Industry Presentation - Consequences and Costs Associated with Mastitis and Metritis

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INTRODUCTION

During the first 30 d of lactation, cows are at high risk for both infectious and metabolic disease issues such as hypocalcemia, ketosis, retained placenta (**RP**), metritis, and abomasa displacement (**DA**). These and other diseases that occur during the early postparturient period are detrimental because they decrease milk production, increase treatment costs, negatively impact reproductive performance, and increase mortality and culling risk. The two most costly of these issues that also result in a high level of antimicrobial use on dairies are mastitis and metritis.

Mastitis is a disease condition characterized by inflammation of the mammary gland and is considered one of the most costly diseases affecting dairy cattle worldwide. Clinical mastitis, more specifically mastitis occurring in the first 30 days in milk (**DIM**), results in a number of negative outcomes including pain and inflammation, reduced milk production (5 - 8 % total lactation loss), decreased reproductive performance (4 - 8 d delay to first service, 23 % reduction in first AI conception rate (**CR**), 15 % reduction in percent pregnant by 320 DIM, and 21-25 more days open), approximately double the risk of premature culling, and a small increase in risk of death (Lucey and Rowlands, 1984; Milian-Suazo et al., 1988; Gröhn et al., 1998; Hortet and Seegers, 1998; Seegers et al., 2003; Santos et al., 2004; Wilson et al., 2004; Bar et al., 2008; Schukken et al., 2009; and Fuenzalida et al., 2015). Due to a combination of a high incidence and the antimicrobial components of commonly used treatment protocols, this disease likely accounts for more cows receiving antimicrobial exposure than any other disease condition. Based upon recent data collected by Santos et al., regional incidence for mastitis in early lactation varies by geographical region and season of calving with ranges from 5.5 to 26.1 % based on on-farm records (Santos et al., 2015).

Metritis is also a very common and complex disease condition in postparturient dairy cattle that is characterized by inflammation of the uterine tissues, and based upon previously mentioned farm-level studies, region average whole herd incidence varies from 18.5 to 27.6 % (Santos et al., 2015). In general, first lactation cows appear to be having a higher incidence, but mature cows tend to have a higher percent of cases that are severe in nature.

Severity can range from very mild to severe, life threatening forms. It is most often diagnosed during the first 14 DIM; but it can negatively affect milk production, reproduction, and culling risk well beyond early lactation. Numerous studies have demonstrated both direct and indirect negative impacts of uterine disease on overall dairy herd performance and profitability (Borsberry and Dobson, 1989; Lee et al., 1989; Rajala and Gröhn, 1998; Fourichon et al., 1999; LeBlanc et al., 2002; and Gilbert et al., 2005). California researchers found that cows with metritis averaged 4.9 lb/d less milk over the first

120 d of lactation compared to normal herdmates (Deluyker et al., 1991). Other work has shown that the level of milk loss varied by DIM:

- Cows with metritis that were culled during the first 30 DIM produced 15.1 lb less milk/d and had a median days-to-exit of 10;
- Cows with metritis that were culled during 31 - 60 DIM produced an average of 9.1 lb less milk/d and had a median days-to-exit of 42; and
- Cows with metritis that survived past 60 DIM experienced an average of 6.2 lb of milk lost/d over the first 110 DIM and then no difference from herdmates (Overton and Fetrow, 2008).

Metritis has been shown to have varying influence on culling with some studies showing no effect while others show that cows that experience metritis are approximately twice as likely to be culled (Gröhn et al., 1998; Rajala-Schultz and Gröhn, 1999; and Wittrock et al., 2011).

Metritis also has significant negative impacts on reproduction. It has been associated with 7 more days to first service, a 20 % lower first service CR, 13 - 19 more days open, and a significant reduction in pregnancy rate (Lee et al., 1989; Fourichon et al., 2000; and Overton and Fetrow, 2008).

The goal of this project was to evaluate commercial herd data from the High Plains region (TX, NM, AZ, CO, and OK) to evaluate the measureable impact of on-farm recorded mastitis and metritis on milk production, reproduction, and culling. Herds that were enrolled in Elanco's Dairy Data Access System that recorded milk production, had at least 2 % recorded mastitis incidence in the first 30 DIM, and at least 5 % recorded metritis incidence were eligible for inclusion. Records were extracted from the DairyComp305 program and included cows that calved anytime during 2014 and were followed for ~300 d or until culled. A total of 32,278 cows from 10 herds were part of the final data set. The analyses were restricted to breed codes for Holstein (68 % of all cows) or Jerseys and crosses (32 %) which were collapsed into a single category.

Descriptive statistics were performed to demonstrate that the herds were representative of commercial herds and included frequency histograms for parity (L = 1, 35 %; L = 2, 30 %; and L > 2, 35 %), calving dates, season of calving, age at first calving (mean of 22.6 mo), and previous days dry (mean of 61.8 d). Herd averages for 120d cumulative milk (9,873 lb) and 305me milk (26,211 lb) were also calculated. Metritis incidence ranged from 7.6 - 16.9 % with a mean of 10 %. Mastitis within the first 30 DIM ranged from 2 – 12.4 % with a mean of 7 %.

First, multivariate nominal logistic fit models were created to evaluate risk factors for metritis and mastitis. In each case, separate models were created for primiparous vs. multiparous cows. The primiparous model for metritis (log odds of yes/no) offered the following potential explanatory variables for consideration: herd, breed code (Ho or Je/X), season fresh, calf outcome (M, F, or Twin), age at fresh category (< 21 mo, 14 %; 21-24 mo, 72 %; and > 24 mo, 14 %), RP (yes/no), and calving ease score (1 - 5). Due to inconsistencies in recording across herds, RP and calving ease were dropped. Breed code was not significantly associated with risk of metritis. Having a male calf or twin resulted in higher odds of metritis with twin calvers much higher than those delivering males. Heifers calving later in age had reduced odds of metritis. Heifers calving in the spring had higher odds of metritis than those calving in fall or winter.

A similar model was created for multiparous cows except previous days open was used instead of age at calving and lactation group (lact = 2 or > 2) was added. Breed code was not a significant predictor, but herd was. Mature cows were at higher odds of metritis than second lactation cows. Having longer previous days open was associated with higher odds of metritis. Again, delivering male or twin calves resulted in higher odds of metritis with twins associated with much higher odds than either male or female calves. Summer calvers had a higher odds for metritis relative to spring or winter calving cows.

Likewise, the primiparous model for mastitis (log odds of yes/no) offered the following potential explanatory variables for consideration: herd, breed code, season fresh, calf outcome, and age at fresh category. Again, herd was significant, but breed code was not. Heifers calving in the summer, fall, and winter were at higher odds for mastitis relative to spring. Heifers calving at an older age were associated with higher odds of mastitis relative to those calving younger or at average age.

For the multiparous mastitis model, herd, breed code, lactation group, and previous days open were all significantly associated with risk of early lactation mastitis, but season fresh and previous lactation 305me was not. Longer days open, Holstein, and older cows were all associated with higher odds of mastitis. Dry log somatic cell count (**SCC**) was significantly associated with odds of early mastitis, but less than half the herd had this variable recorded. Thus, it was dropped from further analyses.

To evaluate the relationship of mastitis and metritis on milk production, a multivariate model to fit least squares means was created using two separate outcomes for production, Milk120 and 305me, for each of the two parity groups, primiparous and multiparous. Milk120 is the estimated cumulative milk through 120 DIM as estimated by DairyComp305. Covariates offered to the primiparous model included herd, breed code, season fresh, age fresh category, calf outcome, mastitis (yes/no), and metritis (yes/no). Breed code was not significant but the remaining covariates were. Adjusting for the impact of these variables, having mastitis in the first 30 DIM was associated with 268 lb less Milk120 and a reduction in 305me of 1,263 lb. Metritis was associated with 184 lb less Milk120 and a reduction in 305me of 575 lb.

For the multiparous cows, a similar set of models was created except that previous lactation 305me and lactation group was added and age fresh category was removed. Only breed code was not significant. Adjusting for the effect of the remaining significant variables, a case of mastitis was estimated to result in a loss of 409 lb of Milk120 and 1,158 lb less 305me while metritis resulted in 337 lb less Milk120 and 633 lb less 305me milk.

To examine the impact of mastitis and metritis on culling and reproduction, separate Cox Proportional Hazards models were created to examine time to event through 300 DIM. Again, separate models were created for the 2 parity groups. For both parity-based models, herd, breed code, season fresh, 305me milk, metritis (yes/no), and mastitis (yes/no) were included. In addition, age at calving category and lactation group were added to the primiparous and multiparous models, respectively.

In the primiparous culling model, only herd, 305me, and mastitis were significantly associated with risk of culling. As expected, a higher 305me was protective against culling while having mastitis resulted in 1.3X higher risk of removal by 300 DIM.

In the multiparous model, all variables were significant and remained in the model. As in the primiparous model, a higher 305me was associated with reduced risk of culling. Adjusting for these multiple covariates, mastitis and metritis in the first 30 DIM were associated with 1.26X and 1.25X higher risk of culling by 300 DIM, respectively.

In the primiparous reproductive model, breed category, 305me, and mastitis were not significant predictors of reproductive outcome. Mastitis was associated with a 37 % reduction in likelihood of pregnancy by 300 DIM. In the multiparous model, only 305me was not significantly associated with risk of pregnancy. Mastitis and metritis resulted in an 11 % and 35 % reduction in likelihood of pregnancy by 300 DIM, respectively.

The negative effect of mastitis and metritis on milk production, culling, and reproduction was expected; but the magnitude of the impact was less than expected. Relative to a larger analysis that included more than double the cows and herds as this one that was conducted by the author, the milk production loss associated with mastitis was almost 50 % less and the metritis effect was also significantly less. The culling risk and reproductive risk were very similar; but in both this analysis and the larger national analysis, the negative impacts of mastitis and metritis were less than expected as compared to published research. There are a number of potential reasons for the differences including:

- Differences in pathogens causing disease,
- Differing levels of severity,
- Different approaches to therapy,
- Different approaches to culling decisions during this historical time of high beef prices and relatively economical replacement heifers, and finally,
- Failure by farms to completely or accurately characterize the level and/or type of disease.

Epidemiologically speaking, failing to properly record disease leads to a recording/reporting bias which leads to an underestimation of the influence of the recorded disease on the herd's health and production. By failing to identify all affected animals, the statistical comparisons are now being made between a subset of affected animals and the remaining population that contains both non-affected and affected cows. This misclassification results in an underestimation of the actual clinical impact and falsely suggests that the diseases are having less of a negative impact than is actually occurring.

CONCLUSIONS

Mastitis and metritis were demonstrated to negatively affect milk production, culling, and reproductive performance in commercial dairy cows in the High Plains region. The apparent impact is less than expected and may be due to a variety of issues including inconsistent disease definition or detection/recording intensity across herds. Improved disease recording and the inclusion of other variables not examined in this data set including RP, DA, calving ease scores, and dry log SCC are likely to change the measured impact of these 2 diseases.

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