



## Northern New York Agricultural Development Program 2021 Project Report

### Evaluation of Calf Barn Ventilation and Its Impact on Calf Health, Growth, and Performance

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#### Cooperating Producers:

- 15 Northern New York dairy farms: Jefferson, Lewis, St. Lawrence, Clinton counties

#### Background:

Raising replacement heifers is a major expense for dairy farmers across New York State and, with the increasing cost of production and decreasing margins, there is even more motivation to make sure heifers are raised to reach their full potential. Calf housing and ventilation systems are two areas many producers are looking at to improve calf health and performance, especially during the pre-weaning period.

In earlier (1980s & 1990s) studies, Erb et al. found that even mildly clinical respiratory disease had long term lasting effects in dairy calves. Such individuals entered the milking string later in life, had a higher incidence of dystocia, and were more likely to be culled in early lactation.

According to the most recent USDA National Animal Health Monitoring System (NAHMS) report, 12.5% of pre-weaned heifers in the U.S. are affected by respiratory illness, with 93.4% of these calves being treated with antibiotics. More locally, as part of a NNYADP research project in June 2015, a total of 437 pre-weaned calves were evaluated on 29 dairy farms across Northern New York. Respiratory scores averaged 2.5 with a range of 0 to 9; 13.3% of calves evaluated scored  $\geq 5$ , 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 individual farms (mean 11.1%), with 44.8% of farms having no respiratory illness (based on

score) and 10.3% of farms having 30 to 50% of evaluated calves exhibiting signs of respiratory illness in the NNYADP research project.

A follow-up study also funded by NNYADP was conducted to evaluate calf health during winter months (November 2016–January 2017). A total of 426 calves were health scored in 27 facilities, with an average of 16.8 calves evaluated per farm. The mean respiratory score was 2.8 with a range of 0 to 9; 14.5% of calves evaluated scored > 5, indicating they had a respiratory challenge and should be treated. This was greater than that observed in the summer of 2015, indicating severity of calf health challenges may change with the season.

Prevalence of respiratory illness among calves in that followup study ranged from 0 to 46% on individual farms (mean 15.0%), with eight farms having no respiratory illness, and six farms having 30% to 46% of evaluated calves showing signs of respiratory illness. 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. Therefore, housing, management, and ventilation are critical factors affecting calf health.

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. Working to develop and monitor calf housing ventilation systems that reduce the risk of respiratory illness will not only provide Northern NY dairy producers with healthier replacement heifers, but will also improve animal welfare. Additionally, with increased public concern regarding antibiotic usage and the humane raising of farm animals comes the increased importance for dairy producers, researchers, and allied industry members to do their part in ensuring animals are raised with health and welfare as a top priority.

**The objectives of this project in 2021** were to assess and troubleshoot ventilation systems (mechanical and/or natural) and calf health in pre-weaned calf barns in Northern NY. Health assessments were completed across seasons to evaluate seasonal differences. This will help NNY producers better understand the importance of investing in and properly managing calf barn ventilation systems. Participating dairies were notified that their information and farm-specific results would be kept confidential.

## **Methods:**

### **Selection of Farms**

Dairy farms across Northern New York were contacted to enroll in this study via in-person farm visits, phone calls, and recommendations from herd veterinarians. Enrolled farms had to be willing to share calf protocols and health records. A total of 15 farms participated from across Jefferson, Lewis, St. Lawrence, and Clinton counties.

The participating farms ranged in size from approximately 100 to 4,000 milking cows, and ranged in management strategies with farms housing calves individually, in pairs, or in small or large groups, and feeding either limited or unlimited amounts of milk replacer or whole milk. In order to capture representative data across the region, farms with all types of ventilation systems (natural, positive pressure tubes, neutral pressure, and cross ventilation) were enrolled; however, operations that utilize calf hutches were excluded from the study as the focus was in part on the impact of the type of housing facility.

## **Calf Health Scoring and Barn Environment**

Between summer and winter 2021, each farm was assessed for calf health and barn environment four times. During each assessment, the temperature, humidity, and temperature humidity index (THI) were recorded outside, inside the barn, and in a subset of calf pens. Pens were assigned a bedding score (1=poor, 3=excellent), and representative bedding samples were collected, weighed, and dried down to determine bedding dry matter.

Additionally, all calves up to a maximum of 50 (if more than 50 were present, only 50 were chosen randomly) were assessed using an adapted version of the University of Wisconsin Calf Health Scoring Chart. Calves were scored on a scale from 0 (no issues) to 3 (extreme) for nasal discharge, eye discharge or ear placement (the highest score between the two), cough, and rectal temperature. If the cumulative health score for an individual calf was equal to or greater than 5, it was classified as a respiratory case. Assessments were categorized by season as summer, fall, or winter.

## **Barn Fogging**

Each calf barn was fogged once during the summer and once during the winter. Using smoke sticks (Superior Signal), the barns were filled with fog so researchers could observe air movement patterns, and calculate how quickly the air was dissipating to therefore estimate the air exchange rate. This was done in two seasons to assess how well the ventilation system settings were working under hot vs. cold season conditions.

## **Results:**

A total of four health assessments were completed for each farm from June 2021-January 2022, with the exception of one farm that only had three health assessments completed. In total, 2,368 calves were scored across the 15 farms. Farms were categorized into one of the following ventilation categories: natural (n=3), positive pressure tube(s) (n=6), cross ventilation (n=3), or neutral pressure (inlet and exhaust fans; n=3). It should be noted that two of the “natural” ventilation farms had chimney fans, but for the sake of this project they are categorized as natural.

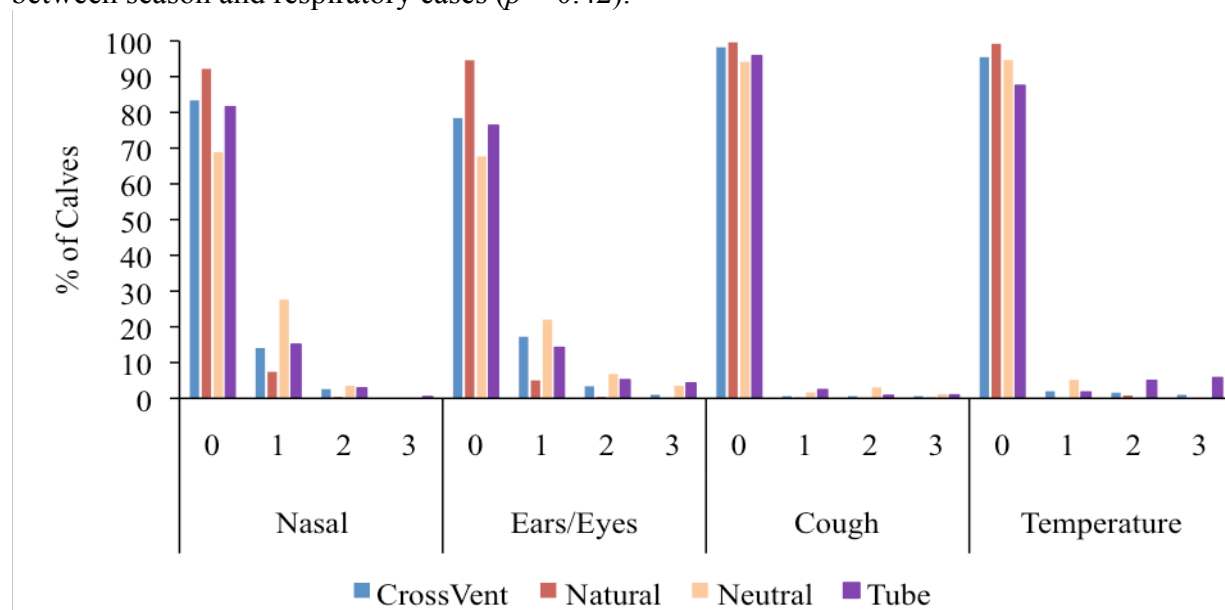
The mean total respiratory score across farms was 1, which indicates very good respiratory health across farms. Only 4.26% of calves (n=98) scored greater than 5 (indicating a clinical respiratory case) which is much lower than the previously reported numbers. Prevalence of respiratory cases on each individual farm varied from 0% to 16%. Out of the 15 farms, 9 had less than 5% of respiratory cases.

Figure 1 illustrates average calf health scores for each category of ventilation system, as a percentage of total calves scored. As demonstrated, naturally-ventilated barns had the highest percentage of score ‘0’ in each health category. Neutral pressure systems had numerically more score ‘1’ in both the nasal and ears/eyes category and had more score ‘3’ in both the ears/eyes and cough categories compared to the other systems. Tube-ventilated barns had the highest core body temperature scores (numerically) compared to the other systems.

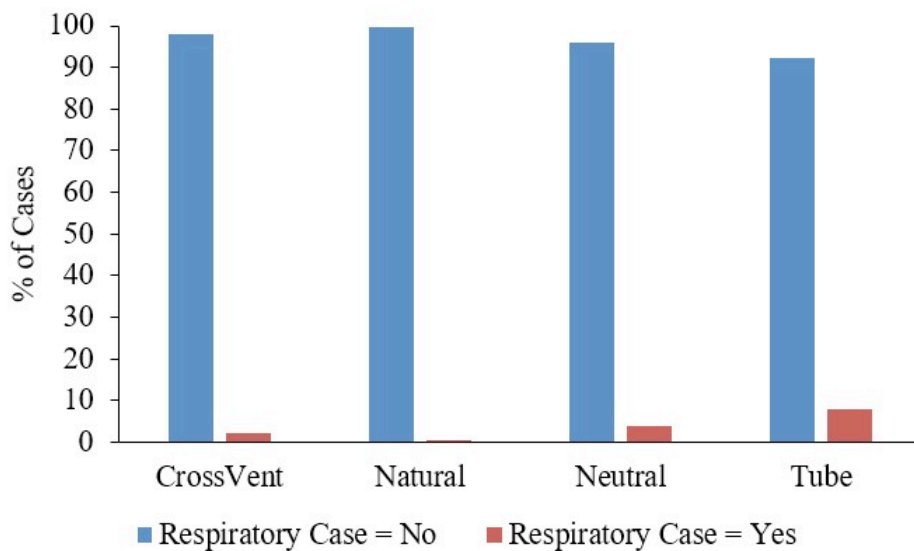
Figure 2 illustrates the percentage of respiratory cases (health score  $\geq 5$ ) between ventilation systems. As demonstrated, there was a low percentage of respiratory cases across all systems, but tube-ventilated systems had the highest percentage of cases (8%) compared to neutral pressure

(4%), cross ventilated (2%), and natural (0.4%). There was no statistical difference in respiratory cases between ventilation systems ( $p = 0.14$ ).

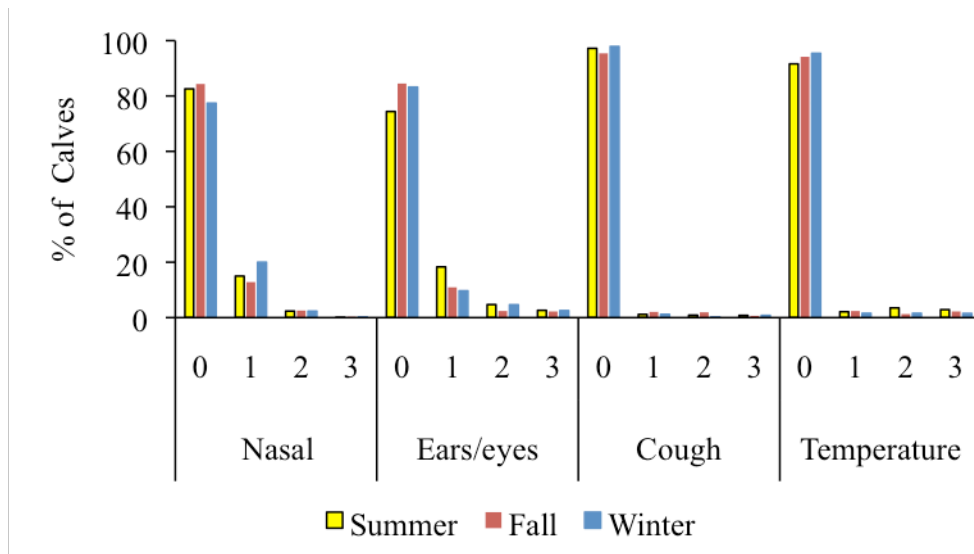
Previous research concluded that calf health scores were different between seasons. This is in agreement with the current study (Figure 3.) when looking at individual health categories between seasons (nasal:  $p = 0.05$ ; ears/eyes:  $p < 0.001$ ; cough:  $p = 0.05$ ; calf temperature:  $p = 0.04$ ). Overall, fall was the season with the lowest health problem scores. Figure 4 illustrates the percentage of respiratory cases by season. When modeled, there was no significant difference between season and respiratory cases ( $p = 0.42$ ).



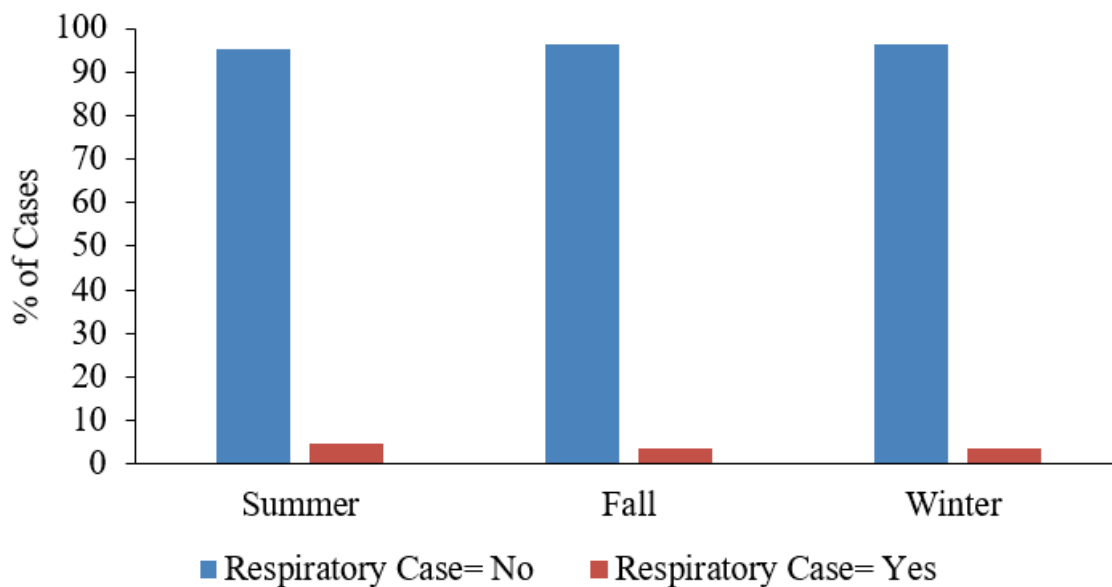
**Figure 1. Calf health scores by ventilation type across 15 farms in Northern New York, NNYADP Calf Barn Ventilation Research, 2021.**



**Figure 2. Respiratory cases by ventilation system across 15 farms in NNY farms in Northern New York, NNYADP Calf Barn Ventilation Research, 2021. A respiratory case is classified as a calf health score of  $\geq 5$ .**



**Figure 3. Calf health scores by season across 15 farms in NNY farms in Northern New York, NNYADP Calf Barn Ventilation Research, 2021.**



**Figure 4. Respiratory cases by season across 15 farms in NNY farms in Northern New York, NNYADP Calf Barn Ventilation Research, 2021. A respiratory case is classified as a calf health score of  $\geq 5$ .**

The results from barn fogging are outlined in Table 1. If farms met the recommended 60 air changes per hour (ACH) for summer, and the recommended 4 ACH for winter there is a “yes” in the column. While these are now considered the ideal targets, some farms are still aiming for past industry recommendations of 45 ACH in the summer and 2 ACH in the winter. If farms were slightly below the ideal recommendation, and measured closer to 45 ACH in summer and 2 ACH in winter, they are classified as “moderate”, and if they were way below the ideal recommendation they are classified as “no”.

When comparing outside to inside barn temperature, humidity, and temperature humidity index (THI), there were, on average, very small differences. On average, the inside temperature was 2.6°F warmer than the outside temperature (range: -9.8 to 14.4°F). On average, the humidity was 0.9% higher inside than outside (range: -9.8 to 14.4%), and the THI was 2.3 points higher inside than outside (range: -4.2 to 12.1).

The average bedding DM% for all farms, across all assessments was 66% (range: 44.0%-85.9%).

### Conclusions/Outcomes/Impacts:

The main goal of this project was to assess calf health and troubleshoot issues across different calf barn ventilation systems. Overall, it was promising to see that, only 4.26% of the 2,368 calves scored had a clinical respiratory case (scored  $\geq 5$ ), with a maximum prevalence within a herd of 16%. The numbers reported in this study are lower than previously reported by NNYADP projects and industry research.

**Table 1. Barn Fogging Results Based on Achieving Recommended ACH<sup>1</sup> by Farm, NNYADP Calf Barn Ventilation Research, 2021.**

Farm ID	Ventilation Type	Summer (60 ACH) <sup>1</sup>	Winter (4 ACH) <sup>1</sup>
1	Cross ventilated	Yes	No
2	Natural	Yes	No
3	Natural	Yes	Yes
4	Tube	Yes	Yes
5	Tube	Yes	Yes
6	Tube	Yes	Yes
7	Natural	Yes	Yes
8	Tube	Moderate	Yes
9	Cross ventilated	Moderate	Yes
10	Cross ventilated	Yes	Yes
11	Tube	Moderate	Yes
12	Neutral pressure	No	No
13	Tube	Yes	Yes
14	Neutral pressure	Yes	No
15	Neutral pressure	Moderate	Moderate

<sup>1</sup>ACH= air changes per hour. The summer and winter targets are based on previous research and recommendations from the University of Wisconsin.

The calf health assessments included observing and scoring calves in the categories of nose, eyes, ears, cough, and rectal temperature. Calves in positive pressure tube-ventilated systems scored the highest (worst), while calves in naturally-ventilated systems scored the best. It was somewhat surprising to see calves in tube systems scored the worst given the popularity of these systems. This may have been a function of observed deficiencies in design, implementation, and/or operation and maintenance of the ventilation system on the study farms. However, given the relative simplicity of this type of system, troubleshooting can usually be easily done to help make improvements.

While there were some numerical differences, the project sample size (n=15 farms) and the statistical power was low, so no significant differences were seen in calf health scores between ventilation types. This is contrary to the researchers' initial hypothesis, as they did expect to see some differences based on anecdotal information from previously working with various dairies on calf barn ventilation.

Individual health categories differed significantly between seasons. On average, calves scored in the fall had the lowest (best) health score. It was not surprising to see these differences in season, however, fall having the best scores in the individual categories was somewhat unexpected as farmers regularly indicate challenges with calf respiratory health in the "transition" seasons of spring and fall. Further, even though significant differences were seen when focusing on individual health criteria, overall there were no significant differences in the total number of respiratory cases on-farm between seasons. Only one assessment was done in fall and winter each for this project, and a larger dataset with more frequent assessments may have found a more expected result.

Bedding samples were taken during the health assessments to analyze dry matter, and on average it was 66%. Previous research has indicated that both calves and cows prefer dry bedding and lying time can be negatively impacted when bedding dry matter drops below 59%. In mature cows, lying time can impact cow comfort and is associated with milk production. For calves, it can also impact comfort and acts as an indicator of overall appropriate bedding and barn management. In this study, five farms were either right at this target level (59%) or below, indicating bedding management is an area of opportunity for improvement.

In addition to health scoring, each barn was fogged in the summer and the winter to observe airflow patterns and to estimate the air exchange rate in these seasons. Based on previous research and on-farm work, the current industry recommendations are to have four air exchanges per hour (ACH) in the winter and 60 ACH in the summer. An air exchange means the entire volume of air in the barn has been removed and replaced with fresh air from outside, to help remove odors, gases, humidity, and dust from the barn environment, and, ultimately, help keep calves healthier.

Half of the farms (n=7) met the targets for ACH for both summer and winter; a few (n=3) farms only met the target for summer and not winter; a few (n=4) farms were scored as moderate, indicating they were close to the target but not quite there; and one farm did not meet the target for summer or winter. The latter farm worked with the researchers and the farm's herd veterinarian to troubleshoot their ventilation system, and made changes to fan placement and settings as a result of fogging. The changes produced improvement in air flow. While the fogging demonstrations are not an exact science and are more of an observational tool, they did prove to be helpful in starting discussions with producers and identifying limitations in their current ventilation systems.

Overall, this project had significant impact for the participating farms. While only a few farms experienced major challenges with calf barn ventilation and calf health, several farms identified areas of opportunity through the project, such as cleaning of fans and routine maintenance of tubes, and worked with the researchers and farm consultants to troubleshoot challenges.

Feedback on this project from farmers and veterinarians has been largely positive. For example,:

- after troubleshooting one-on-one with one farm, the owner informed the researchers of the changes he planned to make, and said “*Great. Thank you. I appreciate the info in the email . . . This has been very helpful. Thanks again.*”
- “*Your study helped us to cut our respiratory treatments in half because we know how to manage our curtains better.*”

In addition to impacting the 15 participating farms, the highlights and key outcomes from this project have been (and will continue to be) shared and made available to all dairy farmers in the 6-county Northern New York region, as well as to industry representatives, to help increase the reach of this project.

In conclusion, the prevalence of calf respiratory cases was low (4.3%) on the participating farms. While the study indicated some numerical differences between ventilation system types, management plays a significant role in the outcome of calf health, and the researchers will continue to work with northern New York dairy producers to identify areas of opportunity to maximize calf health and performance.

### **Outreach:**

The results of this project were presented at the CCE NCRAT Summer Calf Barn Ventilation Workshops: July 27 and 28, 2021; and as part of the CCE NCRAT Virtual Dairy Day: January 18-20, 2022. A series of newsletter and blog articles will be published in a spring 2022 edition of the CCE North Country Advisor extension newsletter and on the CCE NCRAT blog. An article summarizing some of the troubleshooting efforts of this project was written for the CalfTel Blog (<https://calf.tel/calf-corner/calf-ventilation-northern-new-york-case-studies/>).

### **Next Steps:**

Individualized reports will be discussed with each participating farm. This project has generated a lot of interest amongst farms, and farms that were not part of the project have reached out for assistance troubleshooting calf barn ventilation. Some farms have indicated they would like to have their barns fogged again in the near future after they have made changes. Depending on COVID risk and guidelines, the researchers would like to host an in-person on-farm meeting in the spring or summer of 2022 to tour a calf barn, discuss these project results, and review ventilation best management practices. Additional blog and newsletter articles will be written to highlight the project findings with a wide audience of farmers and industry representatives across the Northern New York region.

Given the success of this project and the continued interest in calf barn ventilation, the researchers believe more work should be done locally to continue to help regional dairy farmers improve their calf housing and management.

### **Acknowledgements:**

Thank you to the Northern New York Agricultural Development Program for funding this project. Thank you to all the participating herds, CCE Livestock Educators Grace Ott and Abbey Jantzi for their assistance with data collection, and to herd veterinarians for their assistance in troubleshooting efforts.

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