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Factors affecting management changes on farms participating in a Johne's disease-control program

R. Wolf,[1] H. W. Barkema, J. De Buck, and K. Orsel
Department of Production Animal Health, Faculty of Veterinary Medicine, University of Calgary, Calgary, Alberta, Canada T2N 4N1

ABSTRACT

Modern Johne's disease programs aim to control *Mycobacterium avium* ssp. *paratuberculosis* (MAP) infection through implementation of management practices that reduce the probability of MAP introduction and within-herd transmission on dairy farms. Success of these programs depends on whether weaknesses in management are corrected through implementation of management improvements. The objectives of this study were, therefore, to (1) assess whether scores in risk-assessment (RA) questions predicted suggestions for management changes for the upcoming year; and (2) determine factors as assessed in an RA that motivated producers to make management improvements and assess whether management improvements were influenced by previously received test results. The RA determining on-farm management related to MAP introduction and transmission were conducted annually by herd veterinarians on 370 dairy farms participating in the Alberta Johne's Disease Initiative. A maximum of 3 management changes that the farmer and the veterinarian agreed upon were recorded in a management plan. The MAP infection status of the herds was assessed through culture of 6 environmental samples. Whereas a management change was proposed for only 4% of questions with scores 1 or 2 (low risk), a change was proposed for 19% of questions with scores >2 [high risk; odds ratio (OR) = 11.4]. Improvement in RA question scores was more likely between the first and second annual RA than between the second and third RA (OR = 1.6). Farms with >3 culture-positive environmental samples collected in the previous year were more likely to improve their management than environmental sample culture-negative farms (OR = 1.3). In conclusion, proposed management changes were oriented toward previously identified weaknesses in management practices, suggesting that the RA was properly used to design targeted management suggestions. Furthermore, improvements in management were not randomly distributed among farms participating in the control program. Instead, knowledge of MAP infection status of a herd, suggestions for management improvements, and duration of participation all influenced implementation of management improvements.
Key words: paratuberculosis, control, management

INTRODUCTION

Mycobacterium avium ssp. *paratuberculosis* (**MAP**) is present on dairy farms worldwide (Barkema et al., 2010), causes economic losses to the industry (Wolf et al., 2014b), and is potentially associated with Crohn's disease in humans (Atreya et al., 2014). After in utero or fecal-oral infection, cattle go through an extended incubation period that can ultimately result in development of Johne's disease, a noncurable enteritis (Sweeney, 2011). During incubation, infected cattle frequently remain undetected because antibody production and bacterial shedding occur only intermittently (Mortier et al., 2014a,b), and available tests lack accuracy (Nielsen and Toft, 2008), thereby reducing the effectiveness of testing and culling for successful eradication of MAP on cattle farms (Whitlock and Buergelt, 1996; Garry, 2011). As a consequence, most MAP-control programs are not solely based on testing and culling, but encourage implementation of best management practices to prevent MAP introduction and transmission between infectious and susceptible cattle (McKenna et al., 2006). These MAP-control programs can, however, only be effective if farmers make the appropriate management improvements.

The first step toward successful MAP control using best management practices is to identify weaknesses in management and propose changes (Garry, 2011). Weaknesses in management can be identified through the use of a MAP-specific risk assessment, which is completed by farmers and herd veterinarians working in collaboration. Thereafter, identified weaknesses can be addressed by proposed management improvements (USDA, 2003). However, risk assessment as a tool only makes sense if proposed management changes are actually oriented toward deficiencies in management practices.

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[1]Corresponding author: robert.wolf@stmk.gv.at

The second step, after identifying weaknesses in management, is to improve on-farm management. In 2 US studies, farms generally improved their management during participation in a MAP-control program (Raizman et al., 2006; Wells et al., 2008). Nevertheless, whereas the majority of Ontario dairy farms significantly improved their management, on 20% of the farms, management significantly worsened (Sorge et al., 2011). Decisions regarding management changes are complex and, among others, motivated by expected increases in profit (Edwards-Jones, 2006). Therefore, farmers that know about the presence of a pathogen might be more likely to invest in its control. Furthermore, owners of large herds are regarded as more progressive than owners of small herds (Bergevoet et al., 2004; Sayers et al., 2013), and farms with high risk assessment (**RA**) scores (bad management) make more management improvements (Sorge et al., 2011). Therefore, the objectives of our study were to (1) assess whether scores in RA questions predicted suggestions for management changes for the upcoming year; and (2) determine factors as assessed in an RA that motivated producers to make management improvements and assess whether management improvements were influenced by previously received test results.

MATERIALS AND METHODS

Data Collection

Participants in this longitudinal study consisted of the 370 dairy farms (63% of dairy farms in Alberta, Canada) that voluntarily participated in the Alberta Johne's Disease Initiative (**AJDI**), a management-based MAP-control program (Wolf et al., 2014a). Data were collected between November 2010 and April 2014 (farmers could join and leave the program at any given time). Herds were visited annually by their herd veterinarians, who were trained (half-day workshop at the University of Calgary) regarding the importance of MAP control, the link between MAP and Crohn's disease, effective management strategies to control MAP, and the correct way of conducting AJDI procedures. During each visit, veterinarians conducted an RA that identified risk factors for MAP infection on the farm (Appendix, Table A1). The first 4 RA questions dealt with herd characteristics (e.g., herd size and housing), whereas questions 5 to 34 were actual risk factors and management practices as related to MAP introduction and transmission and were based on previous suggestions for RA design (USDA, 2003). Questions had categorical scores (3–5 categories); a higher score was associated with an increased risk. After identifying high-risk areas, veterinarians and farmers decided on a maximum of 3 proposed management improvements, which were recorded in a management plan (**MP**). Proposal of <3 management improvements was possible if farmers and veterinarians did not see the need for further management improvements. To assess the herds MAP-infection status, 6 environmental samples (**ES**) were collected during the herd visit (Wolf et al., 2014a) and processed within 1 wk after collection using a standardized liquid culture protocol with subsequent PCR confirmation conducted on all samples (Forde et al., 2013; Wolf et al., 2014a).

Statistical Analyses

Data were entered in Microsoft Access (Microsoft Corporation, Redmond, WA, 2007), and management suggestions were linked to associated RA questions. In case of implementation of the suggested change, the scores for these questions were expected to decrease. Data analysis was conducted using STATA 11 (Statacorp, College Station, TX), and statistical significance was defined as $P < 0.05$.

Proposed Management Changes

The number of suggestions in the MP among farms in various years of AJDI participation was compared using a chi-squared test on contingency tables. Proportions of assigned question categories (cattle introductions, visitor access, calf liquid diet, young stock housing, calving pen, lactating and dry cow pens, feeding hygiene and equipment use, and management of likely infected cattle) between veterinarians were also compared using a chi-squared test. Furthermore, proportions of management suggestions made for the different question categories were illustrated in a stacked bar graph, using data from the 9 veterinarians with the highest number of conducted RA. Multilevel logistic regression on question level was used to identify predictors for proposed management changes. The outcome was whether or not (yes = 1, no = 0) an improvement related to a specific question in the RA was proposed in the MP. Predictors were (1) the specific question score in the RA (1, 2, 3, 4, and 5) and (2) the assigned question category (n = 9; categories as described above). The analysis was adjusted for clustering in the data set by including veterinarian, farm, and year of participation as random effects, resulting in a 4-level logistic regression model (Dohoo et al., 2003).

Actual Management Changes

Multilevel logistic regression was also used to identify predictors for actual changes in individual management