



J. Dairy Sci. 100:1–20

<https://doi.org/10.3168/jds.2016-11708>

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Antimicrobial treatment of clinical mastitis in the eastern United States: The influence of dairy farmers' mastitis management and treatment behavior and attitudes

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ABSTRACT

To assess both the behaviors and social variables related to antimicrobial therapy for clinical mastitis, we sent a survey to 1,700 dairy farms in Michigan, Pennsylvania, and Florida in January and February 2013. The survey included questions related to 7 major areas: sociodemographic and farm characteristics, milking proficiency, milking systems, cow environment, infected cow monitoring and treatment, farm labor, and attitudes toward mastitis and related antimicrobial use. The overall response rate was 41% (21% in Florida, 39% in Michigan, and 45% in Pennsylvania). Herd size ranged from 9 to 5,800 cows. Only a small proportion of herds frequently or always cultured milk samples for bacteriology from cows with a high somatic cell count (17%), cows with clinical mastitis (18%), or bulk tank milk (13%). Likewise, only 56% of herds frequently or always maintained records of all treated cows and 49% reviewed records before administering mastitis treatments. Multivariate analysis determined that use of treatment records was associated with increased likelihood of frequent use for both intramammary (IMA) and systemic (SYA) administration of antimicrobial drugs for therapy of clinical mastitis. As would be expected, use of natural (organic) therapies was associated with decreased use of IMA, as was the respondent being a member of an Amish community. Lower levels of education and the use of bacterins to control *Staphylococcus aureus* mastitis were also associated with decreased IMA, whereas increased use of IMA at dry off and the belief that “bad luck” plays a role in mastitis problems were associated with increased IMA. Use of an internal teat sealant, the respondent being the sole proprietor, being from Michigan, use of conductivity to measure subclinical mastitis, the respondent placing increasing

importance on decreasing antibiotic residues in cull cows, and having financial incentives for employees linked to somatic cell count were associated with increased use of SYA for the treatment of clinical mastitis. Use of sand or mattresses for bedding were associated with decreased SYA. These findings highlight the need to improve the acceptance of practices that are consistent with prudent antimicrobial use for the treatment of clinical mastitis on dairy farms. Additionally, the willingness of dairy farmers to administer antimicrobial drugs for the treatment of clinical mastitis is associated with other mastitis-related practices and attitudes.

Key words: clinical mastitis, antimicrobial treatment, behavior, attitudes

INTRODUCTION

Mastitis is the most common reason for antimicrobial drug therapy for cows on US dairy farms (Pol and Ruegg, 2007). In 2007, an estimated 16.4% of the approximately 9 million cows in the United States were treated for this disease (USDA-APHIS, 2008), equating to nearly 1.5 million mastitis cases treated annually. In a Wisconsin study, about 80% of all antimicrobial drugs used were for treatment or prevention of mastitis, which included dry-cow therapy (Pol and Ruegg, 2007). In a Canadian study, intramammary administration of antimicrobials (IMA) was estimated to account for 35% of all antimicrobial use on dairy farms, which was lower than use of antimicrobials administered systemically (SYA, 38%; Saini et al., 2012). However, the proportion of SYA that was administered for the treatment of mastitis was not identified. Although antimicrobial therapy improves animal health and well-being, the economic losses associated with additional labor costs and discarded milk are significant (Erskine et al., 2003). Culled dairy cows account for 67% of residue violations among all marketed livestock in the United States, and 83% of the residues in culled dairy cows resulted from antimicrobial drug use (USDA-FSIS, 2011).

Received July 6, 2016.

Accepted October 9, 2016.

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To date, the risk of emerging antimicrobial resistance among bovine mastitis pathogens has been low, particularly for drugs with high therapeutic value in human medicine (Erskine et al., 2004; Lindeman et al., 2013; McDougall et al., 2014). Nonetheless, prudent use of antimicrobials is needed on dairy farms, similar to the stewardship of antimicrobial resources advocated in human medicine (Weber, 2006). Microbial culture of milk is a practical tool to identify causative agents and target therapeutic regimens for effective mastitis treatment. A study conducted on a large Michigan dairy (Hess et al., 2003) demonstrated that on-farm bacteriologic culture of milk samples, when used as part of the therapeutic selection criteria for cows with clinical mastitis, reduced the number of treated cows by 80%. A recent multi-state study also found a reduction in antimicrobial use when culture-based treatments replaced empirical therapy (Lago et al., 2011a).

Standardized mastitis therapeutic protocols should diminish spontaneous “cow-side” biases and establish uniformity for therapeutic regimens (Wagner and Erskine, 2013). However, actual on-farm therapeutic decisions often differ from veterinary recommendations (Vaarst et al., 2002), which may result from mastitis therapy being administered without veterinary supervision. In a survey of Washington State dairy producers, most agreed that using written protocols for disease treatment could reduce therapeutic errors but fewer than one-third had protocols (Raymond et al., 2006). Additionally, Oliveira and Ruegg (2014) found that there was considerable extra-label drug use for the treatment of clinical mastitis and that over half of IMA for the treatment of clinical mastitis was for cases that were caused by *Escherichia coli* or for cases that did not yield any bacteria on culture.

Risk factors that decrease therapeutic efficacy include (1) increasing cow age, (2) high SCC before treatment, (3) long duration of infection, (4) multiple infected quarters, and (5) infections caused by *Staphylococcus aureus* (Deluyker et al., 2005; Barkema et al., 2006; Pinzón-Sánchez and Ruegg, 2011). Particularly, chronic infections are likely to have poor therapeutic outcomes and may require an extended duration of antimicrobial therapy (Owens and Nickerson, 1990; Erskine et al., 2003; Oliver et al., 2004).

Thus, for veterinarians and advisors who promote prudent antimicrobial use associated with mastitis treatment, it is important to understand the behaviors and attitudes of farm personnel with respect to (1) utilizing bacteriologic data, (2) applying standardized therapy protocols, and (3) identifying cow-level risk factors through the use of records for better assessment of potential therapeutic efficacy.

Swinkels et al. (2015) reported that extended treatment (defined as any therapeutic regimen beyond labeled dosing) was practiced on 37/38 dairy farms and was perceived as part of the social norm of “being a good farmer” and that mastitis was not treated “thoroughly” if clinical symptoms were still visible at the time of cessation of treatment. Interestingly, dairy farmers seemed to administer extended therapy based on wanting to comply with other farmers’ and veterinarians’ perceived norms that extended treatment is better, resulting in treatment protocols being driven by social approval among peers (Swinkels et al., 2015). In a study of dairy farms in the UK, intention to reduce antimicrobial use was strongly driven by the respondents’ belief that their social and advisory network would approve of this behavior (Jones et al., 2015). Additionally, farms that were more likely to remain in milk production were significantly more likely to exhibit positive intentions to reduce antibiotic use.

To gain a better understanding of the attitudes and motivations that might affect decisions on the part of US dairy producers to use antimicrobial drugs for mastitis, this study collected information from a survey sent to dairy farms in Florida (FL), Michigan (MI), and Pennsylvania (PA). Additionally, we included variables that attempted to capture attitudes toward employee training and education. The objectives of this study were 2-fold: (1) to describe self-reported willingness for IMA and SYA for the therapy of clinical mastitis, and (2) to assess the relative and combined influences of management practices and farmer’s attitudes and beliefs on frequency of IMA and SYA for the therapy of clinical mastitis. More specifically, 3 research questions guided the analysis in this study: To what extent are dairy farmers’ management practices or behaviors associated with self-reported IMA and SYA? To what extent are dairy farmers’ attitudes or beliefs associated with self-reported IMA and SYA? What specific dairy farmers’ management practices/behaviors or attitudes/beliefs are the most important in explaining IMA and SYA?

MATERIALS AND METHODS

Dairy Farm Selection

Dairy farm selection protocols and survey questionnaire design were previously described in detail (Schewe et al., 2015). Briefly, a mail survey was sent to a stratified random sample of USDA grade A certified dairy farms (farms meeting requirements for interstate milk shipments set forth by the Pasteurized Milk Ordinance) in MI, PA, and FL. Addresses of 7,983 grade A cer-

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