



## **Northern NY Agricultural Development Program 2016 Project Report**

### **Impact of Environmental Conditions, Housing and Ventilation on Seasonality of Respiratory Disease; Developing Strategies to Reduce the Risk of Respiratory Illness in Pre-weaned Calves in NNY**

#### **Project Leader:**

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#### **Background:**

With the increasing cost of production and decreasing margins, there is continued interest to cost effectively raise healthy productive calves for the future milking herd. In 2012, a study by Jason Karszes of the Cornell University PRO-DAIRY Program, concluded the costs of raising heifers on New York dairy farms ranged from \$1860 to \$2263. Many farmers are willing to invest in their calves if they know there will be a strong return on investment. Calf housing and ventilation systems are two areas many producers are looking at to hopefully improve calf health, especially during the pre-weaning period.

According to the most recent USDA National Animal Health Monitoring System (NAHMS) report, 12.47% of pre-weaned heifers in the U.S. are affected by respiratory illness, with 93.4% of these calves being treated with antibiotics. Calf respiratory disease is associated with decreased average daily gain, increased age at first calving, decreased milk production in first lactation and increased culling in the first 30 days. All of these factors lead to an increase cost of production and decreased revenue.

To provide local data, in June 2015 a total of 437 pre-weaned calves were evaluated on 29 dairy farms across Northern New York. Respiratory scores averaged 2.466 with a range of 0 to 9; 13.33% of calves evaluated scored greater than 5, indicating they have a respiratory challenge and should be treated. This is slightly greater than the national average.

Respiratory illness in pre-weaned calves ranged from 0 to 50% on a farm basis (mean 11.05%), with 44.82% of farms having no respiratory illness (based on score) and 10.32% of farms having 30 to 50% of evaluated calves exhibiting signs of respiratory illness.

There was no difference in respiratory score by housing system (hutch, individual pen or group pen), bedding type (sand, wood, straw or hay), ventilation system, environmental humidity or pen or barn airflow, only environmental temperature impacted respiratory scores.

The data collect from the 2015 calf housing evaluation study suggests that respiratory illness continues to be a challenge on Northern NY dairy farms even when the climate is temperate (average temperature = 75.5 F; average humidity = 45.7%; and average heat index of 70.6 ).

Additional research has been needed to determine if respiratory illness is an even greater challenge when calves experience cold stress, and what factors (environmental measurements, management strategies, housing, bedding quality and airborne bacteria) increase the risk of infection and what strategies can be developed to reduce the risk of respiratory illness in pre-weaned calves.

The primary goal of this project was to evaluate how pre-weaned calf housing, environment, and management strategies impact calf health on dairy farms in Northern NY during periods of cold stress. Other objectives included:

- determining seasonal variation of respiratory illness,
- identifying management practices and/or environmental stressors that impact calf health during the summer vs. winter months, and
- developing management strategies to reduce the risk of respiratory illness in pre-weaned calves across Northern New York.

## **Methods:**

### **Barn Selection:**

The study population consisted of 29 pre-weaned calf facilities identified by practicing veterinarians and extension dairy specialists during the spring of 2015 and evaluated during June 2015. Re-evaluation of these 29 pre-weaned calf facilities during the winter months of January & February 2016 allowed us to determine seasonal difference in environmental measurements, management strategies, and calf health.

A single visit was made to each farm. During initial telephone contact with the owner to schedule the visit, an inquiry was made whether calf health at the time would be

representative of the season (i.e., not a current outbreak). The inquiry was repeated with the owner, manager, or caregiver on the date of the visit. Each facility evaluation will take approximately 2 hours.

#### **Calf Management Survey:**

Information on farm demographics, incidence of pneumonia (treated and/or death loss), colostrum management program, vaccination protocols, nutrition, management, procedures and calf housing evaluation by the producer was collected.

#### **Environmental Assessment of Barns:**

Dimensions of the barn, ridge, sidewall and curtain openings, alleys, and calf pens were measured, with building and pen construction materials such as steel and greenhouse roofs, insulation, woven-wire or solid sided pen panels and covers, etc. recorded.

Temperature, humidity, dew point, wind-chill and airflow outside and in alleyways of the facility were recorded with inside-outside differences calculated.

#### **Assessment of Calf Pens & Calves:**

Depending on the number of preweaned calves in the barn, calves were selected at evenly distributed locations around the barn for evaluation.

- Calf pens were assigned a box factor score related to the number of solid planes around the calf.
- The type of bedding was recorded.
- A bedding sample from pens of subject calves was collected and submitted to QMPS (Canton, NY) for bacterial analysis.
- Each pen was assigned a nesting score based upon an estimate of the ability of the calf to nestle into the bedding.
- Calf health was evaluated by assigning scores for nose, ears, eyes, cough, fecal consistency and temperature.
- Calf age and weight was recorded.
- Calf pen environment was evaluated for temperature, humidity, dew point, wind chill, airflow and ammonia concentration. Differences between these parameters in the calf pen as compared to outside and alleyways was calculated.

#### **Statistical Analysis:**

The impact of environmental conditions, management strategies and bedding quality on the incidence of respiratory disease was evaluated, noting differences between observed respiratory disease during summer and winter months, with management challenges during these seasons identified. Trends in calf health and bedding quality based on seasonality, herd size, type of calf housing and other farm demographics were determined.

#### **Results:**

This study was conducted between 11/29/2016 and 1/4/2017 and included 27 dairy farms that represented 33,557 lactating cows, 32,269 heifers and 2,408 pre-weaned calves

(Table 1). This is roughly 28% of the dairy cattle population in the six northern counties of New York State.

Pre-weaned housing facilities included hutches (n = 8), calves raised in individual pens in a barn (n = 8) and calves reared in group pens in a barn (n = 11). The 27 facilities presented considerable differences in many of the variables evaluated from an environmental, calf health and management standpoint.

### **Calf Health Evaluation:**

A total of 426 calves were health scored in 27 facilities, with an average of 16.8 calves evaluated per farm (range = 9 to 22; Table 2).

The mean respiratory score was 2.81 with a range of 0 to 9; 14.54% of calves evaluated scored  $\geq 5$ , indicating they have a respiratory challenge and should be treated (Figure 1). This is greater than that observed in the summer of 2015. Prevalence of respiratory illness among calves ranged from 0 to 46% on a farm basis (mean 15.01%), with eight farms having no respiratory illness, and six farms having 30 to 46% of evaluated calves exhibiting signs of respiratory illness (Figure 2).

Calf health score was impacted by housing type, bedding, number of calves in a pen, ammonia concentration in pen, temperature and wind chill in the pen. Calves housed in hutches had greater health scores as compared to those in group pens (3.92 vs 2.185, respectively), however, calves in individual pens did not differ in health scores from their counterparts (mean health score = 3.34). As calf numbers/pen increased to more than 5 calves per pen the calf health score increased, indicating a respiratory challenge.

Calves with a body condition score  $\leq 2$  were at a greater risk of having a health score  $\geq 5$  as compared to a calf with a body condition score of  $\geq 3$  (relative risk = 1.7029; 95%CI 1.0355, 2.8006).

Calves in pens with ammonia concentrations of zero were at a lower risk of having a health score  $\geq 5$  as compared to calves housed in a pen with an ammonia concentration  $\geq 1$  (relative risk = 0.49; 95% CI 0.2748, 0.8567).

Percentage of sick calves/farm was impacted by housing system, bedding, number of calves per pen, ammonia concentration (in the pen), nesting score, temperature, wind chill and humidity. The mean fecal score was 0.15 (on a 0 to 3 point scale, with a score  $\geq 2$  indicative of scours); 28.4% of calves evaluated scored  $>1$ . (Figure 3). Prevalence of scours (fecal score  $>1$ ) ranged from 0 to 58% on a farm basis (mean 28.29%), with 3 farms having no scours and six farms have over 40% of evaluated calves exhibiting signs of scours. (Figure 4).

Calf fecal score was impacted by body condition score, number of calves in a pen, nesting score, and dew point in the pen. Calves with a body condition score  $\leq 2$  were more likely to have a fecal score  $\geq 2$  as compared to their counterparts with a BCS  $\geq 3$  (relative risk = 2.74; CI 1.7518, 4.3216).

Percentage of calves with scours (fecal score  $\geq 2$  was impacted by housing system, number of calves per pen, ammonia concentration, nesting score, temperature, heat index and humidity.

### **Conclusions/Outcomes/Impacts:**

Individual calf health scores are impacted by both environmental and management factors. These factors do vary from farm to farm and by seasonality. Housing system continues to have a great impact on calf health score. From an environmental standpoint, ammonia concentration, temperature, wind chill and humidity (all in the calf pen) impact calf health. Management factors including number of calves per pen, bedding type and nesting score all have an impact on calf respiratory health. Fecal score was impacted primarily by management practices (number of calves per pen and nesting score) along with dewpoint.

The recommendations provided to individual farms focused on individual farm management strategies. In general, recommendations include reducing the number of calves per group pen so each calf has a minimum of 35 square feet, increasing the bedding in pens to allow for nesting, and increasing the calorie intake of calves to meet daily requirements.

Revising the feeding equipment cleaning protocol to reduce the risk of bacterial growth, revising or creating new management written protocols and implementing employee training in the area of calf feeding and management were also among the recommended actions.

Prevalence of respiratory illness continues to be a challenge for Northern NY dairy farmers. Mean respiratory scores and overall percentage of calves evaluated with a respiratory score of 5 or greater increased from summer 2015 to winter 2016. The management factors and environmental factors that impacted respiratory health changed based on season. Knowing what factors have the greatest impact on calf health will help farmers manage seasonal changes and hopefully improve respiratory health in the future.

November 2017 Addendum: The majority of farms participating in this study made at least one recommended change. The impact of those changes will be noted after the winter of 2017-2018.

### **Outreach:**

Calf management workshops were held in 5 locations across New York State, and impacted over 100 dairy farms. Research results will be published in the North Country Ag Advisor, and local and regional publications, and will be presented at the American Dairy Science Association meeting in 2018.

All producers who participated in the 2016 study received an individualized report with their evaluation results with recommendations. All producers who participated will be

receiving a copy of the final report, along with a comparison of their results to those of their fellow project participants.

**Next Steps:**

More follow up is needed to evaluate individual farm rates of respiratory illness and incidence of scours throughout changing seasons and management practices. Data continues to be analyzed for bacterial counts in bedding samples and on feeding equipment. This is likely a risk factor for calfhoo illness.

**Acknowledgments:**

Thank you to the 27 NNY farms who allowed us to evaluate their calves, housing system and management practices.

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**Northern NY Agricultural Development Program  
2016 Project Report APPENDIX**

**Impact of Environmental Conditions, Housing and Ventilation  
on Seasonality of Respiratory Disease in Northern New York and  
Developing Strategies to Reduce the Risk of Respiratory Illness  
in Pre-weaned Calves**

**Table 1. Farm Demographics, Calf Respiratory Health Project in NNY, 2015-2016**

	n	means	SD	min	Max	SUM
<b>Total cattle</b>						
<b>Preweaned</b>	27	89.19	55.20	30	200	2408
<b>Heifers</b>	27	1195.15	703.53	260	2325	32269
<b>Lactating &amp; Dry</b>	27	1242.85	729.20	300	2600	33557

**Table 2. Mean calf health scores for Winter, 2016 respiratory study, Calf Respiratory Health Project in NNY, 2015-2016**

Variable	n	mean	SD	Min	Max
<b>Calf level data</b>					
Calves evaluated <sup>1</sup>	431	16.81	3.72	9	22
Age	63	37.14	19.25	1	68
eye	431	0.44	0.59	0	3
ear	431	0.37	0.65	0	3
nose	431	0.32	0.57	0	3

cough	431	0.32	0.56	0	3
fecal	431	1.05	0.92	0	3
Temp	174	102.41	0.93	100	107
Respiratory score	431	2.81	1.64	0	9
Body Condition Score	392	2.54	0.62	1	4
Hock & Knee Score	416	1.07	0.26	1	3
Lameness score	416	1.04	0.20	1	3
<b>Farm level data</b>					
Calves/pen	27	6.44	7.12	1	27
Sick calves/farm <sup>2</sup>	27	2.30	0.42	0	7
Percent sick calves/farm	27	0.14	0.14	0	0

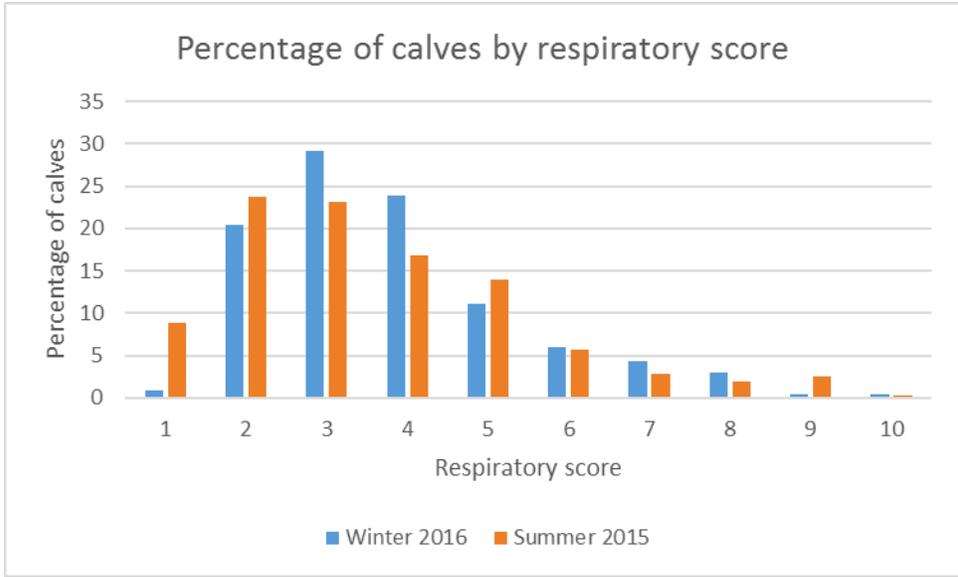
<sup>1</sup> Average number of calves evaluated per farm

<sup>2</sup> Respiratory score  $\geq 5$

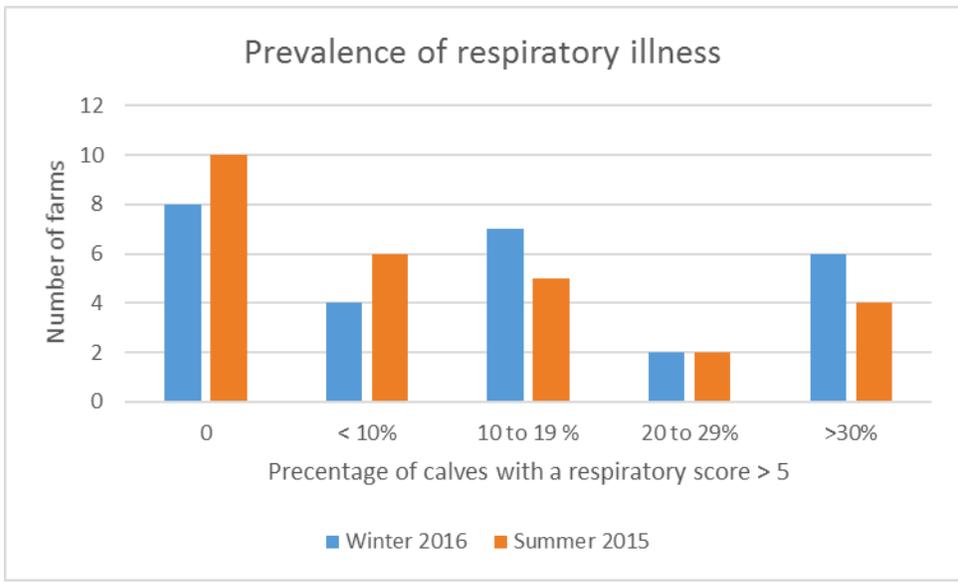
**Table 3. LSmeans for environmental measurements by location within the barn or outside, Calf Respiratory Health Project in NNY, 2015-2016**

Variable	Location					SE
	Pen n = 232	Group calves n= 20	Group feed n= 15	Outside n= 30	Alley n= 38	
Ammonia (ppm)	0.38 <sup>b</sup>	0.3 <sup>b</sup>	0.6 <sup>b</sup>	0.03 <sup>a</sup>	0.34 <sup>b</sup>	0.11
AN	0.01 <sup>a</sup>	0.05 <sup>a</sup>	0 <sup>a</sup>	1.71 <sup>b</sup>	0.22 <sup>a</sup>	0.11
Airflow	0.0006 <sup>a</sup>	0.002 <sup>a</sup>	0 <sup>a</sup>	0.1 <sup>b</sup>	0.015 <sup>a</sup>	0.01
Temperature ( C)	10.97	10.26	10.67	6.3	10.27	4.03
Heat Index	11.56	10.16	10.84	7.35	10.29	5.4
Wind Chill	18.42 <sup>b</sup>	19.22 <sup>b</sup>	19.54 <sup>b</sup>	7.48 <sup>a</sup>	17.84 <sup>b</sup>	1.02
Humidity (%)	62.15	66.03	34.97	61.64	59.3	3.8
Dew Point	3.85 <sup>a</sup>	12.5 <sup>b</sup>	4.53 <sup>a</sup>	2.52 <sup>a</sup>	2.5 <sup>a</sup>	3.27

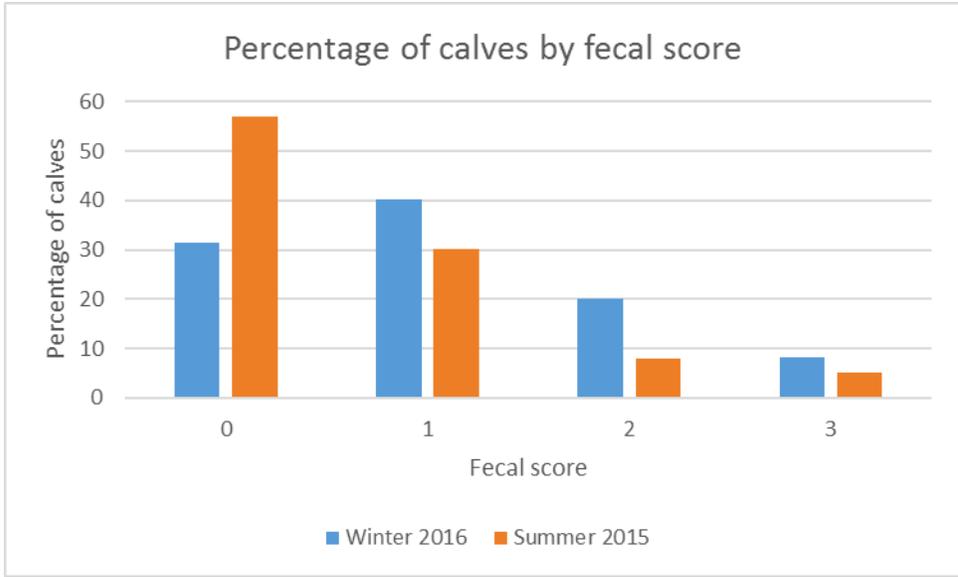
<sup>ab</sup>Means within a row with different superscript letter differ (P < 0.05)



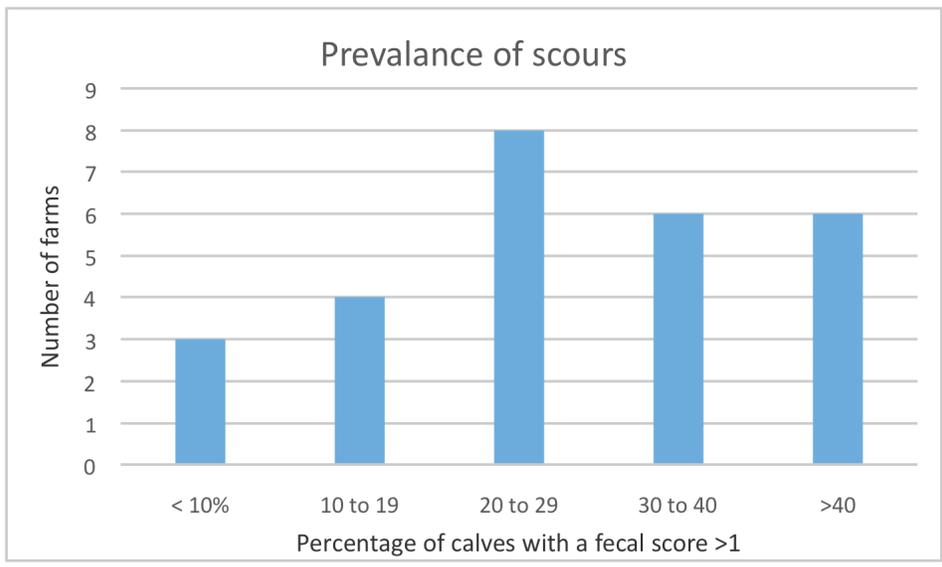
**Figure 1. Percentage of calves by respiratory score, Calf Respiratory Health Project in NNY, 2015-2016. Mean respiratory score: 2.81, range 0 to 9; 14.54% of calves evaluated scored  $\geq 5$ , indicating a respiratory challenge**



**Figure 2. Prevalence of respiratory illness among calves, Calf Respiratory Health Project in NNY, 2015-2016. Mean: 15.01%; range 0 to 46% on a farm basis; eight farms with no respiratory illness; six farms with 30 to 46% of evaluated calves exhibiting signs of respiratory illness.**



**Figure 3. Percentage of calves by fecal score, Calf Respiratory Health Project in NNY, 2015-2016. Mean: 0.15, 28.4% of calves evaluated scored >1. Score of >2 indicates scours.**



**Figure 4. Prevalance of Scours, Calf Respiratory Health Project in NNY, 2015-16. Mean: 28.9%, range: 0 to 58% on a farm basis; 3 farms with no scours, six farms with > 40% of evaluated calves exhibiting signs of scours.**