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Reproductive management practices and performance of Canadian dairy herds using automated activity-monitoring systems

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ABSTRACT

The objectives of this study were to describe the characteristics and motivations of producers who had implemented automated activity-monitoring (AAM) systems and to compare herd reproductive performance before and after the implementation of an AAM system and between herds with AAM and herds managing reproduction based on timed artificial insemination (TAI) or based on other programs. Freestall dairy herds located in Ontario and the western provinces of Canada and enrolled in Dairy Herd Improvement were surveyed through a mail questionnaire between April and July 2010. The data describe the characteristics and reproductive management practices of herds using AAM systems. A total of 505 questionnaires (29%) were returned. On average, 21-d pregnancy risk, conception risk, and 21-d insemination risk did not differ between herds managing reproduction based on an AAM system (18, 39, and 50%, respectively) or a TAI-based program (17, 38, and 49%, respectively). Herds that implemented an AAM system had a significant increase in annual pregnancy risk, from 15 to 17%, and insemination risk increased from 42 to 50%, whereas conception risk was unchanged (37 and 35%) following adoption of the system. The majority of respondents with AAM systems first used the system to manage reproduction in lactating cows. Most herds with AAM were performing artificial insemination twice per day, most commonly with an interval from the estrus alarm to artificial insemination of 7 to 12 h. The most commonly reported reason to adopt an AAM system was a desire to improve reproductive performance. These results support the findings from randomized trials that AAM-based programs can yield comparable reproductive performance to TAI-based programs.

Key words: survey, reproduction, activity-monitoring system, estrus detection

INTRODUCTION

Intensive and accurate estrus detection in dairy herds is a long-standing and ongoing challenge. If superior rates of detection of estrus can be achieved, reproductive programs based on estrus detection can be as profitable as timed artificial insemination (**TAI**) programs with excellent compliance to the protocol (Galvão et al., 2013). Estrus detection efficiency in many North American dairy herds is less than optimal (Senger, 1994; Washburn et al., 2002). Much research focus has been on development of programs that facilitate insemination of cows at a predictable, optimized time relative to ovulation, without estrus detection (Pursley et al., 1995; Souza et al., 2008). Interestingly, despite the efficacy of TAI programs, a large number of herds in North America employ visual estrus detection or estrus detection aids as part of their reproductive management program (USDA, 2009), including the use of estrus detection in combination with TAI programs.

Modern precision technology includes automated activity-monitoring (**AAM**) systems, and reasonable efficiency and accuracy of estrus detection can be achieved with AAM (van Eerdenburg 2008; Hockey et al., 2010; Løvendahl and Chagunda, 2010). Few studies describe herd-level factors that affect the success of AAM systems, but individual animal factors can influence the sensitivity of AAM systems for detecting estrus. Parity, milk yield, stage of lactation, BCS, or lameness at the time of estrus can affect the probability of estrus detection with AAM systems (Arney et al., 1994; López-Gatius et al., 2005; Løvendahl and Chagunda, 2010). The first randomized trial comparing reproductive performance of an AAM-based program to TAI-based programs in North American dairy herds did not find an overall difference in time to pregnancy (Neves et al., 2012), but differences among herds were noted. Comparable overall performance was reported in a controlled trial on 2 dairy farms in Israel (Galon, 2010) and in a study that compared 3 different treatment combinations of AAM-based and TAI-based protocols for first service in lactating cows in the United States (Fricke et al., 2014).

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The first objective of our study was to describe the characteristics and motivations of producers who had implemented AAM systems. The second objective was to compare annual summary herd reproductive performance before and after the implementation of an AAM system. The final objective was to describe the reproductive performance of Canadian dairy herds managing reproduction using AAM-based programs and to compare the performance of these herds to a sample of herds without AAM systems.

MATERIALS AND METHODS

Questionnaire Development and Mail Survey

A cross-sectional study was carried out between April and July 2010 using a mail questionnaire, which was structured based on information from the survey design literature (Dohoo et al., 2009). A purposive sample of all freestall dairy herds (n = 1,750) from the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario, Canada, enrolled in milk recording with Canwest DHI (Guelph, Ontario, Canada) in 2010 received the questionnaire. A response rate of 15% (263 returned questionnaires) was targeted to allow estimation of all proportions of responses with no more than 6% points of error (Abramson, 2011).

The questionnaire (Supplementary File 1; http://dx.doi.org/jds.2014-8221) was designed to collect information on herd characteristics and reproductive management practices with a focus on farms using AAM systems. The survey included 39 questions, 38 of which were closed-ended. Before implementation, the survey was reviewed by faculty and graduate students involved with dairy cattle research from the Department of Population Medicine, University of Guelph (n = 5), and pretested on a convenience sample of dairy producers in Ontario (n = 5). Questions that were unclear or otherwise problematic were revised.

In an attempt to maximize response rate, a few methods known to influence response (Dillman, 2007) were implemented: (1) the survey package included a cover letter, the survey booklet, and a prepaid addressed return envelope; (2) the cover letter clearly stated the objectives of the study, confidentiality of participation and the research team involved, and advised of a draw for 1 of 3 prizes of Can$250 if a completed questionnaire was returned before the deadline; and (3) 3 wk after mailing the survey, an e-mail was sent to thank producers who had already returned the questionnaire and to encourage response from those who had not yet done so. This follow-up was performed by Canwest DHI and the list of customers was not released to the researchers. The Research Ethics Board of the University of Guelph approved the study.

Data Management and Statistical Analyses

Following the survey administration period, a database was built using EpiData Entry 3.1 (Odense, Denmark) into which the responses from each questionnaire received were entered manually. The database entries were checked for accuracy against a sample of the returned questionnaires, which were later exported into a single file in SAS (version 9.2, SAS Institute, Cary, NC). Frequency distributions were calculated for the survey variables. The associations between responses (i.e., herd characteristics, management practices, and respondents' beliefs) and use of AAM systems were assessed with Chi-squared statistics.

Any producer indicating the use of an AAM system for more than 1 yr and consenting to extraction of DHI reproduction data was contacted via e-mail or telephone to obtain the approximate date of implementation of the estrus-detection system. Herd reproductive summary information was obtained from Canwest DHI; annual data were extracted from each farm's DairyComp 305 (Valley Agricultural Software, Tulare, CA) data file and exported into Microsoft Excel (Microsoft Corporation, Redmond, WA). The unique DHI herd number, annual 21-d pregnancy risk (**PR**), insemination and conception risks, and the numbers of inseminations and pregnancies for lactating cows for each year between 1999 and 2010 were compiled into a single database using SAS. Only herds for which the DHI herd number and province identification code on the annual herd summary data matched the same items in the survey were included in the analysis.

Comparative Analysis Before and After Implementation of an AAM System

For the retrospective analysis (i.e., 12-mo periods before and after implementation of the AAM system), the herd data were obtained for the year before employment of the AAM system. Because direct data on conception risk (**CR**) were missing for 1999 to 2004, CR was estimated for all years by dividing PR by 21-d insemination risk (**IR**). The choice of the after year to be used for the comparison was established on the following criteria: herds that started using the AAM system between January and June had their year after starting the subsequent calendar year, whereas herds that implemented the AAM system between July and December had their year after in the calendar year starting 1 yr later. The intent was to select years for comparison that were close in time to implementation