majority of producers found health detection to be easier with AMS.
- Producers reported little effect on milk quality and cow health.
- Farms were able to increase herd size and milk yield, and decrease time devoted to milking-related activities and the number of employees.
- AMS improved perceived profitability, quality of producers' and their cows' lives and had met producers' expectations.
- Despite some challenges, producers perceived transitions to AMS as successful, and would recommend AMS to other dairy producers.

Introduction

Automatic milking systems are becoming increasingly common in Canada. In 2015, approximately 7% of all Canadian dairy farms operated AMS (Canadian Dairy Information Centre, 2016). In order to facilitate transitioning to AMS, and for producers to have realistic expectations, there is a need to benchmark the results of transitioning and to identify the challenges and solutions associated with transitioning to AMS. The overall aim of this study was to conduct a national survey to explore how Canadian dairy producers transitioned to AMS.

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Although AMS survey studies have been published (e.g., Helgren and Reinemann, 2006; Rodenburg and House, 2007; Rousing et al., 2007; Molfino et al., 2014; Moyes et al., 2014; Tousova et al. 2014), many of these are non-Canadian studies that focus on very specific aspects of dairy farming. The Canadian dairy industry is different from that of the United States and European Union in average herd size, milk price, and animal welfare standards (Barkema et al., 2015), suggesting that AMS studies conducted abroad may not always reflect the Canadian dairy industry. The objectives of this study were to document the impacts of transitioning to AMS on producer perceptions of change in important aspects of Canadian dairy farming, and to determine how producers experience the transition.

Materials and Methods

A 2-part national survey study was conducted by telephone, email and in person, across 8 Canadian provinces from spring of 2014 to spring of 2015. Overall, 217 AMS producers from the contact list of 530 AMS producers responded to the survey. Respondents were from British Columbia (BC; n = 8), Alberta (AB; n = 43), Saskatchewan (SK; n = 7), Manitoba (MB; n = 12), Ontario (ON; n = 73), Quebec (QC; n = 66), and the 'Maritimes' (New Brunswick and Nova Scotia; n = 7). Producers were initially contacted by phone with the General Survey, which addressed changes to housing, milk production, milk quality, and milking labour management; current milking statistics; experience with cow training; challenges and solutions experienced during the transition; changes in quality of life and overall level of satisfaction with AMS. After completing the General Survey, producers who were interested were emailed a link with follow-up questions, which consisted of more detailed questions on topics covered in the General Survey, in addition to new questions related to cow health, participation in a DHI program, and use of the Dairy Code of Practice (DCOP). Producers who could not be contacted by phone were emailed a link to the Combined Survey, which contained both the General Survey and follow-up questions. The total number of respondents for General Survey questions was 217, while the number of respondents for the follow-up questions, which were specific to the Combined Survey, was 69.

Farms had a median of 2 AMS units with a mean of 51 cows/robot. Overall, 76% of respondents owned Lely robots, 21% DeLaval, and 3% other brands (BouMatic, Insentec, or unspecified). The median length of time since transition to AMS was 30 months.

■ Changes in Housing, Farm Management and Cow Health, and the Role of the Dairy Code of Practice

Changes to housing were necessary. Overall, 55% of producers built new barns and 47% changed housing system. Most housing system conversions were from tie-stall to free-stall systems. Cleaning and feeding practices mostly stayed the same after installing AMS. Stalls were cleaned out a median of twice/day, and alleyways were cleaned a median of 8 times/day. After transitioning, 36% of producers changed feeding systems (e.g., individual components to a mixed ration). Most producers (83%) provided a mixed ration at the time of the survey. The frequency of feed delivery and feed push up at the bunk stayed the same for 74% and 59% of the producers, respectively. Changes made to housing and management practices (within the limits of this survey) largely met industry standards.

The DCOP was a source of reference for 20% of producers when planning their transition to AMS. Producers believed that AMS positively impacted how well their farm now followed the requirements of the DCOP. A revised DCOP with improved relevance to AMS may increase the current low use of the DCOP as a source of reference for current and prospective AMS farmers.

Changes to health management practices were made by 66% of producers. Most respondents (80%) found health detection easier with an AMS because of the large amount of data the robots provide per cow, and the alarms that notify producers of issues. Still, 19% of producers said health detection was more difficult with this technology and reported difficulties as a result of no longer seeing every cow twice a day and needing to rely on technology to detect most health issues.

Producers reported little change in cow health after the adoption of AMS. The largest proportion of producers perceived a decreased rate of lameness and clinical mastitis (Table 1). Bacterial count and culling rate were reported to have stayed the same by 40% and 59% of producers, respectively. Conception rate was perceived by 63% of producers to have increased.

Table 1. Producers' Perceptions of Change in Cow Health

	Perceptions of Change (% respondents)		
Items	Increased	Decreased	Stayed the Same
Rate of lameness	20	42	38
Rate of clinical mastitis	13	49	38
Bacterial count	34	26	40
Culling rate	25	16	59
Conception rate	63	6	31

▪ Impacts on Milking Labour Management, Milk Production and Quality, and Participation in Dairy Herd Improvement Programs

Farms were able to increase their herd size by 10% to 85 lactating cows. Like other studies (e.g., Wagner-Storch and Palmer, 2003, Hansen, 2015, and Woodford et al., 2015), milk yield per cow/d was reported to have increased. The average milk yield of AMS farms in this study was 32 kg/cow/d, typical for North American AMS dariy farms (Tremblay et al., 2016).

In this study, milking labour managent in CMS refered to moving cows to the holding pen, preparing, milking in and cleaning the parlour. For AMS, milking labour management refered to fetching cows for milking, cleaning and preparing the AMS unit, and addressing maintenance issues. After the adoption of AMS, time devoted to milking labour management decreased from 5.2 to 2.0 h/d. Labour savings with AMS have been studied in the past (Sonck, 1995; Mathijs, 2004; Bijl et al., 2007), but the varied conclusions suggest that labour savings highly depend on the management capabilities of producers (van't Land et al., 2000).

There was a decrease from 2.5 to 2.0 employees after the adoption of AMS. An "employee" was defined as someone who worked full-time or part-time for the farm but was not a family member. It is possible that farms decreased the amount of family labour first before decreasing the amount of employee labour. It is also possible that time saved on milking labour is transferred to more computer-oriented labour since this technology is more data-based (Butler et al., 2012).

Overall, producers perceived little change in milk quality after the transition to AMS. Milk fat and protein levels were reported to stay the same, while bulk tank somatic cell count (BTSCC) either decreased or stayed the same (Table 2). The median milk fat content was 4.0%, while median milk protein content was 3.3%. The geometric mean BTSCC was 180,000 cells/mL.

Table 2. Producers' Perceptions of Change in Milk Quality and Content

	Perceptions of Change (% respondents)		
Item	Increased	Decreased	Stayed the Same
Milk Fat	29	15	56
Milk Protein	12	9	79
BTSCC	20	43	37

AMS milking statistics are summarized in Table 3. The median milkings/cow/day was on the higher end of what has been documented in literature: 2.4 to 3.3 milkings/cow/d (Prescott et al., 1998; Svennersten-Sjaunja et al., 2000; Melin et al., 2005). A median of 4% of a herd were fetched/robot/day, which was on the lower end of a previously documented range in Canada (4 to 25% of a herd; Rodenburg and House, 2007). Farms had half the reported average number of failed/incomplete milkings/robot/day compared to a recent North American AMS study (Tremblay et al., 2016). This difference in finding may be a result of comparing producers' reported values in the current survey study and AMS-generated data in the Tremblay et al. (2016) study.

Table 3. Respondents' AMS Milking Statistics

Milking Statistics with AMS	Overall
Median milkings/cow/day	3.0
Robot occupation rate (% of day)	77
Median number of fetch cows/robot/day	3
Median number of failed/incomplete milkings/robot/day	2.5

There has been concern about reduced participation in dairy herd improvement (DHI) programs with AMS becoming more popular (Barkema et al., 2015). Although 67% of respondents were current participants of DHI, overall participation had decreased with the transition to AMS. In order to maintain their effectiveness in making national evaluations of dairy cattle and milk quality, DHI programs must find ways to attract or uphold attractiveness to AMS users.

■ Producer Experiences: Cow Training, Challenges, and Impact on Quality of Life

Cow training has made transitioning cows to AMS easier (Jago and Kerrisk, 2011). Training heifers prior to calving has shown a positive impact on milking intervals, frequency of feeding, and milk production after calving (Widegren, 2014). However, despite the benefits, most producers in the current study did not train cows (Table 4). For producers who trained their animals, it took on average 7 days to train a cow or heifer. Studies have reported a similar average of 7 to 8 days for a cow to adapt to the AMS (Spolders et al., 2004; Jacobs and Siegford, 2012). Whether or not training occurred, it took an average of 30 days for an entire herd to adapt, which was similar to what Rodenburg (2002) had been previously documented.

Table 4. Training Practices Used by AMS Producers

Item	Overall
Respondents who… (%)	
Train cows only	6
Train heifers only	22
Train both cows and heifers	14
Do not train at all	58
Provide feed during training for… (%)	
Cows	88
Heifers	90
Spray teats during training for… (%)	
Cows	47
Heifers	45

Challenges experienced during the transition included learning to use the technology and data, cow training, a demanding first few days, and changing health management. The list of challenges was diverse (Table 5). Based on the most common solutions, it may be beneficial to implement an international, online, producer-based AMS forum so knowledge can flow more easily between farmers. Transitioning can be made easier by planning in detail for the build/renovations and the labour-intensive start-up, anticipating challenges that might not be a direct result of AMS (e.g., converting housing from tie-stall to free-stall), and opening the lines of communication and building a relationship with veterinarians, nutritionists, and the local AMS dealer so that a network of professionals is available to help with changes in cow health and technical issues with the AMS.

Table 5. Challenges Experienced by Producers (n = 201) During the Transition to and Use of AMS, and Respective Solutions

Challenge (No. respondents with that challenge)[1]	Solutions (No. respondents with those solutions)
Learning to use the AMS (n = 68)	Time and patience (42), getting help from the dealer (10), trial and error (8), get help from younger generation (4), talking to other AMS producers (2), attend seminars (1)[2]
Cow training (n = 51)	Time and patience (28), creating small groups for training (5), recruiting extra help for the training period (4), suggests others to implement training programs (3), culling/selling cows that could not learn (1)[2]

Feed balance and nutrition (n = 31)	Working with a nutritionist or feed consultant (18), trial and error (6), switching feed companies (4), being a better observer (3), talking to other AMS farmers (in Canada and abroad) (2)
Trusting the AMS and changing mindset (n = 30)	Time and patience (23), trusting what the dealers had to say (3)[2]
Demanding first few days/weeks (n = 30)	Time, patience and effort (15), recruiting extra help (10), focusing on working efficiently (1), educating and encouraging employees (1), suggests transitioning in March vs. May in order for the transition to be done before field work season (1)[2]
Changing health management (n = 21)	Feet and leg: trim and check hooves often (be proactive) (7), implement use of footbath (3) Heat detection: be a better observer (2), use activity monitor (2) Reproduction: implement new observation system (2), learn to plan ahead (1) Mastitis: be more vigilant and proactive (2)
Non-AMS transition issues caused by converting from tie stall to free stall (n = 20)	Time and patience to allow cows to adjust (14), some use force to get them to get up (3), install mats to prevent slipping (3), implement trimming schedule and use of footbath for feet/leg issues (2)
Building modifications (n = 17)	Time to plan it out well (8), effort to “just do it” (4), talking to other AMS farmers (2), help from dealer (1)[2]
Technical issues (n = 17)	Technical issue-specific solution (3), self-taught to fix issues (2), help from dealer (2), talking to other AMS farmers (1), replacing the robot (1), preventative maintenance (1), trying not to get frustrated (1)[2]
Feet and leg issues (n = 16)	Implement more frequent trimming and use of footbath (preventative maintenance) (10), install non-slip mats (1), build pack pen for lame cows (1), changed diet (1)[2]
Being on call (n = 15)	Time to adjust and accept it (5), hire help (2), stay on top of maintenance (2), do better at checking and cleaning the AMS unit before bed (1)[2]
Poor service from dealer and lack of support from others (n = 14)	Learning to solve problems by oneself (4), talked to other farmers (2), switching dealers (1), making complaints noticed by dealer (1)[2]

Decreased milk quality (n = 9)	Changing management (e.g., routing cows differently within the barn so they can be examined easier and more frequently) (2), culling high SCC cows (1), giving it time as SCC returned to normal on its own (1), dealer fixed spray apparatus (1)[2]
Finances (n = 6)	Creating a budget (2), time and profit (2), being more efficient (1), re-financing the operation (1)
Employee management and training (n = 6)	Communicate and work patiently with employees (3), create an SOP (1)[2]

1 Respondents were allowed to list more than one challenge (i.e., number of respondents for each challenge are not necessarily independent of one another).
2 Some producers did not have a solution to this challenge

Animal welfare, in this study, encompassed 3 objectives as identified by Fraser (2009): to ensure good physical health and functioning of animals, to limit unpleasant affective states (e.g., pain, fear and distress), and to allow animals to grow and live in a way that is natural for the animal (i.e., to allow expression of innate behaviours). Animal welfare had improved with the adoption of AMS in terms of perceptions of quality of the animals' lives and on the physiological aspects of animal welfare. Producers reported that the quality of their cows' lives had improved as a result of their animals being less stressed. This technology had also improved cow welfare by improving detection of health issues.

Overall, AMS had improved perceived profitability and quality of producers' lives, and met expectations. Improvements to producers' quality of life were similar to what other studies have documented: gaining more time flexibility, work being less stressful and physically demanding, easier employee management, and improving herd health and management (Meskens et al., 2001; Woodford et al., 2014; Hansen, 2015). The majority of producers (86%) would recommend transitioning to AMS to other dairy producers.

■ Conclusions and Implications

This national survey was the first to document the impacts of transitioning to AMS on producer perceptions of change in important aspects of Canadian dairy farming in tandem with determining how producers experience the transition. Findings from this study provide a benchmark of impacts of AMS: housing changes were necessary, feeding and cleaning practices largely stayed the same, cow health and milk quality were maintained, time devoted to milking related activities decreased while herd size and milk production increased, producers' quality of life and animal welfare improved, participation in DHI decreased, and the DCOP had a limited role in the transition to AMS.

Our findings also provide a benchmark of producer experiences during the transition. This study can help producers make a more informed decision about adopting AMS and can act as a transitioning tool by providing producers, AMS dealers, veterinarians, and dairy advisors, with more detailed information on the expectations, challenges and solutions when switching to AMS.

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