# TRANSITION COW MANAGEMENT AND OUTCOMES IN NORTHEAST HERDS

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## INTRODUCTION

Many management factors contribute to cow success during the transition period through means of minimizing stressors, ration formulation and implementation, monitoring and treatment of health disorders, and cow comfort. Limited data exist that investigate the success of different management strategies that contribute to cow success in a commercial dairy setting and therefore, recommendations are often driven by field experience from concepts established through controlled research with comparatively small numbers of cows. Describing non-nutritional factors, such as pen movement, and nutritional factors, such as consumption of different nutrients, with outcome factors such as health and culling events, energy metabolism and inflammation blood biomarkers, milk production, and reproductive performance on well-managed farms, may provide an understanding of which factors contribute to transition cow success.

The objective of this study was to describe herd characteristics, management and nutritional factors pertaining to the transition cow period that may have an effect on milk production, reproductive status, and health in large, high producing Northeastern herds.

## EXPERIMENTAL DESIGN

A prospective cohort study was conducted from a convenience sample of 72 farms located in New York and Vermont between November 2012 and August 2015. Inclusion criteria for herds were: 1) Holstein , 2) ≥ 400 milking cows, 3) free-stall housing, 4) TMR-fed , and 5) enrolled in monthly DHI testing or have on-farm milk recording with record management by Dairy Comp 305 ( DairyComp 305, Valley Ag Software, Tulare, CA) or PC Dart (PC Dart, Dairy Record Management System, Raleigh, NC). A transition cow management survey was filled out by farm personnel which consisted of questions regarding to pen movements, fresh cow checks, pen information, and reproduction management. Farms were enrolled based on the willingness of the farm to participate and characterized into 1 of 6 transition cow nutritional strategies. Characterization was based primarily upon the formulated starch levels, provided by the farm's nutritionist before data collection commenced. We intended to enroll 12 farms in each category. The characteristics of the nutrition strategies were: 1) Low energy dry cow (<16% starch), high energy lactating (>25% starch), 2) Step-up dry cow (far-off <16% starch, close-up >16% starch), high energy lactating, 3) High energy dry cow (>16% starch), high energy lactating, 4) Low energy dry cow, step-up fresh (fresh <25% starch, high >25% starch), 5) Step-up dry cow, step-up fresh, 6) High energy dry cow, step-up fresh. Farms were re-categorized after data collection according to the starch level in rations as predicted by the Cornell Net Carbohydrate and Protein System v. 6.1 (CNCPS version 6.1, Cornell University, Ithaca, NY) using NIR analysis of forage samples collected during herd visits and feed library values for grains and additives.

Each farm was visited 4 times over the course of 10.5 wk for data collection focused on the same cohort of animals during the far-off dry, close-up dry, fresh, and high lactation periods. Animals were scored for body condition (Edmonson et al., 1989) and locomotion (Flower and Weary, 2006) by the same experience technician, and were observed for health disorders through 30 DIM by farm personnel. Blood samples obtained from up to 24 animals per herd, 1/3 primiparous and 2/3 multiparous, were taken from the coccygeal vein or artery from a sub-sample cohort of cows during the close-up dry period visit and from the same cows during the fresh cow period visit. Prepartum samples were analyzed for non-esterified fatty acids (**NEFA**; HR Series NEFA HR(2), Wako Pure Chemical Industries, Osaka, Japan) and postpartum samples were analyzed for NEFA and β-hydroxybutyrate (**BHBA**; Abbott Laboratories, Abbott Park, IL).

## STATISTICAL ANALYSIS

All descriptive analyses were calculated using SAS (SAS 9.4, SAS Institute Inc., Cary, NC). PROC UNIVARIATE was used to obtain means and standard deviations for continuous data. PROC FREQ was used to generate frequencies for categorical data. PROC MEANS and PROC FREQ was used to calculate the prevalence of elevated blood metabolites.

## RESULTS AND DISCUSSION

### Herd Performance

Herd size averaged 935 milking cows (range: 345 to 2900) with an annual rolling herd average of 12,674 kg (Table 1). Within the 40% of herds using recombinant bovine somatotropin (**rbST**) an average of 78% of eligible cows received rbST (Table 2). The number of herds using rbST has decreased compared to previous studies (Bewley et al., 2001; Caraviello et al., 2006; Fulwider et al., 2008; Brotzman et al., 2015). Cows entering into 2$^{nd}$ lactation had similar average days dry compared to cows entering 3$^{rd}$ or greater lactations (Table 3). This is less than what other survey studies reported which ranged 59 to 61 d (Bewley et al., 2001; Kellogg et al., 2001; Brotzman et al., 2015). Herd reported voluntary waiting period was similar between primiparous and multiparous animals (Table 3) which was greater than 52 and 53 d, respectively, as reported by Caraviello et al. (2006). Annual farm recorded transition cow health events are reported in Table 1. It is important to note that clinical ketosis and metritis values are likely underreported as not all herds recorded these disorders consistently.

Table 1. Annual herd reported calving related health events and herd level production

| Production Characteristics | n herds | Mean ± SD |
|---|---|---|
| Herd size, n milking cows | 72 | 935 ± 486 |
| Dairy Herd Improvement herd milk average, kg | 50 | 12,283 ± 1,051 |
| Annual rolling herd average, kg | 69 | 12,674 ± 1,220 |
| Herd average milk yield/cow, kg/d | 69 | 37.8 ± 3.8 |
| | | |
| Health Events | | |
| Stillborn heifer rate, % | 72 | 5.9 ± 1.8 |
| Twinning, % | 72 | 4.1 ± 1.4 |
| Retained Placenta, % | 71 | 6.5 ± 3.8 |
| Metritis ≤ 30 DIM, % | 71 | 6.4 ± 8.5 |
| Displaced Abomasum ≤ 60 DIM, % | 71 | 2.0 ± 1.6 |
| Ketosis ≤ 30 DIM, % | 71 | 6.6 ± 8.9 |

Management Strategies

A key management strategy to optimize postpartum cow performance is to minimize stress during the transition period. Decreasing antagonistic interactions between cows by reducing pen moves and separating primiparous and multiparous animals is a putative strategy to address minimizing stress for a more successful transition period. Over 25% of herds were found to move animals into the close-up dry cow pen more than 1× per wk. Almost 28% of herds moved animals into a maternity pen 0 to 3 d before expected calving. Field investigations by Cook and Nordlund (2004) suggests that cows spending ≥ 3 d in the maternity pen have elevated NEFA concentrations. Even though it is reported that only 18% of herds have separate calving locations for primiparous and multiparous animals, many farms utilize individual calving pens so animals are segregated at the time of calving (Table 2). Herds moved cows out of the maternity or calving pen an average of 4 h after calving. Primiparous animals remained in the first pen they moved to after calving for an average of 23 d compared to about 15 d for multiparous animals (Table 3).

Densities for stocking, water space, and feed bunk space are reported in Table 4. Noteworthy, the stocking density in the close-up dry period was the lowest; however, it had the greatest variability. The variability may be related to the fluctuations in cow numbers that may be seen in the close up pen from cows leaving due to calving or cows entering due to routine pen moves. Cows in the close-up and fresh periods had the most access to water and most access to the feed bunk.

The majority of herds had 2 dry cow groups, i.e. a far off pen and close-up pen, and similar results were found during early lactation. About 93% of herds had 2 early lactation groups, i.e. a fresh cow pen and a high lactation pen. Despite these grouping strategies during the dry and early lactation periods, only 65.3% of herds implemented a 2-ration feeding strategy, i.e. a far-off and close-up ration, during the dry period and 80.6% of herds implemented a 2-ration feeding strategy postpartum, i.e. a fresh and high lactating ration (Table 2). Since the objective of this study was to enroll herds based on different feeding strategies, these results do not represent a random sample, but describe a specific demographic.

Table 2. Frequencies of rBST administration, pen movement, facility type, and grouping and feeding systems in 72 herds.

| Item | Level | Frequency |
|---|---|---|
| Use of recombinant bovine somatotropin (rbST) | | 40.3% |
| Herd moves animals to maternity pen 0 to 3 d before calving | | 27.8% |
| Herd moves animals to calving pen when showing signs of calving | | 72.2% |
| Separate calving location for primiparous and multiparous cows | | 18.0% |
| Dry cow grouping system | 1-group | 9.7% |
| | 2-group | 90.3% |
| Early lactation grouping system | 1-group | 6.9% |
| | 2-group | 93.1% |
| Dry cow feeding strategy | 1-ration | 34.7% |
| | 2-ration | 65.3% |
| Early lactation feeding strategy | 1-ration | 19.4% |
| | 2-ration | 80.6% |
| Percentage of herds separating primiparous and multiparous animals | Far-off period | 71.3% |
| | Close-up period | 31.5% |
| | Fresh period | 25.7% |
| | High period | 86.8% |
| Facility type for far-off animals | Freestall | 92.0% |
| | Bedded pack | 8.0% |
| Facility type for close-up animals | Freestall | 82.4% |
| | Bedded pack | 17.6% |
| Times per week animals moved into pens housing close-up animals | < 1 × | 2.1% |
| | 1 × | 71.6% |
| | > 1 × | 25.3% |

Table 3. Annual herd reported reproductive performance, culling, and pen movements for primiparous and multiparous cows.

| | | Primiparous | Multiparous |
|---|---|---|---|
| Item | N herds | Mean ± SD | Mean ± SD |
| Average days dry, d | 72 | 56.0 ± 6.7 | 57.0 ± 6.3 |
| Voluntary waiting period, d | 72 | 58.0 ± 9.3 | 58.7 ± 9.8 |
| Herd mean cull and death rate ≤ 60 DIM, % | 71 | 5.9 ± 4.5 | 8.4 ± 4.3 |
| Overall herd mean cull and death rate, % | 71 | 20.6 ± 7.8 | 35.7 ± 7.2 |
| Time spent in calving or maternity pen after calving, h | 72 | 3.9 ± 5.4[1] | 4.0 ± 5.6 |
| Time spent in first moved to pen after calving, d | 72 | 23.1 ± 49.4[1] | 14.9 ± 18.5 |

[1] n = 71 herds due to heifers not being raised on 1 farm

Table 4. Densities for stocking, water space, and feed bunk space, based on the number of cows present during each respective visit in 72 herds (mean ± SD).

| Item | Period | | | |
|---|---|---|---|---|
| | Far-off (n pens) | Close-up (n pens) | Fresh (n pens) | High (n pens) |
| Stocking density (cows / stall), % | 94.4 ± 21.2 (102) | 92.9 ± 34.5 (75) | 102.5 ± 21.5 (90) | 118.8 ± 16.4 (187) |
| Linear Water Space, cm/cow | 6.6 ± 4.4 (110) | 9.2 ± 6.4 (90) | 10.0 ± 4.6 (93) | 7.1 ± 2.2 (187) |
| Overall bunk density (cows/headlock spaces[1]), % | 122.5 ± 41.1 (110) | 98.8 ± 44.1 (90) | 121.8 ± 37.7 (93) | 156.5 ± 34.7 (187) |

[1] Headlock spaces = (length of neck rail (cm) / 60.96 cm) or 1 headlock (1 headlock = 60.96 cm of neck rail space)

## Feeding Management

It was more common to find feed bunks with walls, to eliminate the need to pushup feed, during the dry cow period than the lactating period (15.5% of dry cow pens vs. 5.4% of lactating pens). The dry cows were fed fewer times per day than the lactating cows (Table 5).

Table 5. Percentage of pens per period at varying feeding frequencies for 72 herds.

| Feeding Frequency / d | Period | | | |
|---|---|---|---|---|
| | Far-off n = 112 | Close-up n = 91 | Fresh n = 94 | High n = 190 |
| ≤ 1 | 92.9% | 93.4% | 68.1% | 53.7% |
| 1 ≤ 2 | 7.1% | 6.6% | 28.7% | 38.4% |
| 3 | – | – | – | 1.6% |
| 4 | – | – | 3.2% | 3.2% |
| 5 | – | – | – | 1.6% |
| 6 | – | – | – | 1.6% |

The frequency of herds using different feed additives and specific nutrients in rations fed to cows during the close-up, fresh, and high lactating periods are presented in Figure 1. Despite only 65.3% of herds implementing a 2-ration feeding strategy, almost 78% of herds incorporated commercial anionic supplements in the rations fed to the close-up dry cows. Over 80% of herds used rumen-protected amino acids, not including analogs of amino acids, in the rations fed to the fresh and high cows. Over 90% of herds added rumen-protected fat to rations fed to the fresh and high cows.

The chemical composition of rations as formulated and fed in the far-off, close-up, fresh, and high lactating periods, was evaluated using the Cornell Net Carbohydrate and Protein System v. 6.1 (CNCPS version 6.1, Cornell University, Ithaca, NY) and is reported in Table 6. As expected, ME, MP, CP, and starch all increased from the far-off period to the high lactating period. Fermentable starch increased from the far-off period to the high lactating period and the opposite occurred with fermentable NDF, resulting in the total fermentable carbohydrates, on a DM basis, to remain similarly for prepartum and postpartum diets. Although the fermentable total carbohydrate remained about the same across all periods, lactating cows have higher intakes and will consume more total fermentable carbohydrate compared to dry cows, and will have a different profile of carbohydrate intake fractions. Because each farm was visited once while the study cohort was in each phase of the transition from far dry to high lactation, we were unable to ascertain accurate DMI for all pens, so diet assessment is reported on a density basis.

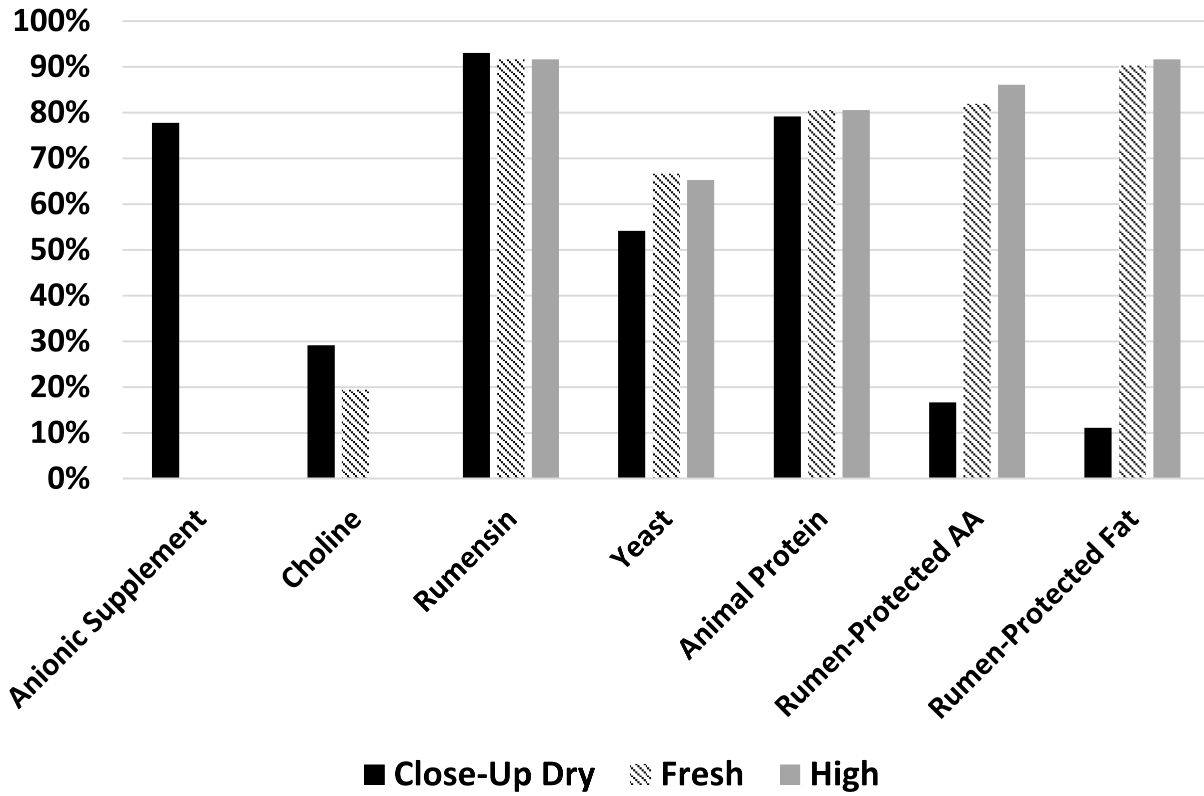


Figure 1. Percentage of herds (n = 72) that feed additives and specific nutrients during the close-up, fresh, and high lactating periods.

Table 6. Predicted chemical composition (CNCPS v. 6.1 using NDS software; mean ± SD) of rations associated with pens respective to period, as formulated from NIR forage analyses for 72 herds. Forage samples were obtained at each visit.

| | Period | | | |
|---|---|---|---|---|
| Nutrient | Far-off<br>n = 91 pens | Close-up<br>n = 79 pens | Fresh<br>n = 74 pens | High[1]<br>n = 92 pens |
| ME, Mcal/kg DM | 2.07 ± 0.10 | 2.11 ± 0.10 | 2.49 ± 0.07 | 2.51 ± 0.07 |
| MP, g/kg DM | 77.2 ± 10.6 | 89.2 ± 7.7 | 107.4 ± 6.5 | 110.1 ± 5.5 |
| Met, %MP | 2.12 ± 0.19 | 2.20 ± 0.21 | 2.36 ± 0.20 | 2.33 ± 0.18 |
| Lys, %MP | 6.90 ± 0.39 | 7.03 ± 0.29 | 6.69 ± 0.23 | 6.60 ± 0.21 |
| His, %MP | 2.60 ± 0.32 | 2.86 ± 0.28 | 2.81 ± 0.16 | 2.80 ± 0.16 |
| CP, %DM | 13.5 ±1.9 | 14.5 ± 1.4 | 16.4 ± 0.9 | 16.5 ± 0.8 |
| Starch, %DM | 14.5 ± 4.5 | 17.8 ± 2.7 | 26.3 ± 2.8 | 27.8 ± 1.8 |
| Sugar, %DM | 3.0 ± 1.0 | 3.3 ± 1.0 | 4.1 ± 1.3 | 4.2 ± 1.3 |
| EE, %DM | 3.3 ± 0.4 | 3.4 ± 0.7 | 5.1 ± 0.7 | 5.1 ± 0.7 |
| NDF, %DM | 47.1 ± 4.9 | 43.1 ± 3.8 | 31.8 ± 2.2 | 30.7 ± 1.9 |
| Forage NDF, %DM | 44.4 ± 6.4 | 37.5 ± 4.7 | 23.9 ± 2.2 | 22.8 ± 2.1 |
| Fermentable total carbohydrate, %DM | 38.4 ± 3.0 | 39.4 ± 2.3 | 39.9 ± 1.6 | 39.4 ± 1.7 |
| Fermentable starch, % DM | 12.9 ± 4.0 | 15.8 ± 2.4 | 21.1 ± 2.2 | 21.7 ± 1.6 |
| Fermentable sugar, %DM | 2.3 ± 0.8 | 2.6 ± 0.8 | 3.0 ± 0.9 | 3.0 ± 0.9 |
| Fermentable NDF, % DM | 17.7 ± 2.4 | 15.9 ± 1.7 | 11.2 ± 1.3 | 10.4 ± 0.8 |

[1]High rations obtained from 68 herds.

Energy Metabolites

Table 7 describes the prevalence of all sampled cows, within the sampling time frame, with elevated prepartum NEFA and postpartum NEFA and BHBA, using established metabolic thresholds (Ospina et al., 2010a). Almost 20% of cows, within the sampling time frame, had elevated metabolites. These elevated metabolites have been associated with a decreased risk of pregnancy, decreased ME305 milk yield, and increased disease incidence (Ospina et al., 2010b). The prevalence of elevated metabolites in herds above the herd alarm level of 15% is displayed in Figure 1 (Ospina et al., 2010c). Almost half the herds had < 15% of cows with elevated prepartum NEFA, and postpartum NEFA and BHBA. As an industry, we still have room for improvement and can decrease the incidence of hyperketonemia further.

Table 7. Prevalence of cows above metabolic threshold as identified by Ospina et al. (2010a).

| Metabolite Cut-Point | Sampling time relative to parturition | Cows, n | Prevalence |
|---|---|---|---|
| NEFA ≥0.27 mmol/L | 2 to 14 d prepartum | 1232 | 19.2% |
| NEFA ≥0.60[1] or 0.70[2] mmol/L | 3 to 14 DIM | 1100 | 19.8% |
| BHBA ≥1.0[1] or 1.2[2] mmol/L | 3 to 14 DIM | 1100 | 19.7% |

[1] Metabolic cut-point used for primiparous cows.
[2] Metabolic cut-point used for multiparous cows.

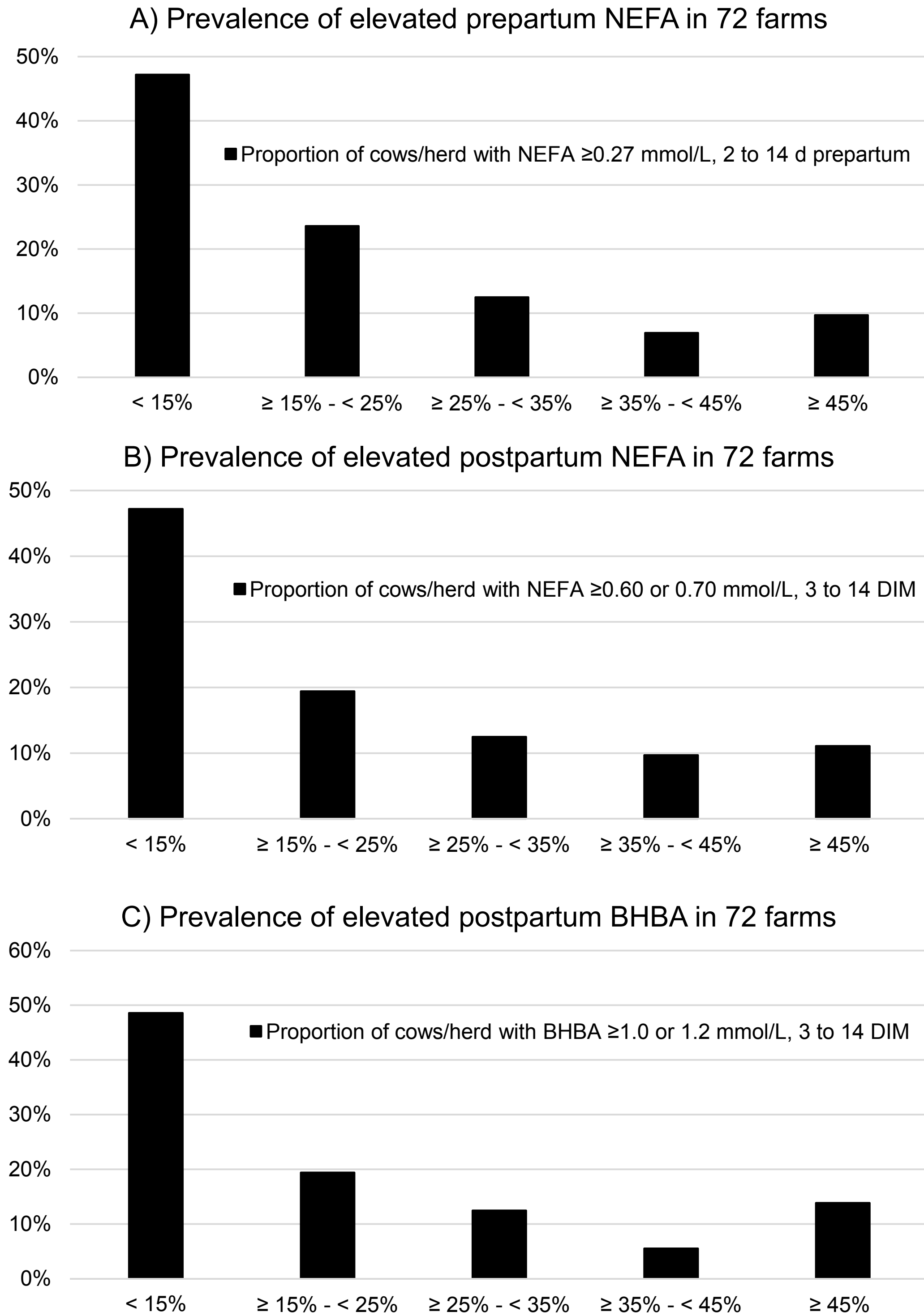


Figure 2. Prevalence of elevated metabolites as a proportion of cows sampled per herd. A) Elevated NEFA (≥0.27 mmol/L) 2 to 14 d prepartum, B) elevated NEFA (≥0.60 mmol/L for primiparous and ≥0.70 mmol/L for multiparous) 3 to 14 DIM, and C) elevated BHBA (≥1.0 mmol/L for primiparous and ≥1.2 mmol/L for multiparous) 3 to 14 DIM.

## CONCLUSIONS AND IMPLICATIONS

These results demonstrate the variability in current practices and health related outcomes in large, progressive dairies in the Northeast and can be used for comparison and advisement purposes. Further analyses will determine if associations exist between different management and nutritional factors with health, culling, milk production, reproductive performance outcomes, and energy and inflammation blood biomarkers.

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