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Comparison of treatment records and inventory of empty drug containers to quantify antimicrobial usage in dairy herds

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ABSTRACT

Assessment of antimicrobial use (AMU) is vital for interpreting the origin of changes in antimicrobial resistance (AMR). The objectives of the present study were to estimate the association between AMU determined using on-farm treatment records (TR) and inventory of empty drug containers (INV). Herds were selected to represent Canadian dairy farms. Producers were asked to record animal health events and treatments on a standard General Health Event form. For inventory data, 40-L receptacles were placed at various locations considered convenient to deposit all empty drug containers. Antimicrobial defined-daily dosages (ADD) were calculated for 51 Canadian herds using the 2 methods. Estimation of AMU was 31,840 ADD using the INV and 14,487 ADD using the TR, indicating that for every TR entry, 2.20 times more treatments were observed using the INV. Mastitis, reproductive conditions, and dry cow therapy were the most frequent reasons for antimicrobial therapy when assessing TR. For all antimicrobials evaluated, mean ADD was higher using the INV versus TR. Regardless, a strong positive correlation (0.80) was observed between the 2 methods, indicating that herds with increased number of ADD recorded using the INV also had increased number of ADD recorded using TR. Furthermore, a positive association was observed for the 6 most commonly used antimicrobials. In comparison to methods used in surveillance programs on AMU in livestock that assume a constant use in all herds (i.e., sales data), INV provided a herd-level specific quantity of AMU positively correlated with AMU recorded at the animal level in general. The INV was easy to implement and provided a measure of total AMU in the herd. Availability of such information would be valuable for interpreting changes in AMR at the herd level and enabling evaluation of interventions for decreasing AMR.

Key words: antimicrobial daily dose, antimicrobial use, antimicrobial resistance, inventory of empty drug containers, treatment record

INTRODUCTION

Antimicrobials are vital to maintain animal productivity, improve animal welfare by limiting disease impact, and improve food safety. However, they are also deemed to increase antimicrobial resistance (**AMR**). Assessing antimicrobial use (**AMU**) is essential for interpretation of AMR patterns (Landers et al., 2012). Quantification of AMU serves as a basis of decision making for control measures and enables evaluation of interventions in AMU. However, obtaining good-quality AMU data in production animals is challenging (Queenan et al., 2016). National data on sales or prescriptions of antimicrobials for production animals yield average results over all farms and animal species, even if a particular antimicrobial is not being used on a subsection of farms (Bondt et al., 2013). However, availability of on-farm recorded data would aid surveillance programs and epidemiological studies, thereby justifying the investment in obtaining such data (Queenan et al., 2016).

On-farm treatment records (**TR**) are important for determining AMU and treatment efficacy in infectious diseases (Gonzalez et al., 2010). Treatment records are often used to identify management deficits that lead to increased number of treatments in a short interval (Rhoda and Pantoja, 2012). In theory, TR should be the definitive method of recording AMU. Recording all antimicrobial treatments would enable dairy producers to keep track of AMU in dairy herds. However, maintaining accurate TR requires considerable effort and

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commitment from all people working with the cattle. Therefore, failure to establish this method on a dairy farm as a result of incomplete and unverifiable records is not rare (Rhoda and Pantoja, 2012).

Other methods for measuring AMU in dairy farms include questionnaires and surveys (Pol and Ruegg, 2007; Eagar et al., 2012; Bryan and Hea, 2017) and inventory (**INV**) of empty drug containers (Saini et al., 2012). Usually, data on AMU in national surveillance systems are based on sales or prescriptions (or both) of antimicrobials. That does not, however, necessarily mean that these drugs were actually used. The INV of empty drug containers using receptacles located at strategic places on a farm is a powerful tool to quantify total AMU (Carson et al., 2008). In theory, the INV has higher sensitivity to detect actual treatments.

In any successful AMR control program, a combination of organization, effort, and willingness is required. The objectives of this study were therefore to (1) compare AMU estimated using TR and INV, and (2) determine whether an association is present between AMU recorded using TR and INV.

MATERIALS AND METHODS

Herd Enrollment

Data for this study were obtained from the National Cohort of Dairy farms of the Canadian Bovine Mastitis Research Network (Reyher et al., 2011). Briefly, 89 dairy herds from several regions in Canada (Alberta, Ontario, Quebec, and the Maritimes provinces Prince Edward Island, New Brunswick, and Nova Scotia) were followed for 2 yr. Herds were specifically selected to represent Canadian milk-recorded herds. Therefore, herds were selected to be a regional representation of the proportion of housing systems (free-stall vs. tie-stall) in the region, and 3 bulk tank SCC (**BTSCC**) strata based on 12-mo geometric mean BTSCC, classified as low, intermediate, and high (<150,000, 150,000 to 300,000, and >300,000 cells/mL, respectively). Additionally, each herd had at least 80% lactating Holstein-Friesian cows milked twice a day and participated in a DHI recording system.

To be included in the present study, a herd had to record at least 1 antimicrobial treatment rendered at animal level, and place at least 1 empty drug container in the receptacles for the duration of the study. In addition, a herd could have no more than 10% of the records with missing data for each of the general health event form (**GHEF**) minimum required fields (cow ID, reason for treatment, treatment date, treatment product, and treatment duration; Figure 1). As a result, 51 herds were included in the study (Table 1).

Antimicrobial Use Data

All farm personnel were instructed by Canadian Bovine Mastitis Research Network technicians to record animal-level health events and treatments, particularly

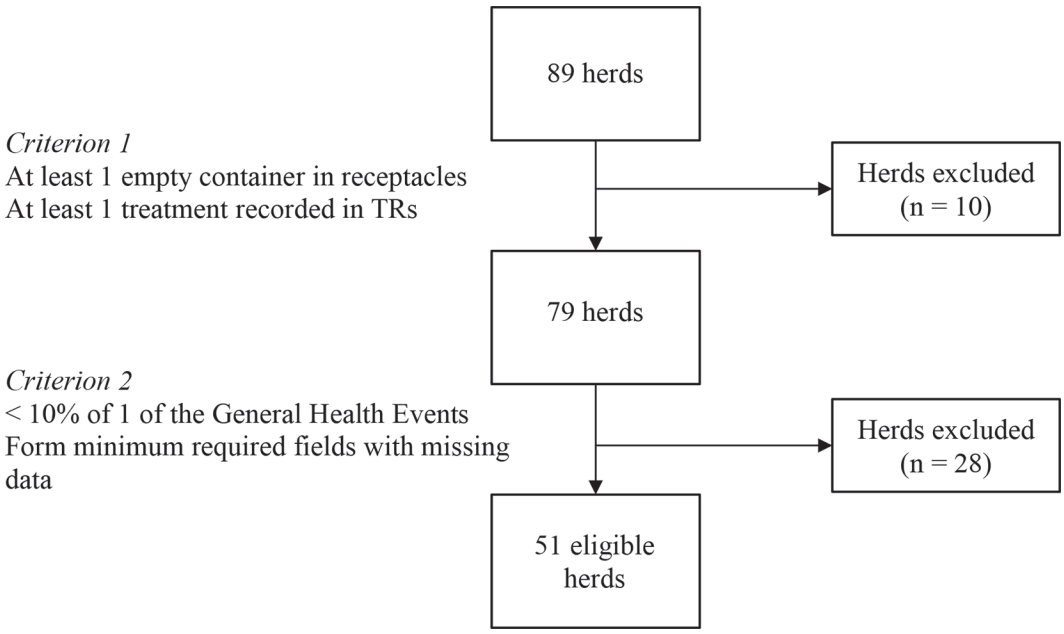

Figure 1. Flow diagram of herd selection process.