

**Title:** Cumulative effects of early lactation diseases on fertility and survival in a multi-State population of Holstein cows

Pablo Pinedo\*<sup>1,7</sup>, Jose Santos<sup>2</sup>, Gustavo Schuenemann<sup>3</sup>, Rodrigo Bicalho<sup>4</sup>, Ricardo Chebel<sup>2</sup>, Klibs Galvao<sup>2</sup>, Robert Gilbert<sup>4</sup>, Sandra Rodriguez-Zas<sup>5</sup>, Guilherme Rosa<sup>6</sup>, Christopher Seabury<sup>7</sup>, William Thatcher<sup>2</sup>; Colorado State University, Fort Collins CO, USA<sup>1</sup>, University of Florida, Gainesville, FL, USA<sup>2</sup>, The Ohio State University, Columbus, OH, USA<sup>3</sup>, Cornell University, Ithaca, NY, USA<sup>4</sup>, University of Illinois, Urbana-Champaign, IL, USA<sup>5</sup>, University of Wisconsin, Madison, WI, USA<sup>6</sup>, Texas A&M University, College Station, TX, USA<sup>7</sup>

### **Introduction:**

Endocrine changes at calving and drastic metabolic adjustments to support milk synthesis result in negative energy balance and immune suppression. Consequently, a substantial proportion of cows are affected by disease around the time of calving, and most health disorders occur in the first 30 DIM. Diseases have been associated with reduced reproductive performance and increased risk of death and culling. However, large multi-State prospective studies analyzing the effect of health events by use of standardized disease definitions and times of assessment are scarce. Therefore, our objective was to test the cumulative effect of combinations of health events on fertility and survival of a large population of Holstein cows in multiple States.

### **Materials and methods:**

A total of 11,733 cows calving in 16 farms located in 4 regions (Northeast [4 herds], Midwest [6 herds], Southeast [1 herd], and the Southwest [5 herds]) were enrolled at parturition and monitored weekly for disease occurrence, reproductive events, and survival. Resumption of ovarian cyclicity (ROC) was assessed via transrectal ultrasonography at 40±3 and 54±3 d postpartum. Pregnancy diagnosis was performed by ultrasonography on d 32±3 after AI and reconfirmed at d 60±3 of gestation. Diseases included retained fetal membranes, metritis (7±3 DIM; foul-smell, watery, brownish vaginal discharge), subclinical ketosis (7±3 DIM; serum BHBA > 1.0 mmol/L), mastitis (farm records), left displaced abomasum, pneumonia, and clinical endometritis (28±3 DIM; from mucopurulent to fetid vaginal discharge). Health related events were grouped into reproductive (REP; dystocia, twins, retained fetal membranes, metritis, and clinical endometritis) and other (OTH; subclinical ketosis, mastitis, displaced abomasum, and pneumonia) and counts for each health event within 50 d postpartum were added into each of the 2 groups. Multivariate logistic regression was used for testing potential associations between multiple categories of disease occurrence (1, 2, 3 and ≥ 4 for REP and 1, 2 and ≥ 3 for OTH) and outcome variables, including ROC, pregnancy at first AI, pregnancy loss at first AI, and survival after 50 DIM. Parity and season were included as fixed effects, and farm and region as random effects in the models.

### **Results:**

Resumption of OC was affected by REP; the odds (95% CI) of ROC multiplied by 0.74 (0.70-0.82), 0.67(0.59-0.76), 0.55 (0.45-0.66), and 0.47 (0.35-0.64) for REP categories 1, 2, 3 and ≥ 4, as compared with no disease presentation. The odds of ROC for cows in OTH categories 1, 2, and ≥ 3 were 0.81 (0.73-0.89), 0.64(0.53-0.78), 0.43 (0.22-0.96), respectively, as compared to the odds of cows without OTH events. Pregnancy at first AI was also reduced by REP; the odds of pregnancy multiplied by 0.75 (0.68-0.82), 0.70 (0.62-0.80), 0.67 (0.55-0.82), and 0.46 (0.32-0.65) for REP categories 1, 2, 3 and ≥ 4, as compared with no disease presentation. The odds of pregnancy for cows in OTH categories 1, 2, and ≥ 3 were 0.92 (0.84-1.03), 0.81 (0.66-0.99), and 0.52 (0.19-1.38) compared to the odds of cows without OTH events. Pregnancy loss at first AI was increased partially by REP; the odds of pregnancy loss multiplied by 1.42 (1.09-1.83), 1.77 (1.29-2.44), 1.65 (0.98-2.77), and 2.50 (0.92-5.52) for REP categories 1, 2, 3 and ≥ 4. Contrarily, pregnancy loss was not affected by OTH events. Survival was reduced by REP; the odds of leaving the herd (death and culling) after 50 DIM multiplied by 1.05 (0.93-1.18), 1.23 (1.05-1.43), 1.38 (1.10-1.72), and 1.51 (1.03-1.26) for REP categories 1, 2, 3 and ≥ 4, relative to no disease presentation. The odds of leaving the herd for cows

in OTH categories 1, 2, and  $\geq 3$  were 1.18 (1.05-1.32), 1.48 (1.19-1.84), 1.69 (0.76-3.75) times the odds of cows without OTH events.

**Conclusion:**

Fertility and survival were significantly affected by the occurrence of REP and OTH during early lactation, and the magnitude of the effect consistently increased with the number of health events.

