Northern NY Agricultural Development Program
2015 Project Report

Evaluating calf housing and its impact on calf respiratory parameters on NNY dairy farms

Project Leader(s):

Kimberley Morrill, PhD: NNY Regional Dairy Specialist, Cornell University, 2043B State HWY 68, Canton, NY 13617, 603-568-1404, kmm434@cornell.edu

Collaborator(s):

- Katie Ballard, Director of Research, Miner Institute
- Emily Chittenden, Cornell University Intern
- Ron Kuck, Dairy and Livestock Educator, Cornell Cooperative Extension Jefferson County

Contributing Producers:

- 29 Northern New York dairy farms

Abstract

The objectives of this project were to:

- Evaluate environmental and air quality parameters across different types of calf housing facilities;
- Evaluate rates of respiratory illness in pre-weaned calves; and
- Determine the impact of environmental factors, air quality, and housing type on calf health.

This was an observational study in which calf facilities were evaluated on a single visit during June, 2015. Housing included hutches (n = 9), individual pens in a barn (n = 11), and group pens in a barn (n = 9). A total of 29 facilities and 437 pre-weaned calves were evaluated.

Facility and calf pen evaluations included:

- wind speed • temperature • relative humidity • heat stress index
- bedding type • bedding composite sample for bacteria counts
- nesting score of calf pens • calf health scoring,
- airborne bacteria.

Data were analyzed using SAS 9.3 to determine the impact of housing type, environmental and air quality variables on calf respiratory score.

Calf facility temperature averaged 24.2^{0}C (range 15.5 to 30.6^{0}C) with a relative humidity of 21.5% (range 10 to 78%) and a heat index of 21.5^{0}C (range 6 to 30.9^{0}C).

Temperature and airborne bacterial counts were greater in hutches as compared to individual and group pens ($P <0.01$).

Humidity was similar for hutches and group pens, but greater than individual pens.

Gram negative airborne bacterial counts were lowest in individual pens.

No difference in heat index was observed across housing type.

Mean calf respiratory score was 2.5 (range of 0 to 9) on a 12-point scale; 13.33% of calves evaluated scored greater than 5, indicating a respiratory challenge. Prevalence of respiratory illness in pre-weaned calves ranged from 0 to 50% of calves on a per farm basis (mean = 11.05% of calves/farm), with 44.82% of farms having no respiratory illness and 10.32% of farms having 30 to 50% of evaluated calves exhibiting signs of respiratory illness. There was a negative correlation between respiratory score and pen temperature (R^2 =0.90). There was a trend for group- housed calves to have higher respiratory scores compared to calves in hutches and individual pens. There was no influence on respiratory score by bedding type, ventilation system, relative humidity, airflow, or airborne bacterial counts.

Data collected from this study suggests that respiratory illness continues to be a challenge, even when weather is temperate. Additional research is needed to evaluate rates of respiratory illness during cold stress and transitional weather, as well as to evaluate management factors that increase the risk of infection.

Background:

Due to increasing cost 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, Cornell University, concluded the costs of raising heifers on New York dairy farms ranged from $1860 to $2263.

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 increased cost of production and decreased revenue. The other benefit of raising healthier calves is the opportunity to use fewer antibiotics on young stock. Minimizing the use of antibiotics on the farm has two benefits: one is financial and, two, our industry is under increasing pressure from the Federal Drug Administration to limit use of antibiotics and thereby limit drug residues.

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 have been two areas many producers are looking at to hopefully improve calf health, especially during the pre-weaning period.

Calf housing and its impact on calf health is often debated. Hutches have been associated with lower morbidity and mortality in dairy calves (Waltner-Toew et al., 1986). But as a convenience, or compromise to labor, farms will house calves either in the main barn or build a separate calf barn. As calves have been moved into housing, the industry has promoted the use of ventilation to improve air quality. Stationary warm air can potentially contain harmful gases (i.e., ammonia), odor, dust, and microorganisms (e.g., fungal spores, viruses, and bacteria).

Many farms have gone to improving calf ventilation with various types of systems to improve air quality. Calf barns use a negative pressure ventilation system (i.e., tunnel ventilation), positive pressure ventilation system (i.e., tube systems) or a neutral pressure ventilation system. These systems depend on the installation of fans and/or tubes to continually supply ventilation to calves without creating significant drifts. No matter what the housing system or type of ventilation in place, calves should be viewed for clinical signs of respiratory disease.

The calf health scoring system developed by McGuirk (2005) can be easily utilized to help track respiratory disease in calves. The scoring system evaluates: rectal temperature, cough (spontaneous or induced), eye scores, ear scores, and nasal discharge. The score is the sum of points from the five categories of clinical signs. The higher the value indicates greater risk of poor calf health, and should be further evaluated or treated for respiratory disease.

Providing calves with the best environment (housing & ventilation) and developing management protocols are key aspects to managing heifer rearing costs. In order for this to occur, current calf environments in NNY need to be evaluated on how they impact calf health, specifically rates of respiratory illness.

Materials & Methods:

Barn Selection:

The study population was a sample of barns referred by practicing veterinarians and extension dairy specialists contacted in the spring of 2015 for assistance in locating suitable Northern New York dairy farms. Three types of pre-weaned calf facilities, each housing a minimum of 12 pre-weaned calves were evaluated:

- hutches,
- individual calf housing in a naturally-ventilated barn
- group calf housing in a naturally-ventilated barn.

Ventilation system was further broken down by:

- only natural ventilation (curtains, sidewalls or outside),
- natural ventilation + fans
- natural ventilation + tube ventilation.

A single visit was made to each farm in June, 2015. During the initial telephone contact with the owner to schedule the visit, an inquiry was made as to whether the calf health at the time was - representative of the season (i.e., not a current outbreak). The inquiry was then repeated with the owner, manager, or caregiver on the date of the visit to ensure normal management was occurring.

Environmental Assessment of Barns:

- Dimensions of the barn, alley-ways, and calf pens or hutches were measured.
- Building and pen construction materials were recorded.
- Temperature, humidity, ammonia concentration, dew-point, barometric pressure and heat index were recorded for outside the calf facility, in alley ways of the calf facility at calf height and at worker height (approximately 5’6”).
- Difference between outside and inside variables was calculated.

Environmental Assessment of Calf Pens

Depending on the number of pre-weaned calves in the barn, a minimum of four and maximum of 26 calves per facility were selected at evenly-distributed locations around the barn to be evaluated and have their pens evaluated.

The type of bedding was recorded (wood, sand, hay or straw), and a nesting score was assigned to each pen based upon an estimate of the ability of the calf to nestle into the bedding. Nesting score 1 was assigned when most of the calves appeared to lie on top of the bedding with legs exposed. Score 2 was assigned when calves would nestle slightly into the bedding, but part of the legs were visible above the bedding. Score 3 was assigned when the calf appeared to nestle deeply into the bedding material and legs were not visible. A facility nesting score was then assigned to each farm.

A composite bedding sample from the pens of subject calves on each farm was collected using a bulb planter inserted to a depth of approximately 10 cm in the center of the pen. The sample was submitted to the Quality Milk Production Services laboratory (Canton, NY) for analysis.

Air from each subject pen and the central alleyway was sampled to determine concentration of airborne bacteria. Airborne bacterial samples were collected using an impaction-type air sampler (airIDEAL, bioMe´rieux, Inc., Hazelwood, MO). Five liters of air was sampled onto a sheep blood agar plate (BAP) for total bacterial counts and 50 L of air was sampled onto an eosin methylene blue agar plate (EMB) for gram-negative bacterial counts. The pen samples were collected by moving the calf quietly to the front of the pen. The air sampler was positioned approximately 0.6 m above the bedded surface, 0.75 m from the rear side of the pen, and at least 1 m from the calf with the air sampler intake plate directed away from the calf. Alley samples were collected in the center of the alley of the facility or hutches. Inoculated plates were incubated at 35 ± 2°C for 48h before bacterial colonies were counted. The bacterial counts (cfu per cubic meter of air) were estimated by counting the clusters of colonies on the agar and using the conversion table in the user’s manual (airIDEAL, 2001). The maximum count measurable by the air sampler is 326,418 cfu/m3.

Temperature, relative humidity and heat index were measured in each subject pen at the time of air microbiological sampling using a handheld temperature and humidity indicator (SPER SCIENTIFIC, Scottsdale, AZ).

Ammonia concentrations were measured using a TOXIRAE II Ammonia Monitor. Samples were collected approximately 0.25 m above the bedding near the center of each selected pen.

Calf Respiratory Disease Assessment:
The total numbers of calves in each barn and pen were counted. In each selected pen, calf ID, birth date and body weight were recorded. A respiratory disease score was assigned based on the calf health scoring guide (McGuirk, 2005). A calf was considered "positive" for respiratory disease if she had a respiratory score of 5 or greater. Prevalence of respiratory illness was calculated for each facility.

Calf Management Survey:
A questionnaire was developed to obtain information about farm demographics and management of colostrum. Farm demographic questions included herd size, operation type, and breed of cattle. Colostrum management practice s included questions on focused on milking procedures; colostrum harvest, feeding, storage, and evaluation of passive transfer in calves. Calf nutrition questions focused on pre-weaning feed management. The prototype was field tested, after which redundancies and unclear questions were modified. The final survey consisted of four farm demographic questions, 20 colostrum management questions, 18 general management questions, and four pre-weaned calf nutrition questions.

Results:

This study was conducted in June, 2015, and included 29 dairy farms that represented 39,633 lactating cows and 33,303 heifers (Table 1). This is roughly 33% of the dairy cattle population in the six northern counties (Clinton, Essex, Franklin, Jefferson, Lewis, St. Lawrence) of New York State.

Table 1. Farm Demographics

Variable	N	Mean	Std Dev	Minimum	Maximum
Total Lactating	27	1271.59	959.4628	140	3000
Total youngstock	27	1092.7	870.5619	65	2800

All 29 farms had Holstein cattle as their primary breed, Jersey cattle were present on 13.9% of participating farms. Ayrshires, Brown Swiss and crossbred cattle were present on 3.4, 6.9 and 10.3% of participating farms.

Pre-weaned housing facilities included hutches (n = 9), calves raised in individual pens in a barn (n = 11) and calves reared in group pens in a barn (n = 9). Ventilation was classified as natural (n = 17), natural + fan (n = 7) and natural + tube ventilation (n = 5). Hutches were classified as naturally-ventilated. The 29 facilities presented considerable differences in many of the variables evaluated from an environmental, calf health and management standpoint.

Calf Health Evaluation:
A total of 437 calves were health scored in 27 facilities (calves were not scored on two of the 29 farms, with an average of 15.55 calves evaluated per farm (range = 4 to 26; Table 2).

Table 2. Mean Calf Health Scores.

Variable	N	Mean	Std Dev	Minimum	Maximum
calves evaluated[1]	427	15.55692	3.99073	4	26
eye	437	0.298589	0.48116	0	2
ear	437	0.224138	0.522224	0	3
cough	437	0.062696	0.287289	0	2
Temperature (F)	437	102.0801	0.805225	99.1	105.7
fecal	437	0.626959	0.898301	0	4
nose	437	0.128527	0.351235	0	2
respiratory score	437	2.466301	1.703631	0	9
Nesting score	437	1.528274	0.841075	0	3
calves/pen	27	3.949254	6.109318	1	25
sick calves/farm	27	1.333333	1.687055	0	6
Percent sick/farm	27	11.43432	13.79614	0	50

[1] Average number of calves evaluated per farm.

The mean respiratory score was 2.47 with a range of 0 to 9; 13.33% of calves evaluated scored ≥ 5, indicating they have a respiratory challenge and should be treated (Figure 1).

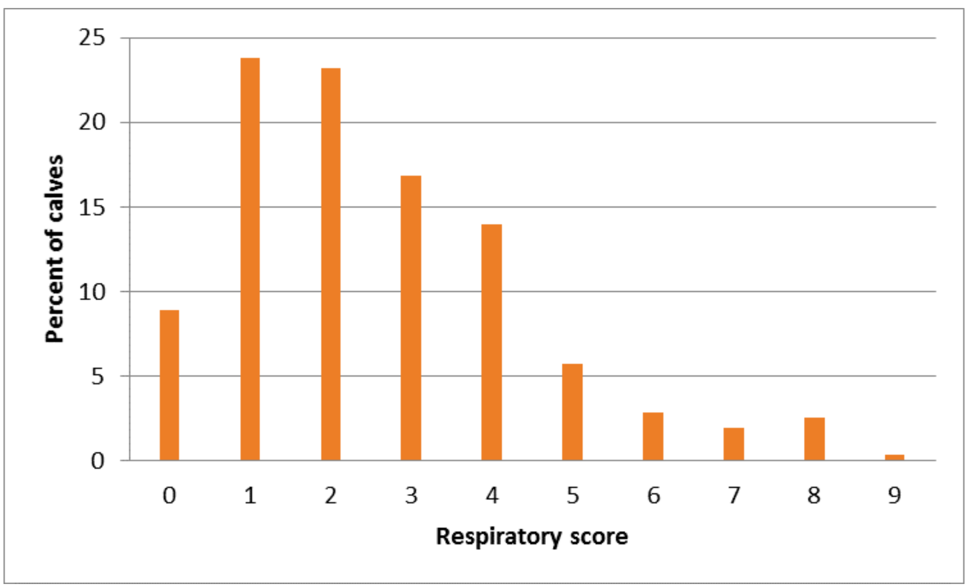

Figure 1. Percent of calves by respiratory score.

Prevalence of respiratory illness among calves ranged from 0 to 50% on a farm basis (mean 11.87%), with 10 (37.04%) farms having no respiratory illness, and four (14.18%) farms having 30 to 50% of evaluated calves exhibiting signs of respiratory illness (Figure 2).

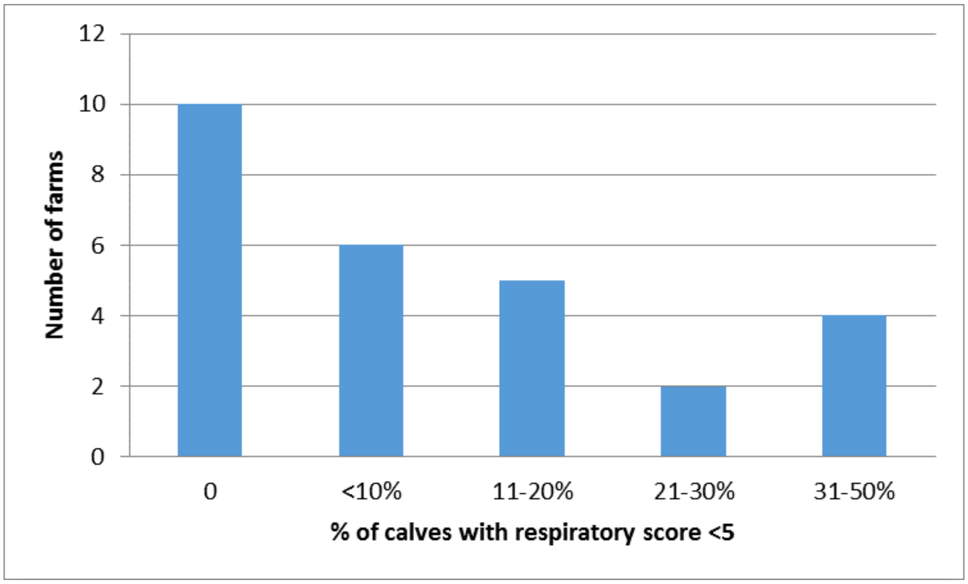

Figure 2. Prevalence of respiratory disease in calves across NNY Farms.

Pen temperature (Figure 3) and housing type (Figure 4) impacted the respiratory score of calves, with calves housed in a group system having a higher mean respiratory score.

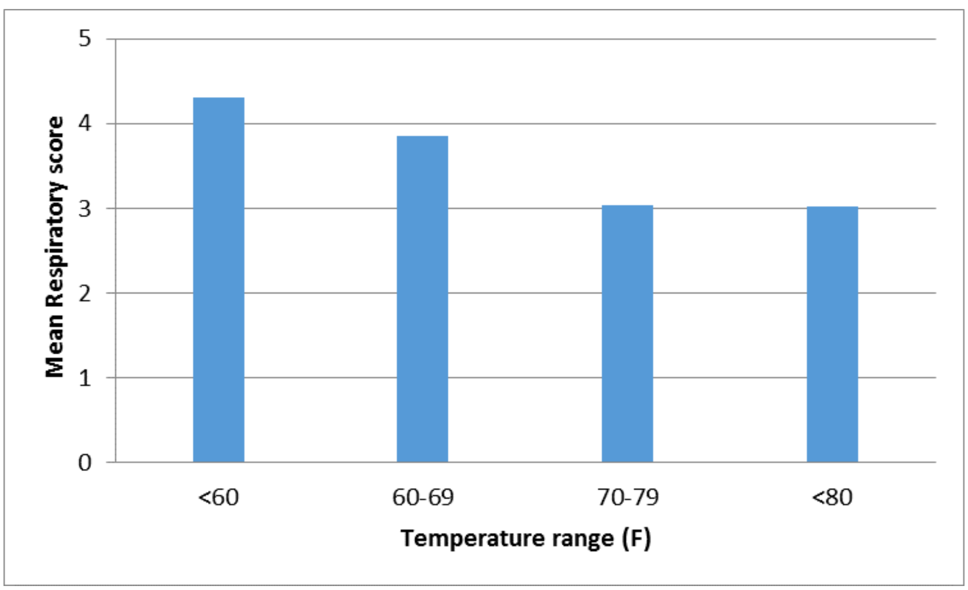

Figure 3. Mean respiratory score by temperature range.

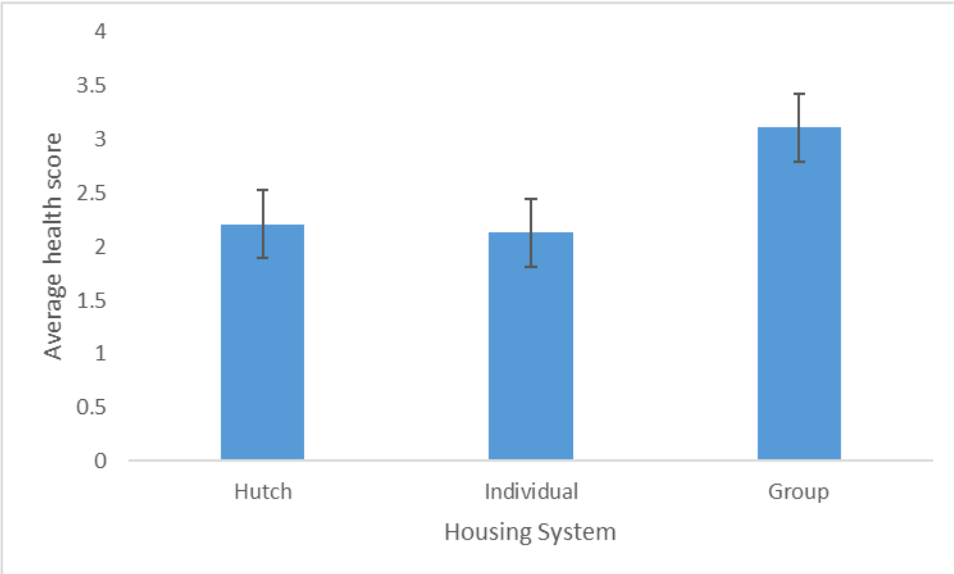

Figure 4. Mean respiratory score by housing system.

There was no difference in respiratory score by bedding source, ventilation system, relative humidity or pen airflow.

There was a moderate negative correlation between lactating herd size and average calf health score (R^2 = -0.36812, P value = 0.058; Figure 5).

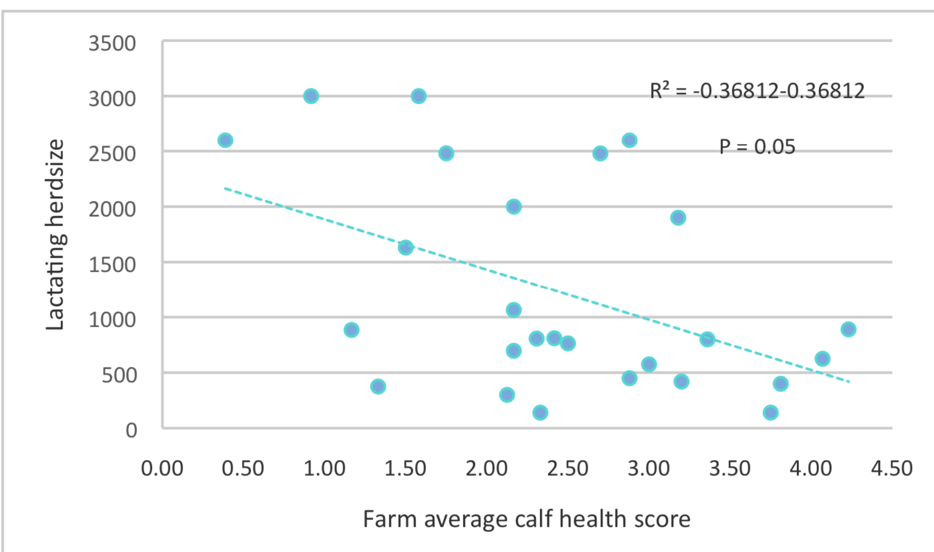

Figure 5. Relationship between lactating herd size and calf health score.

Environmental Evaluation of Calf Facilities:
Average outdoor, alleyway and calf pen temperature, relative humidity, heat index, NH3, An, airflow, barometric pressure, and Dew point is presented in Table 3.

Temperature was greatest in hutches as compared to individual and group pens; it was also greater in naturally-ventilated pens without additional fans or tube systems (Table 3).

Table 3. Mean temperature, humidity, heat index, ammonia, airflow and dew point values for calf pens, outside and alley ways of calf facilities.

Variable	*N*	*Mean*	*SD*	*Min*	*Max*
Temperature (F)					
Outside	38	75.57105	7.224841	60.4	87
Alley - low	35	72.04571	6.847341	60.3	84.2
Alley - high	30	72.42	6.518642	61	82
Calf Pen	301	75.28472	7.458639	55.5	96.2
Humidity (%)					
Outside	38	45.67895	18.84576	10.3	78.4
Alley - low	35	54.23143	17.03147	24.6	91.6
Alley - high	30	51.44333	16.75082	26.7	81.5
Calf Pen	301	51.84086	15.11115	17.8	82.5
Heat Index					
Outside	38	70.63947	11.38725	43	87.7
Alley - low	36	69.08889	8.712906	40.7	79.1
Alley - high	31	69.27419	8.99785	40.5	78.9
Calf Pen	301	68.71694	11.02853	41	95
Airflow					
Outside	38	0.160421	0.268969	0	1.038
Alley - low	36	0.02625	0.041199	0	0.168
Alley - high	31	0.030968	0.032128	0	0.138
Calf Pen	301	0.008515	0.053245	0	0.9
Dew Point					
Outside	38	50.19474	10.76528	23.9	64.2
Alley - low	36	52.55	8.604268	32.3	65.5
Alley - high	31	51.56129	8.561646	32.3	63.6

Temperature varied by location (both in- and outside the facility). Humidity was greater in hutches and group pens as compared to individual pens (Table 4). Heat index was similar across all three housing systems and location within the facility.

Table 4 – Temperature, humidity and heat index by housing type, ventilation system and location in the facility.

	Housing[1]				Ventilation[2]				Location[3]						
Item[1]	1	2	3	SE	1	2	3	SE	1	2	3	5	6	7	SE
Temp.	74.43^{a}	70.07^{b}	71.59^{b}	0.65	74.99^{a}	71.47^{b}	70.64^{b}	0.7	73.44^{ab}	73.64^{ab}	74.31^{a}	69.98^{bc}	68.72^{c}	74.14^{ab}	0.4
Humidity	57.68^{a}	53.16^{b}	58.18^{a}	1.44	46.28^{c}	58.11^{b}	64.64^{a}	1.53	50.68^{c}	56.01^{ab}	56.02^{ab}	61.07^{ab}	61.39^{a}	52.87^{bc}	0.88
Heat	68.87	67.89	69.29	1.06	69.67^{a}	70.71^{a}	65.67^{b}	1.14	70.27	69.01	68.28	68.02	67.46	69.05	0.66

^{a,b} Means within row with different superscript letter differ ($P < 0.05$).
[1] Housing: 1 = hutch, 2 = individual pen, 3 = group pen
[2] Ventilation: 1= natural ventilation, 2 = natural +fan, 3 = natural +tube
[3] Location: 1=outside, 2 = alley low, 3 = pen, 4 = group pen by the feedbunk, 5 = group pen laying area, 6 = alley high.

Airborne Bacterial Counts:

A total of 194 airborne total bacterial count **(TBC)** samples and 182 airborne gram negative bacterial counts **(GNBC)** from calf pens, alleyways, and outside were evaluated.

The difference between the TBC and GNBC was due to 12 GNBC plates exhibiting contamination and were not included in the final data set.

Airborne TBC were greatest in the alleyways at a human height and lowest outside (Table 5). Samples taken in the pen, regardless of hutch, individual pen, laying area of group pens or feeding area of group pen, had similar TBC and were greater than those observed in the alley at calf level and outside.

Table 5. Airborne bacterial counts by location

	Location						
Item[1]	Outside	Alley low	pen	pen feed	pen calf	Alley high	SE
Blood agar (cfu/m^{3})	3.09^{d}	4.12^{c}	4.46^{b}	4.9^{b}	4.86^{b}	6.08^{a}	0.17
Eosin methylene Blue (cfu/m^{3})	2.41^{c}	3.28^{b}	3.55^{ab}	3.88^{b}	4.01^{a}	---	0.16

^{a,b} Means within row with different superscript letter differ ($P < 0.05$).

Gram negative bacterial counts were greatest in the laying and feeding areas of group calf pens.

Type of housing and ventilation system impacted both TBC and GNBC; however bedding material utilized did not impact either count (Table 6).

Table 6. Airborne bacterial counts by bedding, housing and ventilation system

	Bedding Material					Housing				Ventilation[1]			
Item[2]	Wood	Sand	Hay	straw	SE	Hutch	Individual	Group	SE	1	2	3	SE
Blood agar (cfu/m[3])	4.38	4.65	4.63	4.68	0.18	4.77[a]	4.62[ab]	4.37[b]	0.13	4.77[a]	4.55[ab]	4.44[b]	0.13
Eosin methylene Blue (cfu/m[3])	3.34	3.19	3.67	3.5	0.13	3.24[b]	3.75[a]	3.31[b]	0.11	3.56[a]	3.56[a]	3.14[b]	0.12

[a,b] Means within row with different superscript letter differ ($P < 0.05$).

[1]Ventilation 1 = natural, 2 = natural + fan, 3 = natural + tube

[2] All data presented in Log10 format

There was a strong correlation between temperature range and GNBC ($R^2 = 0.99$; Figure 6) and a moderate correlation between airflow and GNBC ($R^2 = 0.44$; Figure 7).

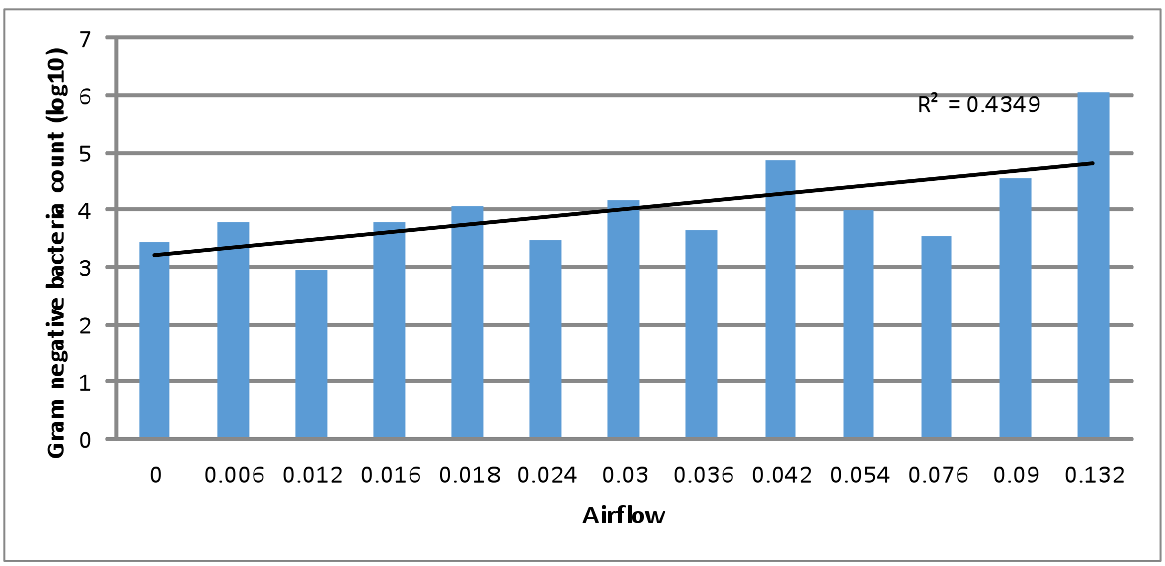

Figure 6. Relationship between airflow and gram negative bacterial organisms in the air.

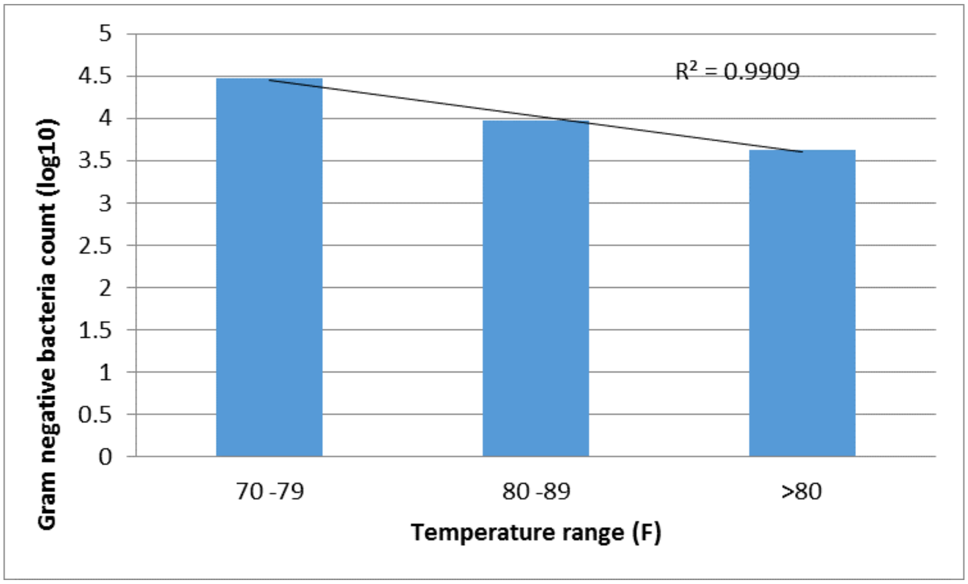

Figure 7. Relationship between temperature range and gram negative bacterial organisms in the air.

No significant correlation was observed between TBC and temperature range or airflow.

Bedding Evaluation:
A total of 35 bedding samples was evaluated from the 29 facilities. If a facility utilized multiple types of bedding, a sample of each bedding type was collected. Only samples with detectable concentrations of organisms were included in mean calculations. *Streptococcus spp.*, *Staphylococcus spp*., and Coliform bacteria were found in all bedding samples, while *Corynebacterium spp*., *Pseudomonas spp*., yeast, and mold were found in fewer than 10 samples, respectively (Table 7).

Table 7. Environmental microorganism counts of bedding samples collected from calf facilities[1]

Variable	n	Mean	SD	Minimum	Maximum
Coliform Bacteria					
E.Coli	30	5.92	1.10	3.28	8.47
Klebsiella	25	5.76	1.22	3.17	7.30
Other Coliforms	1	6.78	.	6.78	6.78
Other Bacteria					
Gram negative bacillus	32	5.92	1.19	3.71	8.26
Gram positive bacillus	30	6.62	1.03	3.23	7.81
Corynebacterium spp	7	6.89	0.41	6.28	7.52
Pseudomonas spp	1	6.85	.	6.85	6.85
Other Organisms					
Yeast	10	6.01	0.96	3.76	6.89
Mold	7	5.11	2.00	2.32	7.13
Total CFU Streptococcus spp	34	6.91	0.78	4.31	8.27
Total CFU Staphylococcus spp	34	7.66	0.91	4.35	8.76
Total CFU Coliforms	34	6.16	1.08	3.53	8.50
Total CFU Other Bacteria	34	7.05	0.71	5.01	8.29
Total CFU other organisms	13	5.88	1.40	2.32	7.13
TOTALCFU	34	7.92	0.76	5.19	8.94

[1]All data presented in Log10 format

Impact of bedding material, housing and ventilation system are presented in Table 8.

Impact of number of calves per pen and nesting score on bedding samples are presented in table 9.

Impact of environmental temperature, heat index and relative humidity on organisms identified in calf bedding are presented in Table 10 in Appendix A.

The majority of farms utilized multiple bedding types with straw and shavings being the most popular (utilized respectively on 77% and 74% of farms), sand was utilized on 33.33% of farms (primarily in hutches), and hay was utilized as a bedding source on 18.5% of farms.

The majority of farms (62.9%) changed bedding type base on the season and weather.

Table 8. Streptococcus, Staphylococcus, Coliform and Other bacterial organisms means by bedding type, housing and ventilation

	Bedding Material					Housing[1]				Ventilation[2]			
Item[3]	Wood	Sand	Hay	straw	SE	1	2	3	SE	1	2	3	SE
Coliform Bacteria													
E.Coli	6.43^{a}	4.51^{d}	5.37^{c}	5.88^{b}	0.23	5.89^{a}	5.3^{b}	5.44^{b}	0.11	5.28^{b}	5.82^{a}	5.53^{a}	0.17
Klebsiella	6.25^{a}	4.74^{b}	4.43^{b}	5.11^{b}	0.35	5.74^{a}	4.93^{b}	4.73^{b}	0.22	4.74^{b}	4.85^{b}	5.81^{a}	0.2
Other Bacteria													
Gram negative bacillus	6.64^{a}	5.48^{bc}	5.39^{c}	5.97^{b}	0.16	6.82^{a}	5.75^{b}	5.05^{c}	0.69	5.01^{c}	5.95^{b}	6.66^{a}	0.16
Gram positive bacillus	6.5^{b}	5.77^{c}	6.68^{ab}	7.18^{a}	0.28	7.01^{a}	6.27^{b}	6.33^{b}	0.13	6.32^{c}	7.29^{a}	5.98^{b}	0.18
Total CFU Streptococcus spp	7.28^{b}	6.49^{c}	7.64^{a}	6.22^{c}	0.11	7.4^{a}	6.82^{b}	6.5^{c}	0.11	6.34^{c}	6.96^{b}	7.41^{a}	0.1
Total CFU Staphylococcus spp	8.03^{a}	7.00^{b}	8.25^{a}	7.14^{b}	0.12	8.9^{a}	7.59^{b}	6.93^{c}	0.07	6.82^{b}	7.97^{a}	8.01^{a}	0.45
Total CFU Coliforms	6.77^{a}	4.97^{c}	5.58^{b}	5.92^{b}	0.15	6.3^{a}	5.57^{b}	5.56^{b}	0.15	5.45^{b}	5.92^{a}	6.01^{a}	0.13
Total CFU Other Bacteria	7.41^{a}	6.73^{b}	7.27^{a}	7.23^{a}	0.1	7.58^{a}	7.09^{b}	6.81^{c}	0.08	6.4^{b}	7.51^{a}	7.57^{a}	0.09
TOTAL CFU	8.26^{b}	7.26^{c}	7.93^{c}	9.87^{a}	0.26	8.46^{ab}	8.63^{a}	7.89^{b}	0.15	8.1^{b}	8.7^{a}	8.17^{b}	0.22

^{a,b} Means within row with different superscript letter differ ($P < 0.05$).

[1] Housing: 1 = hutch, 2 = individual pen, 3 = group pen

[2] Ventilation: 1= natural ventilation, 2 = natural +fan, 3 = natural +tube

[3] All data presented in Log10 format

Table 9. Streptococcus, Staphylococcus, Coliform and Other bacterial organisms means by number of calves/pen and nesting score.[1]

	Calves/pen					Nesting Score					
Item[1]	1	2	3	4	SE	0	1	1.5	2	3	SE
Coliform Bacteria											
EColi	6.02^{ab}	5.91^{ab}	5.86^{b}	6.36^{a}	0.2	5.67^{c}	7.02^{a}	6.12^{b}	7.17^{a}	6.44	0.18
Klebsiella	.	.	.	.	.	5.01^{d}	6.02^{c}	.	6.3^{b}	7.51^{a}	0.13
Other Bacteria						5.7^{c}	6.65^{a}	5.27^{cd}	6.36^{b}	4.94^{d}	0.14
Gram negative bacillus	5.94^{a}	5.07^{b}	5.08^{b}	5.89^{a}	0.18	5.73^{b}	6.13^{a}	7.05^{a}	6.25^{a}	6.48^{a}	0.65
Gram positive bacillus	5.45^{b}	6.64^{a}	5.35^{b}	6.01^{a}	0.34	5.74^{b}	6.13^{b}	7.05^{a}	6.25^{a}	6.48^{a}	0.28
Total CFU Streptococcus spp	6.55	6.31	6.37	6.31	0.17	6.62^{b}	7.01^{a}	6.75^{ab}	7.11^{a}	6.31^{b}	0.13
Total CFU Staphylococcus spp	7.28^{a}	7.04^{ab}	7.11^{ab}	6.82^{b}	0.2	6.93^{b}	7.66^{a}	7.81^{a}	7.68^{a}	7.11^{ab}	0.13
Total CFU Coliforms	5.67	5.88	5.51	6.16	0.24	5.62^{d}	6.86^{b}	6.27^{bc}	7.23^{a}	6.16^{c}	0.15
Total CFU Other Bacteria	6.57^{b}	6.7^{ab}	6.86^{a}	6.71^{ab}	0.11	6.56^{c}	7.47^{a}	6.63^{bc}	7.1^{b}	6.98^{b}	0.13
TOTAL CFU	7.78^{a}	7.67^{ab}	6.71^{b}	7.01^{b}	0.38	6.87^{c}	7.4^{bc}	6.65^{d}	7.73^{b}	8.96^{a}	0.25

[a,b] Means within row with different superscript letter differ ($P < 0.05$).
[1] All data presented in Log10 format

Table 10 is in Appendix A.

Colostrum Management:
Feeding high quality colostrum within the first hours of life is necessary to set the calf up for a healthy future. Nearly 89% of colostrum was collected within 6 hours after parturition.

Colostrum was fed within one hour after birth on 37% of dairies and within 2 hours on an additional 40.7% of dairies. All farms reported feeding colostrum within the first 12 hours after birth, and only 7.4% of farms allowed calves to nurse the dam.

The majority of calves (57.3%) received their first feeding of colostrum by bottle.

The average volume of colostrum fed within the first 24 hours was 4.51 quarts (range 1 to 8 quarts, Table 11). Over 80% of calves received 2 or more feedings of colostrum.

Table 11. Colostrum and milk/milk replacer management practices

Variable	N	Mean	Std Dev	Minimum	Maximum
Colostrum Management					
Quarts fed	27	4.51	1.49	2	8
number of feedings	27	2.16	0.8	1	4
Pre-weaned nutrition					
volume milk/MR	20	5.96	3.03	2	12
weaning age	27	50.30	8.27	42	70

Source of colostrum varied: 14 farms used only one source, while 13 used 2 or more colostrum products. Fresh colostrum from a different cow was the primary source of colostrum on 40% of farms, while a colostrum replacer, pooled colostrum, or colostrum from the dam were also popular options and utilized respectively on 37%, 37% and 33% of farms. Only 11% of farms used frozen colostrum and 7% fed pasteurized colostrum. Two farms did not feed maternal colostrum, and fed 100% colostrum replacer. Colostrum was most often stored in the refrigerator after collection and prior to feeding (55.5%).

Colostrum quality was a concern on 33.33% of farms, and was being assessed on 63% of participating farms. Refractometers and colostrometers were the most popular methods of assessment (25.9 and 22.2%), while few farms evaluated color (7.4%) or consistency (3.7%). All farmers that fed maternal colostrum were being proactive and would discard colostrum that they did not believe was high quality. Common reasons to discard colostrum included: bloody appearance (77%), mastitis (55%), cow was known positive with an illness such as Johnes or leucosis (55%), the cow was sick (48%), had a watery appearance (44%), or had a low IgG concentration (37%).

Calf Nutrition:
Commercial milk replacer was the primary source of nutrition to pre-weaned calves (55.5%), followed by whole milk from the bulk tank or treated cows (29.6%).

Acidified milk replacer (11.1%), milk from high SCC cows (7.4%), pasteurized saleable milk (7.4%), milk from transition cows (3.7%) and pasteurized treated milk (3.7%) were less popular feeding options.

The majority of calves were fed twice a day (55.6%) and received an average of 5.96 quarts/day (range of 2 to 12 qts; Table 11). Over 87% of calves received 4 or more quarts of milk/MR per day.

The average age at weaning was 50.3 days with a range of 42 to 70 days of age. Calf starter was offered within the first week of life on 85.2% of farms and within the second week of life on the remaining dairies.

Hay was offered to pre-weaned calves on 48.1% of farms, 7.4% of farms introduced hay during the weaning period, 22.22 % of farms provided hay to youngstock after weaning and 22.22% of farms did not offer hay to youngstock.

Additional Calf Management Practices:
One third of farms were utilizing blood tests to monitor calves for passive transfer. Over 96% of farms had a regular vaccination program for youngstock.

All farms were dehorning calves, with nearly 60% of calves being dehorned by 4 weeks of age. Electric dehorners, dehorning paste and portasol burners being the most common methods of dehorning (respectively 44%, 29.6% and 33%). Lidocaine was used on 51.8% of farms during the dehorning process, while 11.1% of farms used a different type of pain killer and 37.1% of farms did not use a pain killer during dehorning.

Conclusions/Outcomes/Impacts:

This study was conducted to provide a "local perspective" to NNY dairy producers. The data collected from the 2015 calf housing evaluation study suggests that regardless of pre-weaned housing system, respiratory illness continues to be a challenge on over 20% of NNY dairy farms, with some farms experiencing respiratory illness rates of 50%, even when the climate is temperate (average temperature = 75.5 F; average humidity = 45.7% and an average heat index of 70.6). Calf respiratory scores were slightly greater in group-housed facilities, but were not impacted by ventilation system, bedding, relative humidity or pen airflow. There was a trend for calf respiratory scores to decrease as herd size increased.

Colostrum management is strong on the majority of farms in NNY, but timing to first feeding, and volume of colostrum fed could be improved on 20% of farms. Routinely assessing calves for passive transfer has increased from < 5% (2012 & 2013 data) to 33% of farms in the last 4 years.

The only management aspect that was of concern was only 51.8% of farms were utilizing a painkiller at dehorning.

Additional research is needed to determine if respiratory illness is an even greater challenge when calves experience cold stress or transitional weather, what factors increase the risk of infection, and what strategies can be developed to reduce the risk of respiratory illness in pre-weaned calves.

Future work in this area will continue as we determine seasonal variation of respiratory illness, identify management practices and/or environmental stressors that impact calf health during the summer vs. winter months and develop management strategies to reduce the risk of respiratory illness in pre-weaned calves across Northern New York.

Outreach:

- 2015 Calf Congress, Syracuse, NY: ~ 200 farmers, veterinarians, and industry leaders.
- 2016 NNYADP meeting, Watertown, NY.
- An abstract submitted for a presentation at 2016 American Dairy Science Association Joint Annual Meeting, Salt Lake City, UT.
- "Cow Comfort, Welfare and the Public" workshops, Canton and Chazy, NY, Jan. 2016.

Impact, as a result of this project already includes;

- A farmer in Franklin County changed his calf facility to improve air quality and air flow to newborn calves resulting in immediate health improvement and decreased respiratory scores. Total investment = $100.
- Multiple farms have requested protocol reviews or help in developing new protocol in regards to calf management practices.
- Multiple farms have made management changes to improve colostrum management and feeding after having conversations with researchers during survey collection.
- Multiple farms have requested final results to influence future building and calf rearing plans.

Next Steps:

- Continue to run diagnostic and epidemiological statistics on previously collected and future data to evaluate risk of environmental factors and management practices on calf health.
- Continue to evaluate how pre-weaned calf housing, environment and management strategies impact calf health on dairy farms in Northern New York.
- Determine seasonal variation of respiratory illness.
- Identify management practices and/or environmental stressors that impact calf health during the summer vs. winter months.
- Evaluate impact of nutrition (protein and energy intake) on risk of disease prevalence.
- Develop management strategies to reduce risk of respiratory illness in pre-weaned calves in NNY.

Acknowledgments: This project would not have been possible without NNY dairy farmers allowing us to evaluate their calves, facilities, and management practices. Miner Institute summer students provided assistance with facility evaluations in Clinton County.

Reports and/or articles in which results of this project have been published.
Calf Congress 2015 proceedings.

For More Information: Kimberly Morrill, Ph.D., 603-568-1404, kmm434@cornell.edu