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Evaluation of udder health parameters and risk factors for clinical mastitis in Dutch dairy herds in the context of a restricted antimicrobial usage policy

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ABSTRACT

Recently, many changes have been implemented in Dutch dairy herds. Herd sizes have increased and antimicrobial use has been reduced. Certain types of antimicrobials can only be used in specific circumstances, and the preventive use of antimicrobials in dry cows is prohibited. The aim of this study was to quantify clinical mastitis (CM), subclinical mastitis (SCM), and risk factors associated with CM in Dutch dairy herds in 2013, in the context of these changes. For this study, 240 dairy herds were randomly selected from farms that participated in test-day milk recording, used a conventional milking system, and agreed to participate in the study. Eventually, 233 Dutch dairy farmers had complete records of CM in their herds in 2013 and 224 of these farmers completed a questionnaire on management factors potentially associated with CM. All participating farmers gave consent to use their routinely collected herd data such as test-day records and cow identification and registration data. Clinical and subclinical mastitis incidence rate (CMI and SCMI, respectively) per 100 cows per year, subclinical mastitis prevalence, and average bulk tank milk somatic cell count were obtained for 2013. The risk factor analysis was conducted using a generalized linear model with a log link function and a negative binomial distribution on herd level in Stata 13.1. A median CMI of 28.6 per 100 cows at risk per year, SCMI of 70.1 per 100 cows at risk per year, SCM prevalence of 15.8%, and bulk tank milk somatic cell count of 171 $\times$ 10^3 cells/mL were observed in 2013. Factors that were significantly associated with a higher CMI were cleaning slatted floors only once per day compared with more than 4 times a day (i.e., mechanical), a higher percentage of Holstein Friesian cows present in the herd, treating less than 50% of the cows with CM with antimicrobials, postmilking teat disinfection, and treatment of cows with elevated somatic cell count with antimicrobials. The results of this study indicated that udder health had not deteriorated compared with udder health in previous Dutch studies where herd sizes were somewhat smaller and before the restrictions in antimicrobial use. Several of the risk factors that were found can be influenced by the farmer and can prevent the occurrence of CMI. Still, when cases of CM occur, treatment with antimicrobials might be necessary to cure the CM case and is beneficial for the overall udder health in the herd.

Key words: dairy cattle, clinical mastitis, risk factor, udder health

INTRODUCTION

Worldwide, mastitis is an important disease because of its common occurrence and its significant economic effect (Huijps et al., 2008; Olde Riekerink et al., 2008; Lam et al., 2013). In the Netherlands, the last representative estimate of CM was conducted as part of the national udder health program in 2009 (Lam et al., 2013). Nevertheless, since that study many changes have been implemented in Dutch dairy herds. Herd size has increased from an average of 82 cows (>2 yr) in 2009 to 90 cows (>2 yr) in 2013, and antimicrobial use (**AMU**) was restricted by a new policy aiming to avoid the development of antimicrobial resistance (Hendriksen et al., 2008; Graveland et al., 2011; Scott and Menzies, 2011). For Dutch dairy herds, this meant that antimicrobials that were supplied to farmers by the veterinary practice had to be registered and monitored, restrictions on the use of second and third preference antimicrobials were put into place, and all prophylactic applications of antimicrobials such as blanket dry cow treatment were banned (KNMvD, 2013). As a result, the average animal defined daily dose of AMU per year (**ADDD/yr**) in the dairy industry decreased from 5.0 in 2010 (Hage and Van Deur, 2011) to 3.0 and 2.3 in 2013 and 2014, respectively (SDa, 2014, 2015). These

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Table 1. Questionnaire topics potentially associated with clinical mastitis in the study herds

Topics	Description
General	Herd size, pasturing in summer, replacement rate, growth in herd size in 2013, purchase of cattle in 2013
Housing	Number of cubicles, bedding, type of floor, usage of antiseptics in the cubicles
Hygiene	Cleaning frequency of cubicles and slatted floors
Milking hygiene	Cleaning udder, management of the cows directly after milking, usage of milking gloves, pre- and postmilking teat disinfection, cleaning milk parlor (when, how, and frequency)
Mastitis	Farmers' definition of clinical mastitis, mastitis detection methods, antimicrobial treatment of subclinical and clinical mastitis, dry cow therapy, motivation for selective dry-cow treatment, usage of internal teat sealants

developments may have had an effect on udder health in general and increased the need to optimize management to prevent mastitis and maintain good udder health.

Many studies have investigated management factors associated with subclinical mastitis (**SCM**) (Breen et al., 2009a; Devries et al., 2012; Cicconi-Hogan et al., 2013; Gordon et al., 2013) or clinical mastitis (**CM**; Barkema et al., 1999; Barnouin et al., 2005; O'Reilly et al., 2006; Breen et al., 2009b; Jansen et al., 2009; Richert et al., 2013). These studies were performed, however, in a situation without restrictions on AMU. A study of Passchyn et al. (2014) showed that risk factors for intramammary infections differed between treated and untreated heifers.

Whether the changes in the Dutch dairy industry such as increasing herd size and AMU restriction had an effect on udder health and whether it changed the risk factors for CM was unknown. Therefore, the aim of this study was to estimate udder health parameters and to identify risk factors associated with CM incidence rate (**CMI**) in Dutch dairy herds in 2013, in the context of these changes.

MATERIALS AND METHODS

Study Population

Based on sample size calculations, at least 200 dairy herds had to be included to be able to estimate the CMI with a maximum accepted error of 5 to 6%, and to detect risk factors with an incidence rate ratio of 2.5 or higher (assuming 95% confidence, 80% power, and an expected CMI of 25–30). The drop-out percentage was expected to be at most 20%. Therefore, it was decided to include 240 dairy herds in this study. The inclusion criteria for enrollment into the study were farms with a conventional milking parlor and routine 4 to 6 weekly test-day milk recording to ensure a uniform detection method of CM and similar routine herd data among the study herds. A total of 1,350 dairy herds that met the inclusion criteria were randomly selected using Stata version 13.1 (StataCorp, 2014) and were requested to participate in the study by mail. The first 240 farmers that responded were included.

Data Collection

All enrolled herds were visited during the first month of the study by an employee of GD Animal Health who was specialized in udder health management. At each of these visits, the aim of the study and the definition of CM were explained and farmers were asked to use standard forms to register CM. Farmers were asked to register all CM cases from January 1 to December 31, 2013. During the farm visit, the farmer completed a questionnaire on daily management practices (Table 1). This questionnaire included questions on factors that were assumed to be associated with the occurrence of CM and potentially gave the farmer the possibility to improve and reduce CM. The answers of the questionnaire were digitalized using NetQ premium (NetQuestionnaires Nederland BV, 2014). Finally, all participating farmers gave consent for usage of their routinely collected herd data.

To ensure high data quality and reduce bias, farmers were reminded by e-mail and telephone to return the forms at the end of each month. A procedure was developed in Stata 13.1 (StataCorp, 2014) to be able to timely detect incomplete records and administrative errors. When abnormalities were detected, the farmer was contacted immediately and the submitted data were corrected. For analytical purposes, herd level CM data were combined with the results of the questionnaire and routine test-day milk recording data [provided by the Dutch Royal Cattle Syndicate (CRV, Arnhem)], cow identification and registration data [I&R, provided by the Dutch Enterprise Agency (RVO, Den Haag)], and bulk milk SCC (**BMSCC**) data at a 2-wk interval (provided by Qlip Laboratories, Zutphen). Finally, records on antimicrobial supplies (originating from the MediRund database) were provided by the Dutch Commodity board for dairy (PZ, the Hague). From these data, the ADDD/yr was calculated for intramammary treatment (antimicrobials applied for CM and dry