# Herd Alarm Levels for Health, Reproductive, and Production Effects Based on Non-esterified Fatty Acid and Beta-Hydroxybutyrate Concentrations in Dairy Herds

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## Introduction

Cows normally visit a state of negative energy balance (NEB) during the transition period in response to decreased dry matter intake and increased energy demands early in lactation. Energy balance is commonly measured with non-esterified fatty acid (NEFA) and beta-hydroxybutyrate (BHB) concentrations, and several studies have shown that excessive NEB is associated with detrimental health, reproduction, and production effects at the cow-level. The objectives of this study were to determine the herd alarm level for the proportion of sampled cows with elevated metabolites resulting in herd-level effects, and to describe the herd-level prevalence of elevated metabolite concentrations.

## Materials and Methods

A prospective cohort study was conducted with the following herd inclusion criteria: > 250 milking cows, free-stall housing, feeding total mixed rations (TMR), and using DHIA and/or DairyCOMP 305. A convenience sample of herds was visited by study personnel for cross-sectional sampling. Blood was collected from approximately 20 healthy pre-partum (14 to 2 days before calving) and 20 different healthy post-partum (3 to 14 days-in-milk [DIM]) cows. All serum was delivered to Cornell College of Veterinary Medicine for measurement of NEFA and BHB using a Hitachi 917 auto-analyzer. The outcomes of interest were herd-level pregnancy rate (PR), incidence of displaced abomasum (DA) and clinical ketosis, and average 120 DIM mature-equivalent (ME) 305-d milk production for animals sampled. Pregnancy rate was averaged over two 21-d periods post individual-herd voluntary waiting period. Statistical analyses were performed using SAS version 9.1. Mixed models were evaluated using PROC mixed with herd as a random effect. The range of critical NEFA and BHB levels was based on previous results of concentrations predictive of cow-level health, reproduction, and production effects. The effect of the percent of sampled animals with elevated metabolites on the herd level outcomes of interest was evaluated.

## Results

Sixty-three herds, averaging 940 cows each, were used in the analysis. Results from 1,702 animals (876 pre-partum and 826 post-partum) were evaluated.

Pre-partum sampled cohort: If more than 15% of the animals had NEFA concentrations ≥ 0.27 mEq/L, PR decreased by 1.2% ($P = 0.005$), ME 305-d milk from sampled animals decreased by 529 lb (240 kg) ($P = 0.01$), and the percent of diseases increased by 1.4% ($P = 0.01$).

Post-partum sampled cohort: If more than 15% of the animals had NEFA concentrations ≥ 0.70 mEq/L, percent of disease increased by 1.3% ($P = 0.001$); in heifers, ME 305-d milk increased by 661 lb (300 kg) ($P = 0.03$); and in cows, ME 305-d milk decreased by 1,287 lb (584 kg) ($P < 0.001$). If more than 20% of the animals had NEFA concentrations ≥ 0.70 mEq/L, PR decreased by 1.2% ($P = 0.001$).

If more than 10% of the animals had BHB concentrations ≥ 10 mg/dL, PR decreased by 1% ($P = 0.009$), percent of disease increased by 1% ($P = 0.01$), and in cows, ME 305-d decreased by 1,351 lb (613 kg) ($P < 0.001$). In heifers, BHB was not a significant predictor of ME 305-d milk.

Prevalence: Eighty-four percent of herds had > 15% of sampled animals with pre-partum NEFA levels ≥ 0.27 mEq/L and 66% of herds had >15% of sampled animals with post-partum NEFA levels ≥ 0.70 mEq/L. Lastly, 80% of herds had > 10% of animals sampled with BHB levels ≥ 10mg/dL.

## Significance

The NEFA herd alarm level was 15 to 20% and the BHB herd alarm level was 10%. These data demonstrated that the percent of sampled animals with NEFA and BHB concentrations above critical levels can have detrimental effects on herd-level disease status, reproduction, and production. Additionally, the prevalence information indicated that at least 66% of the herds sampled can improve the energy status of their transition animals.