

Impact of Highly Pathogenic Avian Influenza H5N1 on Dairy Heifer Reproduction

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INTRODUCTION

- 74% of replacement heifers born survive growth, breeding, and calving to become productive members of the milking herd (Overton and Dhuyvetter, 2020)
 - A heifer must lactate for 530 days, ~1.5 lactations to repay her rearing costs (Bulton, et al, 2017)
- Highly Pathogenic Avian Influenza (HPAI), H5N1, is a contagious viral influenza infection documented in cattle, domestic poultry, wild birds, domestic cats, and other domestic and wild mammals (Fig. 1) (Peterson, 2024; Caserta, et al, 2024)

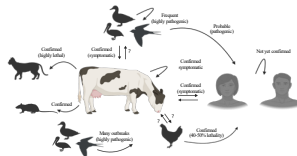


Figure 1: Transmission dynamics of HPAI H5N1, image derived from (Owusu and Sanad, 2025) created using Biorender.com

- In March 2024, H5N1 was detected in a Texas Dairy herd, first known transmission to cattle in the U.S (Garg, et al, 2024)
 - As of Jan. 2026, 1,084 confirmed dairy cases across 19 states, CA with 773 cases (USDA, 2026)
- Symptoms in lactating cows: decreased feed intake, decline in milk production, abnormal milk (thick, yellow consistency), altered fecal consistency, and respiratory distress (Baker et al, 2024; Burrough, et al, 2024; Caserta, et al, 2024)
- 12-month-old heifers oronasally inoculated with H5N1 exhibited moderate nasal replication and shedding without clinical signs or transmission to non-infected heifers (Halwe, et al, 2025)
- The respiratory route in heifers is seen as a mode of infection and transmission of H5N1 (Baker, et al, 2024)
- HPAI-infected human lung cells have shown delayed activation of interferon-stimulated genes (ISGs), including Mx1 and ISG-15 (Zeng, et al, 2007; Belsler, et al, 2011)
 - ISGs are crucial for establishing pregnancy and preventing early embryonic loss
 - Interferon tau (IFN τ) is the pregnancy recognition signal in ruminants and is essential for pregnancy establishment (Bazer, 2013)
- Limited information is available if HPAI affects heifer reproductive performance following an outbreak.

Hypothesis: Heifers exposed to HPAI will experience increased reproductive challenges (reduced 21-d pregnancy rates, 21-d conception risks, and AI submission risks) during and after infection, which could persist into their first lactation.

OBJECTIVE

To assess the effect of herd-level HPAI infection on reproductive performance of dairy heifers across two U.S. regions by comparing outcomes during the 12 months before and 12 months after a HPAI outbreak.

MATERIALS & METHODS

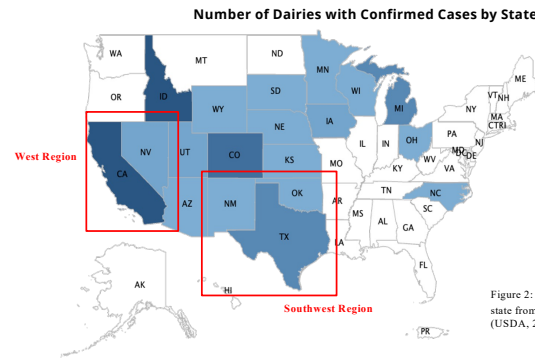


Figure 2: Number of confirmed dairy herds by state from 2024 to 2026 in the United States (USDA, 2026)

- Identified 5 confirmed positive HPAI dairy herds from two regions in the U.S. (Fig.2)
 - Herds with documented and reported HPAI infections were selected to represent a cross-section of different management practices, environmental conditions, and herd sizes.
 - Southwest (n=3; 474,169 records) and West (n=2; 153,633 records)
- Reproductive metrics of 21-d pregnancy rate (PR), 21-d conception risk (CR), and 21-d AI Submission risk (SR) were retrieved from herd management software (Bovisync® and DairyComp 305)
 - 12 months before HPAI infection to assess pre-infection status and 12 months after the outbreak to assess post-infection status (Fig. 3)

Longitudinal Retrospective Cohort, Interrupted Time Series Study

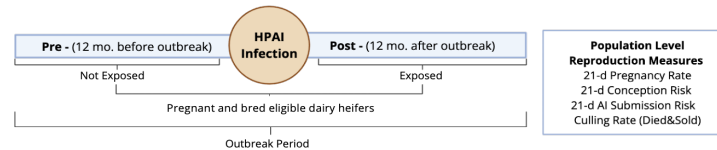


Figure 3: Study Design, created using Biorender.com

- All statistical analyses were performed with PROC GLIMMIX in SAS 9.4
 - Statistical significance was declared at $P < 0.05$ and tendency at $P \leq 0.1$
- Fixed Effects: Month (1–12 mo. pre- and post-outbreak), the outbreak period (12 mo. before and 12 mo. after), and the interaction between month and outbreak period and culling rate (died & sold)
- Random Effects: Intercept and residuals with dairy and year specified as the subject
- Multiple comparisons were adjusted with Tukey-Kramer

RESULTS

- Statistical analysis observed no significant relationship between HPAI infection and PR ($P=0.56$), CR ($P=0.13$), or SR ($P=0.33$) (Fig. 4–6)
- The interaction between month and outbreak period were not significant for PR ($P=0.99$), CR ($P=0.99$), or SR ($P=0.45$)
- There was no influence of cull rate on PR ($P=0.19$), CR ($P=0.72$), and SR ($P=0.39$)

RESULTS

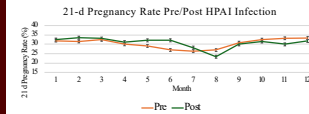


Figure 4: Comparing average 21d Pregnancy Rate in heifers across Southwest and West regions 12 mo. pre-HPAI and 12 mo. post-HPAI infection, no significance observed ($P>0.1$)

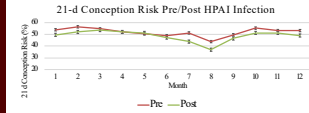


Figure 5: Comparing average 21-d Conception Risk in heifers across Southwest and West regions 12 mo. pre-HPAI and 12 mo. post-HPAI infection, no significance observed ($P>0.1$)

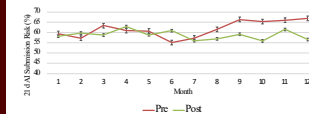


Figure 6: Comparing average 21-d AI Submission Risk in heifers across Southwest and West regions 12 mo. pre-HPAI and 12 mo. post-HPAI infection, no significance observed ($P>0.1$)

DISCUSSION

- Heifers exposed to HPAI had no effects on 21-d PR, 21-d CR, and 21-SR pre and post infection.
- No effects on PR, CR, or SC may be due to increased culling, implementation of breeding protocols, or the addition of precision technology post HPAI infection
 - Cows bred exclusively with a synchronization protocol and timed AI had an 8% higher PR per service than the cows bred based on estrus detection and timed AI (Fricke, et al, 2014)
 - Precision technologies improve heat detection efficiency, detecting estrus in ~80–90% of cows, compared with ~50–56% with visual observation (Marquez, et al, 2022)

CONCLUSION & FUTURE RESEARCH

- HPAI infection was not significantly associated with altered reproductive performance in dairy heifers in the Southwest and West regions of the U.S.
- Further investigation is needed for understanding broader reproductive implications
 - Regional outbreak variability, breeding frequency and protocols, and potential associations with concurrent disease risk in relation to reproductive performance
 - Assessing the number of services per conception, possible associations with culling risk, the influence of heat stress exposure, and seasonal effects on reproduction

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